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CITY OF SUNNYVALE

MASTER PLAN AND PRIMARY TREATMENT DESIGN

TECHNICAL MEMORANDUM

SIP VALIDATION:
MASTER PLAN

FINAL
May 2014

carollo in association with HDR

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CITY OF SUNNYVALE

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TABLE OF CONTENTS

Page No.

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

SIP VALIDATION: MASTER PLAN

1.0 INTRODUCTION

The purpose of this technical memorandum (TM) is to summarize the review of the City of Sunnyvale (City's) Strategic Infrastructure Plan (SIP) for the Water Pollution Control Plant (WPCP). This review of the SIP and all SIP-related work efforts, was conducted as the first step of the current 2013 master planning effort. The 2013 Master Plan will solidify and/or modify the preliminary recommendations presented in the SIP. The purpose of conducting the review was to determine which of the previous findings should be (1) carried forward in current planning efforts as they were presented in the SIP documentation; (2) modified to reflect updated conditions; or (3) re-analyzed.

This review was focused largely on how the preliminary recommendations in the SIP may need to be modified or re-analyzed due to significant changes that have occurred since the SIP was developed. These significant changes include:

- The State Water Board's mandate for ammonia removal at Sacramento Regional's facilities, which has brought more focus on nutrient management issues for San Francisco (SF) Bay.
- Extensive staff management changes within the City's Public Works and Environmental Services Departments.
- The development of the City's Recycled Water System Feasibility Study in April 2013.
- On-going performance issues with the existing secondary process (ponds/fixed growth reactors [FGRs]/air flotation tanks [AFTs]) which could result in difficulties in meeting near-term discharge standards.

Given the extensive staff changes since the development of the SIP, this review was conducted collaboratively with the current City staff to ensure the master plan aligns with their current vision for the WPCP.

2.0 BACKGROUND

2.1 Strategic Infrastructure Plan (SIP)

In 2008, the City engaged Brown and Caldwell (BC) to initiate the preparation of the SIP for the WPCP. The SIP addressed all the system improvements needed to rebuild the WPCP and is comprised of 19 TMs, which are summarized in Table 1.

Table 1	Summary of Strategic Infrastructure Plan (SIP) TMs Master Plan and Primary Treatment Design City of Sunnyvale
TM No.	**TM Name**
	Decision Making
1	Business Case Evaluation of Plan Alternatives
2	Business Case Evaluation Decision Making Methodology
3	Level of Service (LOS) Measures
	Alternatives Development
4	Plant Rehabilitation Alternative Summary
5	Plant Replacement Alternative Goals, Objectives, and Technology Screening Review
6	Plant Replacement Alternatives Summary
	Special Planning
7	Early Execution Projects
8	Headworks and Primary Sedimentation Upgrades Alternatives Evaluation
	Fundamental Information
9	Influent Flows and Loads
10	Solids Loads
11	Regulatory Framework
12	Seismic Performance Goals
13	Electric Power System Level of Service
14	Condition Assessment and Unit Process Performance Review
15	Nitrification System Improvements
16	Evaluation of Dewatering Alternatives
17	Upgrade Alternatives for the Air Flotation Tanks (AFTs)
18	Anaerobic Digestion of Algae
19	Recycled Water Treatment Alternatives

The most debated element of the SIP recommendations was the selection of the secondary treatment process alternative. The SIP compared four alternatives for secondary treatment, which included:

- **Plant Rehabilitation.** This alternative includes rebuilding the plant facilities without making any significant change to the processes. The core secondary treatment process, which includes a combination of 440-acres of oxidation ponds, dissolved air flotation thickener (DAFT) clarification, and FGRs would remain in place.
- **Plant Replacement – Conventional Activated Sludge (AS).** This alternative includes replacing the core secondary treatment process with a conventional activated sludge (AS) process for secondary treatment and nitrification.

- **Plant Replacement – Membrane Bioreactor (MBR) Activated Sludge (AS).** This alternative includes replacing the core secondary treatment process with a membrane bioreactor (MBR) AS process for secondary treatment and nitrification.
- **Plant Rehabilitation – Hybrid Pond and Conventional AS System (Hybrid).** This alternative includes implementing an AS process that would treat a portion of the organic load in combination with the oxidation ponds.

The SIP recommended the City move forward with the Plant Rehabilitation alternative. Should the nitrification performance of the existing WPCP secondary process (pond/FGRs/DAFTS) prove to be insufficient to meet water quality requirements, the SIP recommended the City move forward with the Plant Replacement AS alternative.

The SIP included several less debated recommendations that were common to all secondary treatment alternatives. These recommendations included:

- Implementing new screening, pumping, grit removal and primary sedimentation facilities for improved preliminary and primary treatment.
- Implementing a new primary effluent pipeline to the ponds and flow equalization to mitigate impacts on the secondary treatment process.
- Implementing DAFTs for solids thickening, TPAD for sludge digestion to meet Class A requirements, and screw presses for dewatering of digested sludge.

2.2 Strategic Infrastructure Plan (SIP) Peer Review

The City engaged CH_2M Hill (CH_2M) to conduct a peer review of the SIP. CH_2M confirmed that the SIP was well prepared, but offered a third alternative for rebuilding the plant – the FGRs and Wetlands alternative. This alternative proposed using the existing FGRs as well as additional FGRs for secondary treatment. The ponds would be converted to wetlands and used as a denitrification treatment process following the secondary process.

2.2.1 Peer Review Follow-up

The City decided to hold a workshop in December 2011 to allow a full vetting of all issues among both consulting firms and the City staff. The Plant Rehabilitation alternative was eliminated from consideration on the basis that it provided no advantage over the other alternatives, and is the least able to comply with more stringent anticipated future regulations. It was concluded the Plant Replacement AS alternative and the FGR/wetlands alternatives should be considered further. The Plant Replacement AS alternative project considered both conventional and MBR AS process options.

The workshop also resulted in the identification of projects that are needed to address near-term risks which the City should implement independent of the selection of the secondary treatment process. These projects, identified as the "gap projects," include the following:

- Conversion from sulfur dioxide to sodium bisulfate for de-chlorination.
- Installation of the PE bypass line to the ponds.
- Renovation of the digesters.
- Renovation of the AFTs.
- Conversion of gaseous chlorine to liquid chlorine.
- Retaining the services of a program management consultant to assist in implementing the SIP.
- Preparation of a site and facility master plan and associated California Environmental Quality Act (CEQA) documentation.
- Completion of the design for the preliminary and primary treatment processes.

2.3 Master Plan SIP Review Meeting - June 19th, 2013

As an initial step of the master plan, the latest SIP recommendations were reviewed by Carollo and City staff in a workshop setting. As described above, the SIP was reviewed in light of significant changes that have occurred since the SIP was developed. This memo will summarize the findings of the Master Plan Workshop No. 1 – SIP Validation that took place on June 19th and several subsequent follow-up discussions. The presentation slides and minutes from that workshop are included in Appendix A.

The City's recycled water objectives were recently formalized in the City's Recycled Water System Feasibility Study (April 2013). Based on this feasibility study, a near-term recycled water demand of 1.7± million gallons per day (mgd) was identified by the year 2018. Because of residual pond algae color issues, several alternatives including the installation of an MBR was recommended to meet this near-term demand. This initial phase of recycled water demand could increase by an additional 3.0± mgd based on projections made for recycled water use by Apple (which is outside of the City's service area). A total recycled water demand of 3.6 mgd was identified (within the City) by the year 2035. The approach to supplying near-term and long-term recycled water needs will be evaluated as part of the secondary and tertiary process analysis.

It was noted that an initial high-level assessment of the FGR and Wetlands alternative indicates that this process configuration may not provide sufficient flexibility to deal with more stringent nutrient standards. In addition, a more detailed analysis of the use of wetlands will be prepared as part of the overall secondary treatment process review.

3.0 PLANNING OBJECTIVES

Two sets of planning objectives were developed as part of the SIP. The first set included sixteen (16) Levels of Service (LOS) criteria that were developed as part of the SIP which are summarized in Table 2. The LOS criteria were used as part of the overall business case analysis methodology for assessing the alternatives developed as part of the SIP.

Table 2	**SIP Levels of Service (LOS) Master Plan and Primary Treatment Design City of Sunnyvale**
LOS No.	**LOS Name**
Environmental - Regulatory	
1	Flow Capacity – Permit Rated Flows vs. Projected 2035 Flows
2	NPDES Permit
3	Air Quality Management (Non-GHG) Emissions
4	Stormwater Treatment
Environmental – Non-Regulatory	
5	Biosolids Reuse
6	Sustainability
7	Health and Safety
8	Toxics
Social	
8	Regionalization
9	Good Neighbor
10	Traffic Flow
11	Odor
Financial	
12	Cost Effective Plant/Operations
13	Facility Reliability
14	Decisions
15	Equipment/Buffering/Flow Equalization
16	Safety

As part of the SIP Peer-Review, the Peer Review Team developed a second set of objectives to which an additional objective (flexibility) was added during the June 19, 2013 SIP review meeting:

- **Reliability** – The WPCP should reliably achieve all permit requirements with an industry-standard or superior level of operation and maintenance (O&M), achieved by incorporating the appropriate level of automation technology.
- **Resource Recovery** – Optimize recovery of resources present in the influent wastewater for power generation, nutrient recovery, water reuse, or other beneficial uses, including revenue generation.
- **Power Issues** – Provide the WPCP with a more reliable power supply and, to the extent practical, enhance power reliability for other City users.

- **Community Resources** – The WPCP should provide a benefit to its customers and City residents beyond functioning solely as a wastewater treatment plant, without added costs to rate payers.
- **Innovation** – Incorporate proven technological advances that have emerged since the WPCP was constructed as they may align with the City's other objectives, and allow for flexibility to incorporate future innovations to meet needs as they arise.
- **Financial** – Achieve the optimal balance of capital and long-term O&M costs (life cycle costs), realizing that a low capital cost can be overshadowed by greater O&M costs over the planning horizon.
- **Flexibility** – The ability to adapt to regulatory and financial uncertainty (i.e., phasing of certain improvements).

These seven objectives were utilized to develop a list of overarching planning objectives for the master plan as presented in Table 3.

Table 3 Overall Planning Objectives
Master Plan and Primary Treatment Design
City of Sunnyvale

No.	Planning Objective
1	Develop process improvements to meet current and foreseeable water quality, biosolids and air quality requirements
2	Identify process improvements that are cost effective, incorporate innovative solutions and technologies, and promote City goals to maximize water recycling opportunities
3	Provide the WPCP with a more reliable power supply through renewable energy generation that provides means to meet future heat and power demands
4	Implement improvements to the WPCP site in a manner that maximizes the use of available space, enhances safety through improved traffic circulation and access, and improves public access to the WPCP while ensuring site security
5	Maintain wastewater operations to meet regulatory standards during the coarse of implementing of the Master Plan improvements
6	Implement the recommended WPCP improvements in a manner that provides flexibility in responding to financial and regulatory uncertainty
7	Maximize the useful life of the existing WPCP facilities in a manner that minimizes the rate impacts while maintaining regulatory compliance
8	Incorporate a level of redundancy which provides O&M flexibility to deal with planned and unplanned process downtime
9	In partnership with other agencies, protect the WPCP from flooding and risks associated with sea level rise
10	Minimize life-cycle costs (capital and O&M) to City rate payers

These ten overarching planning objectives will be utilized as appropriate in the analysis of various planning alternatives.

4.0 BASIS OF PLANNING

4.1 Drivers

Five planning drivers were presented at the June 21st Workshop. These include:

- Flows and loads (growth).
- Reliability and replacement.
- Regulatory.
- Policy decisions (e.g., recycled water).
- Optimization (e.g., O&M costs).

Flows and loads as well as regulations were discussed in detail at the workshop.

4.2 Flows and Loads

The 2035 flow projections (shown in Figure 1) developed in the SIP were discussed (i.e., current flows into the WPCP are running below the SIP projections). Therefore, it was agreed this would not be considered a growth-driven plan (i.e., growth would not be the primary driver for new facilities). It was noted by City staff that a collection system master planning effort is ongoing which could impact the 2035 flow projections (i.e., business expansion, redevelopment, daytime population trends, etc).

In separate discussions with City staff, it was noted that the current permitted capacity noted in the National Pollutant Discharge Elimination System (NPDES) documentation is almost double the 2035 projections. City staff was informed that as part of developing future flow and load projections, this permitted capacity value would be reviewed as part of the CEQA documentation for the master plan.

Chemical biochemical oxygen demand (CBOD) and total suspended solids (TSS) projections included in the SIP and the recent load analysis conducted by Carollo indicates an increase in the CBOD, TSS and ammonia loading since 2009. A separate flows and loads analysis has been prepared as part of the master planning effort to confirm the planning values to be used for evaluating process alternatives and ultimate site capacity.

4.3 Regulatory Impacts

The SIP included a detailed review of the regulatory environment in the 2008-2009 time frame. The following provides a 2013 regulatory update for water quality, biosolids and air emissions related issues. At the end of this section, Table 4 provides a summary of the key regulatory issues and potential planning impacts.

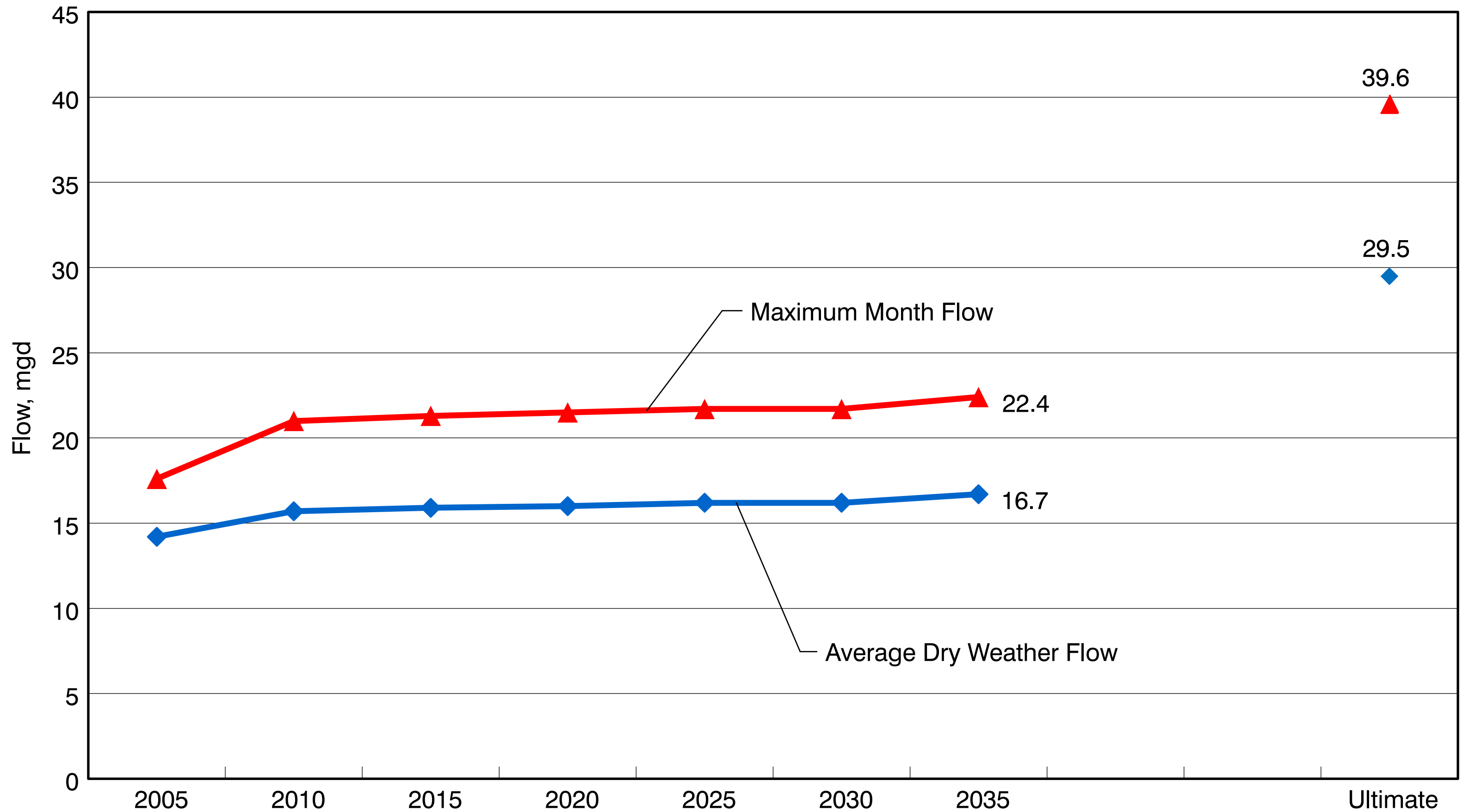

Figure 1
FLOW PROJECTIONS INCUDED IN THE SIP
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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4.3.1 Water Quality – Discharge to San Francisco (SF) Bay

The following assumptions regarding water quality requirements to the San Francisco (SF) Bay should serve as the basis of planning:

- Future nitrogen limits will be established using a mass loading basis (assuming an overall total maximum daily load [TMDL] is developed for SF Bay).
- It is likely the WPCP's current seasonal ammonia limits (summer: 2 milligrams per liter [mg/L] monthly and 5 mg/L peak day and winter: 18 mg/L monthly and 26 mg/L peak day) will remain the same through the next permit cycle (2014 to 2018). Based on the current action plan for developing waste load allocations for nitrogen, Figure 2 was prepared to summarize the proposed implementation of future nitrogen requirements:
  - Assumes in the 2024 permit cycle that ammonia limits become more strict (i.e., lower winter limits) and that total nitrogen limits would be added to the permit, with the emphasis being on annual mass limits for total nitrogen (precise limits not known at this time).
  - Assumes that total nitrogen low level compliance (i.e., TN ≤ 8 mg/L]) will be required no earlier that 2034 (TN currently ranges from 12 mg/L to 17 mg/L in the summer to 19 mg/L to 23 mg/L in the winter).
- Based on this analysis, master planning of future secondary facilities would be based on water quality-based ammonia/total nitrogen limits.
- Phosphorus has been identified as a potential future nutrient of concern, but timing for compliance has not been discussed (nor are there drivers or evidence related to phosphorus regulations in SF Bay). Site space would be provided for future phosphorus removal facilities (i.e., chemical addition) at the WPCP based on meeting a 1-mg/L total phosphorus limit.

4.3.2 Water Quality – First Flush Stormwater Treatment

The following assumptions regarding the treatment of first flush stormwater at the WPCP should serve as the basis of planning:

- City completed a study (EOA – Mercury Special Study in December 2007) which evaluated the potential of diverting wet weather and dry weather first flush stormwater diversions for the removal of mercury and total suspended solids (see EOA paper in Appendix B):
  - Wet weather diversion of up to 11 mgd and dry weather diversions of up to 4 mgd would be expected from the Baylands Pump Station No. 1.
  - Either a first flush or dry weather project appears to be technically feasible.

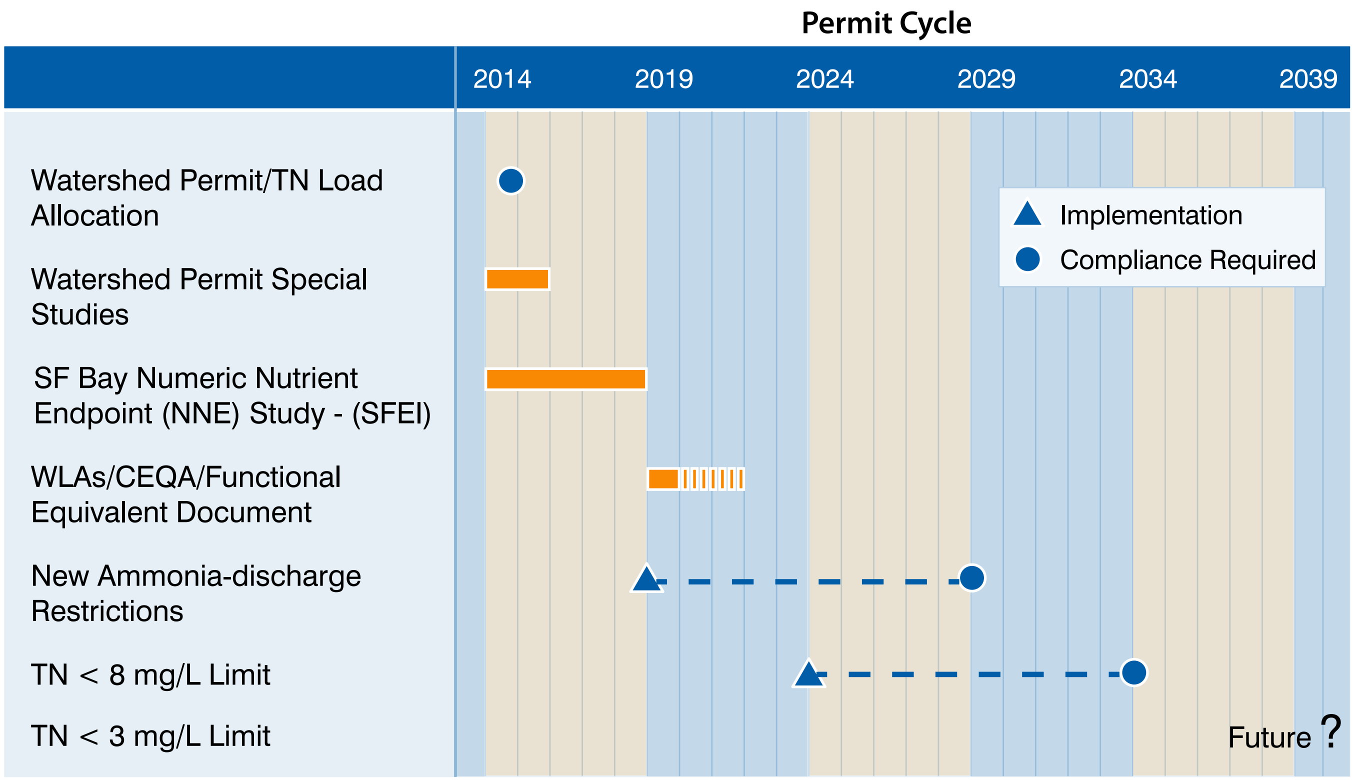


Figure 2
NITROGEN COMPLIANCE SCHEDULE
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

- Based on assumptions used for estimated loadings and diversions events, mercury loading reductions of 3.2 grams per year for a first flush project and 0.89 grams per year for a dry weather project were calculated.
- Unit costs for removal of mercury were considered very high ($28,440 per gram of mercury for first flush project or $60,110 per gram for a dry weather project which did not include a prorated share of all potential WPCP operating costs). It was recommended that other more cost-effective loading reduction strategies should be pursued.

- The SF Bay Region RWQCB issued a stormwater NPDES permit in October 2009 for all municipal separate storm sewer systems (the Municipal Regional Permit [MRP]), with emphasis on the control of mercury and PCBs to SF Bay, pursuant to the adopted TMDLs for those pollutants. Pilot projects were to be completed for several strategies to achieve load reductions, including the feasibility of diverting first flush stormwater flows to municipal publicly owned treatment works (POTWs).

- BACWA studies completed in 2010 indicated the following (see BACWA white paper in the Appendix C):
  - Only dry weather diversions are currently practiced/first flush diversions have not been proven.
  - Reductions in mercury/PCBs need to be further evaluated.
  - Fish kills from the first flush out of stormwater pump station wetwells (which were one of the key drivers for considering diversions to POTWs) can be reduced with best management practices (i.e., using pumper trucks to clean out wetwells that have gone septic).

- The Water Board has not formally responded to the MRP pilot studies, but Water Board staff continues to assert that diversions to POTWs should be a viable “best management practice” (BMP) for some locations. The next iteration of the MRP is scheduled for adoption on July 1, 2015. Current discussions are trending toward more site-specific strategies in older industrial areas or for other projects (such as roadway projects or private development) to be implemented.

4.3.3 <u>Water Quality – Recycled Water</u>

The following assumptions regarding water quality requirements for the recycled water uses identified in the City’s Recycled Water System Feasibility Study (April 2013) as well as the City’s discussions with Apple:

- The Recycled Water Feasibility Study identified users that could be supplied with treated effluent which meets Title 22 water quality requirements (including Apple).

- For indirect potable reuse (IPR) uses, there would be TN limits of 10 mg/L as well as requirements for membrane filtration.

4.3.4 Biosolids

The following assumptions regarding biosolids disposal regulations should serve as the basis of planning:

- As long as the ponds are used for solids treatment, the solids can remain in the ponds indefinitely (unless pond treatment capacity is impacted). Solids started accumulating in the ponds in the 1960s, however recent testing has shown that that settled material would not be classified as toxic.
- There are no near-term (10+ years) drivers for producing Class A sludge (no apparent federal or state regulations are anticipated).
- Because of future changes in disposal opportunities (i.e., ability to use biosolids as alternative daily cover or ADC in landfills), the City will need to develop a more diversified portfolio for disposal. This could include utilizing land application and ADC as long as possible and continued monitoring of the progress for regional alternatives for diversification (Bay Area Biosolids-to-Energy project).
- Space should be allocated on the WPCP site to provide for either pre-processing or post-process options to meet Class A requirements for at least a portion of the biosolids produced.

4.3.5 Air Emissions – Criteria Pollutants

The following assumptions regarding air emissions regulations should serve as the basis of planning:

- City is in negotiations with the Bay Area Air Quality Management District (BAAQMD) regarding an Enforcement Agreement necessary for continued operation of the existing influent engines until the new headworks is operational in late 2018 (engines will be out of compliance with BAAQMD Regulation 9, Rule 8 as of January 1, 2016).
- City should develop a strategy for “exiting” Title V compliance requirements once the influent engines are retired (will require Environmental Protection Agency [EPA] approval). Ideally, electrification of the headworks will coincide with the Title V permit renewal. If so, the City could exit the Title V program before the renewal documents are due in November 2017.
- The Title V permits for the WPCP and landfill, while issues separately, are tied together via Condition 11586 of the landfill’s Title V permit. This condition requires that the landfill gas either be “vented” to the IC engines (S-14 or S-15) at the WPCP or flared at the landfill. Depending on the composition of the landfill gas, this has potential implications to impact emissions from the WPCP.

4.3.6 Air Emissions – Greenhouse Gases (GHGs)

The following assumptions regarding air emissions regulations should serve as the basis of planning:

- Under AB 32, annual GHG reporting is required if stationary combustion emission are equal to or greater than 10,000 metric tons of carbon dioxide equivalent per year. If the City uses measured heating values (instead of default values) for biogas under Tier 2 reporting, the estimated reported emissions would drop below the 10,000 metric ton threshold. If the City can show that if estimated emissions fall below the 10,000 metric ton threshold for three consecutive years (i.e., 2013, 2014 and 2015), then the City will be able to cease reporting from year 2016 forward or until emissions exceed the threshold during a future calendar year.
- For EPA, reporting of GHG emissions, is triggered by the landfill methane generation and recovery (annual threshold of 25,000 metric tons of carbon dioxide equivalent). To cease reporting, onsite stationary combustion emissions must fall below 15,000 metric tons of carbon dioxide equivalent for three consecutive years. The City's emissions have been below the 15,000 metric ton threshold since beginning reporting in 2010. However, the City must notify EPA in advance of their intent to exit reporting. The City has notified EPA as part of submitting their 2013 emissions report and no longer need to report GHG emissions to EPA for calendar year 2014 and beyond (or until emissions exceed the threshold during a future calendar year).

4.3.7 Air Emissions – Odor Control

The following assumptions regarding air emissions regulations should serve as the basis of planning:

- Because of current BAAQMD standards, the degree of odor control to be implemented as part of the master planning improvements is a policy decision. Odor control criteria typically impact the planning and design of the headworks, primary treatment process, and thickening and dewatering treatment processes.

4.3.8 Regulatory Impacts Summary

Table 4 provides a summary of the key regulatory issues and potential planning impacts.

Table 4 Summary of Potential Regulatory Issues and Potential Planning Impacts Master Plan and Primary Treatment Design City of Sunnyvale		
Topic	**Issue**	**Potential Impact**
Nitrogen Reduction to SF Bay	More stringent effluent limits will be implemented – specifics for requirements and timing is subject to scientific review/negotiations	Flexibility in implementation of secondary treatment facilities to provided just-in-time improvements
Constituents of Emerging Concerns (CECs)	There is a trend of increasing regulation and it is anticipated that new effluent limits will be added to permits in the distant future.	Maximize removal through increased source control and pollution prevention programs. Provide site space for potential AOP processes
Recycled Water – Title 22 Uses	A recycled water plan for the City has identified potential reuse customers	Requires both WPCP and infrastructure delivery improvements
Recycled Water – Indirect Potable Reuse	Potential exists to supply treated effluent for water supply uses	Will require outside funding of certain technologies to be implemented
Biosolids	Landfilling of biosolids is becoming increasingly restrictive	Diversifying biosolids management alternatives.
Air Emissions – Criteria Pollutants	Compliance with Title V requirements will continue until the influent engines are retired	Opportunity to purse a strategy for exiting from Title V once the influent engines are retired
Air Emissions – Greenhouse Gases (GHGs)	GHGs are currently reported based on reporting approaches that could be modified	Opportunity to eliminate need for GHG reporting if changes are made to methodology as well as a result of reduced landfill gas production
Air Emissions - Odors	Policy decisions and not specific BAAQMD standards drive odor improvements	Odor control strategy should be developed

5.0 PROCESS FACILITY REVIEW

5.1 Liquid Treatment

The three remaining secondary treatment alternatives developed through the SIP and the various SIP review processes were discussed at the June 21st Workshop. These include:

- Plant Replacement – Conventional AS.
- Plant Replacement – MBR AS.

- FGRs and Wetlands.

Figures 3, 4 and 5 present site layouts for each alternative that were developed as part of the SIP and subsequent SIP review efforts.

The wetland option will be re-analyzed on the basis that stringent total nitrogen (TN) limits (<8 mg/L) may be difficult to reliably meet with this process.

It was agreed the following assumptions regarding liquids treatment should serve as the basis of planning:

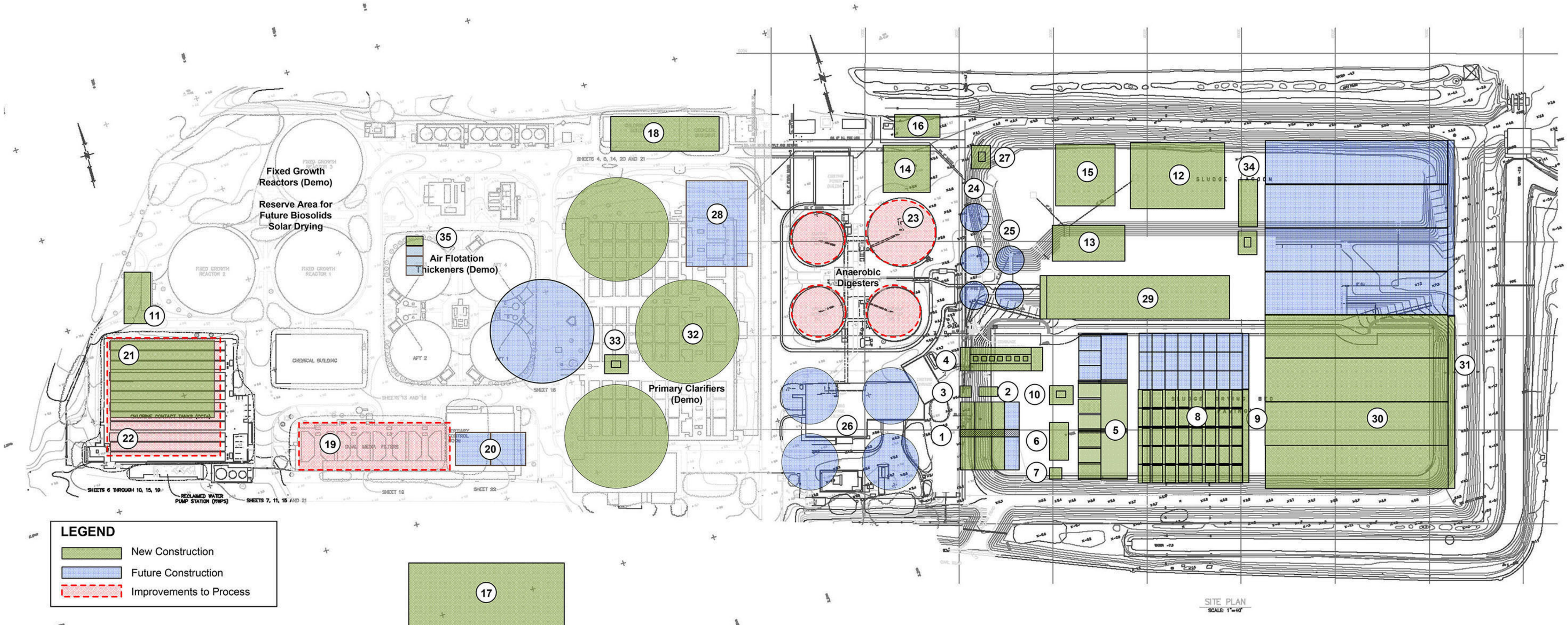
- SIP recommendations for screening, raw sewage pumping, grit removal and primary treatment are viable and should be carried forward. Further refinement of the alternatives for grit removal should be considered as part of the master planning effort (i.e., grit and chemically-enhanced primary treatment (CEPT) field testing).
- SIP recommendations for a primary effluent pipeline to the ponds and flow equalization to mitigate impacts on the secondary treatment process are viable and should be carried forward.
- Implementing “ultra fine” screening in lieu of primary treatment is not appropriate for plants as large as the WPCP.
- The benefits of CEPT should be analyzed and considered as part of the master plan.
- Treatment alternatives for recycled water production were identified for each secondary treatment alternative and will be analyzed and considered as part of the master plan.

5.2 Solids Treatment

Figure 6 includes a site layout of the solids treatment facilities recommended in the SIP.

It was agreed the following assumptions regarding solids treatment should serve as the basis of planning:

- Both rotary drum thickeners and DAFTs (per SIP) are acceptable technologies for thickening of WAS solids or for co-thickening of primary/WAS solids as well.
- Alternatives to temperature phased anaerobic digestion (TPAD) recommended in the SIP, such as sludge pretreatment prior to digestion, should be considered in the master plan to meet Class A requirements. Additional analysis of the digestion process is required based on updated solids loading information. This additional analysis is described in more detail in the June 19th Workshop minutes included in Appendix A.



KEY

1. Screening Facility
2. Screenings Washer / Compactors
3. Screenings Storage Bin Station
4. Raw Sewage Pump Station
5. Grit Removal Tanks and Equipment Gallery
6. Grit Washer/Compactors
7. Grit Bin Station
8. Primary Sedimentation Tanks
9. Primary Effluent Channel
10. Headworks and Primaries Area Substation
11. Hypochlorite / Bisulfite Storage
12. Solids Dewatering
13. DAF Co-Thickening
14. Relocated Site Utilities (hot water, plant air, etc.)
15. New Maintenance Facility
16. Relocated Landfill Gas Booster Blowers and Flare
17. Administration Building
18. Power Distribution Center (w/Stand-By Power)
19. Dual Media Filter Improvements
20. Future Filter Cells for Denitrification
21. UV for Bay Discharge above Cl2 Contact Tanks
22. Recycled Water Disinfection Channels
23. Anaerobic Digesters Improvements
24. Future Digested Sludge Storage for Class A Sludge
25. Future Batch Tanks for Class A Sludge Digestion
26. Future Anaerobic Digesters for Organics Digestion
27. Solids Handling Area Substation
28. Future Biogas Processing / Combined Heat Power
29. Return Sludge Reaeration Tank
30. Activated Sludge Aeration Basins 1-4
31. Aeration Basin Effluent Channel
32. Secondary Clarifiers
33. Tertiary Treatment Area Substation
34. Blower Building and Substation
35. Cloth Media Filters for Recy. Water (if Denite filters req.)

SITE	Sunnyvale Strategic Implementation Plan: Plant Replacement Alternative A
TITLE	Final Layout (Including Ultimate Influent Flow Allocation)
Brown AND Caldwell	DATE October 2009; PROJECT 135083-005-001; Figure 2

Figure 3
PLANT REPLACEMENT
ACTIVATED SLUDGE (AS) ALTERNATIVE – SITE LAYOUT
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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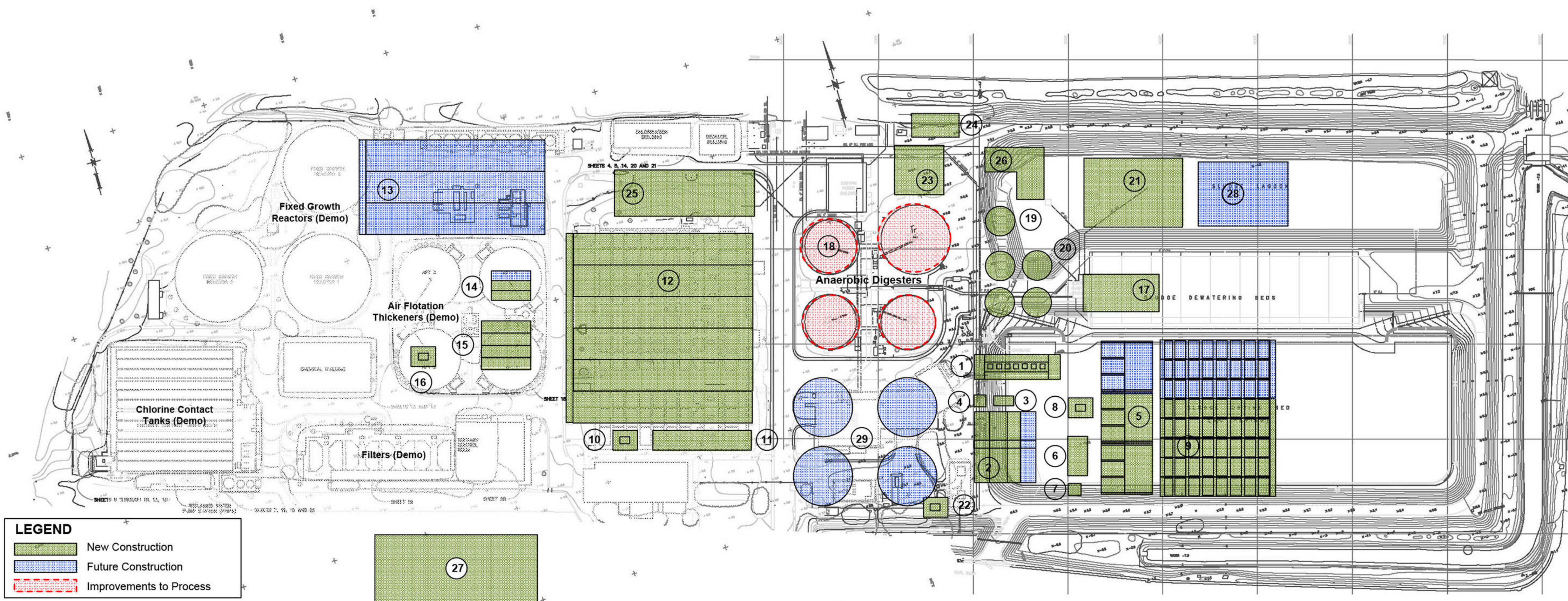

KEY

1. Raw Sewage Pump Station
2. Screening Facility
3. Screenings Washer/Compactor
4. Screenings Storage Bin Station
5. Grit Removal Tanks and Equipment Gallery
6. Grit Washer/ Compactors
7. Grit Bin Station
8. Headworks and Primaries Area Substation
9. Primary Sedimentation Tanks
10. MBR Area Substation
11. Blower Building
12. MBR Tanks 1-6
13. Future MBR Tanks
14. UV Disinfection Channels
15. UV Disinfection for Recycled Water
16. UV Disinfection Area Substation
17. Co-Thickening
18. Anaerobic Digesters Improvements
19. Digested Sludge Storage
20. Pasteurization Tanks (4)
21. Solids Dewatering
22. Solids Handling Area Substation
23. Relocated Site Utilities from Primary Control Building (hot water, plant air, etc.)
24. New Location of Landfill Gas Booster Blowers and Landfill Gas Flare
25. Power Distribution Center (with Stand-By Power)
26. New Maintenance Facility
27. Administration Building
28. Future Biogas Processing/Combined Heat Power
29. Future Anaerobic Digesters for Organics Digestion

SITE	Sunnyvale Strategic Implementation Plan: Plant Replacement Alternative B
TITLE	Final Layout (Including Ultimate Influent Flow Allocation)
Brown AND Caldwell	DATE October 2009 / PROJECT 135083-005-001 / Figure B-6

Figure 4
PLANT REPLACEMENT
MBR ALTERNATIVE – SITE LAYOUT
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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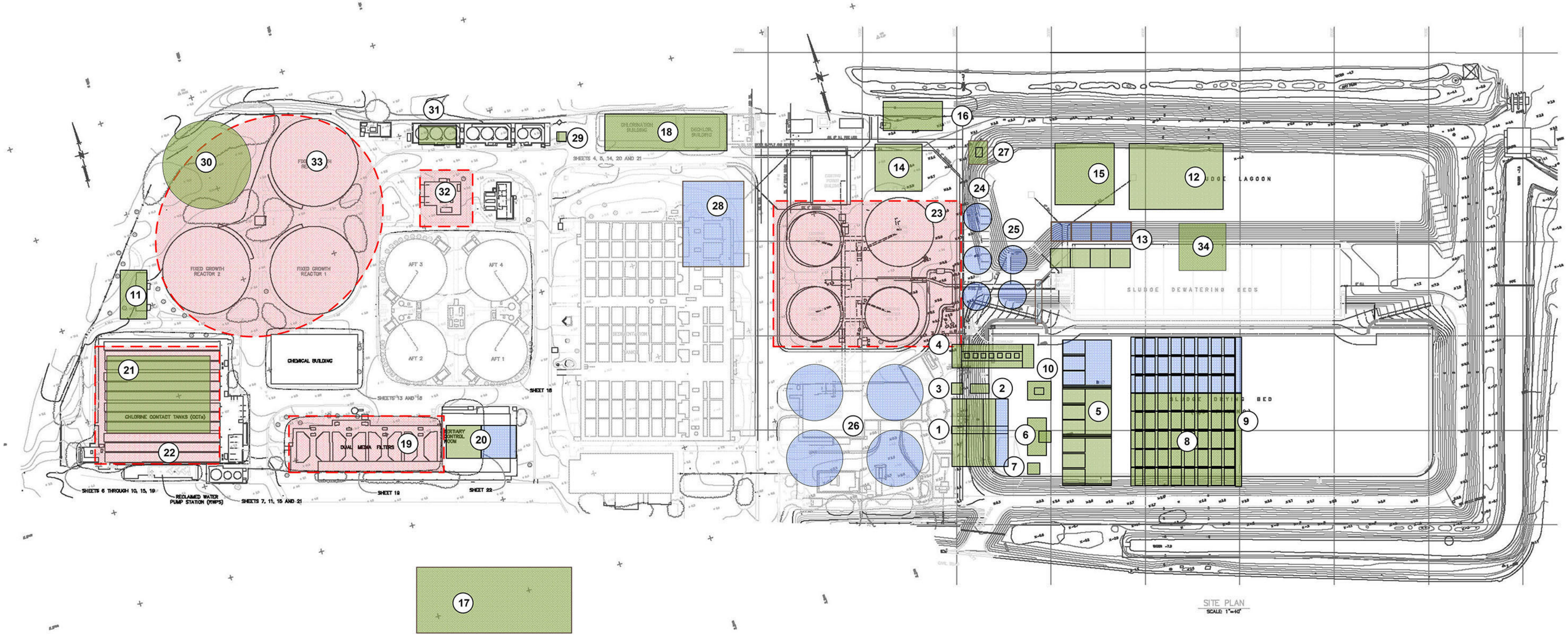

KEY

1. Screening Facility
2. Screenings Washer / Compactors
3. Screenings Storage Bin Station
4. Raw Sewage Pump Station
5. Grit Removal Tanks and Equipment Gallery
6. Grit Washer / Compactors
7. Grit Storage Bin Station
8. Primary Sedimentation Tanks
9. Primary Effluent Channel
10. Headworks and Primaries Area Substation
11. New Sodium Hypochorite and Bisulfite Storage Tanks
12. Solids Dewatering Building
13. Rectangular DAFTs (Recycled Water)
14. Relocated Site Utilities from Primary Control Building (Hot Water, Plant Air, etc.)
15. New Maintenance Facility
16. New Location of Landfill Gas Booster Blowers and Landfill Gas Flare
17. New Administration Building
18. Power Distribution Center (with Stand-By Power)
19. Dual Media Filter Improvements
20. Dual Media Filtration (Recycled Water)
21. UV for Bay Discharge above Chlorine Contact Tanks
22. Improved Chlorine Contact Tanks for Recycled Water
23. Anaerobic Digester Improvements
24. Future Digested Sludge Storage for Class A Sludge
25. Future Batch Tanks for Class A Sludge Digestion
26. Future Anaerobic Digesters for Organics Digestion
27. Solids Area Substation
28. Future Biogas Processing / Combined Heat Power
29. Digester / Dewatering Return Flow Pump Station
30. New C and N Trickling Filter
31. Snail Control Chemical Feed Station
32. NTF Influent Pump Station
33. Upgrades and Rehabilitation: Nitrifying Trickling Filters
34. Chemically Enhanced Primary Treatment Chemical Storage

LEGEND

- New Construction
- Future Construction
- Improvements to Process

SITE	Sunnyvale Strategic Implementation Plan CEPT / C and N TF / Wetlands Option
TITLE	Final Layout (Including Ultimate Influent Flow Allocation)
Brown AND Caldwell	DATE October 2009 PROJECT 135083-005-001 Figure 3

Figure 5
FGRs AND WETLANDS ALTERNATIVE – SITE LAYOUT
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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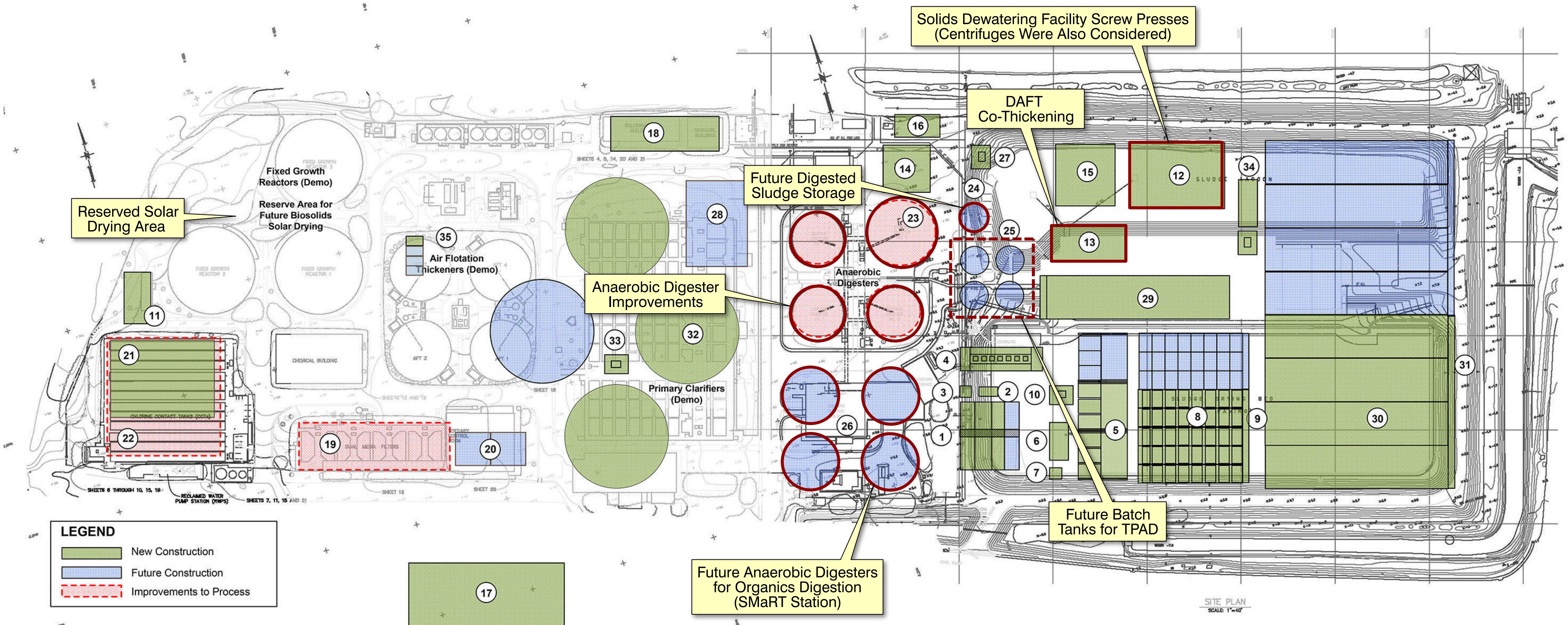

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9. Primary Effluent Channel
10. Headworks and Primaries Area Substation
11. Hypochlorite / Bisulfite Storage
12. Solids Dewatering
13. DAF Co-Thickening
14. Relocated Site Utilities (hot water, plant air, etc.)
15. New Maintenance Facility
16. Relocated Landfill Gas Booster Blowers and Flare
17. Administration Building
18. Power Distribution Center (w/Stand-By Power)
19. Dual Media Filter Improvements
20. Future Filter Cells for Denitrification
21. UV for Bay Discharge above Cl2 Contact Tanks
22. Recycled Water Disinfection Channels
23. Anaerobic Digesters Improvements
24. Future Digested Sludge Storage for Class A Sludge
25. Future Batch Tanks for Class A Sludge Digestion
26. Future Anaerobic Digesters for Organics Digestion
27. Solids Handling Area Substation
28. Future Biogas Processing / Combined Heat Power
29. Return Sludge Reaeration Tank
30. Activated Sludge Aeration Basins 1-4
31. Aeration Basin Effluent Channel
32. Secondary Clarifiers
33. Tertiary Treatment Area Substation
34. Blower Building and Substation
35. Cloth Media Filters for Recy. Water (if Denite filters req.)

SITE	Sunnyvale Strategic Implementation Plan: Plant Replacement Alternative A
TITLE	Final Layout (Including Ultimate Influent Flow Allocation)
Brown and Caldwell	DATE October 2009 PROJECT 135083-005-001 — Figure 2

Disposal is the Main Issue with Solids Treatment

Figure 6
SITE LAYOUT FOR SOLIDS TREATMENT FACILITIES RECOMMENDED IN SIP
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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- Screw presses are a robust and simple solids dewatering process to operate, but cannot easily be adjusted to accommodate process changes. In comparison, centrifuges have more process flexibility and produce drier solids, but are a more complex O&M process (both were included in the SIP). Both technologies should be considered as part of the master plan alternative analysis.
- The site layout must accommodate a future fats, oil, and grease (FOG) facility.

5.3 Energy

Figure 7 includes a site layout of the energy-related facilities recommended in the SIP and in the subsequent Gas Management System Evaluation developed by CDM Smith in May 2013.

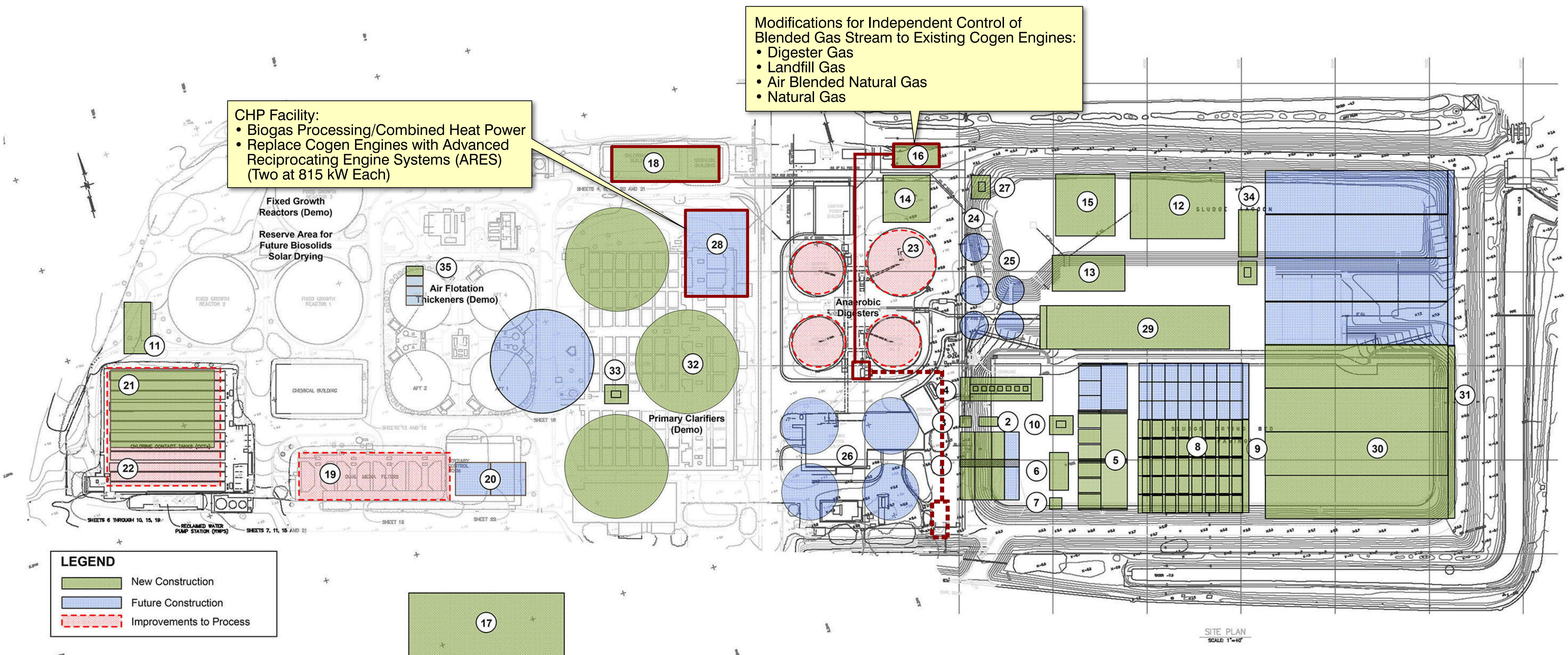
The following assumptions regarding energy should serve as the basis of planning:

- The existing cogeneration engines, which have a remaining service life of up to 10 years, are limited to operating at 600 kW, instead of their full capacity of 800 kW due to fuel feed limitations.
- A boiler may be required (the CDM Smith 2013 Gas Management report indicated a boiler may not be needed). The need for a boiler will be driven by the reliability of the heat recovery system that may be implemented.
- The WPCP's projected heat load must be updated for the master plan, based on the treatment processes selected.

5.4 Support Systems

The following assumptions regarding support systems should serve as the basis of planning:

- The master planning effort must confirm the SIP recommendation for a 2,000-kW standby generator.
- The recommendation for a portable generator (up to 1,250-kW in size) included in the 2013 Gas Management System Evaluation should be further evaluated. Modifications will likely be needed at the motor control center (MCCs) to make use of the portable generator. These modifications could move ahead as a parallel project.
- The proposed electrical distribution system described in the SIP (power distribution center and area substations) will require further evaluation as part of the master plan.



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30. Activated Sludge Aeration Basins 1-4
31. Aeration Basin Effluent Channel
32. Secondary Clarifiers
33. Tertiary Treatment Area Substation
34. Blower Building and Substation
35. Cloth Media Filters for Recy. Water (if Denite filters req.)

SITE: Sunnyvale Strategic Implementation Plan: Plant Replacement Alternative A

TITLE: Final Layout (Including Ultimate Influent Flow Allocation)

Brown AND Caldwell

DATE: October 2009

PROJECT: 135083-005-001

Figure 2

Boiler Needed to Heat Digesters When Engine-Driven IPS Pumps Retired

Figure 7
SITE LAYOUT FOR ENERGY FACILITIES RECOMMENDED IN SIP
SIP VALIDATION
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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- The master plan should include a significant analysis of and recommendations for the automation of the process facilities at the WPCP (not addressed in the SIP).
- The SIP provided an odor control allowance that included containment and odor treatment for the headworks, primary sedimentation tanks, aeration basins, thickening and dewatering facilities. Further refinement of these recommendations will be developed as part of the master plan.

5.5 Support Facilities

The following assumptions regarding support facilities should serve as the basis of planning:

- Implementation of a new Administration Building should not be limited to the current process site constraints.
- Implementing a new access road to the Bay Trails needs to be assessed as a viable alternative by the City at an early stage of the planning process.
- Utilizing a portion of the landfill to accommodate the new Administration Building may be viable, as a portion of the landfill was re-graded to accommodate the new hazardous waste facility.
- City staff confirmed that additional maintenance and warehouse space will need to be considered as part of the building programming effort.
- The site layout should evaluate the potential space needs for a future RO process (as well as considerations for brine disposal).

6.0 SIP COST SUMMARY

Estimates of costs for the elements identified in the SIP were prepared for the two plant replacement alternatives: (1) conventional AS and (2) MBR. Based on the phasing assumptions, each group of elements corresponding to the major WPCP improvements were escalated to the mid-point of construction. To those construction cost estimates, “soft costs” were also incorporated into the overall planning estimates to account for engineering, legal and administration costs. Soft costs are typically added to the estimated construction cost estimates on a percentage basis. For the SIP, the following soft cost percentages were included: (1) 15 percent for planning/design/EIR; (2) 7 percent for project management fees; (3) 8 percent for construction management fees and (4) 10 percent for a construction change order allowance. These soft cost percentages calculate to an overall project cost multiplier of 1.46. Normally the construction change order allowance would be included as part of the construction costs and not in the overall “soft” program costs. The overall project cost multiplier would be reduced to 1.33 if the construction change order allowance is not included (which is on the low side but more typical of a project cost multiplier).

Based on the projects identified in the SIP, an overall program cost of $272± million was identified in 2009 dollars ($194± in construction dollars). This was based on implementation of conventional activated sludge (see spreadsheet excerpted from the SIP in Appendix D). Based on the assumed project implementation (which included three phases of major improvements), this program cost escalated to $435± million ($320± million in construction dollars). Assumptions included completion of the improvements by February 15, 2022.

A detailed listing of projects was prepared based on three large bid packages (see spreadsheet excerpted from the SIP in the Appendix D), which totaled $288± million in construction costs (each bid package was escalated to a different mid-point of construction based on the assumed implementation schedule). This is lower than the initial estimate of $320± million, but there was no specific explanation found for this difference. There were some adjustments made (i.e., adding an odor allowance of $11.9± million and adding UV to replace chlorine), but that did not account for the entire difference in construction values. A subsequent summary of escalated construction costs was prepared which totaled $274± million in escalated construction costs (which did not include the $11.9± million in odor allowance). No explanation for this adjustment was found, but based on conversations with City staff, this reduction was likely associated with eliminating costs associated with the facultative ponds (i.e., dredging, earthwork and control structures), which total just under $14± million.

The City has prepared a current budget allocation for the proposed WPCP improvements which total $318± in escalated project costs. Escalated construction costs account for $278 million of those costs, which leaves $40 million for the "soft" project costs (multiplier of 1.14), which is not consistent with level of soft costs typically used. If a more typical project cost multiplier of 1.35 were used, the available escalated construction dollars would be reduced to $236± million.

In order to facilitate a meaningful discussion with City staff regarding project budgets to be developed as part of this master planning update, a summary of the three bid packages has been prepared. Table 5 summarizes the costs developed in the SIP estimate by major process area and then adjusts each construction value (which was escalated to the mid-point of each bid package) back to a common un-escalated cost value – in this case June 2014. A more detailed breakdown of these costs can be found in Appendix E. This listing of project elements and associated costs will serve as the starting point for comparison with the proposed improvements identified as part of the Master Plan update.

Table 5	**SIP Cost Summary – Construction Dollars Master Plan and Primary Treatment Design City of Sunnyvale**	
Item	**Dollars Escalated to Midpoint of Construction (Millions)(1)**	**Dollars Adjusted to June 2014 (Millions)**
Headworks/Primary Sedimentation Basins	$41.1	$43.6
Headworks/Primary Site Demonstration and Restoration	12.4	13.1
Secondary Treatment	77.3	72.4
Filtration/Disinfection	12.4	11.9
Sludge Thickening	12.1	11.2
Support Facilities	5.0	4.9
Dewatering	26.9	25.7
Digestion	48.5	42.5
Digester Gas Management	24.2	21.2
Miscellaneous Plant Improvements	26.8	25.0
Total	**$286.7±**	**$271.5±**

Note:
(1) Details of mid-point for each element in Appendix E.

APPENDIX A - SIP VALIDATION WORKSHOP MINUTES AND SLIDES – JUNE 19TH, 2013

Engineers...Working Wonders With Water™

CONFERENCE MEMORANDUM

Project:	Master Plan and Primary Treatment Design	**Conf. Date:**	June 19, 2013
Client:	City of Sunnyvale	**Issue Date:**	July 2, 2013
Location:	City of Sunnyvale City Hall, 456 W. Olive, West Conference Room		
Attendees:	City: Craig Mobeck, Dan Hammons, Manuel Pineda, Kent Steffens, Bhavani Yerrapotu, John Stufflebean, Kapil Verma	Carollo/HDR:	Jim Hagstrom, Jamel Demir, Jan Davel, Dave Reardon, Dana Hunt
Purpose:	Review basis of planning and SIP recommendations to establish a foundation for the detailed master planning analysis.		
Distribution:	Attendees, Bryan Berdeen	**File:**	9265A.00

Discussion:
The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us.

Introduction – Meeting Purpose, Review Agenda

1. Jim: This workshop is really not to drive decisions as much, but rather to get feedback which will help with the work to come. In addition, our goal today is to listen and get your general sense and feedback on the body of work done for the SIP process. We have some important process decisions to make in October, so we want to ensure we have the benefit of this initial staff input.

Planning Objectives

1. In the SIP there were two levels of planning objectives identified, 1) sixteen Levels of Service (LOS) criteria, and 2) six objectives identified during the SIP Peer Review. Believe that the six objectives more concisely describe the intent for the planning efforts.

2. Craig: In addition to these six objectives, need to consider including “flexibility” (i.e., ability to adapt to regulatory uncertainty and the ability to add features to the plant at a later date if we cannot afford them now). Carollo will add flexibility to the list.

3. Discussed the $318 million budget identified in the SIP. John: Need to be open to modifications to this amount if this is not enough to meet our objectives. We need to understand the implications of screening anything out if it cannot fall within the $318 million number.

4. John: Automation needs to be worked into the objectives (either as a separate item or identified as part of other objectives).

5. Bhavani: Power Issues is really a requirement to address a shortcoming (not really a soft objective like the others).

6. Bhavani: Some consideration of O&M issues should be included. Dan: Make sure the WPCP facilities are efficient, safe and meet compliance requirements, per the Plant's mission statement.

7. John: Financial – why would you not just identify the lowest present worth cost? Jamel: Sometimes, the lowest present worth cost alternative does not necessarily define the best option (low capital with high O&M costs that are more variable). Having an objective for "optimal financial balance" captures this.

8. Bhavani: Innovation – is that truly an objective we should strive for? If you're not willing to beta test, how can you venture into new territory? Jamel: The definition of innovation can mean re-combining existing technologies - it does not exclusively mean using less proven new technology. Jim: This an interesting time in this industry – a lot of research being developed for nitrogen removal. In our proposal we suggested a different combination of your treatment processes to achieve a near-term nitrogen objective. Provides flexibility to incorporate some of these new technologies as they become more proven. John: We're in the heart of Silicon Valley, where innovation is a high priority. We just don't want to build anything that has a high risk of failure. The decision was that Innovation will remain in the list.

9. There was an action for Carollo to refine the list from the SIP Peer Review and update it per the meeting.

Review Basis of Planning

1. Jim: We're really trying to frame the basis of planning work necessary for the work we're trying to accomplish in October.

2. Jamel: Presented five planning drivers – will discuss only flows/loads and regulatory.

Flow & Loads

1. The SIP flow projections do not look controversial. Your ultimate permitted capacity is almost double the 2035 projections. We have to be clear on the sensitivity of meeting this capacity. Craig: Right now we're seeing less than 14 mgd. Bhavani: ABAG numbers could modify these projections Kent: A lot of unplanned office space being developed. Jamel: What isn't clear from the analysis is the influence of commuter influx on the diurnal flow curve. Craig: Numbers drop down dramatically (not only weekends, but also after 5 pm daily). Identified need to have the City obtain diurnal curve info. John: The 16.7 mgd number being a little higher or lower does not really make much difference, it's really the ultimate flow that will make a big difference in our choices (facilities to meet the ultimate flow were not part of the $318 million budget). Some question about how the City could possibly get to such a high flow, even if we took in Cupertino, Bhavani: Need to remember that these ultimate flow estimates represent the permitted plant capacity – could be factor as the Regional Board allocates nitrogen allocations as part of the SF Bay TMDL.

2. CBOD and TSS: Presented data that shows increases in CBOD and TSS after 2009. Sampler and location changed in 2009. Also implemented a more rigorous program of

cleaning of the sewers. Dan: Noted high loads initially and then settled down. Could mean this data has some validity. Carollo to perform some further in-house peer review before presenting to the City. Will require a separate working meeting to resolve. Jan went through a graph showing TSS removal rates. 60% is considered very good and 70%-80% is extremely high. The Sunnyvale data for removal rates look to be extremely high. There will be a breakout meeting to review this issue and resolve it.

3. Regulations: Assumptions in the SIP included a TN of 3 mg/L to be implemented by 2020 (unclear what the basis for this was). Jamel mentioned that this appears inconsistent with current info being published by BACWA and is extremely high. Jamel mentioned that the information coming from the Regional Board has referenced future limits at less than 8mg/L. Also noted discussion in SIP about implementation of year-round ammonia limits in the next permit renewal. Bhavani: We don't believe we'll be going to a year-round ammonia limit. Believe our current requirements will remain the same through 2020. Current thinking is that the City could be receiving a load limit, and the ammonia concentration will be linked to the permitted plant flow (i.e., build out flow?). Expect two permit cycles to get compliant with a new nitrogen limit (2025±). Jim noted that even for 100% recycle, you need to expect an ammonia/nitrate limit due to requirements for indirect or direct potable reuse (IPR and DPR). Aquatic organisms are driving these standards, not human consumption. Bhavani: This is an appropriate break-out meeting topic.

Biosolids

1. Synagro takes our dried solids away to Kirby Canyon or San Joaquin valley. Landfills are going to become less and less available.

2. Solids in the ponds - when ponds are in treatment mode, the solids can remain indefinitely. Jamel referenced that there is a possibility that once the ponds are not part of the treatment process, the solids must be removed within two year (not rigorously enforced – more of a self-reporting obligation). John: need to keep the ponds in the process flow schematic (equalization?).

3. Jamel: Master plan will have to assume some dollars for removal of solids from the ponds. Even keeping the ponds for equalization will also require you to remove the solids, Does not necessarily mean a dredging operation (i.e., using your new dewatering facility will allow you to gradually clear them out more cost effectively). The $318 million SIP budget numbers do not include the costs for cleaning out the ponds. Bhavani: We've already spent $4 million on Synagro – not sure how effective this has been. John: Sludge started accumulating in those ponds in the 1960's, which could mean a lot of constituents are potentially included.

4. Kent: The bigger question is what the future of the ponds is if no longer used for solids handling. John: Could it be used for recycled water storage (removal of solids would likely be required). Jamel: You need about a tenth of that pond acreage for diurnal equalization/wet weather storage. The remaining 400 acres could be used for these other purposes. The City mentioned that the issue of what to do with the ponds is a big one that needs to be looked at very carefully as part of the Master Plan.

Air

1. Brief discussion of Title 5 issues at the WPCP. Bhavani: I would like us to have a breakout meeting for further evaluation of all of this. Dan: Because we utilize landfill gas, we have to report GHG under AB32. GHGs were not addressed in the SIP.

2. Odors: Are a policy decision - need to get direction from the City. Headworks, primaries, and thickening/dewatering are candidates - not sure if this is captured in the $318 million SIP budget. Craig: Take a look at Appendix C of the Business Case Evaluation of Plan Alternatives TM. It shows what was covered, which some of the time included aerated grit, thickening, screening and dewatering. Action Carollo will look at Appendix C.

Review SIP Recommendations

Liquids

1. All alternatives had screening removal, raw sewage pumping, grit removal, and primaries. SIP had these laid out as separate facilities (not in one structure). Carollo is looking at the option of possibly locating them in one structure. Also included a new PE pipeline to the ponds, and flow equalization to mitigate impact on secondary treatment. Carollo is also looking at surface loadings to see if the primaries need to be larger.

2. Bhavani: Anything in the SIP that would lead you one way or the other regarding the primaries? BC defaults to aerated grit removal - suggesting a review of other alternatives (vortex grit basins). Sedimentation basin modeling could show we need bigger tanks than SIP came up with. This could impact your $318 million number.

3. Jim: Ultra-fine screen filtration was mentioned (in lieu of primaries). Falls within cutting edge of technology. Maybe more appropriate for small facilities, not that appropriate for a plant this size. Based on discussions with City staff and Carollo's knowledge and experience with the ultra-fine screen filters, Carollo recommended that this should be considered a "no go".

4. CEPT: SIP peer review presented potential benefits. Proposing to perform doing field testing to determine if benefits are real.

5. Presented the history of the development for the SIP secondary alternatives. The three remaining options include: (1) conventional activated sludge, (2) MBR activated sludge, and (3) FGRs combined with wetlands. Have prepared a high-level assessment that indicates that even if all the ponds are converted to wetlands, would only be able to get down to a TN of 10 mg/L. May require additional denitrification filters in case you cannot get all the nitrate out. The two teams (B&C and CH2M Hill) differed significantly on the cost associated with this option. John: Would be okay to screen this option out early - this would have to be clearly justified. Based on more recent analysis, Carollo feels that utilizing ponds as wetlands for a denitrification process, could be difficult to implement and would need some type of pilot.

6. Unclear about the impact of the Basin Plan if the effluent is not filtered – needs to be included in the side meeting on regulations (relates to the 10:1 dilution credits)

7. Kent: We'll need to clearly define what happens to the ponds if they are not converted to wetlands. John: So if the ponds are used for "polishing," how will this impact the compliance

issues? What is the impact of solids removal? Jim: There are plants in California with two compliance points (for different suits of constituents). There was discussion that the ponds could be used for equalization during high flows, or be used for discharge in case there are process issues at the pant.

8. Recycled water:
   A. Activated Sludge: Cloth media for recycled water, dual-media filters (DMF) for discharge. Bhavani: We're thinking of new filters being built, although SIP mentions refurbishment. We tested cloth filters, didn't work well on the pond effluent, though UV remains as a disinfection option.
   B. MBR: No filtration required - can go directly to disinfection.
   C. FGRs and Wetlands: No filtration for bay discharge (unless required via Basin Plan or is viewed as backsliding by regulators), dual-media filters for reuse.

9. Layouts:
   A. Activated Sludge: SIP showed clarifiers on east side and aeration basins on west side (needs to be reviewed). SIP also showed four more digesters for additional organics coming in. SIP also assumed TPAD for meeting Class A requirements (other alternatives should be reviewed). The new construction will likely impact the current drying operation – may be costly to accommodate (will be assessed by Carollo as part of the master plan). John: The marginal cost of contract dewatering will likely make that more favorable.
   B. MBR facility: Smallest footprint, using UV.
   C. FGRs and Wetland: Also reduced plant footprint.

10. Schedule: New headworks and primaries by 2019. This gives you about 6 years to construct the future aeration basins.

Solids

1. Initial SIP recommendations included rotary drums for co-thickening, but later layouts indicate DAFTs. Both are acceptable.

2. In addition to TPAD, should consider sludge pretreatment ahead of digestion to meet Class A. John mentioned that the Class A biosolids concept was not a policy decision, but rather an idea that was brought up in response to the shrinking number of locations for Class B biosolids. Four additional digesters for organics would have to be re-evaluated for return on investment (ROI). Need to perform an updated solids balance to confirm that the existing digesters are sufficient for activated sludge. KJ looked at this –need to determine which data the KJ report used for the digester evaluation (the post 2009 high numbers?).

3. Screw presses are reasonably robust for solids dewatering, but has limited "tweaking" ability. A centrifuge will give you more processing flexibility and dryer solids.

4. FOG/food waste: Understand that the City could take this in in future. Bhavani: City has completed a 75% design, but has an ROI of 15 years. Need to plan for this on the site. Dave: This will also have an impact on the energy balance. Also, the landscape for FOG is radically changing, e.g., the tipping fee for FOG could go away entirely. This would make the ROI evaluation even worse. John: We could franchise FOG in Sunnyvale, like we do with solid waste. Landfill gas could go away, we'd be replacing it with FOG. Bhavani: The shear

drop of natural gas prices also has a big impact on the viability of this project. John: No matter what, we need to have the site layout configured to accommodate a future FOG facility. We would use FOG to maximize gas production, however, will not increase digester capacity to accept FOG.

Energy

1. The cogen engines cannot be operated at full capacity due to emission limits (600 kW). Slated to be replaced within the next 10 years. CDM's work includes heat-recovery off the engines. If the influent gas engines go away then a boiler would likely be required for heat. Dave: You probably need a boiler as back-up heat, even if you do heat recovery. Future heat loads could change with TPAD, or heat drying of dewatered solids. Bhavani: CDM's report really only covers the next 10 years, after that the Master Plan recommendations govern.

Support Systems

1. SIP shows if electrical distribution at 480V (could be 4160V).

2. SIP indicated standby 2,000 kW – to be confirmed in the Master Plan.

3. The portable 1,250 kW generator will require modifications to accommodate at the MCCs. This is likely to move ahead as a parallel project.

4. Bhavani: SIP was light on automation and electrical backbone, so our effort would need to correct this. Jim: We're starting pretty much from scratch on the ACS plan. There are already ten or so meetings planned to facilitate this effort between July and the end of 2013.

Support Facilities

1. The fast tracking of the Admin Building is still in play. Karen Burks will initiate discussion on this soon – focus on space needs, required facilities, parking, etc. John: BC showed it would not fit on the site, so it could really go anywhere. Jamel: We'll need to be clear on the boundary constraints.

2. Kent: We may be getting ahead of ourselves, since we don't even have the level of automation defined, i.e., staff requirements. Bhavani: There may be no reason to move on this for the next few years, by which point we'll know our staff requirements. Jim: We can hold off on this. We tried to level the burden on your staff by spreading out the effort, so bringing the Admin Building to, say, 20% effort complete and then stopping for the process layouts to be developed. Jim mentioned that this would fit in with the existing scope for this item. John: Assuming that the SCADA control system will be in the Admin Building; this would impact timing also. The decision was to do some preliminary work on this item and try and develop a footprint that could be used for space planning needs.

3. Assume that the new access road is still in play, and would impact the location of the Admin Building possibilities. Some portion of the landfill was moved to make room for the hazardous waste facility – maybe more landfill modifications could be possible to accommodate the Admin Building.

4. Craig: Sounds like we can get started on the Admin Building data collection, staff interviews, etc. None of this will be throw-away anyway.

5. John: If we go MBR, the District would pay for an RO facility, but would want space on the site for it. Also the issue of brine disposal would need to be resolved – it's not part of the Master Plan scope, but keep this in the back of your mind.

Potential Decision-Making Approaches

1. Today's objective is not to decide how we're going to make decisions, we'll do that in a series of smaller meetings.

2. Some considerations:
   A. What stakeholders are involved?
      1) Kent: It depends, if all the options are contained within our budget, the decision remains within this room. If it exceeds the budget, the City Manager and others will need to be involved. The pond decision is one of the biggest decisions we need to make and outside interest groups will likely want to be involved.
      2) Site planning: If you keep the issues within the fence line, it will not involve others. If you expand (e.g. access road), it will involve others (City Planning, Parks and Rec [part of Public Works], etc.).
      3) Access road: Someone on the City's staff needs to help with a parallel effort on this. Craig: There's a feasibility review effort that's part of additional services scope. Bhavani: We may want to float this idea internally first. Kent: A flood-control project is slated for the near future in this area. Carollo to provide some background info on this road for staff consideration.

3. Decision-making spectrum: Most/least subjective and least/most rigorous. Showed example of TBL Consensus-Based approach as was used in the SIP Peer Review vs. the TBL Business Case Analysis (based on the Levels of Service criteria) used in the SIP.

4. John: A very rigorous weighting (SIP) approach will be difficult to develop, and not be very helpful in the final analysis. We'll follow the TBL Consensus-Based approach (SIP Peer Review). Bhavani: This was the approach in San José, just need to make sure we document it very carefully.

Action Items

Refer to attached Action Log.

Prepared By:

J.L. Davel

JLD:JLD

This Meeting will be a Success if …

- ✓ Obtain feedback on the planning objectives
- ✓ Obtain staff feedback to develop initial basis for regulatory framework
- ✓ Engage staff in meaningful discussion of the major SIP elements
- ✓ Obtain City feedback on decision-making approach

Agenda

1. Review objectives
2. Review basis of planning
3. Review SIP recommendations
4. Review potential decision-making approaches
5. Next Steps/Action Items

Review Objectives

SIP Peer Review Identified Six Objectives

- Reliability - WPCP should reliably achieve all permit requirements
- Resource Recovery – optimize recovery of resources
- Power Issues – provide WPCP with more reliable power supply
- Community Resources – WPCP should provide a benefit to its customers
- Innovation – incorporate proven technological advances
- Financial – achieve optimal balance of capital and O&M costs

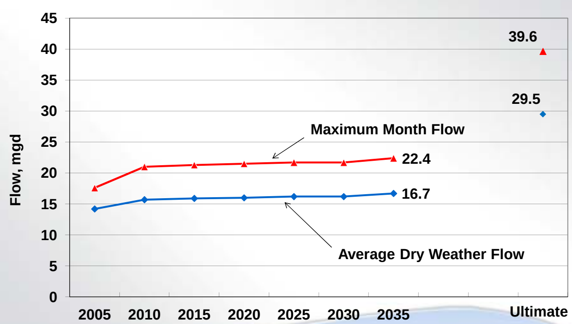
Review Basis of Planning

Planning Drivers

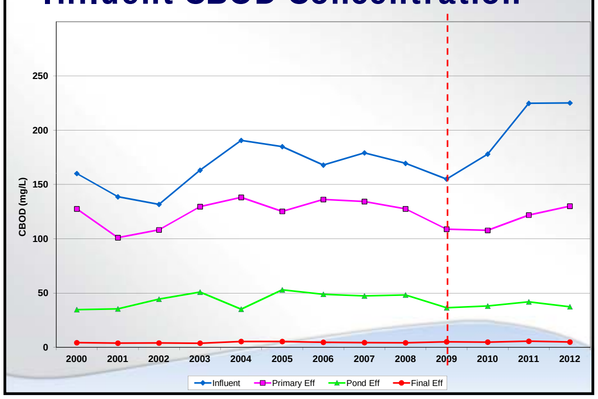
- **Flows/Loads (Growth)**
- Reliability/ Replacement
- **Regulatory**
- Policy Decision (Recycled Water)
- Optimization (O&M Costs)

Flow and Loads

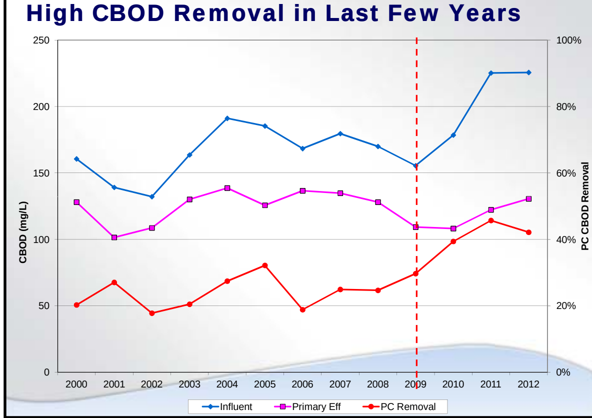
SIP Flow Projections



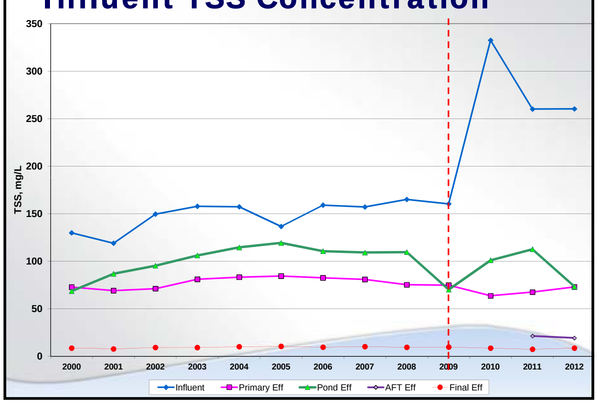
Influent CBOD Concentration



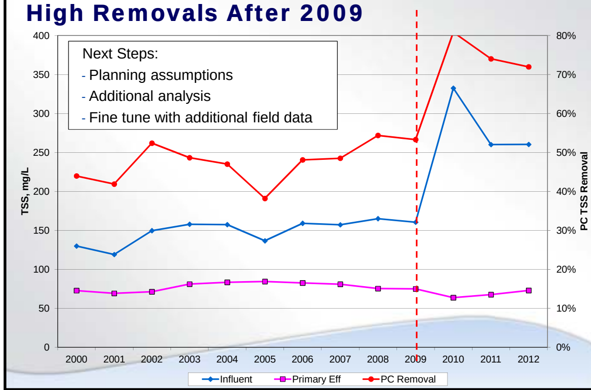
High CBOD Removal in Last Few Years



Influent TSS Concentration



Very Low Removal Prior to 2009 and Very High Removals After 2009

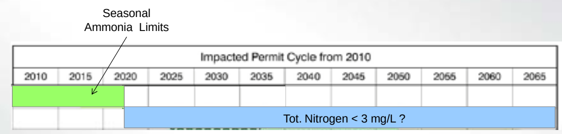


Regulatory

Regulatory

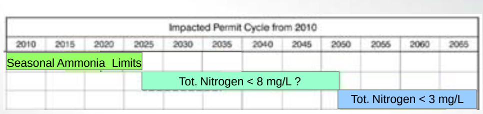
- Water quality
- Biosolids
- Air

SIP - Water Quality Regulations



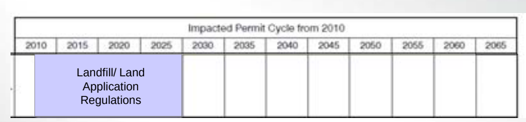
- Ammonia – permit limits remain the same until TN limits are implemented (i.e., no year-round limits)
- Total Nitrogen – set in 2015 with a 5-year compliance schedule

Anticipated Water Quality Regulations



- Ammonia – permit limits remain the same until TN limits are implemented (i.e., no year-round limits)
- Total Nitrogen – set in 2015 with a 10 year compliance schedule
- Potential future issues – even lower TN, CECs

Anticipated Biosolids Regulations



- Land application of solids becoming increasingly restricted (ADC use not considered beneficial reuse)
- Fewer landfills accepting biosolids
- SIP provided general discussion regarding flexibility to produce Class A solids

Impact of Biosolids Regulations

- Keep pond treatment
  - Solids in pond can remain there indefinitely
- Abandon pond treatment
  - Remove all solids from ponds within 2 years (self reporting)
- Develop biosolids disposal plan
  - Evaluate treating to Class A to increase disposal options (SIP recommended TPAD)
  - Evaluate treating solids for alternative disposal
    - Conversion to energy/fertilizer/ compost

Air Regulations

Impacted Permit Cycle from 2010											
2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065
BAAQMD Emission Standards for Internal Combustion Engines											
CAA Section 129											
California AB 32											
EPA GHG Reporting Rule											

Impact of Air Standards

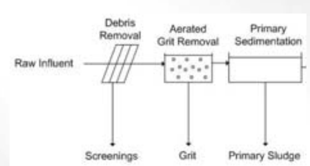
- Title V requirements impact current influent engine operation (MACT)
- Currently GHGs are not an issue, and no discussion of GHGs has been presented as a future issue
- No specific discussion of odor approach presented in the SIP – policy decision

Review SIP Recommendations

SIP Areas of Focus

- Liquids
- Solids
- Energy
- Support Systems/Facilities

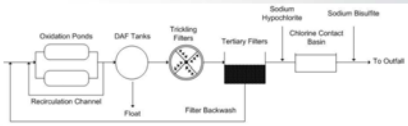
SIP – Liquids
Same Headworks and Primaries



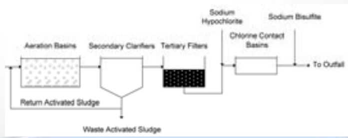
- New PE pipeline to ponds
- Flow equalization provided
  - 30 acres of monthly peak flows
  - 2 acres of daily diurnal flows

SIP – Liquids
Four Alternatives

1. Plant Rehab

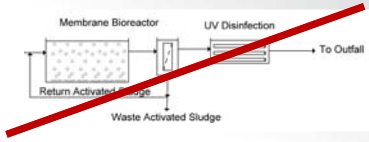


2. New Plant (AS)

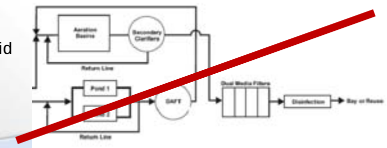


SIP – Liquids
Four Alternatives

3. New Plant (MBR)

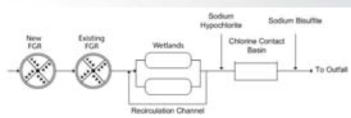


4. Plant Rehab Hybrid (ponds/AS)

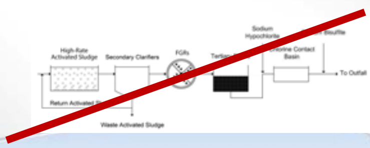


SIP Peer Review – two new alternatives

1. FGRs and Wetlands
   Assumes CEPT



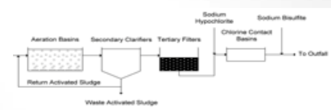
2. New Plant (High-Rate AS)



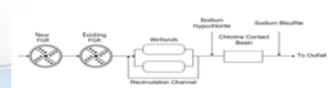
Following SIP Peer Review – down to two alternatives

1. Plant Rehab

2. New Plant (AS)

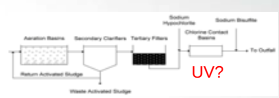


3. FGRs and Wetlands

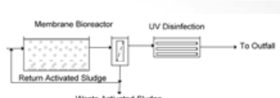


Today – MBR back to achieve recycled water objectives

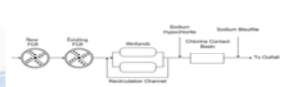
New Plant (AS)



New Plant (MBR)

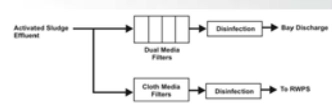


FGRs and Wetlands



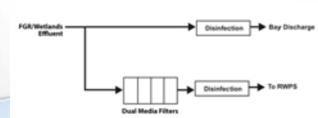
Recycled Water Alternatives

New Plant (AS)

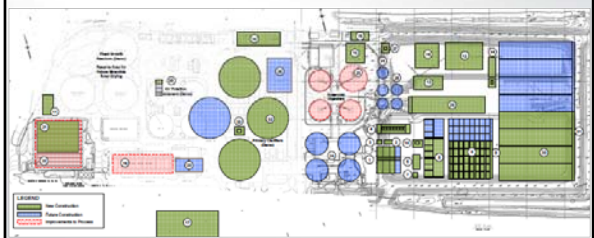


New Plant (MBR)

FGRs and Wetlands

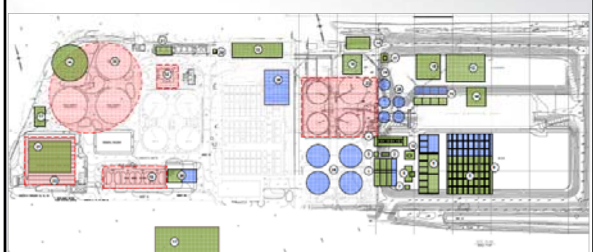


New Plant (Activated Sludge)



New Plant (MBR)

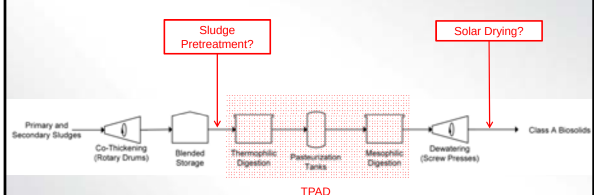
FGRs and Wetlands



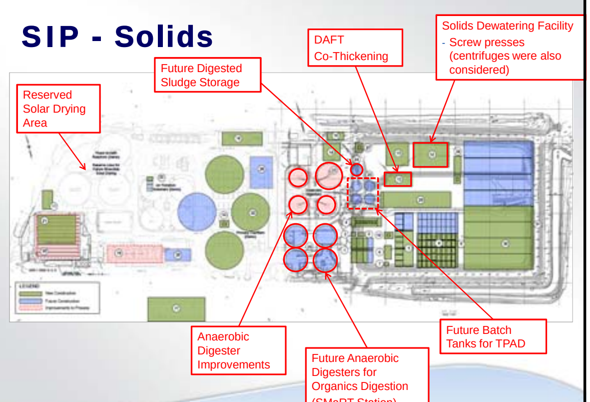
Liquids Schedule

Process Upgrades	2011-2015	2016-2020	2021-2025	2026-2030
Headworks/ Primary Treatment	Design	Construction		
Secondary Treatment		Design	Construction	Meet TN<8 mg/L
Recycled Water (Fast Track)	Design	Construction		

SIP – Solids

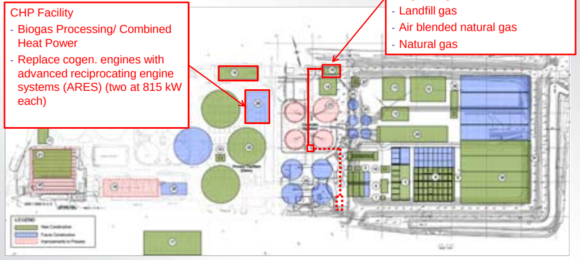


SIP - Solids

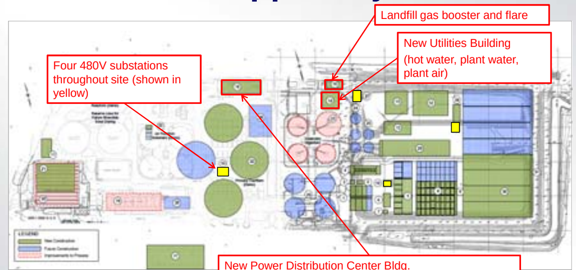


Disposal is the main issue with solids treatment.

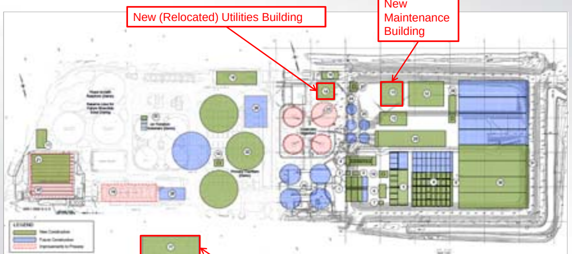
SIP/CDM – Energy



SIP/CDM - Support Systems



SIP - Support Facilities

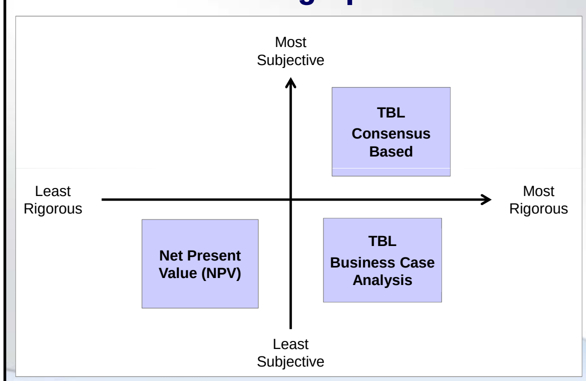


Review Potential Decision-Making Approaches

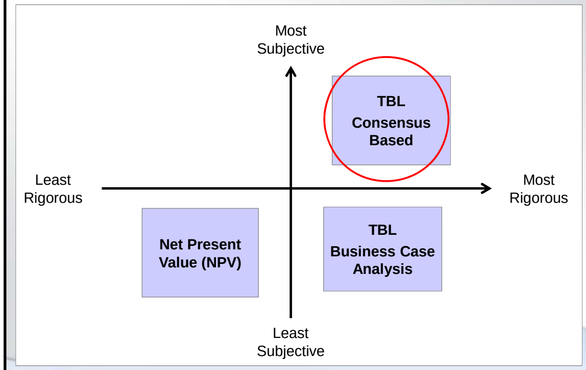
Decision-making Considerations

- What stakeholders will be involved in the decision making process?
- What key decisions, if any, need to be defended?
- What level of rigor will be required to make those decisions?

Decision-making spectrum



Decision-making spectrum

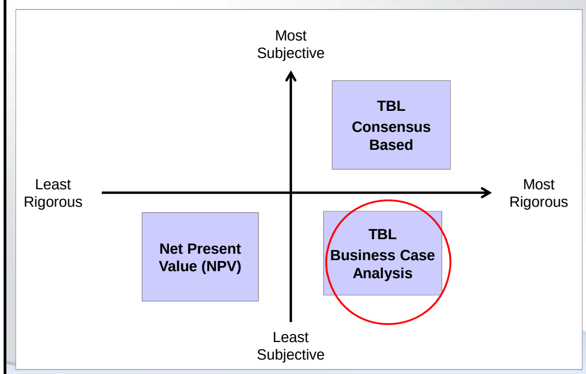


Peer Review Approach

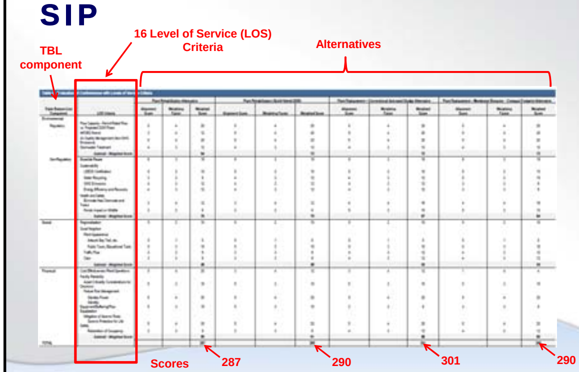
Criteria	Natural System: SIP Plant Rehabilitation Alternative (ponds)	Natural System: Peer Review Option 5: PC (CEPT + FGRs + Wetland)	Activated Sludge: SIP Plant Replacement Alternative (Activated Sludge)	Activated Sludge: Peer Review Option 2: PC + High-rate Activated Sludge + FGRs + filtration
Reliability – ability of the system to consistently meet discharge requirements	+	+	+	+
Operational Control – ability to make adjustments to the process to achieve a consistent desired result (effluent quality, energy use, good neighbor)	-	o	+	+
Effluent Quality – future constituents, current and potential future BOD/TSS, year-round ammonia, total nitrogen	o (existing limits)	++ (future total nitrogen, total phosphorous)	++ (future total nitrogen, total phosphorous)	o (existing limits)
Resource Efficiency – net energy efficiency	o	++	-	o
Pond Land Use – beneficially uses pond acreage at appropriate cost or risk	o (ponds stay ponds)	+ (more attractive use of ponds)	+ (potentially more attractive use of the ponds)	+ (potentially more attractive use of the ponds)
Innovation – advances status quo to achieve superior technical, economic, and social benefits	o	+	-	-
Capital Cost	+	++	-	o
O&M Cost	o	+	-	o

Notes:
++ = provides best performance relative to criteria as compared against other alternatives
+ = provides superior performance relative to criteria as compared against other alternatives
o = neutral performance relative to criteria as compared against other alternatives
- = does not meet the criteria
PC = primary clarification

Decision-making spectrum



Business case analysis from SIP



Next Steps/ Action Items

This Meeting will be a Success if …

- ✓ Obtain feedback on the planning objectives
- ✓ Obtain staff feedback to develop initial basis for regulatory framework
- ✓ Engage staff in meaningful discussion of the major SIP elements
- ✓ Obtain City feedback on decision-making approach

APPENDIX B -– EOA – MERCURY SPECIAL STUDY (DECEMBER 2007)

City of Sunnyvale
Water Pollution Control Plant

Mercury Special Study

NPDES Permit Provision #5

December 15, 2007

EOA, Inc.

December 14, 2007

Mr. Bruce H. Wolfe
Regional Water Quality Control Board
1515 Clay Street
Suite 1400
Oakland, CA 94612

Re: City of Sunnyvale Water Pollution Control Plant
Final Report for Mercury Special Study

Dear Mr. Wolfe:

The attached Final Report is submitted by the City of Sunnyvale Water Pollution Control Plant (WPCP), pursuant to Provision 5b of the City's NPDES Permit (Order R2-2003-0079).

As required under Provision 5a, a study workplan was submitted to the Water Board on June 22, 2004, and was modified based on discussions between the City, its consultant, and Water Board staff at a meeting at the WPCP on June 2, 2005. The study includes data from samples collected over a multi-year period from December 2004 through December 2006. The enclosed final report was prepared on the City's behalf by EOA Inc, which assisted the City in conducting the study. If you have questions regarding this report, please call me at (408) 730-7268, or Ray Goebel of EOA at 510-832-2852, ext. 113.

I, Lorrie Gervin, hereby certify under penalty of law that this document and all attachments have been prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. The information is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Sincerely,

Lorrie Gervin, P.E.
Environmental Division Manager

ADDRESS ALL MAIL TO: P.O. BOX 3707 SUNNYVALE, CALIFORNIA 94088-3707
TDD (408) 730-7501

City of Sunnyvale
Water Pollution Control Plant

Mercury Special Study

NPDES Permit Provision #5

December 15, 2007

Prepared by:

EOA, Inc

Table of Contents

List of Tables

List of Figures

Attachments

1.0 INTRODUCTION

On August 20th, 2003 the City of Sunnyvale WPCP's NPDES permit No. CA0037621 was reissued by the Regional Water Quality Control Board, San Francisco Bay Region as Order R2-2003-0079. Provision 5 of the permit included the following requirements for a mercury special study:

> *a. Workplan*. The Discharger shall submit a work plan, acceptable to the Executive Officer, that includes, but is not limited to, the following: a strategy to determine an appropriate site for "first flush" characterization and assessment, and for identification and evaluation of options for directing mercury contaminated storm water to the WWTP; and a schedule to implement the minimum 2-year study.
>
> *b. Final Report*. The Discharger shall submit a final report, acceptable to the Executive Officer, that includes the following: analyzed data to determine mercury loadings associated with "first flush" storm water, and identifies and evaluates the feasibility, costs, and benefits of directing mercury contaminated storm water to the Plant.

The *Workplan for Mercury Special Study* was submitted to the Regional Board December 15, 2003. Although the City did not receive Water Board comments on the workplan, it proceeded with implementation, so as to ensure that the permit-specified study duration (minimum two-year) would be met. Consistent with the workplan, the City developed a Monitoring Plan that identified appropriate sites for first flush characterization and procedures to gather data needed to analyze mercury loadings associated with "first flush" storm water. Two sites were selected for monitoring, including the Sunnyvale West Flood Control Channel at Mathilda Avenue, and a storm drain manhole near the entrance of the WPCP at Borregas Avenue near Caribbean Drive. The *Mercury Special Study Monitoring Plan* was submitted to the Regional Board on June 22, 2004. A copy was also distributed electronically to the Clean Estuary Partnership (CEP) Mercury Workgroup for their information.

At the request of Water Board staff, representatives from the City and its consultant for the study (EOA, Inc) met at the WPCP on June 2, 2005 to discuss the project and tour the City' two storm drain pump station sites located in the vicinity of the WPCP. During that meeting, Water Board staff requested that the emphasis of the monitoring be shifted from characterizing mercury loadings associated with "first flush" conditions to dry weather flows in the storm water system. In response to that request, the City proposed that the location for Borregas storm drain samples be switched to the Baylands Pump Station No. 1 fore bay, located adjacent to the WPCP's eastern boundary, and that those samples be collected during the dry season. The proposed changes were transmitted to Water Board staff in September 2005. Samples were collected from the Baylands Pump Station in October 2005 and August 2005.

As required under Provision 5c, annual Progress Reports were submitted to the Water Board in February of 2005, 2006, and 2007.

2.0 LITERATURE REVIEW

The workplan called for a focused literature review to identify sources of information regarding treatment of urban runoff at wastewater treatment plants, with an emphasis on the most relevant and practical information from work conducted in the Bay Area.

2.1 Mercury Management by Bay Area Wastewater Treatment Plants

This Clean Estuary Project (CEP) study examined approaches and feasibility of mercury management strategies for Bay Area wastewater treatment plants that would be impacted by the San Francisco Bay mercury TMDL. (Ref 1) One strategy examined was the use, at strategic locations, of excess wastewater treatment plant capacity to reduce mercury (and other pollutant) loading from urban runoff. The study did not assess feasibility at specific treatment plants, but rather sought to identify key factors to be considered in making such an assessment. Factors identified included:

- The need to analyze the concept "available excess capacity" relative to both hydraulic and solids loadings and the future capacity needs of the treatment plant
- Location of the plant relative to areas with elevated mercury concentrations and potential loading reductions
- Impact on treatment plant NPDES compliance (85% removal requirements for BOD and TSS, effluent limits for conventional and toxic pollutants, and bypass prohibitions)
- Potential impact on treatment plant biosolids
- Costs and funding mechanisms between wastewater and stormwater agencies

Using Oakland's Ettie St. pumping station as a hypothetical example of a diversion project, the study cited the following general trends impacting the feasibility of improving water quality by capturing urban stormwater:

1. Feasibility of treating urban stormwater increases with increasing pollutant concentrations in sediments
2. Feasibility also increases with increasing TSS levels in stormwater
3. Feasibility decreases with increasing distance to the treatment plant
4. Feasibility increases with increasing wet weather capacity
5. Discreet, targeted water quality improvement systems may be more feasible than blending urban runoff with sewage.

2.2 City of San Jose Study

The City of San Jose conducted an investigation of first flush pollutant loading between May 1997 and April 2000 (Ref. 2). The purpose of the study was to investigate how the occurrence and magnitude of first flush events in stormwater may influence the effective management of urban runoff pollution. During eight storm events, four samples were collected at each of 25 stations. Sample teams were assigned 4-5 sampling stations to cycle through four times as quickly as possible, to obtain samples from the first part of the storm. Three of the storms were designated as first flush storms because they were the first substantial storms of the season. The remaining five storms were designated background storms. The samples were analyzed for a variety of pollutants including total metals. The following conclusions were drawn from the evaluation of study data:

- There was no consistent relationship found between storm size and the occurrence of a first flush phenomenon for total or dissolved metals. However, there does seem to be specific combinations of site and storm circumstances that result in a first flush effect of dissolved metals.
- With the exception of mercury, total metals did not show a tendency for first flush behavior. Concentration of total mercury in the first flush storm samples was slightly elevated relative to background storms. The reasons for the anomalous total mercury results, compared to other metals, are not known.
- First flush phenomenon is exhibited more prominently in smaller catchments.
- There is a slight correlation between occurrence of first flush phenomenon and percent impervious coverage within the drainage area.
- The results did not show a strong relationship between any land use characteristics and the occurrence of a first flush in metals.

2.3 EBMUD Offsets Projects

The Offset Projects was initiated by East Bay Municipal Utility District (EBMUD) in 2005 to investigate offsetting reductions of toxic pollutants in discharges from its wet-weather facilities (WWFs) in response to a Time Schedule Order (Ref 3). The process included identification of pollutants of concern (POCs) discharged by the WWFs, quantifying loads of those POCs, and projecting potential baseline loads against which offsetting load reductions would be credited. The types of potential projects that were characterized and evaluated including site remediation, source control, wetlands and creek restoration, stormwater treatment wetlands, a household hazardous waste collection facility, stormwater management, and others. Of greatest relevance to the Sunnyvale study is the Ettie Street Pump Station Diversion project.

The Ettie Street Pump Station Diversion project would divert dry-weather and some first-flush wet-weather flows from the Ettie Street Flood Control Pump Station Watershed in West Oakland to EBMUD's main wastewater treatment plant (MWWTP) for treatment and discharge through the MWWTP outfall. The project's goal would be to reduce loadings of conventional pollutants, trace metals and PAHs in urban runoff. For the dry weather flow diversion component (1000 gpm for 180 days), the estimated order of magnitude load reduction for mercury is 0.1 lb/yr. The estimated mercury reduction for a combined dry weather plus first flush (1000 gpm for 236 days and 7,690 gpm for 3.5 days equivalent) is 1 lb/yr. The project would require upgrading the Ettie St Pump Station and construction of a pipeline to the MWWTP. Estimated capital construction costs are $13 M (including a $3.6M EBMUD Capacity Fee). Estimated annual O&M costs are $1.0 M. The project would require coordination with other agencies, including but not limited to the City of Oakland and the Alameda County Public Works Department. No decision has been made regarding implementation of this project, although a related pilot project at the Ettie Street Pump Station is underway, as described below.

2.4 EBMUD Environmental Enhancement Project

This project is being undertaken to meet a provision of the NPDES permit for EBMUD Wet Weather Facilities. (Ref 4). It involves a pilot project to divert a small amount (up to 75 gpm) of dry weather urban runoff plus first flush wet weather flow from the Ettie Street Pump Station through an existing sanitary sewer line to EBMUD MWWTP. The project also includes a monitoring component to characterize pollutant concentrations, for use in evaluating the potential benefits of a larger scale project.

2.5 Zone 4 Line A – Small Tributaries Loading Study Hayward Line D Project

This project is one of several being conducted by the Sources Pathways and Loadings Work Group of the Regional Monitoring Program (RMP). It involves detailed hydrographic analysis and pollutant monitoring of a small, urban, industrialized watershed in Hayward. The results may provide more accurate estimates of pollutant loadings to the Bay than those extrapolated from investigations of other (typically larger) watersheds.

3.0 SAMPLING SITES

The two locations chosen for the City's first flush sampling effort are described in this section. Also discussed are the two Baylands Stormwater Pump Stations, one of which (Station No 1) was selected for dry season sampling. Sample locations are shown in Figure 1. All of the selected sample locations are within reasonable proximity to the WPCP or to a sanitary sewer trunk line.

3.1 Sunnyvale West Channel at Mathilda Avenue

Sunnyvale West Channel is an artificial stormwater collection and flood control channel operated by the Santa Clara Valley Water District (SCVWD). The West Channel watershed lies to the east of Stevens Creek, and extends from the margins of the Bay at the north to beyond El Camino Avenue to the south. The channel flows into Moffett Channel, which in turn flows into Guadalupe Slough. Although the West Channel passes along the western boundary of the WPCP, a sample location upstream of the tidal area was chosen, at the point where the it crosses under Mathilda Avenue. The area upstream from the sampling location is zoned for general industrial, industrial service, and residential uses.

The West Channel was also identified as a sample location for the Santa Clara Valley Urban Runoff Pollution Prevention Program's (SCVURPPP's) Five Year Monitoring Plan. SCVURPPP collected wet and dry season samples from both the Sunnyvale East and West Channels over the period from September 2004 through February 2006. .

3.2 Borregas Avenue Storm Drain System

Surface runoff from an area of approximately 500 acres immediately south of the WPCP and north of State Route 237 (a.k.a. the Moffett Park Area) flows into a storm drainage system with a main trunk line on Borregas Avenue.[1] At the north end of Borregas Ave, the system discharges to an open channel that runs along the south and east sides of the WPCP to Baylands Pump Station No. 1 (Baylands PS #1), located near the northeast corner of the plant. Baylands PS #1 discharges into a channel that runs across the top (north side) of the WPCP into Moffett Channel. Because of the pump station, there are no backwater (tidal) effects in this drainage system. The Moffett Park area is zoned for general industrial use, but is best characterized as light industrial (defense and high tech firms), with several restaurants and hotels. A manhole located near Borregas Avenue and Caribbean Drive was selected as the sampling location.

3.3 Baylands Pump Stations

The City operates two pump stations on the north side of the City. Baylands Pump Station No. 1 (Baylands PS #1), located immediately east of the WPCP, collects water from the Borregas Avenue storm drain system as described above. Baylands Pump Station #2 (Baylands PS #2) is located on Calabazes Creek on the eastern edge of Baylands Park, about a mile from the park entrance, or 2.5 miles from the WPCP. In addition to stormwater runoff, both systems are subject to shallow groundwater infiltration. During the June 2005 site visit with Water Board staff, the 2700 gpm pump at Baylands PS #2 operated frequently. Based on visual observations, the flow appeared to consist entirely of very low turbidity groundwater. Given that observation, plus the distance from the WPCP and the absence of sanitary sewers in the area, Baylands PS #2 was ruled out as potential dry weather diversion site. In contrast, groundwater infiltration into Baylands PS #1 apparently occurs at a much lower rate (pumps were not observed to operate during the June 2005 site visit or during several other site visits), and the location is highly favorable relative to potential diversion to the WPCP. Thus Baylands PS #1 was chosen as the alternative site for dry weather monitoring. Because Baylands PS #1 serves the Borregas Avenue Storm Drain System, the wet weather monitoring results collected for the latter are also relevant to a wet weather diversion system located at Baylands PS #1.

4.0 SAMPLING PROGRAM

4.1 First Flush Phenomenon

Provision 5 calls for characterization of "first flush" runoff. A first flush phenomenon of pollutants in stormwater occurs when rainfall after a dry period entrains a greater pollutant load from catchment surfaces than that of subsequent rainfall. The permit did not provide a specific definition of first flush, and previous studies have defined it in various ways. A first flush can be defined as runoff from the first substantial storm of the season.[2] For this case, the goal would be to collect a series of samples for the duration of the first storm only. A first flush can also be defined as the runoff of a large percentage of the pollutant load during the initial stages of a storm event.[3]

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[1] Large laterals also feed in from the west, from lines on Caribbean Ave and the northern end of Mathilda Ave. The drainage area overlaps somewhat with the northern end of the West Channel drainage area.

[2] See Reference 1

[3] Lee JH, Bang KW, Ketchum LH, Choe JS, and Yu MJ, First Flush Analysis of Urban Storm Runoff, Science of the Total Environment, 293 (1-3): 163-175, 2002.

This definition would allow for sampling of any storm event that is preceded by several days of dry weather, with samples collected only during the initial stages of the event.[4] This more general definition was used for Sunnyvale study, although an effort was made to capture storms that occurred early in the wet season.

4.2 Sample Collection and Analysis

The objective for the first flush sampling was to collect multiple grab samples during the first hours of a storm event. For all three years, the goal of collecting samples early in the wet season was realized. In fact, the December 2004 sampling event was conducted during the initial hours of the first significant rainfall event of that wet season.

Samples collected were analyzed for total mercury, total suspended solids (TSS), and for other standard water quality parameters (temperature, dissolved oxygen, pH and specific conductance). Selected samples were also analyzed for dissolved mercury and monomethyl mercury. Total and dissolved mercury was analyzed by Caltest Laboratory using EPA Method 1631 to achieve the lowest reporting limits. The remaining tests were conducted at the Sunnyvale WPCP laboratory. Flows were not determined, however, estimates of flow are used in Section 5 in connection with potential diversion scenarios.

4.3 Sampling Results

Results from wet season and dry season sampling are presented in Tables 1 and 2, respectively. More detailed listings that include standard water quality parameters and results from field blanks are included in Attachment A.

The October 2004 samples were collected during the initial hours of the first significant storm of 2004. The results exhibit a pronounced first flush effect, in terms of both total mercury and TSS. At the West Channel sampling location, mercury concentrations declined by 65% from levels observed during the first hour (average of first two samples) to the level observed five hours later. The drop in TSS was equally pronounced, from 97 mg/L to 22 mg/L, a 73% drop. For the Borregas Avenue storm drain samples, changes over time were less pronounced.

The October 2004 samples were also analyzed for methylmercury. The first samples at both locations were slightly above the 0.02 ug/L detection limit. The remaining samples at both locations were below detection limit.

The December 21, 2005 samples from the West Channel exhibited lower total mercury concentrations than in the October 2004 samples. The concentration declined by approximately 50% from the first sample to the one collected an hour later. The lower levels are likely a consequence of earlier storm events that occurred in December 2005, and suggest that the October 2004 “first storm, first hour” may not be representative of first flush concentrations after the first major storm. This supposition is further supported by the December 12, 2006 sample results, for

[4] The California Industrial Activities Storm Water General Permit Order 97-03-DWQ defines a storm event as any storm preceded by three days of dry weather.

which concentrations are significantly lower than either of the two previous years. Records indicate that a modest amount of rainfall (0.39 inches total for San Jose) fell in the November 2006.

The December 2005 and 2006 samples from the West Channel were also analyzed for dissolved mercury. The dissolved mercury fraction (as a percent of total) ranged from 22% to 44%, with an average value of 28%.

Dry weather samples were collected from the fore bay of the Baylands Pumps Station No 1 in October 2005 and August 2006. Total mercury concentrations in these samples were very low (0.0031 ug/L and 0.0015 ug/L, respectively).

The correlation between total mercury and TSS is illustrated in Figure 3 for all data where matched pairs were available. Since one of the TSS dry weather samples was not analyzed for TSS, only one dry weather point is included on the graph as indicated. As observed in previous studies, total mercury and TSS are highly correlated.

Table 1. Wet Weather Sampling Results

Date	Time	Total Hg ug/L	TSS mg/L	Diss. Hg ug/L	Methyl Hg ug/L
Sunnyvale West Channel					
10/19/2004	0912	0.057	102		J 0.029
10/19/2004	0952	0.048	96		< 0.02
10/19/2004	1343	0.018	22		< 0.02
12/21/2005	1632	0.034	N/A	0.0087	
12/21/2005	1730	0.018	N/A	0.008	
12/12/2006	940	0.0130	9	0.0029	
12/12/2006	1050	0.0096	6	0.0023	
12/12/2006	1155	0.0094	10	0.0022	
Borregas Ave Storm Drain					
10/19/2004	0932	0.032	36		J 0.021
10/19/2004	1115	0.026	32		< 0.02
10/19/2004	1402	0.020	8		< 0.02

Table 2. Dry Weather Sampling Results

Date	Time	Total Hg ug/L	TSS mg/L	Diss. Hg ug/L
Bayland Pump Station #1				
10/14/2005	1540	0.0031	N/A	
8/4/2006	0850	0.0015	5	0.0008

Results from sampling of the Sunnyvale West Channel conducted by SCVURPPP are presented in Table 3 for comparison. The SCVURPPP samples were collected during both the wet and dry seasons. However, the sampling protocol did not call for wet weather samples to be collected during storm events, so the results of the wet season samples are not directly comparable to the those in Table 1. For these samples, solids were characterized by measuring suspended sediment concentrations (SSC). The dry season SCVURPPP results are similar to those for Baylands PS #1, i.e., very low total mercury and low suspended solids. SCVURPPP sampling in Sunnyvale Flood Control East Channel (not shown) yielded results very similar to those for the West Channel.

Table 3. SCVURPPP Sampling Results for Sunnyvale West Channel*

Date	Total Hg ug/L	Suspended Sediment Concentration (SSC) mg/L
Wet Season		
1/24/05	<0.005	2
2/7/06	J0.005	25.3
Dry Season		
9/28/04	<0.0012	6.1
10/5/05	J0.005	3.4

* Data from Ref. 5

In summary, the results from sampling conducted for this study indicate that a first flush phenomena exists at the two sampling sites, with the effect most pronounced at the very beginning of the wet season, and less so after several storm events. The 2004 “first storm-first hour” concentrations were in the 0.047-0.048 ug/L (47-57 ng/L) range. The remaining first flush data, which ranged from 0.0094-0.035 ug/L (9.4-34 ng/L), may be more typical of first flush conditions that would be encountered over the course of a wet season. The observed dry weather concentrations were very low (1.5-3.1 ng/L), but were consistent with other dry weather results from the same watersheds. As expected, total mercury and TSS are highly correlated.

5.0 EVALUATION OF POTENTIAL DIVERSION OPTIONS

Consistent with the requirements of NPDES permit Provision 5 and the subsequent request by Water Board staff to evaluate dry weather diversions, the following analysis considers both first flush and dry weather diversion.

In addition to the factors described in Section 2.1 that should be considered in assessing the potential for a diversion project, a number of engineering issues also need to be addressed:

- Because first flush flows are by definition limited duration events, the diversion system must be sized to accommodate a significant amount of that flow in order to achieve meaningful pollutant capture. The characteristics of the particular watershed will dictate whether continued diversion after the first flush is cost effective in providing additional pollutant capture. The need to accommodate high flows will generally require significant capital outlays for pumping and/or conveyance facilities. Where feasible, use of an existing stormwater pump station as a diversion point may provide a portion of that infrastructure (i.e. the high capacity pumps), and reduce capital costs. Operation and maintenance (O&M) costs and requirements should also be considered, even when "excess" capacity exists at the plant. O&M costs may include costs associated with the diversion facilities, and the incremental costs for treatment of the diverted flow. Capital and operating costs can be combined into a single equivalent cost (e.g. present value or annualized cost), and if pollutant loading/reduction estimates are available, a figure of merit (cost per unit of pollutant removed) can be calculated for comparison to alternative pollutant reduction strategies.

- The analysis for dry weather diversions is similar, except that flows are typically lower, resulting in reduced infrastructure costs. If flows are continuous, the diversion facilities are more fully utilized. On the other hand, dry weather pollutant concentrations are typically lower, so that the resulting cost per unit of pollutant removed will not necessarily be lower, in spite of reduced infrastructure costs.

5.1 Capacity Considerations

The Sunnyvale WPCP has a permitted flow capacity of 29.5 mgd. Current average dry weather flow (ADWF) to the plant is in the range of 14.0-14.7 mgd. Peak daily wet season flows up to 29 mgd occur, but are more typically in the 20-22 mgd range.[5] Because that collection system has relatively low levels of inflow and infiltration (estimated 5% of total influent flow on an annual basis), the design of the plant throughout historic expansions has not provided for a large excess hydraulic capacity (relative to the ADWF) in order to accommodate large transient increases in wet weather flows. The nominal peak wet weather design flow (for the primary plant) is approximately 40 mgd, with all ten primary sedimentation basins in service. This is in contrast to other Bay Area POTWs, where peak wet weather hydraulic capacity of the primary plant may be many multiples of the ADWF.

Given the normal availability of the primary sedimentation basins (the basins are maintenance-intensive relative to other plant processes, and 2-3 basins are frequently out of service for maintenance or repairs), a peak plant flow of 32 mgd represents a reasonable target for the maximum primary plant flow under a first flush diversion scenario. Given that peak wet weather plant influent flows typically run 20-22 mgd , this corresponds to an "availability" of up to 10-12 mgd (~7,000-8,300 gpm).[6] This availability would decline if plant influent flows increased significantly from their current levels.

[5] During the February 1998 "El Nino" event, a peak daily flow of 38.9 mgd was recorded. However, no other daily flows over the past 15 years have exceeded 29 mgd..

[6] This analysis is based on flows rates expressed as total daily flows. Data to characterize plant influent flows over shorter duration periods (e.g. a 4-6 hr period that might comprise a first flush event), are not readily available. Depending on the characteristics of the plant influent hydrograph during peak flow events, the available capacity for short-term diversions might be somewhat greater than 10-12 mgd.

Diversions of such large flows could be very disruptive to treatment plant operations, unless the diversion was anticipated and accompanied by bringing additional sedimentation basins on-line. Even under controlled conditions, some decline in performance of the primary sedimentation process (from pre-diversion conditions) could be expected. However, because the oxidation ponds provide a long detention time and conditions conducive to sedimentation, any such changes would not likely have a significant impact on plant final effluent quality, or on the plant's ability to meet 85% CBOD and TSS removal requirements.

Diversion directly to the oxidation ponds is a possible alternative that would eliminate the potential for adverse impacts on the primary plant. Assuming the conveyance line could discharge to the existing primary effluent line (at the sedimentation basin effluent structure), an additional 200 feet of conveyance line would be required. The main disadvantage of such an approach would be that solids removed from the diverted flow would accumulate in the ponds, rather than being removed through the primary plant, and would thus add to the total pond sediment load.

5.2 First Flush Diversion

Potential sites for diversion of first flush flows to the WPCP include the Sunnyvale West Channel and the Baylands PS #1. Both are relatively close to the WPCP; the latter has pumping infrastructure that may be suitable for use in a diversion scheme. Diversion from the Sunnyvale East Flood Control Channel was deemed impractical because of the distance from the plant (approximately 3600 ft), absence of existing pumping or conveyance infrastructure, and jurisdictional considerations (the channel is owned and operated by the SCVWD).

The West Channel runs along western edge of WPCP before its convergence with Moffett Channel. (The WPCP discharges to the Channel at a point immediately down stream from the convergence point). Diversion at this location would require pumping facilities, but the length of conveyance pipeline would be minimal. However, the West Channel is under tidal influence at this location, and sees the full range (approximately 8.5 ft) of tidally induced surface elevation change. The tidal influent would rule out flow diversion much of the time. An upstream location subject to reduced tidal influences, e.g. between Bordaux Dr. and Mathilda Ave, would be more suitable in this regard. However, there is no-City owned property available for siting a diversion pump station along the Channel until the Fire Station on the East side of the Mathilda Ave/light rail corridor. Diversion from the Fire Station property (if feasible) would require a conveyance pipeline back across Mathilda Avenue, a challenging proposition in its own right. From the east side of Mathilda Ave, the conveyance line would need to run along the West Channel right-of-way to the WPCP (approximately 6,400 ft), or be routed on City streets (including Mathilda Ave and Moffett Park Drive) or via new easements across private properties to a 42-inch sewer line that runs north on Borregas to the WPCP (minimum 2,200 - 2,600 ft).[7,8] All of these options would face significant constructability issues that could render the options infeasible.

[7] The SCVWD is generally disinclined to approve easements along it's flood control channel rights-of-way, because such easements may constrain maintenance or future construction activities, or compromise the channel's flood control functions.

[8] Although no detailed capacity analysis of this new line was conducted, it is assumed that the 42" line, which replaced an earlier 33" line, has some excess capacity.

Baylands PS #1 drains a smaller (approximately 500 acre) watershed than the West Channel, but has several characteristics that make wet weather diversion relatively more feasible. The existing pumping infrastructure could most likely be used. The capacity of the primary pump at Baylands PS #1 (approximately 7750 gpm, or 11.2 mgd) is well-matched to the available treatment plant capacity described in Section 5.2. However, to reduce the hydraulic impact of rapidly diverting such a large volume of flow to the plant, a variable speed drive would be installed on the existing pump, so that flows could be ramped up gradually. A variable speed pump would also allow continuous pump operation when influent flows to the station were below 7750 gpm. Other infrastructure requirements would include automatic diversion valves, fittings, and controls, and a conveyance pipeline to the plant headworks or primary sedimentation basins (approximately 1000 ft of 16”-18” diameter line), or, if routed directly to the ponds for treatment, to the primary effluent line (approximately 1200 ft). The conveyance line would be located on WPCP property, minimizing a number of permitting and constructability issues.

5.3 Dry Weather Diversion

For many of the same reasons outlined above, Baylands PS #1 represents the most feasible location for diversion of dry weather flows to the WPCP. Under dry weather conditions, the available flow, rather than plant capacity, is the limiting factor on pollutant capture. Dry weather flows from Baylands PS No.1 are not well characterized. City Public Works staff estimate that during the dry season, the primary pump runs for 2-3 minutes per hour, corresponding to an estimated daily flow of 372,000 – 558,000 gallons per day (roughly 260 – 390 gal/minute continuous basis).[9] Staff believe that groundwater infiltration constitutes a significant portion of this flow. The TSS measurement from 8/4/06 (5 mg/L) tends to support this view.

For dry weather diversion, a smaller pump operating under continuous or near-continuous conditions and discharging through a smaller conveyance line would be more cost effective, and would eliminate the transient loadings that would occur if the current intermittent flow were simply diverting to the treatment plant. A 4”-6” line would be required to accommodate the maximum estimated flow of 388 gpm.[10,11] The lower dry weather flow could routed to the plant headworks, the primary sedimentation basins, or to the primary effluent line

5.4 Potential Loading Reductions

Potential reductions in mercury loadings to the Bay can be calculated based on estimated concentrations, flow volumes, and removal rates at the WPCP. Concentration values are subject to significant uncertainty, but are probably valid to within plus or minus 50%, which is sufficiently accurate for this conceptual analysis. Flows volumes can be specified based on capacity or other considerations as long as the specified flows do not exceed the available first flush flows in the storm drain system. (A review of pumping records for Baylands PS #1 indicates that flows during

[9] The larger “emergency” engine driven pumps have run time meters. Data from these meters confirm that they do not operate during the dry season.

[10] This value should be considered a very rough estimate and not used as a basis for design unless verified.

[11] A combined first flush + dry weather system could use the larger conveyance line during the dry season. However, such a project should still include a separate pump for dry weather flows.

significant storm events exceed 7750 gpm, and thus meet this criterion). Treatment plant removal performance can be extrapolated from current performance with a reasonable degree of confidence.

As discussed in Section 4.3, the cluster of total mercury concentration values on left side of Figure 3 most likely provide the best estimate of first flush values throughout a wet season. The average of these values, plus the two additional values from December 2005 not included on Figure 3 (because no TSS values were available) is 0.020 ug/L.[12] If the two values representing the "first storm-first hour" sample at the West Channel are also included (i.e., the upper right points on Figure 2), the average rises to 0.026 ug/L. The latter will be used to characterize the average first flush concentration, with the caveat that it may overestimate to the average concentration over the season. The 0.026 ug/L value is numerically equivalent to the average of the three wet weather samples from Borregas storm drain system (which feeds Baylands PS #1) collected on 10/19/04 during the first storm of the season.

For first flush diversion, the flow volume used for the loading estimates is based on practical (i.e. use of existing pumping infrastructure) and WPCP capacity considerations, which converge at a pumping rate of about 11 mgd. Based on that flow rate and a first flush duration of 6 hours, the volume diverted would be 2.75 million gallon per event. For purposes of calculations, a total of 12 diversion events per year are assumed.

The dry weather total mercury concentration is characterized by the average of the Baylands PS #1 samples, 0.0023 ug/L (2.3 ng/L). Though based on only two samples, this value is consistent with the SCVURPPP results from dry weather sampling of urban runoff in Sunnyvale. For loading calculations, a continuous flow of 300 gpm (0.43 mgd) over an 8-month period is assumed.

Removal rates for mercury at the WPCP are high, averaging approximately 98%. Although WPCP effluent mercury data show an increase in effluent concentrations with increased flow, the correlation is poor. A review of plant influent data revealed no consistent relationship between influent flow and influent mercury concentration. In the absence of information regarding removal performance at higher flows, the WPCP's average removal rate of 98% was used to calculate the potential loading reductions.[13]

Potential loading reductions (grams mercury per year) calculated on the basis of the above assumptions are listed in Table 4.

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[12] Note that these data include both the Borregas storm drain and West Channel samples.

[13] The average concentration in dry weather runoff (0.0023 ug/L) is actually less than the average plant final effluent concentration. Nevertheless, it is assumed here that overall removal rate of 98% will apply on a mass basis.

Table 4. Projected Mercury Loading Reductions

Date	First Flush Only	Dry Weather Only
Volume Diverted, million gal/yr	33	104
Concentration, ug/L	0.026	0.0023
Pollutant Loading Reduction, grams mercury/yr	3.19	0.89

5.5 Estimated Costs

Costs for diversion are estimated based on the estimated capital costs for new facilities plus the incremental treatment costs, annualized to an equivalent cost per million gallons basis. A cost per volume approach is particularly appropriate for the treatment cost component because treatment costs at the Sunnyvale WPCP are strongly volume dependant, due primarily to the polymer coagulant used in the tertiary plant's air flotation tanks (AFTs).[14] Costs for pumping and for other chemicals (chlorine and sulfur dioxide) also vary directly with flow. Operating labor costs are relatively insensitive to flow for the increment of flows associated with the diversion projects, and are therefore not included in the treatment costs. However, an allowance for O&M labor associated with the new infrastructure only was included as part of the annualized capital costs.

The estimated costs are summarized in Table 5. Additional detail is provided in Attachment B. A review of Table 5 indicates that the for first flush treatment, capital costs account for roughly 90% of the total annualized cost, whereas for dry weather diversion, the total annualize cost is more evenly split between capital and treatment costs. (The same unit treatment cost - $278/Mgal - was used in both cases. The greater treatment cost for the dry weather scenario reflects the larger volume treated). If the total annual costs are divided by the projected pollutant loading reductions listed in Table 4, the resulting ratios represents the total cost per gram of mercury removed. As indicated in Table 5, these values range from $28,440 per gram removed for first flush diversion to $60,110 per gram removed for dry weather diversion. The drivers for these high unit costs include: 1) the relatively high infrastructure costs associated with the first flush scenario, 2) treatment cost (both scenarios), and 3) the very low mercury concentrations in the dry weather scenario. Note that the impact of item (3) more than offsets the reduced infrastructure costs for a dry weather project, resulting in a higher cost per gram of mercury removed.

The cost/removal ratio for a combined first flush and dry weather project would fall within the range of cost/removal ratios listed in Table 5 for the two scenarios.

[14] The AFTs are essentially secondary clarifiers, removing solids from the pond effluent plus additional solids contributed by the fixed growth reactors used for nitrification.

Table 5. Projected Costs

Date	First Flush Only	Dry Weather Only
Capital Cost, $million	$1.1 M	$274,000
Annualized Capital Cost, $/yr	$81,550	$24,600
Treatment Cost, $/yr	$9,170	$28,900
Total annualized cost, $/yr	$90,720	$53,500
Cost / Removal Ratio, $/gram Hg removed	$28,440	$60,110

6.0 SUMMARY

The following summarizes the results of the City's Mercury Special Study:

- Monitoring was conducted at two locations in the City of Sunnyvale stormwater drainage system during the initial hours of storm event ("first flush" samples) to characterize mercury concentrations in the resulting runoff. Low level mercury analysis (Method 1361) was used to provide the lowest possible detection levels. A total of four sample events, each involving 2-3 samples per event were conducted over a three year period. Concentrations ranged from 0.013 ug/L to 0.057 ug/L (13-57 ng/L), with an average across all results of 0.026 ug/L (26 ng/L). The two highest concentrations were observed during the first hour of the first significant rainfall of the 2004 wet season. In all cases, the highest concentration was observed in the first sample of a set, and declined in subsequent samples, indicating that a "first flush" phenomenon most likely exists for these catchments. As anticipated, the results for total mercury and total suspended solids were highly correlated.

- At the request of Water Board staff, several samples were also collected during the dry season for use in analyzing a dry season diversion scenario. Samples were collected at the Baylands Pump Station No. 1 Pump in October 2005 and August 2006. The average total mercury concentration of 0.0023 ug/L (2.3 ng/L) was an order of magnitude lower than the average of the wet season samples. The dry season results were consistent with results from other dry season monitoring conducted in Sunnyvale by SCVURPPP.

- Several potential diversion locations were examined. Baylands Pump Station No. 1 was identified as the most practical and cost-effective location for either first flush or dry season diversion. The analysis assumed that the station's existing primary pump would be suitable for use in first flush diversion project. For a dry season project, a new, smaller pump that could operate continuously would be more suitable.

- The WPCP capacity analysis indicates that diversion of first flush flows at a rate up to 7600 gal/min (11 mgd rate) appear to be technically feasible, and would not result in significant adverse impacts. Dry weather diversion flows are limited by the available flow, rather than WPCP capacity. Dry weather flows from Baylands Pump Station No.1 are not well characterized, but are roughly estimated to be in the range of 260 – 390 gpm.

- For purposes of estimating loadings and costs, it is assumed that a first flush diversion project would consist of 12 six-hour diversion events per year. A dry weather-only project would consist of eight months continuous diversion at 300 gpm. These flow, coupled with the average concentrations described above were used to estimate potential loading reductions. (These values would need to be verified before resources were committed to any project. Such verification should include ongoing sampling during a wet season to determine if elevated first flush concentrations persist throughout the wet season). In the absence of better information, it was assumed that the WPCP's current 98% mercury removal efficiency would be maintained during either diversion scenario.

- Based on these assumptions, the calculated mercury loading reductions are 3.2 grams/yr for a first flush project, and 0.89 grams/yr for a dry weather project.

- Costs for both scenarios were estimated based on annualized capital (infrastructure) costs and treatment plant operating costs. In both cases the primary component of infrastructure costs are the pipeline required to route the diverted flow to the primary sedimentation basins or to the oxidation ponds. The primary component of the treatment costs are the chemical costs associated with the secondary clarification process, energy costs for tertiary plant pumping, and chemical costs for the chlorination and dechlorination processes. The treatment cost component did <u>not</u> include a prorated share of other WPCP operating costs (e.g. plant operating or administrative labor). If included, the calculated treatment costs would be much higher than indicated in this analysis.

- Expressed as a ratio of cost to mass removed, the estimated costs were $28,440/gram mercury removed for a first flush project, and $60,110/gram mercury removed for a dry weather project. Costs for a combined first flush plus dry weather project would fall within this range. These are ongoing costs, incurred for each gram removed over time.

- In summary, either a first flush or dry weather project appears to be technically feasible. To the extent that the average first flush concentration (26 ng/l) used for the analysis would be sustained over an entire wet season, the first flush project is less expensive than the dry season project from a cost per gram mercury removed perspective. However, the unit costs for either option (or for a combine first flush plus dry season project) are very high, and other loading reduction strategies may be more cost effective.

The following additional observations and comments are relevant to this report's analysis:

- Relative to the feasibility criteria described in Section 2.1 (CEP project analysis for urban runoff diversion projects), the Sunnyvale WPCP project scenarios are positive for most of the criteria, except that mercury concentrations are not particularly high for either scenario. This is reflected in the high unit cost per gram mercury removed under either scenario. Alternative strategies, such as removal of sediments from storm drainage systems, may prove to be more cost-effective than routing large amounts of water containing low mercury concentrations through wastewater treatment plants.

- The high treatment costs for mercury removal also reflect, to some extent, a mismatch between the treatment technologies that are most cost-effective for removal of solids versus those utilized in a wastewater treatment plant. Any flow diverted through a wastewater plant will pass through biological treatment processes for removal of soluble BOD (and in some cases, nutrient conversion or removal). These processes are largely unnecessary, or at the very least, inefficient, for removal of particulates. Although the costs associated with the biological treatment processes at the Sunnyvale WPCP (i.e. the oxidation ponds and fixed growth reactors) are relatively low, the post-biological clarification process are high, and thus overall treatment costs are comparable to other wastewater treatment plants.

- To the extent that credits for removal of pollutants such as mercury from stormwater and urban runoff may be appropriate, consideration should be given to the fact that most treatment plants provide such treatment to some degree if the sewer system is subject to inflow and infiltration (I&I) during the wet season. Analytical methods are available to estimate the quantities of both inflow and infiltrations based on a treatment plant's influent hydrographs.

- Of greater significance for the Sunnyvale WPCP than treatment of I&I is the fact that the plant's 400 acre oxidation ponds capture and treat approximately 217 million gallons of rainfall during a typical (20 inches rainfall) year. A study by SFEI estimated the concentration of mercury in Bay Area rainfall to be on the order of 8 ng/L. (Ref 6) This value is several times higher than the average dry season runoff concentration (2.3 ng/L) measured during the City's study, and corresponds to a removal rate for mercury of 6.4 grams/year, approximately twice the amount that would be removed by the first flush diversion project described in this report, and over six times the amount for the dry season project.[15]

- Interagency issues related to a diversion project were not addressed as part of this study. The fact that the City of Sunnyvale operates both the WPCP and the Baylands Pump Station should facilitate these issues. However, since the WPCP is funded primarily through fees imposed on users of the sewer system, there are cost allocation issues that would need to be addressed in connection with any diversion project.

[15] The treatment of rainfall at the WPCP was noted in a June 5, 2006 comment letter submitted by the City to the Water Board in connection with the proposed Basin Plan amendments for mercury.

REFERENCES

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2. J. Soller, et al, *Evaluation of Seasonal Scale First Flush Pollutant Loading and Implication for Urban Runoff Management*, Journal of Environmental Management, April 2005. (Results were also included Santa Clara Valley Urban Runoff Pollution Prevention Program FY02-03 Annual Report)

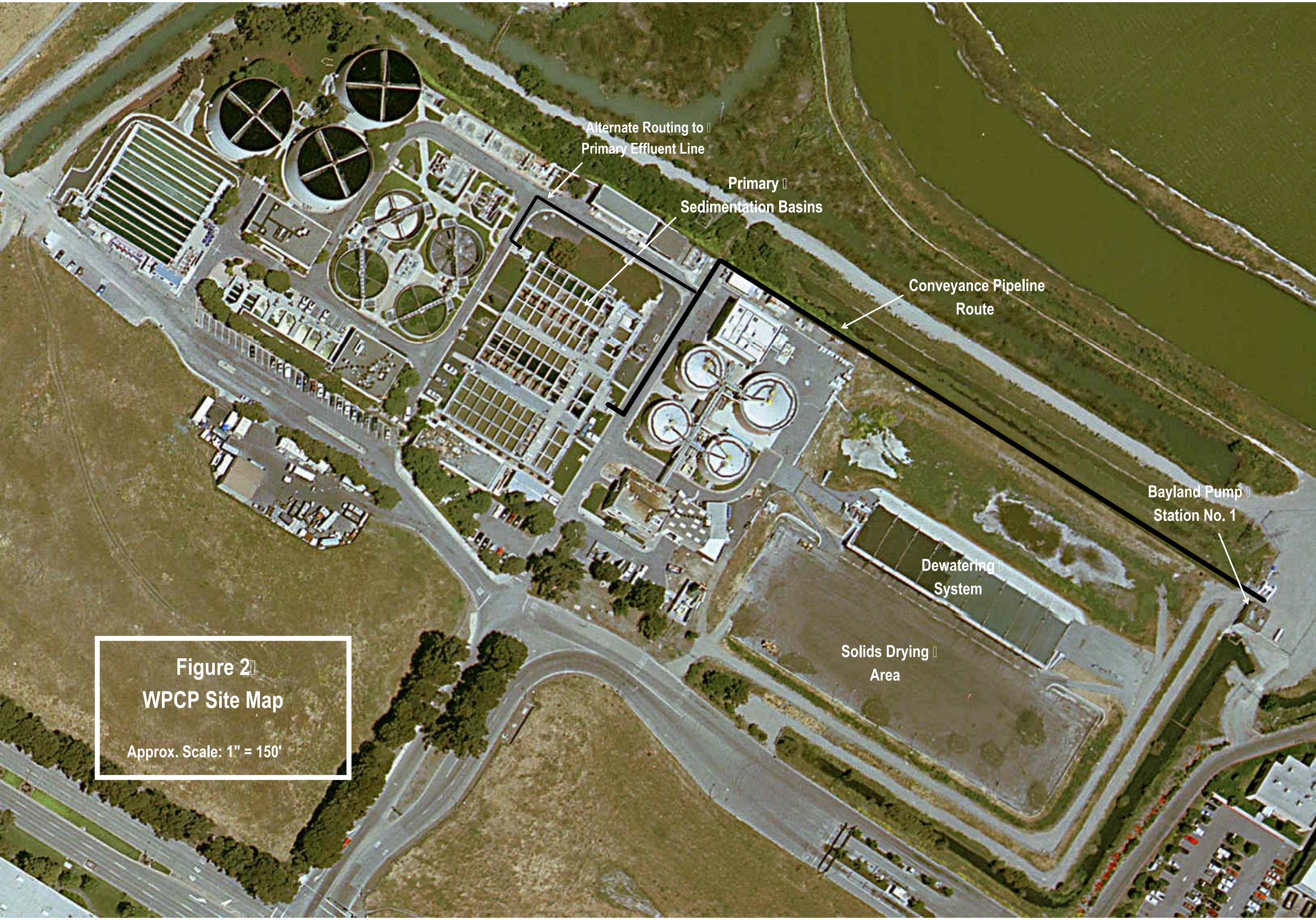
3. *Technical Memorandum - Offset Projects*, prepared for EBMUD by Larry Walker & Associates, et al, November 2007.

4. Personal communication with Gayle Tupper, EBMUD, November 2007.

5. *SCVURPPP Watershed Monitoring and Assessment Program, Monitoring and Assessment Summary Report – Santa Clara Basin Creeks (2002-2007),* EOA, Inc., September 15, 2007

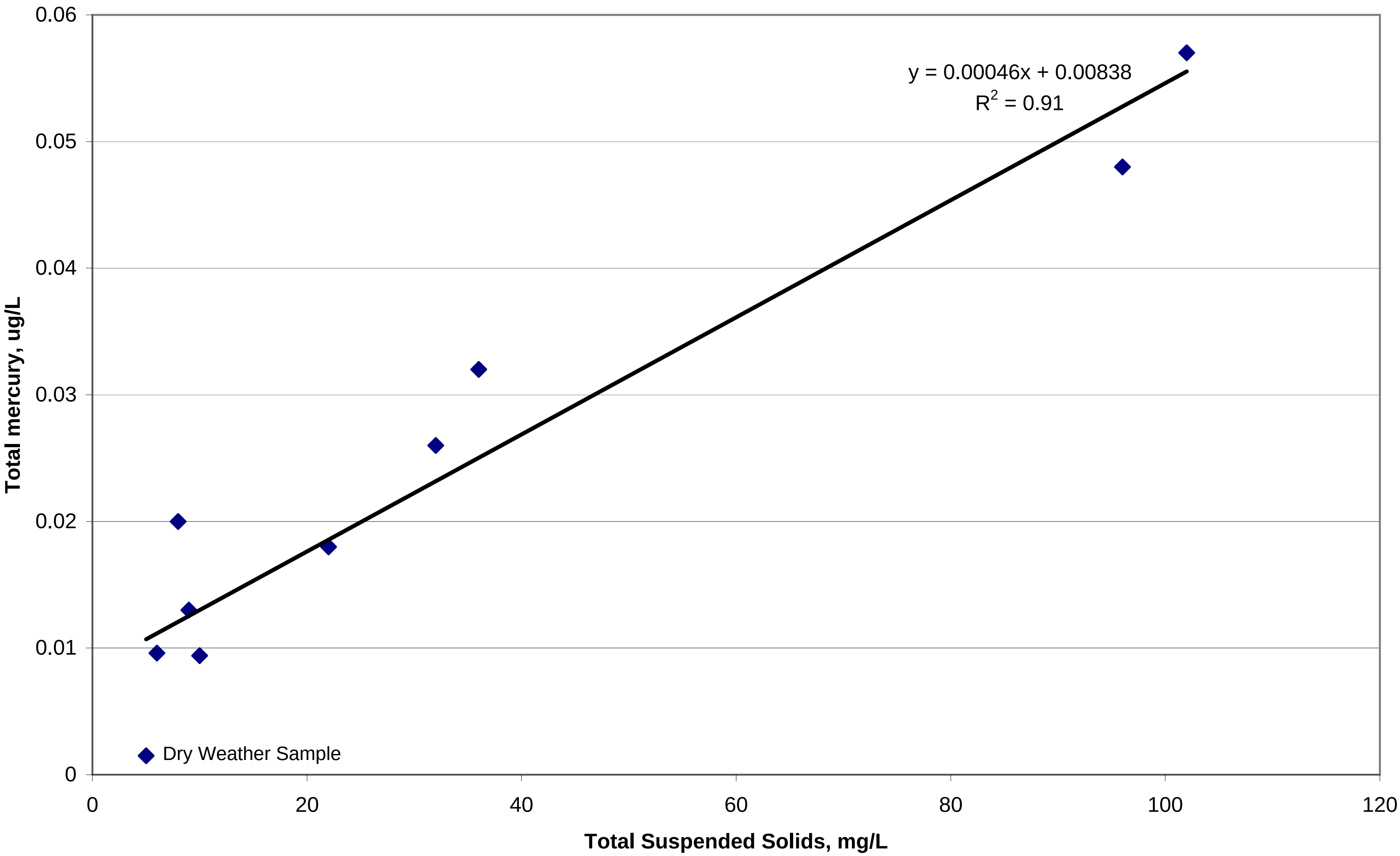
6. *San Francisco Bay Atmospheric Deposition Study Part I: Mercury*, San Francisco Estuary Institute, July 2001.

Figure 1
Sample Location Map



Alternate Routing to
Primary Effluent Line
Primary
Sedimentation Basins
Conveyance Pipeline
Route
Bayland Pump
Station No. 1
Dewatering
System
Solids Drying
Area
Figure 2
WPCP Site Map
Approx. Scale: 1" = 150'

Figure 3. Total Mercury - TSS correlation



ATTACHMENT A

Attachment A
City of Sunnyvale Mercury Study - Sampling Results

Location	Date	Time	Total Mercury ug/L	TSS mg/L	Specific Conduct. umho/cm	pH	DO mg/L	Temp. deg C	Methyl Mercury ng/L	Dissolved Mercury ug/L
Sunnyvale West Channel										
Sample Results										
	10/19/2004	0912	0.057	102	117.9	7.0	10.2		J 0.029	
	10/19/2004	0952	0.048	96	80.3	7.1	10.1		< 0.02	
	10/19/2004	1343	0.018	22	223.7	7.5	9.3		< 0.02	
	12/21/2005	1632	0.034		99.1		9.4	16.6		0.0087
	12/21/2005	1730	0.018		169.7		8.9	16.5		0.008
	12/12/2006	940	0.0130	9	91.8	7.2	10.5	11		0.0029
	12/12/2006	1050	0.0096	6	184.5	7.4	10.2	12		0.0023
	12/12/2006	1155	0.0094	10	317.5	7.5	9.7	12		0.0022
Field Blanks										
	10/19/2004	0912	<0.0005						< 0.02	
	10/19/2004	0932	<0.0005						< 0.02	
	12/21/2005	1632	0.0036							
	12/21/2005	1730	0.0005							
	12/12/2006	940	0.0029							
	12/12/2006	1050	0.0016							
	12/12/2006	1155	0.0015							
Borregas Ave Storm Drain										
Sample Results										
	10/19/2004	0932	0.032	36	105.4	7.1	9.8		J 0.021	
	10/19/2004	1115	0.026	32	79.2	7.1	9.6		< 0.02	
	10/19/2004	1402	0.020	8	121.5	7.2	8.7		< 0.02	
Field Blanks										
	10/19/2004	0912	<0.0005						< 0.02	
	10/19/2004	0932	<0.0005						< 0.02	
Baylands Pump Station #1										
Sample Results										
	10/14/2005	1540	0.0031	-	6140	7.5	8.6			
	8/4/2006	0850	0.0015	5	3722	7.2	2.9	19		0.0008
Field Blanks										
	10/14/2005	1540	0.0017	-						
	8/4/2006	0850	0.0009							<0.0005

ATTACHMENT B

Planning Level Capital Costs for First Flush Diversion Based at Bayland PS #1
Assuming use of existing primary pump with VFD added, 18" Pipeline to Sed Basins

Description	Quan	Unit	Installed Unit $	Total Cost
Site work	1	ls	10000	10,000
Pump VFD	1	ea	75000	75,000
Automatic valves & actuators	2	ea	15000	30,000
Flowmeter	1	ea	15000	15,000
18" Pipeline to Primary Sed Basins	1000	ft	400	400,000
Piping structural & tie-in at Baylands PS	1	ls	10000	10,000
Piping structural & tie-in at Sed Basins	1	ls	30000	30,000
Electrical	1	ls	15000	15,000
Controls and SCADA	1	ls	40000	40,000
Testing & Startup	1	ls	5000	5,000
Mob/Demob	1	ls	10000	10,000
Subtotal				630,000
Contingency			30%	189,000
Total Construction Cost				819,000
Engineering/Legal/Contract Admin.			30%	245,700
Total Capital Cost				**$1,064,700**
Annualized Capital Cost @ 30 yrs, 5% interest				**$69,260**
New facilities O&M @ 1.5% of construction cost/annum				**$12,285**
New Facilities Total Annualized Cost				**$81,545**

Planning Level Capital Costs for Dry Weather Diversion Based at Bayland PS #1

Assuming new 300 gpm pump with VFD, 6" Pipeline to Sed Basins

Description	Quan	Unit	Installed Unit $	Total Cost
Site work	1	ls	2500	2,500
Pump and VFD, 300 gpm	1	ea	10000	10,000
Valves & Fittings	1	ls	2500	2,500
Flowmeter	1	ea	5000	5,000
6" Pipeline to Primary Sed Basins	1000	ft	125	125,000
Piping structural & tie-in at Baylands PS	1	ls	5000	5,000
Piping structural & tie-in at Sed Basins	1	ls	5000	5,000
Electrical	1	ls	5000	5,000
Controls and SCADA	1	ls	25000	25,000
Testing & Startup	1	ls	2500	2,500
Mob/Demob	1	ls	2500	2,500
Subtotal				190,000
Contingency			30%	57,000
Total Construction Cost				247,000
Engineering/Legal/Contract Admin			30%	74,100
Total Capital Cost				**$321,100**
Annualized Capital Cost @ 30 yrs, 5% interest				**$20,888**
New facilities O&M @ 1.5% of construction cost/annum				**$3,705**
New Facilities Total Annualized Cost				**$24,593**

Treatment Costs (Tertiary Plant Chemical and Power Only)

Costs per million gallons treated

Polymer	$206	
Tertiary Plant Pumping	$58	@ $0.13/kw-hr
Chlorine	$5	
Sulfur Dioxide	$8	
Total	**$277**	

APPENDIX C - BACWA WHITE PAPER (2010)

Bay Area Clean Water Agencies
A Joint Powers Public Agency
Leading the Way to Protect our Bay

STORMWATER DIVERSION WHITE PAPER

FINAL

September 2010

Prepared by

carollo
Engineers...Working Wonders With Water®

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Stormwater is a significant source of pollution into urban waterways. Stormwater consists of both wet weather flows due to rainfall, as well as dry weather flows due to irrigation runoff, pool draining, washdown water, construction work, and other related activities. One practice to mitigate dry weather stormwater pollution that has been implemented in Southern California is to divert these dry weather flows to sanitary sewer systems in locations where there is excess conveyance and treatment capacity. These projects have demonstrated success in reducing bacterial indicators in surface waters.

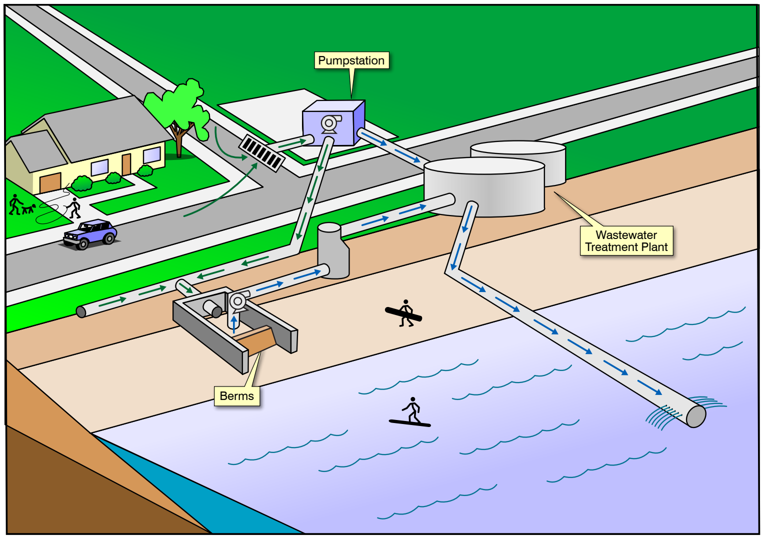
There is some interest amongst regulators in implementing diversion projects in Northern California. The San Francisco Regional Water Quality Control Board (RWQCB) issued a Municipal Regional Stormwater NPDES Permit (MRP) to stormwater agencies in five San Francisco Bay Area (Bay Area) counties. The MRP requires the permittees to conduct a feasibility study and construct five diversion pilot projects. The RWQCB's driver for requiring diversions is to reduce concentrations of mercury and PCBs in stormwater runoff to San Francisco Bay.

The objective of this White Paper is to identify the challenges and opportunities associated with diversions of flow from stormwater systems to a POTW. The issues and concerns addressed in this paper include:

- What are the institutional, technical and economic challenges that need to be overcome to implement diversions?
- What are the potential watershed and institutional opportunities associated with diversions?

The White Paper was developed using published and grey literature. In addition, significant information was obtained through the case studies of the following agencies:

- City of LA
- Orange County Sanitation District
- City of Ventura
- City of Santa Cruz
- East Bay Municipal Utility District



Conceptual diversion structure layout.

While the scope of the White Paper included the analysis of both dry weather and first flush flows, no example of a POTW accepting first flush flows was identified either as a case study or in the literature. However, a stormwater treatment facility in Santa Monica, CA (that does not accept municipal wastewater), does treat some wet weather flows if they are below the facility's hydraulic capacity. Additionally, a potential schematic for treating a first flush volume is proposed in this White Paper. The majority of this White Paper pertains to dry weather flows only.

Institutional Issues

Interest in diversions in the Bay Area is being driven by regulations such as the stormwater MRP as well as stormwater TMDLs. However, based on the analysis of existing statutes, the RWQCB can only encourage, not require, POTWs to accept the diversion.

Interagency agreements are key to a successful diversion project, since stormwater and wastewater are often handled by different agencies, or different divisions within the same agency. One approach that has been successful is for the POTW to issue dry weather runoff discharge permits to stormwater agencies, where the permit lists the terms under which the POTW will accept diversions. Additionally, there are several models to partition construction and O&M costs that have been implemented by the Case Study agencies.

Technical Considerations

Diversion structures that have been implemented by Southern California agencies are mostly constructed by pumping water that has been screened for trash from stormwater pump stations to a nearby sanitary collection system connection. Alternatively, diversions can be implemented by installing an inflatable dam in a stormwater channel, and water that accumulates behind the dam is pumped to the sanitary collection system.

A third, non-structural strategy is to implement operational diversions where a stormwater sump that is stagnant becomes septic during the dry season. The stagnant water in these sumps is suspected of causing fish kills (due to low dissolved oxygen conditions) when the first rain leads to enough flow to trigger the pumps but not enough flow to dilute the pollutants in the stormwater. In such a situation, an agency can send staff to these sumps on a rotating basis to manually pump out the water to the sanitary system.

The technical challenges in implementing diversions chiefly lie in protecting POTWs from high flows or high pollutant loads. This means monitoring and restricting stormwater flows and quality, and shutting them down if a safe threshold is exceeded.

Flows to the POTW can be restricted by using small pipe sizes and small pumps. For an additional level of control, valves can be closed or pumps can be shut down either manually or automatically in response to rainfall or high flows. There are a number of closed conduit and open channel approaches to measure flow, such as differential pressure meters, positive displacement meters, ultrasonic meters, magnetic meters, open channel meters etc. Controlling the flow from the stormwater system to the sewer system can be accomplished through passive, manual, automated and remote control mechanisms. In general, the risk of exceeding and overwhelming the flow capacity of the sanitary sewer collection and treatment system can be mitigated by providing redundancy in the stormwater diversion design and control systems.

Constituents in stormwater in addition to the targeted compounds (mercury and PCBs) could potentially leads to process problems or permit violations by the POTW. Water quality monitoring is more difficult than flow monitoring, since it generally needs to be performed in a lab. However, some pollutants can be measured in-situ with online meters, such as conductivity, dissolved oxygen, and the concentrations of some hydrocarbons. One strategy that may be employed to manage the potential impacts of diversions on the POTWs operation is to maintain a low ratio of the flow rate of the diversion to sanitary flows. This practice was employed by Case Study agencies.

In addition to conveying dry weather flows to a POTW, diversions could be operated to target other potential benefits for stormwater agencies. One such operational approach is using diversions to flush sections of a stormwater collection system and convey the flushing flow to a POTW during the dry season. Additionally, diversions could be used for intentional conveyance of flow resulting from street cleaning. In this case, the suspended solids and particulate associated pollutants would be conveyed to the POTW for treatment during the dry season. The Case Study agencies did not use diversions for collection system flushing or conveyance of flow from street cleaning.

The driver for considering diversions is to provide a water quality benefit in the watershed. The Southern California Case Study agencies each realized their water quality goals, which were either to improve aesthetics or odors near a pump station or receiving water, to reduce odor near a pump station, or to reduce coliform loading into receiving waterbodies. These results are encouraging, but are not immediately applicable to the Bay Area, where the drivers are reduced mercury and PCB runoff to San Francisco Bay.

There are potential negative watershed impacts of implementing diversions. Diversions from the stormwater system to a POTW could result in local flow loss in receiving waterbodies. In addition, implementation of diversions may discourage implementation of practices within a watershed aimed at reducing flows and pollutant loads, such as source control, water conservation, and low impact development practices/technologies.

Estimated Costs

Construction and O&M costs were investigated for diversion projects and compared to the costs associated with implementing onsite sand filtration in stormwater pump stations. This represents a benchmark, or avoided cost to which diversions can be compared.

Outstanding Issues and Future Work

This White Paper explored a range of institutional, technical and economic issues pertaining to diversions. However, more data is needed in several areas, such as POTW process and treatment cost impacts due to diversion flows. Additionally, big-picture issues such as the role of diversions in a holistically managed water environment have yet to be undertaken.

1. INTRODUCTION

Stormwater is a significant source of pollution into urban waterways, under certain conditions. Stormwater consists of both wet weather flows due to rainfall, as well as dry weather flows due to irrigation runoff, pool draining, construction work, and other related activities. Municipalities are required through their National Pollutant Discharge Elimination System (NPDES) system permits to mitigate stormwater flows and pollution contributed by stormwater to waterways. One practice that has been implemented in Southern California is to divert these dry weather flows to sanitary sewer systems with excess conveyance and treatment capacity. These projects have demonstrated success in reducing bacterial indicators in surface waters.

Because of the relative success of these programs in Southern California, stormwater diversions have been considered by San Francisco Bay Area (Bay Area) regulators as a one potential strategy to address local water quality concerns. The regulated community has raised issues and concerns about the technical, economic and institutional feasibility of these diversions. Consequently, the Bay Area Clean Water Agencies (BACWA) has commissioned the development this White Paper to help Bay Area wastewater agencies, stormwater agencies, regulators, and other interested stakeholders better understand the issues associated with stormwater diversions.

1.1. Problem Definition and Background

Wet weather flow in a stormwater collection system is the result of rainfall events, where surface runoff is collected via stormdrains and catchments. The wet weather induced flow in a stormwater collection system is the flow that is typically thought of as "stormwater". There is significantly more literature and information on the runoff, collection, pollutant transport and discharge of wet weather induced flows than for dry weather flows. Therefore, a detailed discussion of wet weather flow and associated pollutant transport is not included in this paper.

Natural sources (e.g. springs, shallow groundwater) and anthropogenic activities contribute to dry weather flows. Examples of anthropogenic activities include irrigation excess, hard surface washing, pool draining, and other activities. Figure 1 shows the various sources of dry

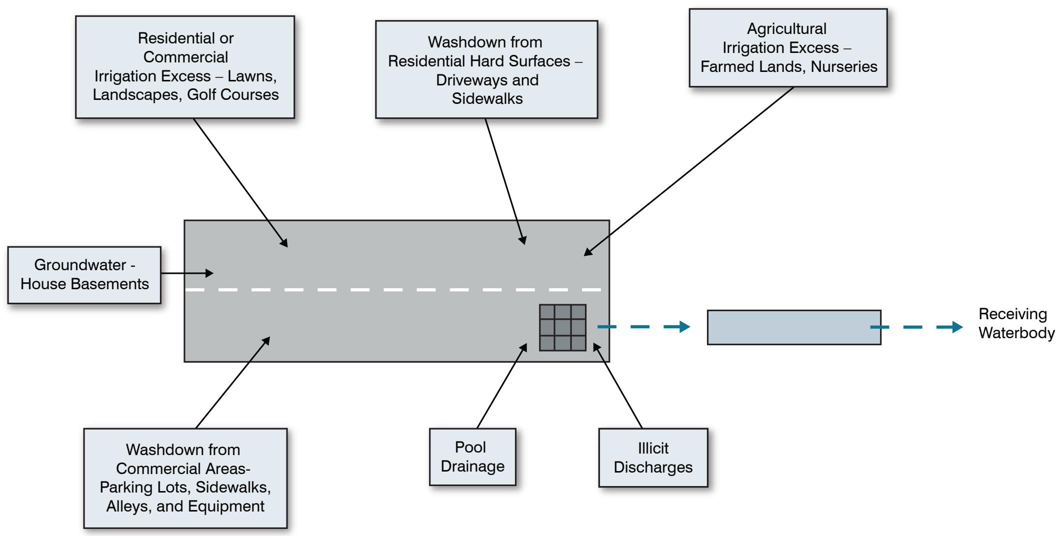


Figure 1
SOURCES OF DRY WEATHER RUNOFF FROM ANTHROPOGENIC ACTIVITIES
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

weather flow in stormwater collection systems. There are pollutants in dry weather flows that are a result of the types of uses of water associated with the runoff to the stormwater collection system. Figure 2 shows the sources and types of pollutants in dry weather flows.

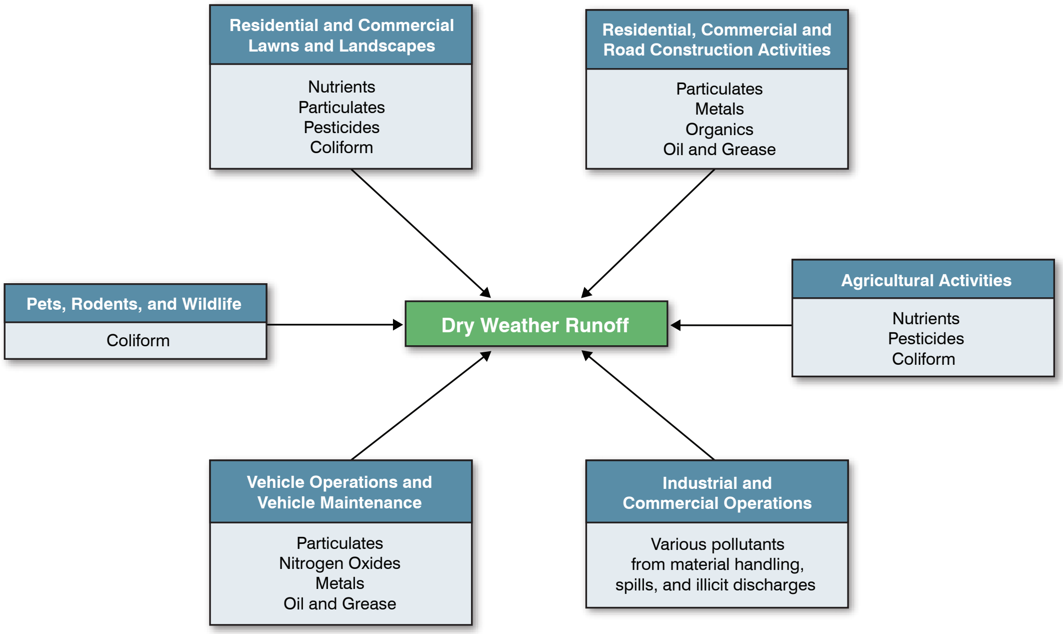


FIGURE 2
SOURCES OF POLLUTANTS IN DRY WEATHER RUNOFF
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

According to the National Research Council, "Stormwater runoff from the built environment remains one of the great challenges of modern water pollution control, as this source of contamination is a principal contributor to water quality impairment of waterbodies nationwide." (2008). In the Bay Area, surface waters are impacted by stormwater-derived pollutants such as mercury, PCBs, dioxin and pesticides.

The USEPA manages urban stormwater through the NPDES Stormwater Program, and regulates stormwater discharges from municipal separate storm sewer systems (MS4s). Regulated MS4s are required to develop and implement stormwater management programs (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges. Stormwater management programs include stormwater best management practices (BMPs) that are designed to address the following:

- Peak runoff flows and volumes
- Pollutant transport
- Treatment

The effectiveness of stormwater BMPs at controlling flow, controlling pollutant transport and providing treatment is highly variable and depends on BMP selection, hydrodynamic and water quality conditions, and other site-specific parameters. Stormwater diversions go beyond what counts as a BMP, and should not be considered a BMP.

The issues and concerns addressed in this paper include:

- What are the institutional, technical and economic challenges that need to be overcome to consider the viability of a proposed diversion?
- What are the potential watershed and institutional opportunities associated with diversions?

Different stakeholders may have a different metrics for success for siting and implementing stormwater diversion projects. These metrics include:

- Siting and implementing a diversion to address a specific water quality issue or pollutant "hot spot".
- Diverting and treating stormwater from the largest possible catchment area in order to treat as much stormwater as possible per diversion project.
- Siting diversions where there is proximity between a stormwater pump and a sanitary collection system so as to pick the "low hanging fruit" in stormwater treatment.

This White Paper does not make recommendations as to which approach is the most appropriate for the Bay Area. Different sites will have different objectives, therefore there are a range of appropriate approaches to planning diversions. The strategies listed above are not mutually exclusive, and while they are important in planning a specific diversion project, they do not affect the analysis of the feasibility of diversions in general.

1.2. Project Objectives

The objective of this paper is to identify the challenges and opportunities associated with diversions of flow from stormwater systems to a POTW's. The intended use of this paper is to provide information that may help agencies evaluate the costs, benefits, and impacts associated with stormwater diversion project(s). The paper includes:

- Detailed discussion of the institutional, technical and economic issues associated with diversions.
- Results of case studies of diversion projects used to illustrate how challenges have been overcome, what benefits have been realized, and at what cost.
- Identification of follow-up studies based on the analysis completed.
- Decision checklist/flowchart (per April 22nd, 2010 contract amendment, see Appendix D).
- Table of interagency (stormwater and wastewater) overlap (per April 22nd, 2010 contract amendment, see Appendix E).

The objective of this paper includes identifying the challenges and opportunities for diverting both wet (first flush) and dry weather runoff in a stormwater collection system. None of the Case Study agencies divert first flush, or any other wet weather flows for treatment at a POTW. Where noted, the technical analysis in this paper includes separate discussion of first flush flow diversions, however, the majority of the analysis focuses on dry weather diversions.

2. OVERALL APPROACH TO ANALYSIS

2.1. Stakeholder Involvement

Since this White Paper was envisioned as guidance to help Bay Area stormwater and wastewater agencies make decisions about stormwater diversions, agency stakeholders were key to shaping the White Paper development. There were three levels of involvement in guiding the White Paper development:

- **Team Members -** *BACWA and Carollo Engineers* - Led the White Paper effort
- **Steering Committee -** *One representative each from BACWA, BASMAA, USEPA Region 9, the San Francisco Bay Regional Water Quality Control Board (RWQCB) and San Francisco Baykeeper* - Directed the scope and content of the white paper
- **Stakeholder Group -** *A group of stormwater and wastewater agency representatives from throughout the Bay Area* - provided initial feedback about content of white paper, as well as review of white paper

A draft outline for the White Paper was developed by the Team Members in the spring of 2009 and presented to the Stakeholder Group at a meeting held in San Leandro on June 4, 2009. The outline was updated based on feedback from the Stakeholder Group. The Steering Committee met for the first time on September 14, 2009 to finalize the scope and outline. On April 22, 2010, the contract was amended to expand the White Paper, and include a decision checklist and list for wastewater agencies, as well as a list of interagency (stormwater and wastewater) overlap in the Bay Area. Figure 3 illustrates the White Paper development process and the levels of involvement.

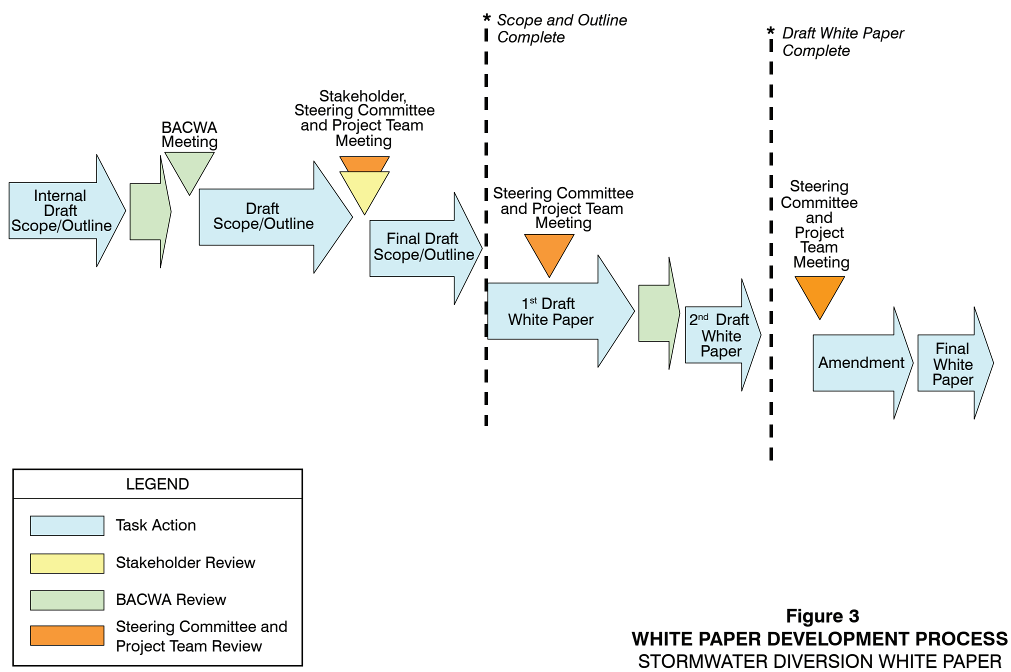


Figure 3
WHITE PAPER DEVELOPMENT PROCESS
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

2.2. Approach to Analysis

The analysis presented in this White Paper is based on a review both of published literature as well as experience gained from examining Case Study agencies that have implemented diversions. This is a “desktop” level evaluation of existing information to yield insight into institutional, technical and economic issues pertaining to stormwater diversions.

The White Paper was developed using published and grey literature. In addition, significant information was obtained through the case studies of the following agencies:

- City of LA
- Orange County Sanitation District

- City of Ventura
- City of Santa Cruz
- East Bay Municipal Utility District

The first four Case Study agencies have implemented full-scale diversion projects and their experiences heavily inform this White Paper. East Bay Municipal Utility District implemented a pilot diversion project, and the results of which are currently being evaluated.

Appendix A includes a summary of the five Case Studies. In addition, Appendix B includes information on the Santa Monica Urban Runoff Reclamation Facility (SMURRF), which was designed to treat runoff diverted from the stormwater collection system. While designed to treat dry weather runoff specifically, the SMURRF will accept all flows up to the treatment system capacity, therefore, certain hydrologic conditions will result in some treatment of wet weather flows. SMURRF does not treat any municipal wastewater and is considered a "super" stormwater BMP.

3. INSTITUTIONAL ISSUES

Regulatory issues are a major consideration driving POTWs and stormwater agencies to explore stormwater diversions. Additionally, interagency relationships and agreements are essential in implementing a successful diversion project. This section summarizes the current and anticipated regulatory environment, as well as the importance of interagency agreements with respect to stormwater diversions.

3.1. Existing Regulations

In 2009, the RWQCB adopted a Municipal Regional Stormwater NPDES Permit that requires permittees to study diversion feasibility in their service area to address runoff of mercury and PCBs. Beside this permit, no regulations have been identified that directly govern diversions - either to require their existence or to guide how they are implemented. However, implementing stormwater diversions may trigger other regulatory consequences, some of which are considered in this section. The case study agencies provided information on regulatory or other drivers for implementing diversions. However, specific research on details of applicable stormwater permits, for example, was not conducted.

3.1.1. Total Maximum Daily Load (TMDL) Program

The San Francisco Bay and certain tributary waters are identified as impaired due to the presence of a number of constituents. These constituents are included on the 303(d) List of Impaired Waters and require that a TMDL be developed for each pollutant. A TMDL is equivalent to the assimilative capacity of a water body for a pollutant. Based on the TMDL, a waste load allocations (WLA) may be given to point sources and/or a load allocation (LA) to non-point sources such as stormwater, to attain the allowable loadings into the water body of the pollutant.

Stormwater agencies in the Bay Area have to meet TMDLs for the following:

- Mercury loading to San Francisco Bay - Regional urban runoff WLA is 82 kg/yr to be achieved by 2028
- PCB loading to San Francisco Bay - Regional urban runoff WLA is 2 kg/yr (TMDL approved by EPA in March 2010)
- Diazinon in urban creeks - Allowance of 100 ng/L as one-hour average
- Pesticide-related toxicity in urban creeks - Allowance of 1.0 TU (acute or chronic toxicity unit)

TMDLs are planned or in development for PBDEs, DDT, dieldrin, chlordane, selenium, furan compounds and trash for the San Francisco Bay. Addressing TMDLs for constituents that are removed from the liquid stream during wastewater treatment could be an important driver for stormwater diversion implementation.

3.1.2. Municipal Regional Permit Diversion Provisions

The San Francisco RWQCB issued a Municipal Regional Stormwater NPDES Permit (CAS612008 / WDR Order No. R2-2009-074) (MRP) to municipal permittees in Alameda, Contra Costa, San Mateo, Santa Clara, and Solano Counties. Provision C.11.f of the MRP requires the permittees to conduct a feasibility study and construct five diversion pilot projects (one in each of the permitted counties), and evaluate the reduction in mercury that is achieved by the projects. Provision C.12.f of the MRP lists the same requirements for evaluating the removal of PCBs. The permittees are then required to document reduced mercury and PCB loads to the San Francisco Bay that result from the diversion.

In their 2014 Integrated Monitoring Report, the Permittees are required to include:

- An evaluation of pilot program effectiveness
- Estimates of mercury and PCB loads reduced
- An updated feasibility evaluation procedures to guide future diversion project selection

3.1.3. Combined vs. Separate Sewers

The Combined Sewer Overflow (CSO) Control Policy is intended to achieve cost effective CSO controls for wet weather events that ultimately meet the goals of the Clean Water Act. Although this paper does not deal with wet weather events, an issue is whether a storm drain that is temporarily connected to a sanitary sewer to divert dry weather flows becomes a “temporary” combined sewer system potentially impacted by the CSO Policy.

While it is possible that a “temporary” combined sewer may become subject to the USEPA’s CSO Control Policy, the policy appears to only apply to wet weather CSOs. The CSO Policy provides in relevant part, “Discharges from CSSs during dry weather are prohibited by the CWA. Accordingly, the permitting provisions of this Policy do not apply to CSOs during dry weather.” (*Ibid*.) Therefore, it is unlikely that the acceptance of dry weather flows by a wastewater agency would require the wastewater agency to comply with the CSO Policy. Indeed, none of the Case Study agencies became subject to the CSO Policy as a result of their diversion projects.

3.1.4. Water Rights Issues

Diverting dry weather flows has the potential to reduce flows in some Bay Area creeks and streams. In general, these stream flows discharge to the San Francisco Bay and are not diverted by downstream users. However, these flows are critical to habitat in the streams, as well as habitat and fishery restoration projects along the edge of the bay. An agency that reduces these flows would have to consider whether the effect of its action could be detrimental to the these ecosystems. Therefore, beneficial stream flows must be considered prior to implementing a diversion project.

Based on our understanding that dry weather flows in the Bay Area are not generally put to beneficial use by downstream diverters, agencies may be able to divert those flows into sanitary sewers in compliance with the law of water rights. Numerous water rights issues would nevertheless have to be addressed. Agencies may be required to obtain a permit to appropriate water from the State Water Resources Control Board, particularly if the diversion is directly from a creek or stream instead of an underground connection between a component of the MS4 with the sanitary sewer. However, it appears that the State Water Resources Control Board has not required such permits in the past (at least for the Southern California Case Study agencies) because the diverted water is not put to beneficial use.

Any project to construct a diversion in a creek or stream may also be subject to permitting programs administered by the Regional Water Quality Control Boards, the Department of Fish and Game and the U.S. Army Corps of Engineers. In addition, the project would likely undergo environmental review under the California Environmental Quality Act, which would require analysis of the total environmental impact of the diversion project. For example, the impact of the diversion on "in -stream" uses would be considered. Potentially, dry weather diversions raise the question of whether in-stream uses below the point of diversion should be compromised to protect other aquatic or wildlife resources in the San Francisco Bay that will benefit from the improved water quality provided by the treatment of dry weather flow.

3.2. Regional Water Quality Control Board Authority

The question remains as to whether the Regional Board or the EPA could implement this type of program by a unilateral action. From initial review, it does not appear that the Regional Board would have authority under Porter-Cologne or the CWA to compel a wastewater agency to accept and treat stormwater flows from a separate stormwater agency or flows subject to a separate MS4 permit. Most simply put, the Regional Board's authority to regulate a POTW is based on permitting discharges from the POTW. Waste discharge requirements ("WDRs") regulate discharges from the POTW by imposing limitations, prohibitions, and other similar requirements on the discharge. If the POTW is not accepting and treating dry weather storm flows, it has no related discharge, and logically, the Regional Board then cannot impose conditions in the wastewater agency's permit with respect to such flows. Any requirement to accept and treat stormwater flows would be premised on ensuring a stormwater agency's compliance with its MS4 permit, rather than to regulate the POTW's compliance with its permit. The regulatory authority to impose a requirement on a POTW that is designed to address compliance with a different permit holder is questionable, and this is certainly more clear when the MS4 is a separate local agency.

Discharges of stormwater flows to a POTW from an MS4 are similar to discharges to POTWs from other non-domestic sources, and the National Pretreatment Program provisions should be applicable to discharges of dry weather flows to the POTW. Notably, POTWs are not required to accept discharges from non-domestic sources. The Pretreatment Program explicitly prohibits discharges to POTWs that would cause pass-through or interference. (40 C.F.R. § 403.5(a)(1).). It also requires that POTWs deny or condition discharges to the POTW from non-domestic sources, (40 C.F.R. § 403.8(f)(1)(i)), and it further authorizes POTWs to adopt local requirements that are more stringent than the Pretreatment Program requirements. (40 C.F.R. § 403.4.) Accordingly, the Pretreatment Program regulations provide a basis for a POTW to reject all discharges of stormwater from an MS4 and not just those discharges that would cause pass-through or interference or that would cause the POTW to violate its NPDES permit. Hence, requirements in a POTW's permit mandating collection of stormwater (a nondomestic source) would be inconsistent with the time worn policies embedded in the Pretreatment Program regulations.

Moreover, the Regional Board may not be able to compel certain POTWs to accept and treat stormwater if the POTWs do not have the statutory authority to address stormwater issues. Local entities can only exercise the authority that is granted to them in their respective enabling acts or by the state Constitution. For example, county sanitation districts are not authorized by their enabling act to operate and maintain facilities for the treatment of stormwater, Therefore, a sanitation district would presumably not have the authority to accept and treat stormwater unless the Legislature amended the County Sanitation District Act to provide for such authority, as it did in the case of OCSD.

A local agency's authority is further limited by service designations and other actions of the Local Agency Formation Commission ("LAFCO"). Even if a POTW's enabling act authorized it to accept and treat stormwater flows, the existing LAFCO designations for stormwater services may need to be addressed if the POTW is not currently designated by LAFCO to provide stormwater services. Under Cortese-Knox, LAFCO also determines the jurisdictional boundaries of a public service provider and authorizes the provision of particular services within the provider's jurisdictional boundaries. In addition, LAFCO regulations require authorization from LAFCO for the provision of services outside of a POTW's jurisdictional boundaries. Based on a number of circumstances in the Bay Area, the MS4 discharges may be from entities that are not within the jurisdictional boundaries of the POTW, thus potentially requiring an additional LAFCO approval.

Both legislative modifications and LAFCO approvals certainly can be overcome. However, the potential need to address these issues which are outside of the control of the POTW underlines the lack of the Regional Board's practical and legal ability to unilaterally mandate a dry weather collection and treatment program for certain POTWs.

In the five Case Studies that were examined as part of this evaluation, none of the Agencies implemented diversions due to a direct mandate from their RWQCB. However, diversions were a key component to addressing bacteria TMDLs in Los Angeles and Orange County that were approved after the diversion programs had begun. Additionally, in their recent stormwater permit, the municipal stormwater agencies within Los Angeles County were required to study diversion feasibility in conjunction with the County Sanitation Districts of Los Angeles.

3.3. Existing Related Agreements

There are few existing agreements and local laws (e.g. ordinances) in California that relate to stormwater diversions, including a POTW's ability to accept, deny or condition the acceptance of stormwater diversions (e.g. flow restrictions, pretreatment requirements). Most wastewater agencies operating separate sewers currently forbid the discharge of stormwater into the sanitary system. However, many wastewater agencies have a stipulation in their rules that allow discharges to the sanitary system with the permission of the POTW. An agency that wishes to implement a diversion project would need to consider interagency challenges (described below) when developing a framework to permit diversions.

3.4. Interagency Challenges

Implementing a diversion project requires agreements between stormwater management agencies and wastewater collection and treatment agencies. Sometimes in a small municipality, stormwater and wastewater are governed by the same division in the same agency, and a diversion project can be handled entirely internally, although this situation is not common in the Bay Area. If wastewater and stormwater are handled by the same agency and division, the agency's charter and policies would need to be examined and possibly amended to ensure that they are consistent with allowing stormwater flows into sanitary sewers.

In some circumstances, the two agencies will be entirely separate, for example, when the POTW is a regional facility, and individual municipalities are responsible for stormwater services. In such a situation, clear agreements between the agencies need to be adopted with respect to the following:

- **Ownership -** Who owns the diversion structure(s)?
- **Funding -** Who pays capital costs,capacity costs and O&M?
- **Duration of commitment/reversibility -** Can the POTW refuse future flows?
- **Operational concerns, regulatory concerns, liability -** Who is responsible for a failure or an exceedance of a regulatory limit?

In other situations, stormwater and wastewater will be handled by two divisions within the same agency. In these cases, the types of agreements are similar to those required for interagency cooperation, although depending on the structure of the agency, the agreements can be less formal.

The solutions to these issues that were implemented by the Case Study agencies are summarized in Table 1.

Table 1. Case Study Interagency Agreements

Wastewater Agency	Stormwater Agency	Ownership of Diversions	Are diversions reversible?	Funding Structure
City of LA	City of LA, City of Santa Monica, County of LA	City of LA, City of Santa Monica, County of LA	Yes	Capital costs paid by stormwater fund. O&M costs and a temporary connection fee are paid from stormwater fund to wastewater fund.
OCSD	Cities and County (permittees)	Permittees	Yes, at discretion of OCSD	Cities pay capital costs. OCSD pays O&M costs up to 4 mgd, above which permittees pay industrial rate for the entire flow
City of Ventura	City of Ventura	City of Ventura	No formal agreement	General fund paid by connection fees. Stormwater fund pays capital and O&M costs at industrial rates
City of Santa Cruz	City of Santa Cruz	City of Santa Cruz	Not addressed	All internal within City

One potential concern about diversions is that they will lead to overflows from the sanitary sewer system, or overwhelm the capacity of a POTW during wet weather. A POTW has the ability to protect itself from liabilities "outside of the fence" by making sure that agreements with the stormwater agencies make the stormwater agency responsible for proper functioning of the diversion. This is the approach taken in Orange County where the permittees own the diversions, but OCSD staff can shut them down if necessary to reduce flow to the plant.

None of the Case Study agencies have experienced problems either in their sanitary collection systems or at their treatment facilities due to accidental discharges from the diversions during wet weather. This success illustrates how proper design of the diversion can result in protection from capacity exceedances due to diversions This issue will be further explored in the following Section on Technical Considerations. Therefore, potential wet weather overflows, or treatment plant upsets due to wet weather flows, will not be further considered as an institutional issue.

3.5. Benefits to POTWs and Stormwater Agencies

If a POTW accepts a diversion that results in an improvement in receiving water quality, then the entire watershed benefits. However, from a regulatory perspective, it is the stormwater agency that directly benefits. Specifically, the stormwater agency may be able to achieve reduced pollutant loading into San Francisco Bay, including an enhanced ability to achieve a TMDL load allocation because a portion of the contaminant load is potentially being reduced by the POTW.

Interagency Agreements in Orange County

OCSD implemented a detailed strategy to deal with the institutional issues associated with allowing Cities to discharge to the sanitary sewer system. Their strategy involved the following institutional elements:

- An ordinance establishing waste discharge regulations for stormwater diversions.
- A policy to lay out the requirements to obtain permission to implement diversions.
- A permitting process to set the terms of how the participating Cities (permittees) discharge dry weather flow into the sanitary sewer. The permittees are required to show that there is no feasible alternative to a diversion and that they are carrying out other BMPs to prevent dry weather runoff.
- A provision in their permits that allows them to refuse diversions at any time if they find that it interferes with their primary function of collecting, treating and discharging sanitary flows.
- The permittees are entirely responsible for the operation and upkeep of the diversions.
- OCSD staff have the ability to shut the diversions down if flows are higher than what they are willing to accept to the POTW

While the POTW does not see direct regulatory benefits, there are potential trade offs that could be negotiated with the RWQCB that would provide incentives for POTWs to accept stormwater diversions, including allowances for removal of stormwater pollutants:

- Passthrough credit for any stormwater pollutant that is not removed during wastewater treatment. This would require monitoring stormwater quality at diversions to determine the impact of diversion flows on effluent quality.
- Increased WLAs for pollutants that have TMDLs and are present in stormwater.
- Increased allowance for effluent toxicity variability.

Could OCSD's model work in the Bay Area?

It would be possible for Bay Area agencies to implement a permitted diversion program similar to OCSD's if the program is based on a voluntary arrangement to provide services between the POTW and the agency responsible for the MS4 discharges. The basic premise of the OCSD program is to treat stormwater dischargers in the same manner as industrial dischargers and that same format could potentially be applied here provided there is no limitation placed on the POTW's ability to fully condition acceptance of a discharge.

The authority of Bay Area agencies to adopt and implement a program similar to the one adopted by OCSD will vary depending on whether the enabling act of the individual POTW authorizes the POTW to treat stormwater. For example, sanitary districts are authorized by their enabling act to operate storm water drains and storm water collection, outfall and disposal systems, (Health and Safety Code § 6512(a)), while sanitation districts are not. Therefore, a sanitary district would presumably have the authority to adopt and implement an ordinance similar to that adopted by OCSD without any additional legislation. In contrast, as stated earlier, a sanitation district would likely have to receive authority from the Legislature prior to adopting and implementing such a program.

It must be recognized that the OCSD program is fully based on voluntary participation by various cities, most of which have representatives on the OCSD Board. There is an important distinction between use of an ordinance like the one adopted by OCSD to control voluntary discharges as compared to a POTW having the regulatory authority to enforce its provisions on a separate public agency that is not voluntarily seeking to discharge to the POTW. Stated differently, if the local public agencies seeking to discharge stormwater are doing so on a voluntary basis then this ordinance format should be relatively easily to implement. However, if the discharging local entities are coerced or compelled by the Regional Board or others to discharge to the POTW, then the legal authority of the POTW to enforce the terms of an ordinance similar to OCSD's becomes less clear. For instance, the legal authority of a sanitary district to unilaterally require pretreatment and exact fees and charges from a city which does not voluntarily submit to the sanitary district's requirements is subject to substantial question.

There are also questions as to whether the POTW's treatment of the stormwater can be temporary, depending on future demands on the POTW's capacity. These and other similar questions on the specifics of a diversion program again depend on whether the program is truly voluntary and based primarily on quasi-contractual basis between the POTW and the city or other discharging entity. Provided the city or other discharging entity is voluntarily participating in the program and is not being required to participate in this program, then essentially the parties can agree to reasonable terms that protect the POTW's ability to modify or terminate the program as may be needed. Nonetheless, if over a number of years this type of dry weather collection and treatment program becomes a cornerstone of the MS4 program, the practical ability to dramatically modify or eliminate the program upon which MS4 permittees depend would become more difficult. This risk can be mitigated but not in a practical sense eliminated through use of short-term contracts or permits with clear and absolute language disclaiming the creation of any vested rights or similar issues of detrimental reliance.

None of the Case Study agencies were given any regulatory credits from the RWQCB. However, the RWQCBs did not require them to accept the diversions. In other circumstances where, for example, a diversion is mandated, regulatory relief may be a reasonable permit consideration.

In addition to direct regulatory benefits, POTWs that accept diversions would potentially be viewed as being "good neighbors" in the community by helping with a water quality issue that is beyond their primary function and responsibility. In general, cooperation between wastewater and stormwater agencies (or divisions within the same agency) has the potential to result in economic and noneconomic benefits to the communities within a watershed due to maximizing the use of existing wastewater collection and treatment facilities.

3.6. Potential Regulatory Impacts to POTWs and Stormwater Agencies

Accepting diversions opens POTWs to increased potential of violating NPDES discharge requirements, since stormwater diversions further decreases the wastewater agency's control over influent quality. Regulatory responsibilities and liability concerns for POTWs accepting stormwater diversions are summarized below:

- **Increased effluent loading for some constituents -** Pollutants such as nitrogen can not be removed below a given concentration due to the function of the biological processes involved, regardless of influent concentrations. Therefore, increased total effluent flow due to diversion flows, even where concentrations of a pollutant are negligible in the diversion flows, will increase the discharge loading of some pollutants.
- **Violation of permit limits -** A slug of a pollutant such as mercury in the diversion flow can overwhelm the ability of a POTW to remove that pollutant and cause an exceedance of a permitted effluent limit. Depending on pollutant concentrations and stormwater flow, a large pollutant slug may also cause a treatment plant upset.
- **Triggering reasonable potential for a pollutant that is not currently in the NPDES permit -** A one-time detection of a pollutant from stormwater could trigger reasonable potential and cause the pollutant to be assigned a water quality based effluent limit in the subsequent permit. This would lead to increased monitoring and reporting burdens even if detection of the pollutant was a one-time event.
- **Impacts on biosolids quality -** Hydrophobic constituents such as PCBs and methylmercury partition from the liquid to the solid streams during wastewater treatment. Therefore, it is anticipated that diversions that are successful at decreasing loading to the San Francisco Bay will impact biosolids quality.
- **Reduced pollutant allocations to pretreatment program permittees -** If there is significant loading to the POTWs of regulated constituents from stormwater, this could reduce the allocations from existing business, and prevent the growth of new businesses.
- **Loss of capacity -** Accepting stormwater reduces a POTW's ability to accept new flows when there is growth in their service area.

No effluent water quality impacts have been observed at the Case Study POTWs, although the experiences in Southern California are not directly applicable, since those diversions targeted areas with high bacteria, rather than recalcitrant compounds such as mercury and PCBs. In addition, the Case Study agencies did not conduct any monitoring or analysis to specifically determine if the diversions effect effluent water quality. In general, diversion flows are relatively small compared to the sanitary flows, and stormwater pollutants are greatly diluted prior to effluent discharge. Requiring stormwater agencies to monitor stormwater quality and to implement BMPs to improve that quality is an additional level of protection for POTWs. Additionally, a POTW can retain the authority to shut down a diversion if necessary. Stormwater monitoring approaches will be further explored in the following section on Technical Considerations.

CONSTITUENTS IN OCSD DRY WEATHER RUNOFF PERMITS
Arsenic (As)
Cadmium (Cd)
Chromium Total (Cr)
Copper (Cu)
Lead (Pb)
Mercury (Hg)
Nickel (Ni)
Silver (Ag)
Zinc (Zn)
Combined Metals (Platinum, Palladium, Gold)
Total Metals (Cr, Cu, Ni, Zn)
Cyanide (Total) †
Cyanide (Amenable) †
Polychlorinated Biphenyls
Pesticides
Total Toxic Organics
Total Phenols
Sulfide (Total)
Sulfide (Dissolved)
Oil & Grease (Mineral or Petroleum)
Ammonia (as N)
Biochemical Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)
Total Suspended Solids (TSS)
pH

Stormwater agencies have significantly less liability concerns with respect to federal and state regulations when implementing a diversion, since they are transferring responsibility for their water quality to the POTW. However, a POTW that accepts diversions can require the stormwater agency to contractually accept shared responsibilities, or under the POTWs pretreatment requirements. See adjacent text box for a summary of OCSD's requirements for permittees.

Key Requirements for Stormwater Permittees Discharging to OCSD

- Monitor and meet discharge limits for a suite of 25 constituents
- Implement BMPs to reduce pollutant loads to the POTW
- Monitor and report flows

The table at right presents the constituents that are limited in the dry weather runoff permits issued to dry weather permittees by the wastewater agency.

4. TECHNICAL CONSIDERATIONS

Creating a temporary combined system raises concerns about potential technical problems for stormwater and wastewater agencies. Many of these technical considerations can be addressed by appropriate engineering of the diversion structures, and have been explored in the literature and by the Case Study agencies. Table 2 lists potential technical problems and identifies possible solutions to those issues that are explored in further detail in the following sections.

Table 2. Technical Issues and Potential Solutions

Technical Issue	Potential Solutions	Section in Text
Wet weather flows from diversion cause overflow or POTW treatment process upset	• Flow is monitored and pumps automatically shut down when flow exceeds threshold • Rain gauge detecting precipitation either automatically shuts down pump or alerts staff to remotely or manually close diversion valve • Small pipe size passively limits flow from diversion • Pump size limits flow from diversion to POTW	• 4.2.1 and 4.3
Pollutants in stormwater may cause POTW treatment process upset	• Limit flow of diversions so that dilution with sanitary flows reduces concentration of stormwater pollutants in the influent • Identify and mitigate possible sources of pollutants prior to implementing diversion • Install real-time sensors for some pollutants (PAHs, LEL) to automatically shut down diversion if set threshold is exceeded	• 4.6 • 4.7 • 4.2.2
Pollutants in stormwater cause permit violation	• Limit flow of diversions so that dilution with sanitary flows reduces concentration of stormwater pollutants in the influent • Land use/pretreatment/BMPs	• 4.6
Stagnant water in stormdrains causes fish kills after first rain triggers discharge	• Implement "operational" diversion	• 4.1
Potential explosion due to gasoline or other explosive liquid getting into the stormwater system.	• Install real-time sensors for some pollutants (PAHs, LEL) to automatically shut down diversion if set threshold is exceeded to protect sanitary sewer	• 4.2.2

4.1. Structural vs. Operational Diversions

The following sections detail the monitoring and control of semi-permanent or permanent diversion structures. However, diversions can be implemented by mobile operational staff with little permanent infrastructure. For example, in Orange County, stormwater staff rotates around stormwater wells during the dry season to pump out collected flows that have become septic.

This strategy could be useful in the Bay Area at stormwater sumps that collect dry weather flows, but where the flows are too small to trigger the pumps for months at a time. After the first storm in the fall, fish kills have been observed near stormwater outfalls. It is hypothesized that a light rain after a dry period can trigger stormwater pumps to outfalls even when the flow is insufficient to dilute the pollutants in the stormwater wells. This causes a slug of potentially toxic stormwater to be discharged to the San Francisco Bay. A program in the Bay Area where dry weather flows are "diverted" by maintenance staff on a semi-regular basis could help alleviate this problem with little capital investment.

4.2. Monitoring

There are several reasons to collect flow and water quality monitoring data for the diverted dry weather runoff. Site-specific conditions and interagency agreements will dictate the specific needs for flow and water quality data. Benefits of monitoring include:

- Understanding the collection system and treatment capacity used by diversions
- Determining allowance for additional treatment and pollutant removals achieved
- Demonstrating compliance with permit limits
- Tracking costs for treatment and conveyance

4.2.1. Flow Monitoring

There are a number of closed conduit and open channel approaches to measure flow. Selection of a particular type of flow meter is typically based on a number of factors including accuracy, calibration and reporting requirements, as well as cost, ease of installation and maintenance, as well as other site specific considerations. Examples of the major classes of flow measurement devices include differential pressure meters, positive displacement meters, ultrasonic meters, magnetic meters, open channel meters etc.

Table 3 summarizes the approaches used by the agencies surveyed for this study.

Flow Meters in Orange County

The Urban Runoff Study (CH2M Hill, 2004) completed for OCSD provides information on the flow meters used at 16 urban runoff diversion sites. Diversion flows are measured with magnetic flow meters in all but one of the 16 diversions addressed in the study.

4.2.2. Water Quality Monitoring

Table 3. Flow monitoring approached used by Case Study Agencies

Agency	Flow Monitored (Y/N)	Methodology	Purpose
City of Los Angeles	Y	Magnetic flow meters located at the diversion pumps	Quantify diversion flow.
OCSD	Y	Monitored by contributing cities and counties. Almost all diversions are monitored with flow meters.	Quantify diversion flow. Basis for fees if total flow is >4 mgd
City of Ventura	Y	Type of meter not known	Quantify diversion flow.
City of Santa Cruz	Y	Type of meter not known	Quantify diversion flow.

Water quality monitoring can range significantly in complexity and cost. Collecting water quality data on dry weather diversions is complicated because pollutant concentrations are variable and unpredictable. A water quality program needs to be focused around the intended use of the data and should include identification of the parameters to be measured, the frequency of data collection, conditions for data collection (event or time based), type of sample collection (grab or composite), monitoring budget, and availability of field and lab staff.

In addition to addressing these issues, a water quality monitoring program must incorporate standard QA/QC measures for both sample collection and analysis. In some cases it may be important to understand the variability of pollutant concentrations in dry weather runoff. Stein and Ackerman (2007) suggest that repeated measurements can be used to capture this variability.

Some pollutants can be measured in-situ with online meters, such as conductivity and dissolved oxygen. These types of meters are typically programmed to take measurements at specified intervals. Field calibration of in-situ meters is required at various intervals depending on the specific instrumentation. Some gaseous phase contaminants, such as hydrogen sulfide (H_2S) and explosive chemicals (LEL) can also be measured with in-situ meters.

Pollutants, including metals and coliform, are most effectively measured in a laboratory and therefore require field collection of samples and subsequent laboratory analysis. Samples can be manually collected and transported or shipped to a laboratory for analysis. Alternatively, samples can be collected by automated samples at regular intervals or based on the occurrence of an event (i.e. flow trigger). Automated samplers require that samples are retrieved, within sample hold times, and transported or shipped to a laboratory for analysis.

In some cases, it may be important to understand the pollutant loads in dry weather runoff in stormwater systems. Determining loads is challenging because both flow and concentration in dry weather runoff can be highly variable. Additional information on these challenges can be found in Stein and Ackerman (2007), where an approach for estimating pollutant loads from storm drains in dry weather conditions is explicitly addressed.

The monitoring programs implemented by the Case Study agencies surveyed varied from programs relying on visual inspection or occasional sampling to more rigorous programs designed to meet permit agreements. Table 4 is a summary of the monitoring programs implemented by the Case Study agencies surveyed.

Stormwater Quality Monitoring

As discussed in section 3.4 OCSD has established a permitting process of participating cities and counties with diversions. The permit requires the permittees to monitor pesticides, metals, oil and grease, BOD, PCB, and total toxic organics.

Table 4 Case Study Agency Monitoring Programs

Agency	Water Quality Monitored (Y/N)	Methodology
City of Los Angeles	Y	Some manual grab samples for bacteriological parameters. There are LEL sensors in each diversion pump wet well to detect the presence of hydrocarbons, which causes the pump station to be shut down automatically if a set level is exceeded.
OCSD	Y	The OCSD permit includes a list of pollutants to monitor and the contributing cities and counties collect the data.
City of Ventura	Y	Manual grab samples from bottom of sump.
City of Santa Cruz	Y	Visual inspection for oil sheen on the water surface in the catchments that are manually pumped to the sewer.

4.3. Flow Control

Implementing a stormwater diversion requires that separate stormwater and sewer systems operate as a combined system, at least on a temporary basis, within some portion of the stormwater and sewer service areas. It is important that in creating a “temporary combined system” the stormwater flows are monitored and controlled, because unrestricted diversions from a stormwater system under wet weather conditions could overwhelm sanitary sewer collection systems and treatment facilities.

Controlling the flow from the stormwater system to the sewer system can be accomplished through passive, manual, automated and remote control mechanisms.

- **Passive Controls -** These types of controls rely on the design or components of the infrastructure that connects the stormwater system to the sewer system. Examples of passive controls include capacity limiting pipe diameters and pump.
- **Manual Controls -** These types of controls are located at the diversion structures and are accessible by operation staff. Manual controls include access to open and close valves or turn pumps on and off.
- **Automated Controls -** These types of controls are typically used on mechanical equipment. For example, water level sensors in a pumping wet well can be used to trigger the pump to shut down.
- **Remote Controls -** These types of controls typically rely on telemetry to send a signal from a remote location. For example, a telemetry system can be designed such that when rain gauges in a stormwater catchment measure rainfall, a signal is sent to shut the diversion pumps off. Telemetry can also be used to provide operators with remote control of diversion pumps, which is typically programmed to allow operators to override signals or other programming logic as needed.

LA Diversion Design

The City of LA has a relatively sophisticated, and standard design for stormwater diversion structures within their service area. Figure 5 shows a schematic of the diversion structure that connects an existing stormwater pipe to an existing sewer pipe. In this system, water flows by gravity from the stormwater pipe to a trash separator unit, where it is passively screened and then flows by gravity to a pumping wet well. Water accumulated in this wet well is pumped out of the wet well and into a pipe that is connected to the sewer pipe. There are a number of flow control mechanisms in this system, including the diameter of the pipe between the screening wet well and the pump wet well, manual access to turn off the pumps, a water level sensor in the pump wet well that shuts the pumps off if a specified water level is realized, LEL sensors that shut off the pumps if hydrocarbons in the gas space are detected, and a telemetry system that allows operators to turn off the pumps from a remote location. If the pumps shut off either due to a water level exceedence or exceedence of the LEL, then the drainage will back-up within the pumping wet well and the trash separator, forcing water to remain in the stormwater pipe.

In general, the risk of exceeding and overwhelming the flow capacity of the sanitary sewer collection and treatment system can be mitigated by providing redundancy in the stormwater diversion design and control systems. For most systems surveyed, more than one flow control mechanism was implemented. Figure 4 presents an example of a system that uses passive and manual controls. The passive control is the diameter of the diversion pipeline and the manual control is the valve on the diversion pipeline. As shown in Figure 5, the City of LA uses a sophisticated diversion system design where diversions are controlled by passive, manual, automatic and remote mechanisms. In addition, each diversion structure includes a back-up power system.

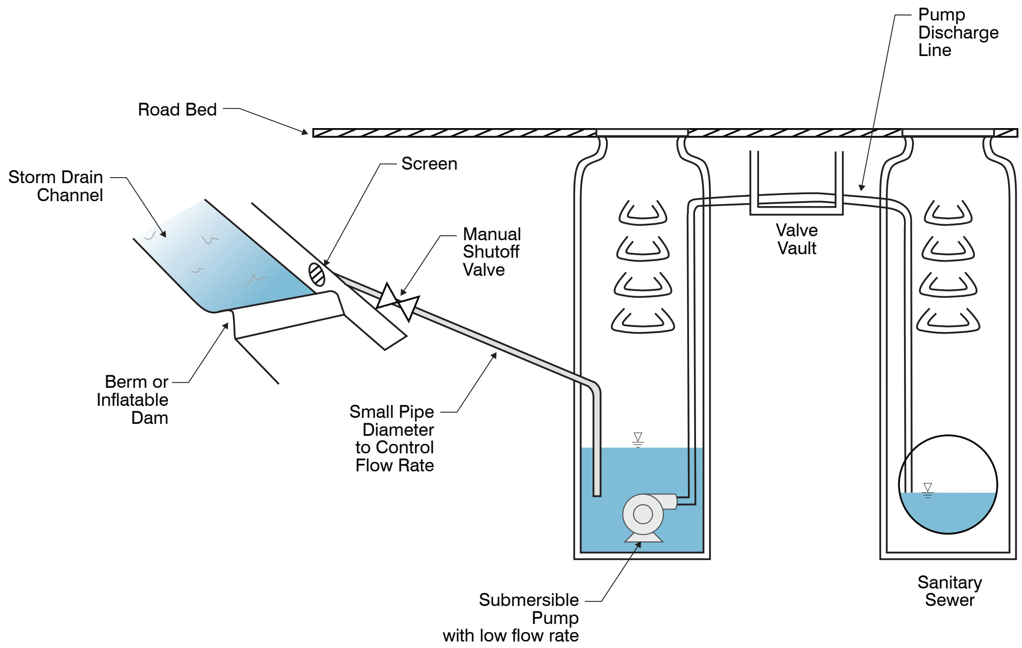


Figure 4
PASSIVE DIVERSION SCHEMATIC
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

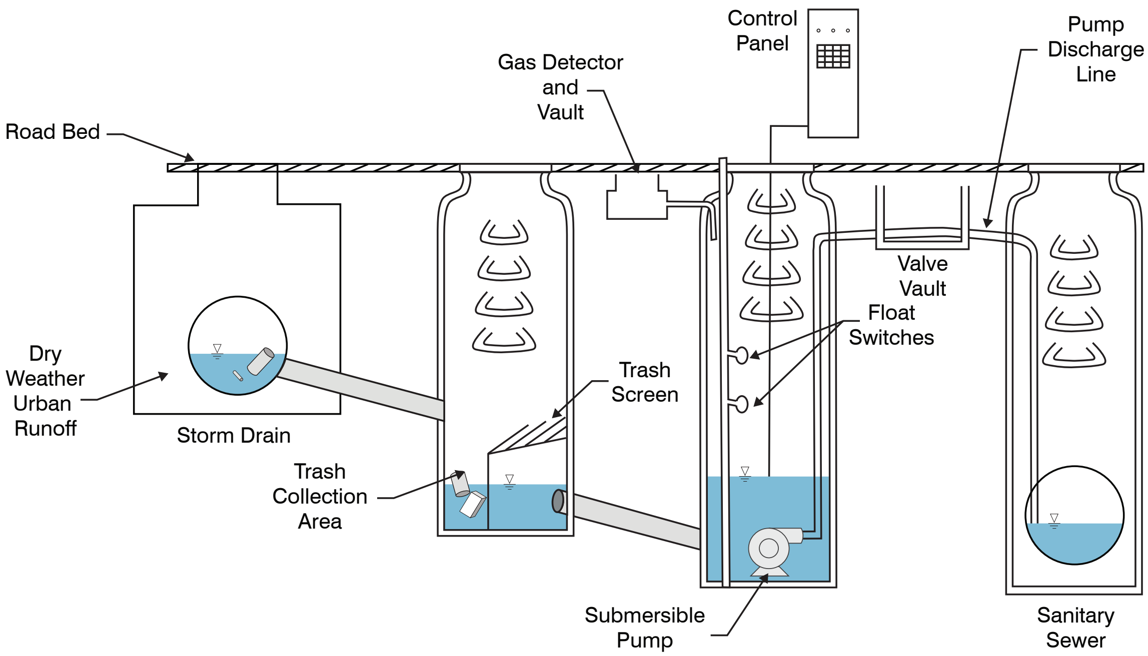


Figure 5
DRY WEATHER DIVERSION SCHEMATIC
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

Table 5 (following page) includes a summary of the flow control mechanisms used by the City of LA and the other Case Study agencies surveyed. In addition, the Urban Runoff Study developed for OCSD includes information on the flow control mechanisms for 16 diversions that discharge to OCSD.

Diversions Can Provide Preliminary Treatment

Among other approaches, OCSD has employed a hydrodynamic Continuous Deflective Separation (CDS™) Unit (Dry Weather Diversion Study 2003). The Cleo Street diversion receives flow through a reinforced concrete diversion box along a 66-inch RCP with a weir designed to direct flow into the unit. The diverted flow continues downstream of the CDS™ unit where the flow pumped to the sanitary sewer. The CDS™ unit provides removal of trash debris and sediment and is designed to treat flow up to 3 cfs. Flow in excess of 3 cfs bypasses via the diversion weir and continues downstream to the ocean.

4.4. Treating First Flush versus Dry Weather Flows

No examples of POTWs purposefully treating first flush flows were identified. The Case Study agencies shut down diversions at the onset of wet weather to protect their collection systems and treatment facilities, as described above. Although no precedent for treating first flush flows was identified, possible solutions to divert first flush flows are considered in this section.

There are two approaches for treating first flush flows that were considered. The first is a flow-based approach, as practiced by the Santa Monica Urban Runoff Recycling Facility (SMURRF). The second is the volume-based approach.

The Santa Monica Urban Runoff Recycling Facility (SMURRF) is a facility designed and operated exclusively for stormwater treatment (i.e. SMURRF does not treat any municipal wastewater). Under certain conditions, SMURRF may treat both wet weather and dry weather flows. As noted in Appendix B, SMURRF accepts all flow up to the treatment facility capacity. The system can treat up to 500,000 gpd on a regular basis and up to 750,000 gpd for short periods. Because the normal daily dry weather flow is between 300,000 and 400,000 gpd, there is additional capacity for some wet weather flows to be treated.

The treatment facility is protected because the maximum pump capacity is no greater than the capacity of the facility. However, if a storm with the potential to exceed the pump flow capacity is predicted, SMURRF staff can manually shut down the pumps to avoid any problems. This is their current operating procedure when a storm is predicted to arrive overnight when staff is unavailable to monitor flows.

While the treatment of some wet weather flows at SMURRF is noteworthy since it illustrates an approach to capture first flush flows, this system is significantly different from a POTW in the respect that SMURRF is not a POTW that was permitted, designed and constructed for the purpose of treating municipal wastewater.

The volume-based approach involves diverting stormwater from a relatively small catchment area that is a hot-spot for polluted runoff. A storage tank, or cistern, is installed to capture the first flush up to the volume of the storage facility, and flows in excess of this capacity are returned to the storm drain. A schematic of this approach is illustrated in Figure 6.

Table 5. Summary of Flow Control Mechanisms Used by Case Study Agencies

Agency	Flow Control Measures (Y/N)	Methodology
City of Los Angeles	Y	Passive Control - Pipe diameter/weir from the screening wet well to pumping wet well limits flow. Pump size limits flow. Manual Control - Pumps can be manually turned off via control panel at street Automated Control - Pumps turn off when water level sensor is triggered. Pumps will also turn off if lower explosive limit (LEL) sensors detect hydrocarbons in the air in the pump wet well. Remote Control - Pumps can be turned off via remote telemetry/SCADA system.
OCSD	Y	Passive Control - Pipe and pump size limit flow. Manual Control - Manual valve on diversion can be opened/closed. Automated Control - Pumps turn off when water level sensor is triggered. Remote Control - Rain gauges are located within the catchment watersheds. When a gauge registers precipitation, the pump are SCADA system. Pumps are programmed to turn back on after a specified period after the rain event. (Note: Not all OCSD diversion use all of the above controls. See the Urban Runoff Study for details.)
City of Ventura	Y	Automated Control - Pumps are limited to 5 gpm. When 5 gpm is reached, the pumps shut down automatically. Remote Control - Rain gauges are located within the catchment watersheds. When a gauge registers precipitation, the pumps are automatically shut down. Pumps are programmed to turn back on after a specified period after the rain event. Telemetry system allows staff to remotely turn pumps on and off and override the automated controls.
City of Santa Cruz	Y	Manual Control - In one case, a valve is manually opened during the summer months. This valve may also be opened during winter months when rainfall is infrequent. Other diversions in the system are located at stormwater pump stations. During dry weather, the water that collects in the sumps is manually pumped into the sewer on a weekly basis.

4.5. Constituents in Stormwater

Characterizing the pollutants in dry weather runoff is complicated by two factors: (1) there is limited water quality data in published or grey literature, (2) the water quality of diversions varies with space and time and is dependent on catchment characteristics and various activities occurring within these catchments at a given time.

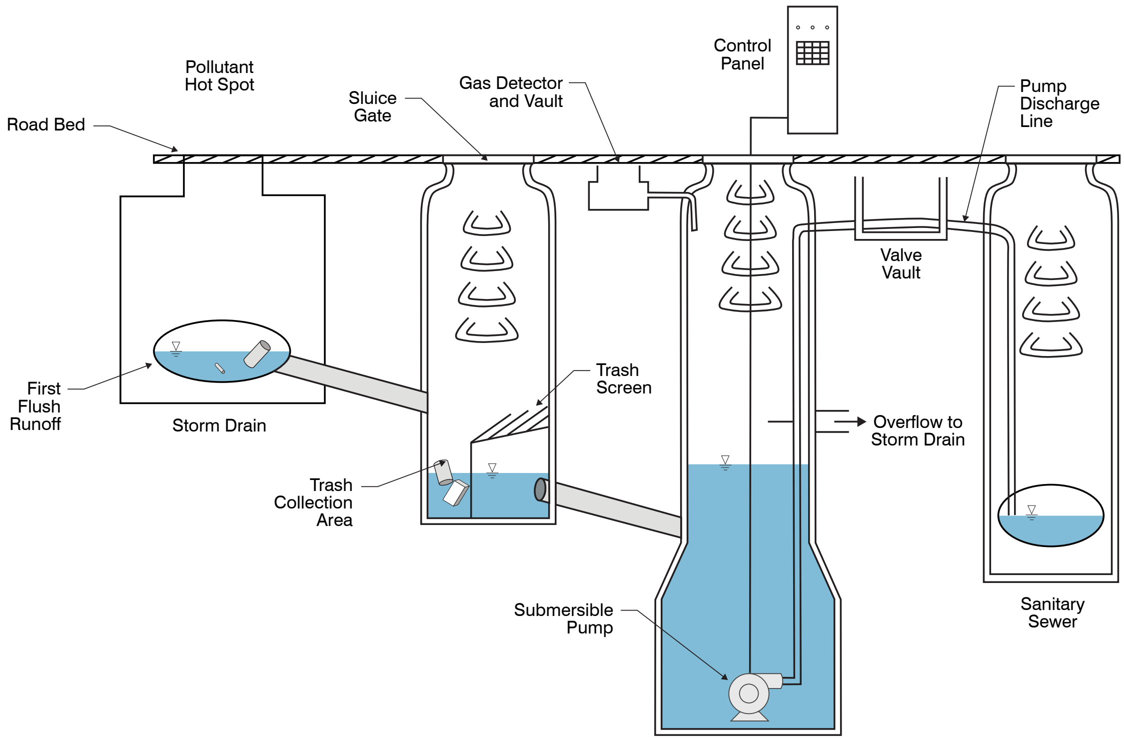


Figure 6
FIRST FLUSH VOLUME
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

Stein and Ackerman (2007) studied dry weather loadings of nutrients, metals and bacteria in six urban watersheds in the Los Angeles, California area. The pollutant concentrations in dry weather runoff in storm drains are presented in Table 6 (following page). Stein and Ackerman (2007) make several key points, including:

- Variation in the concentration range and consistency across storm drains varied by constituent.
- Observation of appreciable metals and nutrient concentrations were not consistent across all storm drains.
- Consistently high bacteria concentrations were measured in all storm drains.
- Additional sampling of storm drains discharging to Ballona Creek suggested that the metals in dry weather flows occurred predominantly in the dissolved form.

Table 7 presents a summary of dry weather runoff water quality data compiled the Urban Runoff Study (CH2M Hill, 2004) and from the Calleguas Creek Watershed: Dry Season Urban Runoff Characterization (LWA, 2005). The compiled data are from southern California catchments and are not necessarily representative of dry weather runoff quality in the Bay Area. In Urban Runoff Study, the authors note that the majority of data points were below detection limits and that median concentrations were lower than average concentrations, suggesting that concentrations are generally low, but with a few high concentration excursions.

Table 6. Pollutant concentrations in dry weather runoff collected from Storm Drains (Stein and Ackerman, 2007)

Constituent	Units	LA River	Coyote Creek	San Gabriel River	San Jose Creek	Walnut Creek	Bellona
Enterococcus	MPN/100 mL	2177	21,321	22,225	12,130	13,373	775
E. Coli	MPN/100 mL	644	1,152	1,041	754	1,767	359
Total coliform	MPN/100 mL	48,148	140,637	149,700	56,464	65,209	25,518
TSS	mg/L	208	13	13	34	17	22
Hardness	mg/L	NS	323	319	415	289	457
Cr	µg/L	3	0.3	0.4	0.7	0	2
Cu	µg/L	25	5.8	26	8	13	19
Fe	µg/L	288	469	571	1,911	558	515
Pb	µg/L	2	2	3	2	3	4
Ni	µg/L	3	1	9	5	1	5
Zn	µg/L	122	57	213	117	73	79
Total Ammonia-N	mg/L	1	0.1	0.6	0.7	0.1	NS
Nitrate-Nitrite	mg/L	1*	4	3	3	1	NS
TKN	mg/L	6	2	4	2	2	NS
Total phosphate-P	mg/L	0.6	0.4	0.8	0.4	0.3	NS

Source: Stein and Ackerman (2007)
Note: Additional data on the standard errors about the mean values are included in Stein and Ackerman (2007)

Tables 6 and 7 (following page) suggest that dry weather runoff can be characterized by detected and in some cases elevated concentrations of:

- Total and fecal coliform
- Metals - Copper, lead, silver iron, and zinc
- Pesticides - Diazinon, dacthal (Calleguas Creek Watershed Study)

In addition, detectable concentrations of acetone, chloroform and MTBE were found in half of the diversions measured as part of the Urban Runoff Study. In general, there have not been studies targeting mercury and PCBs in dry weather runoff.

Results from EBMUD study and discussion of methodology will go here.

Table 7 Summary of dry weather runoff water quality data from the Urban Runoff Study and from the Calleguas Creek Watershed Study

Minimum, Maximum, Median and Average Concentrations in Dry Weather Runoff									
			Median Concentration[a]					Average Concentration[b]	Average Concentration[d]
Constituent	Min[c]	Max[c]	Orange County SD	LA County	Orange County RDMD	City of San Diego	County of San Diego	Calleguas	Pico-Kenter Storm Drain (Santa Monica)
BOD (mg/L)	6	47	0	6	-	-	-	-	1.79
TSS (mg/L)	3	735	33	58	7	-	-	17.5	-
Oil and Grease (mg/L)	ND	530	4	3	5	5	2	-	4.5
TDS	670	1730	-	-	-	-	-	1177	2834
Fecal Coliform (mpn/100 mL)	2	160,000	230	4500	6925	3000	5000	1338	160 (cells/mL)
Total Coliform (mpn/100 mL)	2	3,000,000	800	134,800	23,500	24,000	13,000	4016	4288 (cells/mL)
Cr (µg/L)	ND	120	4	<10	<8	-	-	-	17.7
Cu (µg/L)	ND	247	40	15.5	8.1	23.7	30	12.5	37.1
Pb (µg/L)	ND	196	ND	19	<2	32.5	18	-	75.6
Zn (µg/L)	5	2900	200	20	38	38	100	18.3	75.0
Cd (µg/L)	ND	110	ND	-	ND	2.5	0.01	-	13.5
Ni (µg/L)	ND	760	23	-	7	-	-	5.8	8.3
As (µg/L)	ND	0.5	0.07	-	-	-	-	-	-
Se (µg/L)	0.1	3.4	-	-	-	-	-	-	0.9
Ammonia (mg/L)	ND	60	26	0.1	0.1	0.3	0.5	-	1.01
Nitrate (mg/L)	ND	40	-	2.7	2.1	0.3	1.5	0.6	1.79
TKN (mg/L)	0.9	28	-	1.5	-	-	-	4.4	-
Total P (mg/L)	ND	12.8	-	0.3	1.2	0.8	0.3	0.5	-
Diazinon (µg/L)	ND	12	0.2	-	ND	0.2	0.5	0.046	-
Chlorpyrifos (µg/L)	ND	3	ND	-	ND	0.1	0.5	-	-
Dacthal (µg/L)	ND	0.035	-	-	-	-	-	-	0.016

a. Source CH2M Hill (2004)
b. Source LWA (2005)
c. Includes the minimum and maximum concentrations reported in the study on dry weather flow in Calleguas (LWA, 2005)
d. Source CH2M Hill (2004). Only average concentration reported, therefore not included in minimum and maximum range

4.6. Treatability of Dry Weather Constituents

Stormwater diversions potentially provide a mechanism for improving water quality if the pollutants in the diverted flows can be reduced by treatment at a POTW. To assess the potential treatability of dry weather diversions, the dry weather runoff water quality should be analyzed. In addition, process performance data for the treatment plant that will receive the diversions should be used to estimate treatability of specific pollutants.

Table 8 presents a summary of ranges of removal efficiencies typically achieved by conventional tertiary wastewater treatment plants. The information in this table is intended as an approximate guideline, and should not be used in lieu of site-specific process data. Comparison of the removal efficiencies presented in Table 8 and the list of pollutant that occur more frequently in dry weather runoff, suggests that there may be potential for water quality benefits for coliform, metals and pesticides.

> Both mercury and PCBs are removed from the liquid stream to the solid stream during wastewater treatment. Therefore, it is anticipated that any reduced loading of these constituents to San Francisco Bay due to diversions will result in increased loading to biosolids.

Table 8. Removal efficiencies achieved with secondary treatment and filtration

Constituent	Typical Secondary Treatment	Conventional Filtration	Microfiltration
TDS	orange	orange	orange
BOD/TSS	green	green	blue
TOC	green	green	green
Ammonia	orange	orange	orange
Arsenic	orange	red	red
Copper	green	green	green
Lead	green	green	blue
Mercury	blue	blue	blue
Silver	green	green	ND
Zinc	orange	green	green
Coliform	blue	blue	blue
Persistent Organic Pollutants (e.g. dioxin, PCBs)	Unknown, due to high variability in influent and effluent.		
Pesticides	orange	red	red

red = <40% removal
orange = 40-70% removal
green = 70 - 95% removal
blue = >95% removal
ND = No data available

None of the Case Study agencies surveyed have quantified specific reductions in pollutant concentrations or loads as a result of implementing diversions. In southern California, the driver for implementing diversions has been primarily to reduce coliform related beach closures. For these agencies, it has not been important to demonstrate treatability of fecal and total coliform because it is well known and documented that with proper operation, a POTW is highly effective at reducing fecal and total coliform concentrations. The Dry Weather Diversion Study (2003) presents an alternative to treatment of diversions at a POTW.

Use of Existing Facilities for Stormwater Collection and Treatment

Under dry weather conditions, POTWs typically have excess capacity that could potentially be used for treatment of dry weather runoff. However, there are challenges associated with growth that may "trump" available capacity for diversions. In addition, there is the possibility that even dry weather diversions could overwhelm collection system capacity.

Collection systems also generally have excess capacity during dry weather that is designed for peak flows and I/I.

There are several approaches to address the issue of diversions using capacity that is available to accommodate growth and the potential for overwhelming collection system capacity, including:

- In assessing feasibility of a particular diversion, studies should be conducted to determine the potential flow volume that could be diverted. To minimize impacts on available capacity, the diversion flows should be small relative to the wastewater flows in the sewer pipe that will receive the diversions. A hydraulic capacity analysis of the collection system should be completed prior to implementing any diversions.
- These issues can also be mitigated though non-technical approaches. Stormwater agencies and POTWs need to agree on the relative importance of using available capacity for stormwater flows versus to accommodate growth. Interagency agreements can be used to establish the conditions and terms for both accepting and terminating dry weather flow diversions.

The diversion programs implemented by the Case Study agencies surveyed have a common aspect, which is that the diversion flows are small relative to wastewater flows. In addition, the diversions are only occurring in dry weather conditions when the respective sanitary sewers have the most available capacity. Specific data on the diversion flow relative to wastewater flows in the sewer pipes receiving the diversions were not available. Discussion of the terms and conditions outlined in interagency agreements is discussed in section 3.4.

4.7. Benefits to Stormwater Agencies

In addition to conveying dry weather flows to a POTW, diversions could be operated to target other potential benefits for stormwater agencies. These types of operations include:

- Cleaning of the stormwater collection system and pump stations - Diversions could be used to flush sections of a stormwater collection system and convey the flushing flow to a POTW. The intentional flushing should occur in the dry season, when there may be stagnant water that has collected in the stormwater catchments and pump stations, and when POTWs have treatment capacity.
- Treatment of flows used for street cleaning - Street cleaning can be a source of flow that is characterized by relatively high suspended solids concentrations and high particulate associated pollutants. Diversions could be used for intentional conveyance of flow resulting from street cleaning. In this case, the suspended solids and particulate associated pollutants would be conveyed to the POTW for treatment. Diversions used for this purpose should occur in the dry season when particulates have build up on streets, and when the POTW has treatment capacity.

None of the Case Study agencies surveyed were using the diversions for intentional flushing of the stormwater collection system. None of the agencies surveyed were specifically targeting the diversion of flow generated by street cleaning. However, flow generated by street cleaning is potentially a component of the dry weather runoff that is diverted by these systems.

4.8. Potential Process Impacts to POTWs

Dry weather diversions have the potential to impact biological treatment processes at POTWs as a result of slug loadings of pollutants and increased pollutant concentrations in biosolids.

The approaches for mitigating the potential impacts on POTWs due to a slug pollutant load include shutting down a diversion if a high pollutant concentration in the diversion flow is suspected, or by limiting (though diversion design and location) the amount of flow that is diverted to the sewer system. Additional detail on these approaches is included below:

- **Real time monitoring data -** Real time monitoring systems can be configured to measure specific pollutants or surrogate pollutants in diversion flows. If a concentration threshold is exceeded, a signal can be sent to a valve or pump that would result in stopping the diversion. This approach relies on operation of the monitoring instrumentation and that the pollutant or suite of pollutants measured capture the types of pollutants that could impact treatment processes.
- **Dilution -** Diversion systems can be designed to limit the diversion flow to a small percentage of the wastewater flow. This approach relies on the mechanism of dilution to minimize the potential for the pollutants in the diverted flow to have a significant impact on wastewater treatment processes and biosolids quality.
- **Analysis of pollutant transport potential -** Analysis of the watershed area contributing to a diversion site can be used to help understand the potential for a specific pollutant slugs that may impact POTW processes. If an upset occurred, this information may help determine the source of the process upset.

Another potential issue that was raised during discussions with wastewater agencies is that of soil bacteria shifting the microbial communities in activated sludge processes. Specifically, the concern was that seeding the activated sludge with filamentous bacteria such as Nocardia would lead to foaming. However, wastewater facilities are already exposed to soil-derived bacteria due to introduction during wet weather inflow and infiltration. Additionally, filamentous bacteria from the soil wash out from the system unless the conditions in the aeration basin are such as to promote foaming (in which case there would be a problem anyway, independent of any stormwater).

Land Use Surveys Can Protect Diversion Water Quality

To help understand potential pollutant slug impacts, OCSD has conducted watershed surveys on the catchments contributing to each diversion. The surveys examined the land use characteristics, types of industries, and activities within the watershed that could lead to pollutant loading to a POTW via a stormwater diversions.

Case Study Information

The diversion programs implemented by the Case Study agencies surveyed all rely on dilution to mitigate impacts on treatment processes or biosolids quality. Table 9 summarizes the average diversion flows and treatment plant flows for each Case Study agency.

Unintended Consequences

While most of the focus on the risk from diversions pertains to POTW impacts, diverting dry weather flows can also impact the stormwater system. For example, the Talbert Channel diversion in Orange County is an inflatable dam that diverts dry weather flows. Due to the removal of flushing flows from the channels, an algae bloom developed downstream. The bloom was sprayed with a copper-containing pesticide, reducing the water quality benefit from the diversion.

Talbert Channel Diversion

In Ventura, while the diversion flows are small relative to the influent wastewater flows, treatment plant operators suggested that the increased flows from diversions contributed to ongoing issues with achieving nitrification in their activated sludge process. However, at the time, the treatment plant was operating at the very edge of nitrification capacity, and any increase in flow was suspected as a potential impact to the achieving sufficient nitrification to meet permit limits. A process expansion/upgrade at the Ventura Water Reclamation Facility that will enhance the nitrification process, is currently under construction..

Table 9. Comparison of Case Study Agency Diversion flows to Wastewater Flows

Agency	Average Annual Diversion Flow (mgd)	POTW Average Annual Flow (mgd)	Percentage Diversion Flow (%)
City of LA	17	280	6.1
OCSD	1 to 3	88 (Plant No 1) [a] 156 (Plant No.2) [a]	1.2 [b]
City of Ventura	0.006	9.3	0.1
City of Santa Cruz	0.5 [c]	10	5

a. 2005 Data
b. Percentage based on combined treatment plant flows of 244 mgd and diversion flow of 3 mgd
c. Agency staff indicated that the flow diversion was several hundred thousand gallons per day. Conservatively assumed a diversion flow of 500,000 gal/day.

4.9. Watershed Impacts and Benefits

One of the drivers for implementing diversions is to provide water quality benefits through treatment of dry weather flows at a POTW as opposed to either:

- Untreated discharge via a storm drain (i.e. “do nothing”)
- Direct stormwater treatment
- Employment/enhancement of stormwater BMPs

For the purpose of this study, it is assumed that rapid sand filtration would be used for direct stormwater treatment. Additional information on other alternatives to diversion and treatment at a POTW is included in the Dry Weather Diversion Study. The study specifically addresses alternatives for treatment of bacteria including wet ponds/constructed wetlands, constructed wetland/vegetated channel, and a Clear Creek systems, which is a proprietary system consisting of filtration and UV treatment.

Table 10. Information Needed to Assess Impacts and Benefits

Scenario: Implement Diversion versus "Do Nothing"	
System Component	**Information Requirements**
Receiving Water	• Are there pollutants in the receiving water that are causing water quality problems or affecting attainment of beneficial uses? • Are low flow conditions contributing to water quality problems or affecting attainment of beneficial uses? • Would removing the flow from the storm drain negatively impact water quality and/or habitat?
Dry Weather Runoff	• What are the pollutants in the dry weather runoff? • Are these pollutants the same pollutants that are causing problems in the receiving water? • Can source control be implemented to reduce pollutant concentrations in dry-weather runoff? • If the dry weather runoff was diverted would there be a measurable change in receiving water quality?
POTW	• Are the pollutants in the dry weather runoff well removed by wastewater treatment processes? • Would the diversion impact treatment performance or biosolids quality and therefore have a negative impact within the watershed?
Scenario: Implement Diversion versus Direct Stormwater Treatment	
System Component	**Information Requirements**
Receiving Water	• Are there pollutants in the receiving water that are causing water quality problems or affecting attainment of beneficial uses? • Are low flow conditions contributing to water quality problems or affecting attainment of beneficial uses? • Would removing the flow from the storm drain negatively impact water quality and/or habitat?
Dry Weather Runoff	• What are the pollutants in the dry weather runoff? • Are these pollutants the same pollutants that are causing problems in the receiving water? • Can source control be implemented to reduce pollutant concentrations in dry-weather runoff? • If the dry weather runoff was diverted would there be a measurable change in receiving water quality? • Is the dry weather discharge flow significant relative to flow in the receiving waterbody in the dry season?
Rapid Sand Filtration	• Are the pollutants in the dry weather runoff well removed by rapid sand filtration?
POTW	• Are the pollutants in the dry weather runoff well removed by wastewater treatment processes? • Would the diversion impact treatment performance or biosolids quality and therefore have a negative impact within the watershed?

In addition to potentially providing a water quality benefit, there are potential negative watershed impacts of implementing diversions. Diversions from the stormwater system to a POTW will typically result in a change in discharge location (i.e. the receiving waterbodies for the storm drain and POTW discharges are not necessarily the same). Therefore, diversions could potentially have a negative watershed impact by resulting in flow loss in receiving waterbodies (i.e. the typically smaller streams and creeks that receive stormwater discharges). In some circumstances this could affect habitat and/or fisheries restoration projects. In addition, potential disadvantages of diversions include discouraging source control of pollutants, water conservation, and LID concepts/technologies.

Understanding the potential watershed benefits and impacts is a critical part of the decision making process for implementing diversions. Accurate assessment of the potential benefit and impacts requires knowledge of hydrology and water quality and ecosystem and sensitive species. The information required to evaluate the benefits and impacts of implementing diversions as compared to “doing nothing” and compared to direct stormwater treatment is outlined in Table 10. These tables do not include addressing all the aspects of feasibility (institutional/regulatory, technical, and economic) of diversions or direct stormwater treatment, as the intent in this section is limited to understanding how to assess the watershed benefits and impacts.

Discussion of the pollutants and pollutant concentrations in dry weather runoff is included in section 4.5. Discussion of the treatability of these pollutants at a POTW is included in section 4.5. Information on the effectiveness of rapid sand filtration for various pollutant removal is available in the stormwater literature: The International Stormwater Best Management Practices database (www.bmpdatabase.org) includes data and links to reports that address the effectiveness of media filters at removing various pollutants. Table 11 is a qualitative summary of the effectiveness of media filters as reported in the California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook - Municipal (CASQA, 2003). It is important to note that focus and evaluation of stormwater BMPs has been on wet weather flows. Differences between the characteristics of wet and dry weather flows in stormwater systems may impact pollutant removal efficiencies (i.e. particulate versus dissolved metals).

The Case Study agencies surveyed have made the decision to implement diversions with the intent of improving water quality, aesthetics, and/or to protect biologically sensitive areas. In most cases, the diversions were implemented to reduce bacteria loadings to receiving waters.

Quantifying the watershed benefits of implementing diversions is challenging because there multiple and interrelated factors that contribute to watershed health. The Case Studies provide some anecdotal evidence suggesting that a reduction in beach closures had occurred as a result of implementing the diversions. Table 12 summarizes the drivers for implementing diversions and if there is any indication of water quality benefits as a result of the diversion program.

Table 11. Qualitative Summary of Pollutant Removal by Stormwater Media Filters

Pollutant	Removal Efficiency
Sediment	High
Nutrients	Low
Trash	High
Metals	High
Bacteria	Medium
Oil and Grease	High
Organics	High
Oxygen Demanding	High

Table 12. Drivers for Case Study agencies' diversions

Agency	Driver	Water Quality Benefits Realized
City of LA	Reduce coliform related beach closures and improved water quality at the beaches. Bacteria TMDL for Santa Monica Bay.	Heal the Bay (2009) reports that the diversions have improved water quality and reduced beach closures. Part of the success is also due to reduced SSOs.
OCSD	Reduce coliform related beach closures and improved water quality at the beaches. Protection of biologically sensitive areas.	Orange County Health Care Annual Beach Water Quality Report states improved water quality due to the diversions (and reduced SSOs). Anecdotal evidence that the Crystal Cove ecosystem has improved as a result of the diversion.
City of Ventura	Aesthetics on popular beach.	Beach aesthetics have improved No decrease in coliform related beach closures.
City of Santa Cruz	Reduce bacteria loadings. Aesthetics.	Anecdotal evidence that one of the diversions has improved beach water quality

Identifying Sites for Diversions

The Dry Weather Diversion Study (RBF Consulting, 2003) includes a decision tree (Figure7) to help determine the eligibility of a diversion. While the decision tree focuses on the issue of reducing bacteria concentrations in receiving waters, the decision tree provides insight into the overall approach to deciding whether to implement a diversion.

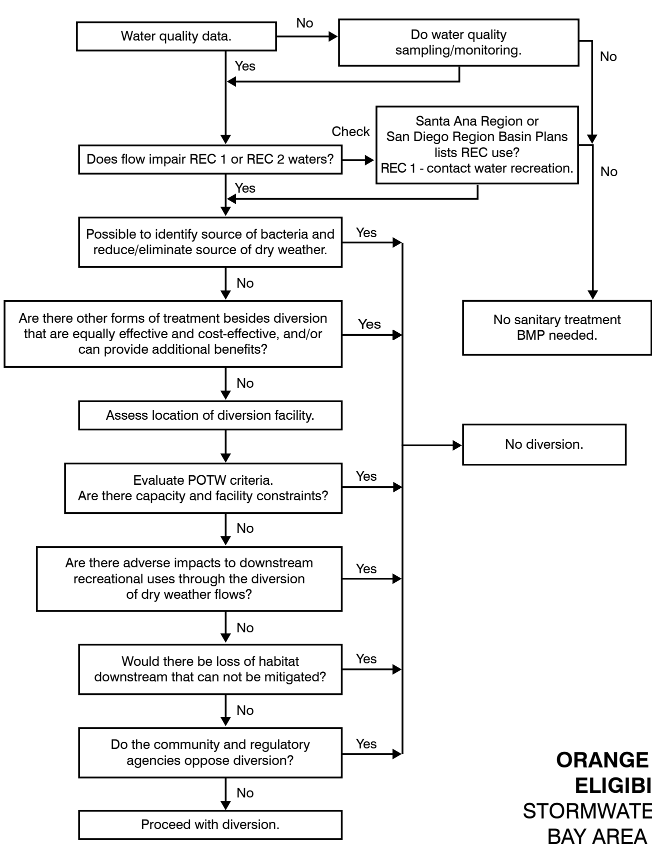


Figure 7
ORANGE COUNTY'S DIVERSION ELIGIBILITY DECISION TREE
STORMWATER DIVERSION WHITE PAPER
BAY AREA CLEAN WATER AGENCIES

5. ESTIMATED COSTS

This section presents planning-level capital and operations and maintenance (O&M) cost estimates for stormwater diversion projects, and compares them to the costs of implementing on-site stormwater sand filters.

5.1. Basis of Costs

These planning-level capital and O&M cost estimates for diversion structures and sand filters are based on the costs reported for similar facilities that have been constructed for other agencies. These costs are presented in "cost curve" format, and are for planning purposes only. Typical accuracy ranges for estimates developed from these cost curves are in the range of -20% to –50% on the low side, and +30% to +100% on the high side. All cost estimates are presented in July 2010 dollars.

Costs for diversion projects are also compared to the costs associated with implementing on-site stormwater sand filters. It should be noted that the comparison of diversions versus using on-site sand filters for treating stormwater should not be on the basis of costs alone, since the benefits may be different with diversions versus using sand filters. In southern California, the target pollutant in dry weather flows is coliform. A typical stormwater sand filter is not an effective treatment technology for coliform bacteria. RBF (2003) provides alternative technologies that were considered in by OCSD, including Clear Creek Systems (onsite filtration followed by UV disinfection), wet basins, and constructed wetlands. Coliform removal efficiencies for these technologies range from 70% to greater than 90%. In the Bay Area, implementing stormwater sand filters as an alternative to a diversion may be more appropriate. Sand filtration will be effective at removing suspended solids and particle-associated pollutants, which comprise many of the pollutants of concern in stormwater in the Bay Area.

5.2. Estimated Construction Costs

The capital and operations and maintenance (O&M) cost estimates were based on data from OCSD and the City of Los Angeles. Costs for stormwater filters were developed primarily from Caltrans data for stormwater runoff applications. In addition, costs for Clear Creek Systems, wet basins, and constructed wetlands were adapted from RBF (2003).

Costs for diversions were obtained from a range of diversion projects that have been implemented in OCSD (RBF Consulting, 2003). A subset of all the costs reported was used for this analysis. The high costs for some channel diversion structures were eliminated. The OCSD data showed that some diversions can cost on the order of $10/gpd or more. The low costs for other diversion structures were also eliminated as not representative (for example, those "simple" diversions that were implemented in existing pump stations).

An average construction cost was calculated for City of LA diversion structures based on the average flow treated by the diversions and reported approximate costs for the diversion structures. The resulting projects are summarized and presented in Table 13. Presented in Table 13 are construction costs, average daily diverted flow, and the calculated unit construction cost. (Note: flows are based on actual recorded, and not on design flows).

Table 13. Stormwater Diversion Construction Cost Estimates

Agency	Location	Construction Cost $	Average Dry Weather Flow Diverted (gpd)	Unit Construction Cost ($/gpd)
OCSD	Linda Lane @ Via Mecha	$ 53,000	14,000	$ 3.79
OCSD	Laguna Cyn @ Forest Ave	$ 20,000	140,000	$ 0.14
OCSD	Bluebird Canyon	$ 40,000	30,000	$ 1.33
OCSD	Dumond Dr./Victoria Beach	$ 13,000	5,000	$ 2.60
OCSD	Fisherman's Cove	$ 13,000	2,000	$ 6.50
OCSD	El Paseo@Laguna Ave (Main Beach)	$ 40,000	10,000	$ 4.00
OCSD	5th Ave @ Coast Hwy	$ 13,000	2,000	$ 6.50
OCSD	Cleo St. @ Gaviota	$ 113,000	35,000	$ 3.23
OCSD	Aliso Creek/ Sulphur Creek Confl	$ 53,000	174,506	$ 0.30
OCSD	Aliso Creek (J01), at mouth	$ 463,000	234,061	$ 1.98
City of LA	-	$ 530,000	700,000	$0.76
Adapted from RBF (2003)				

Costs for stormwater filters were obtained from Caltrans data (Caltrans 2004), as shown in Table 14. The Caltrans cost data show construction costs associated with a filter that could treat a specified water quality volume in a 24 hour period. Both a daily average flow and peak hour flow were estimated to convert this treated volume to a flow. This approach was used to bracket the range of costs of the sand filters (lower range and upper range), as shown in Table 14.

Table 14. Stormwater Sand Filter Construction Cost Estimates

Filter	Construction Cost ($)	Peak Wet Weather Flow (gpd)	Average Wet Weather Flow (gpd)	Unit Construction Cost ($/gpd) – Lower Range	Unit Construction Cost ($/gpd) – Upper Range
1	$506,000	151,800	30,360	$3.33	$16.67
2	$694,400	286,440	57,288	$2.42	$12.12
3	$688,200	293,040	58,608	$2.35	$11.74
4	$343,200	377,520	75,504	$0.91	$4.55
5	$307,400	139,920	27,984	$2.20	$10.98
6	$612,000	158,400	31,680	$3.86	$19.32
Adapted from Caltrans (2004)					

One complicating issue is that the diversion projects were designed to treat a relatively constant low flow volume generated in dry weather periods. Stormwater filters are typically designed to treat a peak flow condition for a specified wet weather event. In making this cost comparison, the assumption is that the stormwater filters would be sized for treating relatively continuous dry weather flows, which is not a typical stormwater application for this technology. This is the reason, in part, for the wide range of costs for the stormwater filters. It is also noteworthy that cost data for filters are based on a much smaller range of flows than for the diversions.

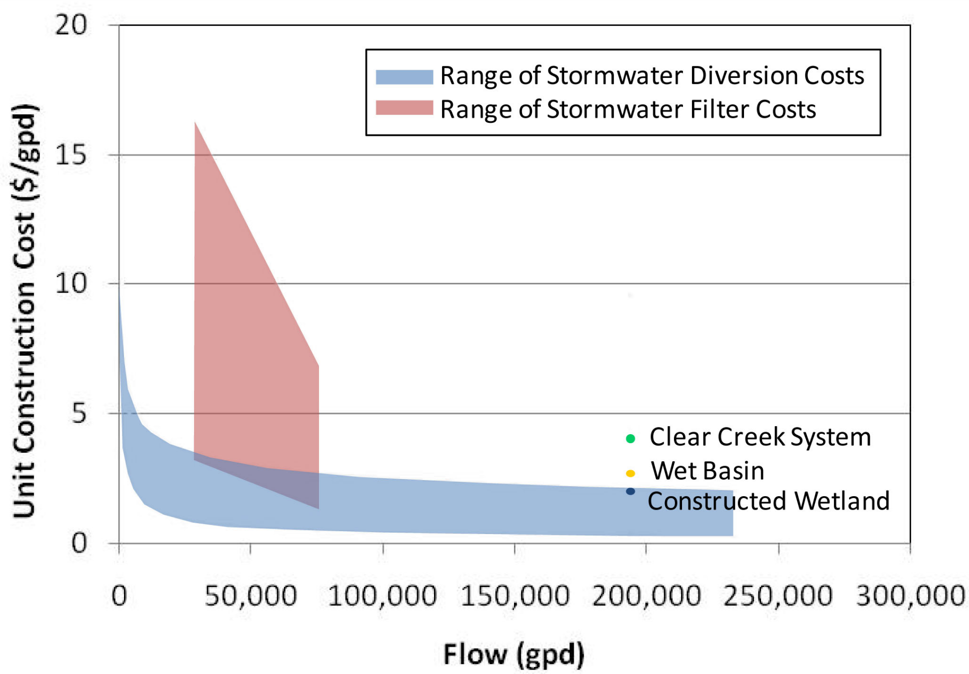
Costs for Clear Creek Systems, wet basins, and constructed wetlands were adapted from RBF (2003), where the costs of these systems were estimated for a flow of approximately 193,000 gpd. The reported costs for the Clear Creek systems ranged from approximately $130,000 to $1,300,000 depending on the design of the housing system for the treatment system. An average construction cost of approximately $800,000 was used in this analysis. Table 15 presents the construction costs for these alternative technologies.

Table 15. Other Alternative Technologies

Technology	Estimated Construction Cost $	Average Dry Weather Flow Diverted (gpd)	Unit Construction Cost ($/gpd)
Clear Creek System	$ 794,000	193,000	$ 4.10
Wet Basin	$ 530,000	193,000	$ 2.73
Constructed Wetland	$ 397,000	193,000	$ 2.05
Adapted from RBF (2003)			

Figure 8 presents the range for the cost curve (in $/gallons per day) for diversion projects. This range was developed by extending +30% and -30% from the fit curve, to capture the variability of the data. Figure 8 also includes the range of unit costs for stormwater filter projects, and the estimated costs the other alternative technologies that were considered in OCSD.

Figure 8. Unit Construction Costs for Stormwater Diversions and Stormwater Filters



The results suggest that the low range of the sand filter costs is comparable to the cost of a diversion in the flow range of approximately 30,000 to 75,000 gpd. However, the wide range of stormwater filter costs is influenced by the design parameters of the stormwater filter. Therefore, it is possible that the stormwater filter would be several times the unit cost of a diversion at this flow range. At flows greater than 75,000 gpd it is difficult to make a comparison between stormwater filters and diversion due to the lack of data for stormwater filters at higher flows. For OCSD, the comparison of alternative treatment technologies was based on a flow of 193,000 gpd. At this flow, the unit cost for a diversion is comparable to a constructed wetland, but is less than a wet basin or a Clear Creek System. However, the data used to generate the diversion costs were a subset of all the OCSD diversion cost data presented in RBF (2003), selected to represent the more "typical" diversions". As noted previously, a large channel diversion that requires a rubber dam and more sophisticated design can cost upwards of $10/gpd.

At flows greater than 300,000 gpd, the site specific considerations for implementing a diversion versus an alternative technology become even more influential. One parameter that would significantly affect costs is the proximity of the stormdrain system to the sewer system and feasibility of conveying relative high flows from the stormdrain to the sewer. There are other considerations at high flows that have been noted elsewhere, and include loss of streamflow and the capacity of the sewer system.

While the unit construction cost curves provide some insight into the relative capital costs for diversions and alternative technologies, the data set used to develop the cost curves suggests that the construction costs are highly variable and site specific. In evaluating the construction costs of a diversion relative to an alternative technology, more detailed costs estimates should be prepared that take into account site specific considerations.

5.3. Estimated Operations & Maintenance Costs (O&M)

O&M costs were also obtained for the same diversion projects whose construction costs were presented in the previous section. Table 16 presents O&M cost data for diversions. The high variability of the results limits the development of a meaningful cost curve. However, the average annual O&M cost for the diversion projects reported is in the range of ~$40,000 to ~$60,000. Based on rainfall data for southern California, it is estimated that there are 326 dry weather days per year. The annual volume of dry weather flow diverted was calculated by multiplying the average dry weather flow by the number of dry weather days per year (326). This diverted volume was used in the calculation of the unit O&M costs presented in Table 15.

The estimated O&M cost for a stormwater filter is approximately 5 percent of the capital construction cost per year (Schueler, T.R. 1992. "A Current Assessment of Urban Best Management Practices"). Unit O&M costs for Clear Creek systems, wet basins, and constructed wetlands, are $0.92 per thousand gallons, $0.36 per thousand gallons and $0.36 per thousand gallons, respectively (RBF 2003).

It is recommended that for any site-specific evaluation of the O&M costs of a diversion compared to an alternative technology, more detailed O&M costs estimates should to be developed. Site specific conditions and the final filter technology are going to strongly influence both capital and O&M costs.

Table 16. Stormwater Diversion O&M Cost Estimates

Agency	Location	Annual O&M Cost $	Average Dry Weather Flow Diverted (gpd)	Unit O&M Cost ($/thousand gal treated)
OCSD	Linda Lane @ Via Mecha	$19,200	14,000	$4.21
OCSD	Laguna Cyn @ Forest Ave	$9,600	140,000	$0.21
OCSD	Bluebird Canyon	$24,000	30,000	$2.45
OCSD	Dumond Dr./Victoria Beach	$6,000	5,000	$3.68
OCSD	Fisherman's Cove	$2,400	2,000	$3.68
OCSD	El Paseo@Laguna Ave (Main Beach)	$12,000	10,000	$3.68
OCSD	5th Ave @ Coast Hwy	$3,600	2,000	$5.52
OCSD	Cleo St. @ Gaviota	$25,200	35,000	$2.21
OCSD	Aliso Creek/ Sulphur Creek Confl	$55,200	174,506	$0.97
OCSD	Aliso Creek (J01), at mouth	$58,800	234,061	$0.77
City of LA	-	$35,000	700,000	$0.20

6. OUTSTANDING ISSUES AND FUTURE WORK

The objective of this paper is to provide a broad overview of the factors and variables that should be, and that have been, considered by agencies implementing diversion projects. The analysis presented in this White Paper is based on a review both of published literature as well as information/data provided by the Case Study agencies that have implemented diversions. The White Paper has provided an excellent opportunity to compile information that forms the basis for understanding the potential regulatory/institutional, technical and economic benefits and challenges with implementing stormwater diversions in the Bay Area.

Through the research and development of this White Paper, issues that warranted additional investigation were identified as areas of future work, including:

- Process Impacts of Diverted Flows - There is limited information about process impacts of treating dry weather stormwater flows because each of the Case Study agencies felt that stormwater diversions are a small enough portion of their flow that the impacts on the process are negligible. Therefore, there has been limited analysis done on impacts of diversions on effluent and biosolids quality, or the increased costs of treatment. The potential impacts on effluent and biosolids quality are site specific and depend on a number of parameters including specfic pollutant loads from the diversions, physical chemical characteristics of the pollutants in the diversion flows and the effectiveness of existing treatment processes. These potential impacts on Bay Area POTWs warrants further investigation.
- Diversion Project Feasibility - The information provided by the Case Study agencies suggested that the feasibility of a diversion project needs to be addressed on a case-by –case basis. An area of future work includes applying the decision checklist/flowchart to a specific potential diversion site, and evaluating all of the specific regulatory/institutional, technical and economic benefits and challenges.
- Changes in Service Rates - Planning-level costs were developed as part of this White Paper. There is a need to understand how these costs would translate into rate increases. This would need to be done on a case-by-case basis since rate structures vary by agency.
- Watershed Management - There are larger issues pertaining to changing the paradigm of watershed resource management, where wastewater and stormwater are treated as a single resource. Consideration of the evolution to a more holistic approach to watershed resource management would be a worthwhile discussion for the agencies responsible for regulations and the regulated entities.

7. LITERATURE CITED/REFERENCES

California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook - Municipal (CASQA, 2003).

CH2MHILL, "Urban Runoff Study" prepared for the Orange County Sanitation Source Control Division, 2004.

Heal the Bay, "Heal the Bay's 2009 End of Summer Beach Report Card" http://www.healthebay.org/assets/pdfdocs/brc/summer/2009/2009%20Summer%20Report.pdf.

Larry Walker and Associates, "Calleguas Creek Watershed: Dry Season Urban Runoff Characterization," 2005.

National Research Council, "Urban Stormwater Management in the United States" Committee on Reducing Stormwater Discharge Contributions to Water Pollution, National Academies Press, 2008.

Orange County….[reference to be inserted]

RBF Consulting, "Dry Weather Diversion Study," prepared for the County of Orange, Orange County Flood Control District and the incorporated cities of Orange County, 2003.

Stein and Ackerman, "Dry Weather Water Quality Loading in Arid, Urban Watersheds in the Los Angeles Basin, California, USA," Journal of the American Water Resources Association, 43(2), 2007.

Wossink and Hunt "The Economics of Structural Stormwater BMPs in North Carolina" WRRI Project # 50260, May 2003.

APPENDIX A – GLOSSARY

Glossary of Terms

BMP - Best management practice. Stormwater agencies are required to implement BMPs to control stormwater pollution as part of their MS4 permit.

Dry Weather Flow - Runoff with a source other than rainfall, such as irrigation, pool drainage, washdown water, illicit connections, etc.

First Flush - The initial runoff during a storm. The first flush contains higher concentrations of pollutants, especially after a long dry period.

Hot Spot - An area in a stormwater catchment basin with an unusually high concentration of pollutants that may be carried away by stormwater.

I/I - Inflow and infiltration. This is the wet weather stormwater that enters a sanitary collection system through manholes, cracks in the pipe and illicit connections.

MS4 - Municipal Separate Storm Sewer Systems. This is the category under which stormwater agencies permit as part of the NPDES program.

NPDES - National Pollutant Discharge Elimination System. This is the Federal program administered by authorized states to issue permits to point source and non point source dischargers.

POTW - Publicly owned treatment works. These are facilities that mainly treat sanitary sewage.

Reasonable Potential - The State must determine whether a discharge has a reasonable potential to cause an excursion of a receiving water pollutant criteria or objective. If the finding is that there is a reasonable potential, the pollutant is given a water quality based effluent limit in a discharger's NPDES permit.

RWQCB - Regional Water Quality Control Board

SMP - Stormwater Management Plan. Municipalities are required to assemble Stormwater Management Plans as part of their MS4 permits.

Stormwater - Either dry or wet weather flows

TMDL - Total Maximum Daily Load. This is the regulated amount of a pollutant that can be discharged to a receiving water.

USEPA - United States Environmental Protection Agency.

Waste Load Allocation - The mass of a pollutant that each discharger has the right to add to an impaired water body, as per the TMDL.

APPENDIX B – REGULATORY REFERENCES

Regulatory References

California Regional Water Quality Control Board, San Francisco Bay Region - Municipal Regional Stormwater NPDES Permit Order R2-2009-0074; NPDES Permit No. CAS612008
http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2009/R2-2009-0074.pdf

Code of Federal Regulations (CFR), Part 403—General Pretreatment Regulations for Existing and New Sources of Pollution
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=02a07ed6cf6ad5aa111dd79dd2b7725f&rgn=div5&view=text&node=40:28.0.1.1.4&idno=40

State of California - Porter-Cologne Water Quality Control Act
http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf

US Environmental Protection Agency - Combined Sewer Overflow Control Policy
http://www.epa.gov/npdes/pubs/owm0111.pdf

TMDLs cited in white paper

Regional Water Quality Control Board, San Francisco Bay Region

Mercury in San Francisco Bay
http://www.swrcb.ca.gov/rwqcb2/water_issues/programs/TMDLs/sfbaymercury/sr080906.pdf

PCBs in San Francisco Bay
http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf

Diazinon and Pesticide-Related Toxicity in Bay Area Urban Creeks
http://www.swrcb.ca.gov/rwqcb2/water_issues/programs/TMDLs/urbancrksdiazinon/b_final_staff_report.pdf

APPENDIX C – CASE STUDIES

BACWA Stormwater Diversion White Paper
Case Studies Reporting Form

Agency: OCSD

Name of Respondent: Tom Meregillano/Jim Colston

Job Title of Respondent: Regulatory Specialist of Source Control/XXX

Contact Information:
Phone: x7457
Email: tmeregillano@ocsd.com/jcolston@ocsd.com

GENERAL

Are there any available documents on your stormwater diversion project?
Yes, Tom to send documents:
1. The initial CH2M Hill study on capacity to accept dry weather stormwater diversions.
2. The OCSD Board Policy (adopted in 1999?) on acceptance of dry weather stormwater diversions.
3. An example pretreatment program permit for one of the 4 cities that currently divert.
4. The follow up study (3-yr post study) by CH2M Hill assessing the program.
5. Data summary on stormwater quality and flow.
6. Any O&M cost data on the additional cost to treat these dry weather diversions at the plant (separate from the costs to divert).
7. Any capital, and O&M costs on the diversion facilities, if available.

Number of diversions (first flush versus dry weather flows):
18, dry weather only. Dry weather, dry days only. As soon as the rain gauge registers rain, the pump stations shut down. Diversions are accepted on a case by case basis, based on priority and pipe capacity. Permitted as pretreatment.

Number of years diversions have been in place:
Since 1999 (emergency only)/2000 (full time).

Size (area) of stormwater service area:
Stormwater service area owned by individual cities and county. OCSD service area (all cities/county). Diversions provided to over half of the service area, but theoretically available to entire service area. Diversions granted based on priority, priority based on water quality impact (beach, sensitive area). Decisions made by Stormwater Technical Advisory Committee (cities and county) using a standard work flow process. OCSD can decline.

Capacity of stormwater system:
Stormwater service area owned by individual cities and county. CH2M Hill did a capacity study to determine which pipes could take what flows for OCSD.

Estimated annual flow sent to wastewater treatment plant by diversions:
Between 1 and 3 mgd. Have capacity to take 10 mgd.

Capacity of receiving wastewater treatment plant:
Not discussed.

INSTITUTIONAL ISSUES

What was the regulatory impetus to implement the diversions?
The RWQCB was putting pressure on the cities to address the beach closures, wanted major flows to be diverted. OCSD did a study to determine if the high bacteria counts were due to the outfall - study showed that was not the case, due to the nonpoint source runoffs. Public has been pointing the finger at OCSD. While this was not OCSD's problem to solve, they stepped up (Blake Anderson) to provide a "band aid" - a temporary fix on an emergency basis. Now, it has turned in to more of a permanent solution.

Please describe the roles of the stormwater and wastewater agencies in planning and implementing the diversions (if applicable).
The RWQCB was not involved in the process at all.

Did the wastewater agency receive any regulatory concessions or protections (i.e. to prevent permit violations) from the Regional Board in exchange for accepting the stormwater flows?
No.

Has there been a change in the POTW permit status as a result of accepting stormwater diversions (i.e. regulated as a CSO versus an SSO?)
Not discussed, but assume no.

Is there an agreement between the stormwater and wastewater agencies to terminate the diversion program/system? If so, what are the conditions for terminating the stormwater diversion program/system?
OCSD does have the right to refuse diversions and to stop taking flows at their discretion. Tom to provide this policy language to us.

TECHNICAL ISSUES

What were the water quality benefits the diversions were designed to achieve?
Reduced bacteria loadings leading to beach closures. Later diversions also aimed at protecting biologically sensitive areas, like Cove Creek. Divert from Santa Ana, Greenough (?), and Talbert, as well as from 2 creeks in the Irvine Water District.

What criteria were use to determine the diversion location and volume?
Areas that would have the most water quality benefit, ie not stagnant areas, ones with a lot of flushing. Creeks, rivers, biologically sensitive areas. 4 mgd set based on the City of Huntington Beach's estimate of 1 mgd of flows and the County's estimate of 1 mgd and using a safety factor of 2 ((1 mgd+1 mgd)*2 = 4 mgd). This was a policy decision. Blake felt it was not up to OCSD to solve the urban stormwater runoff problem.

Have the diversions achieved those goals?

Yes. Orange County Health Care Annual Beach Water Quality Report states improved water quality due to the diversions (and reduced SSOs).

How have the diversions affected wastewater treatment operations or effluent quality, if at all?
No. The stormwater is cleaner than sewage. However, 4 mgd (stormwater flows) out of 220 mgd (wastewater flows) is pretty small. In addition, they have seen some “exotic” chemicals, mostly pesticides (likely from golf course and nursery runoff). Since they are recycling water and doing groundwater recharge, they are paying close attention to these chemicals and may potentially decide in the future to no longer take flows due to the impacts to the GWR from these pollutants.

How is stormwater quality monitored?
OCSD provides a list of pollutants to monitor, and the cities do the monitoring.

How is flow monitored?
Cities self monitor flows (how was not discussed) and send monthly flows to OCSD.OCSD compiles all the flows and sends them back out to the cities.

How is stormwater flow to the wastewater treatment plan controlled (manual, automatic, remote, passive)?
Telemetry. The flows are only accepted on dry days. When the rain gauge registers, the pump stations automatically turn off.

ECONOMIC ISSUES

How are the costs for the diversions allocated between the stormwater and wastewater agencies (if applicable)?
Accept flows up to 4 mgd at no cost to cities/county. Any flows over 4 mgd, the cities/county pay the industrial rate structure (level 1).

Was the wastewater agency able to recoup any costs incurred by implementing the project? From whom?
The cities paid for the costs to install the diversions. Rubber dams are being used to close off channels. Treatment costs are not shared, but this may change in the future.

Are costs available for either/both project costs or O&M costs for the diversions?
Yes, in CH2M Hill report. Tom to provide.

OTHER

Are there other aspects of your diversion project that are important to note?
It has been a very positive program but expensive.

Are there other stormwater and/or wastewater agencies in California or other states, that you think could provide information for this study?
San Diego and SOCWA.

BACWA Stormwater Diversion White Paper
Case Studies Reporting Form

Agency: City of Los Angeles, CA

Name of Respondent: Adel Hagekhalil/Wing Tam

Job Title of Respondent: Assistant Director/Assistant Division Manager

Contact Information:
Phone: 213-485-2210/213-485-3985
Email: adel.hagekhalil@lacity.org/wing.tam@lacity.org

GENERAL

Are there any available documents on your stormwater diversion project?
Wing Tam to send presentation material, costs, contact information, stormwater master plan, permission letter from EPA

Number of diversions (first flush versus dry weather flows):
23 in total, 8 are owned by the City that go directly to Santa Monica Bay, the County (Public Works) and Santa Monica own the others. The 8th Street diversion was added to address high bacteria counts (7,000-8,000)coming from that area of the City due to homeless and produce that were directly discharged to the LA River. Cost was bout $100,000-$200,000. Dry weather only. Pump stations shut during a rain event. Diversions based on benefit to receiving water, proximity to a large trunk sewer, pump station. There are 4 phases of low flow diversions - they are upgrading the collection system and the 8 City owned diversions. 2000 storm drains discharge to LA River. 300 storm drains discharge to Balloa Creek.

Number of years diversions have been in place:
Since 1997 or 1998. Initially just dry summer flows, as of 2009/2010 (winter) they will take year round dry flows. Expecting winter flows to be much larger than summer flows - the groundwater table is up and people use more water. After a rain event the diversion is shut down for 3 days. They are looking at first flush, will be conducting a pilot study to take the “worst” of the flows (ie, worst in terms of loading). SCCWRP is doing a regional research project on first flush.

Size (area) of stormwater service area:
1500 miles of pipe

Capacity of stormwater system:
Not available.

Estimated annual flow sent to wastewater treatment plant by diversions:
17 mgd, dry weather only

Capacity of receiving wastewater treatment plant:
375 mgd at Hyperion, currently seeing flows of 280 mgd. No collection system capacity issues with dry summer flows, one concern with dry winter flows - City is upgrading that section of the

collection system at Santa Monica Canyon Channel (capacity is 3.2 mgd, upgrade will be 7.75 mgd).

INSTITUTIONAL ISSUES

What was the regulatory impetus to implement the diversions?
Initially no regulatory driver, impetus was the water quality at the beaches forcing beach closures. Then a bacterial TMDL for Santa Monica Bay was put in to place which furthered the efforts to take dry weather flows - NPDES permit amended to include TMDL. Wing to send presentation.

If applicable, please describe the roles of the stormwater and wastewater agencies in planning and implementing the diversions (including description of existing agreements and local laws, and POTWs ability to accept/deny/condition diversions).
Low flow stormwater master plan was initially done (1996) to investigate taking the diversions. Expanded definition of low flow to include no rain.

Did the wastewater agency receive any regulatory concessions or protections (i.e. to prevent permit violations) from the Regional Board in exchange for accepting the stormwater flows?
No. However, they had to get permission from EPA to take the dry weather flows in order to not jeopardize the EPA grants that they were given to fund Hyperion WWTP.

Has there been a change in the POTW permit status as a result of accepting stormwater diversions (i.e. regulated as a CSO versus an SSO?)
No. However the RWQCB will change the stormwater NPDES permit to include the bacteria TMDL exceedences. The Basin Plan has not been amended, but the City is still liable for any exceedences. The City has seen a 10% in bacteria.

Is there an agreement between the stormwater and wastewater agencies to terminate the diversion program/system? If so, what are the conditions for terminating the stormwater diversion program/system?
City has 29 contract cities who don't want to pay for stormwater

Describe interface issues (i.e. ownership of infrastructure, funding, liability, etc.)

What is the permitting vehicle for regulating the diversions?
RWQCB considers this a stormwater BMP for LA. LAstormwater.org has the permit online. City has a permit for the collection system and a permit for the stormwater system.

TECHNICAL ISSUES

What were the water quality benefits the diversions were designed to achieve?
Originally, reduced beach closures and improved water quality at the beaches. Then, in addition, to meet the bacteria TMDL for Santa Monica Bay. The TMDL is measured by geometric mean in "allowable days". Went into effect in 2003 for dry weather, 2005 for wet

weather. Dry weather from April 1 to Oct 31 is 0 days, from Nov 11 to March 31 is 3 days, in wet weather is 17 days. Also AB411 is a statewide bill.

What criteria were use to determine the diversion location and volume?
Diversions were discharges to Santa Monica Bay. The 8th Street diversion was added because of very high loadings in that catchment area due to fish markets, etc.

Have the diversions achieved those goals? If not, what are the main obstacles?
Yes. Heal the Bay (Mark Gold) reports that the diversions have improved water quality and reduced beach closures. Part of the success is also due to reduced SSOs.

How have the diversions affected wastewater treatment process operations (including physical, chemical and biological processes), effluent quality, or biosolids, if at all?
No, but 17 mgd out of 300 mgd is not significant. And only dry flows are taken (no wet flows).

How is stormwater quality monitored?
It is not. There is some monitoring for bacteria, but that is limited. Specific projects monitor more than bacteria. There are some concerns where there is not much dilution. There are LEL sensors in each diversion pump wet well to detect the presence of hydrocarbons (due to a gasoline spill), which causes the pump station to be shut down automatically if a set level is exceeded. It also sends a message to the WWTP to alert them. The screens are cleaned regularly of trash and leaves to prevent overflows at the wet well.

How is flow monitored?
Mag meters on the pumps. They also use some portable velocity meters and weird to temporarily monitor flows.

How is stormwater flow to the wastewater treatment plan controlled (manual, automatic, remote, passive)?
Flow is controlled by design - pipe size/weir from the screening wet well to the pump wet well, the pump capacity, and the flow level sensors in the pump wet well. The pump stations can be shut down manually, automatically (level sensors), and via SCADA. There is a mechanical screen prior to the pumps that collects trash. They are adding a new diversion (7th Street) that is gravity. There will be a valve and a trap to prevent gas transfer. They do all their designs in house. There is no treatment occurring in the system. A big issue is backup power - either permanent or a plug for temporary power is installed at each diversion.

ECONOMIC ISSUES

How are the costs for the diversions allocated between the stormwater and wastewater agencies (if applicable)?
Capital costs to design and construct the diversions were paid for by the stormwater fund. Paid for largely with Prop O funds.

Was the wastewater agency able to recoup any costs incurred by implementing the project? From whom?
They did not pay for the capital costs. O&M costs are paid based on flowfor by the stormwater fund to the wastewater fund via an annual service charge. A connection fee to hook up to the collection system was not charged as the connection is considered a “temporary connection”. Not taking any capacity permanently.

Are costs available for either/both project costs or O&M costs for the diversions?
Yes, Wing to send. Estimated costs are $300,000 - $400,000 per year in O&M costs for the 8 pump stations.

OTHER

Are there other aspects of your diversion project that are important to note?

Are there other stormwater and/or wastewater agencies in California or other states, that you think could provide information for this study?
Los Angeles County Sanitation District (this might not be the technical name) - they have issues about when they discharge at certain times of the day and their detention ponds, different than the City. Wing to send contact info. Los Angeles County Public Works, OCSD, Ventura, and San Diego. Talk to Mark Gold at Heal the Bay. Look at SMURFF - half owned by City, half owned by Santa Monica. Provides treatment, has MF and UV. City of LA has control.

DATA PROVIDED

- Presentation
- LA Sanitation Year at a Glance

OTHER

- Santa Monica captures some first flush flows.
- LA is trying to raise additional funds for stormwater. They feel that planning/water quality issues will really start to come to the forefront.
- The City is doing a pilot to disconnect residential drains to the stormwater system and to use rain barrels or rain gardens instead. The pilot will lead to the development of standards. City does LID to address water quality and water supply issues.
- City is conducting pilot studies on new technology for maintenance - where a bacteria (good) is used to eat another bacteria (bad) or FOG.

TOUR

8th Street Diversion
- **sfdsfs**

BACWA Stormwater Diversion White Paper
Case Studies Reporting Form

Agency:City of Santa Cruz

Name of Respondent: Steve Wolfman

Job Title of Respondent: Associate Engineer, Public Works Department

Contact Information:
Phone: 831-420-6050
Email:

GENERAL

Are there any available documents on your stormwater diversion project?
On the City website in the stormwater permit section there is a stormwater management plan (chap 1) that includes a chapter on the Neary Lagoon, which is the largest of the 4 diversions.

Number of diversions (first flush versus dry weather flows):
4, all dry weather.

Number of years diversions have been in place:
Near Lagoon for 10 years. Other three for 2 years.

Size (area) of stormwater service area:
Nearly Lagoon - several hundred acres
Other three - several acres

Capacity of stormwater system:
Unknown

Estimated annual flow sent to wastewater treatment plant by diversions:
Nearly Lagoon - several hundred thousand gallons per day
Other three - very low flow that is manually discharged from pump station approximately once per week.

Capacity of receiving wastewater treatment plant:
17 mgd

INSTITUTIONAL ISSUES

What was the regulatory impetus to implement the diversions?
Neary Lagoon - The lagoon detains storm water, urban runoff, and groundwater from the watershed prior to its discharge into Monterey Bay. A fixed weir controls the water level. The City used to keep the lagoon backed up during the summer when there was a lot of beach use.

This led to water quality issues from stagnant water that was then released all at once. Current operation is to use the diversion to drain the lagoon and send the water to the WWTP. There was not a specific regulatory driver, but the City had some general concern about the old approach with respect to water quality 9bacteria and others) when the lagoon was released.

Other three - These catchments drain to waters impaired for bacteria. Driver was to improve water quality condition.

If applicable, please describe the roles of the stormwater and wastewater agencies in planning and implementing the diversions (including description of existing agreements and local laws, and POTWs ability to accept/deny/condition diversions).
Not applicable since the city is responsible for stormwater and wastewater.

Did the wastewater agency receive any regulatory concessions or protections (i.e. to prevent permit violations) from the Regional Board in exchange for accepting the stormwater flows?
No

Has there been a change in the POTW permit status as a result of accepting stormwater diversions (i.e. regulated as a CSO versus an SSO?)
No, but in the preamble of the permit there is reference to having permission for the POTW to accept stormwater.

Is there an agreement between the stormwater and wastewater agencies to terminate the diversion program/system? If so, what are the conditions for terminating the stormwater diversion program/system?
No

Describe interface issues (i.e. ownership of infrastructure, funding, liability, etc.)
Not applicable

TECHNICAL ISSUES

What were the water quality benefits the diversions were designed to achieve?
Neary Lagoon - bacteria loadings, aesthetics
Other three - bacteria

What criteria were use to determine the diversion location and volume?
Unknown

Have the diversions achieved those goals? If not, what are the main obstacles?
Neary Lagoon - yes
Other three - no specific information on effects on receiving waters

How have the diversions affected wastewater treatment process operations (including physical, chemical and biological processes), effluent quality, or biosolids, if at all?
Not a concern since diversion flow is low relative to treatment capacity.

How is stormwater quality monitored?

The MS4 permit may have information on monitoring,

How is flow monitored?
Unknown

How is stormwater flow to the wastewater treatment plan controlled (manual, automatic, remote, passive)?
Neary Lagoon - Upstream of the weir there is a valve that the City manually opens. Typically this valve is open during the summer months as well as other times of the year when rainfall happens to be infrequent. Use of the beach (nice weather) can be the driver for draining the lagoon to the WWTP.

Other three - These diversions are at stormwater pump stations. It is very low flow. Approximately once per week in the dry season, and operator manually turns on the pump that feeds a small (2 inch) line going to the WWTP.

ECONOMIC ISSUES

How are the costs for the diversions allocated between the stormwater and wastewater agencies (if applicable)?
Not applicable

Was the wastewater agency able to recoup any costs incurred by implementing the project? From whom?
Not applicable

Are costs available for either/both project costs or O&M costs for the diversions?
Neary Lagoon - Capital cost about 10K, O&M not well known
Other diversions - About 50K or less each. However, these were constructed with grant money and other related projects were completed, including local projects that minimized infiltration in the areas upstream of these diversions.

OTHER

Are there other aspects of your diversion project that are important to note?

Are there other stormwater and/or wastewater agencies in California or other states, that you think could provide information for this study?

BACWA Stormwater Diversion White Paper
Case Studies Reporting Form

Agency: City of Ventura

Name of Respondent: Richard Bradley

Job Title of Respondent: Environmental Services Supervisor (responsible for diversion project)

GENERAL

Are there any available documents on your stormwater diversion project? No time to retrieve.

Number of diversions (first flush versus dry weather flows): 2 diversions - each in a separate location. Both dry weather flows. Never heard of first flush diversions.

Number of years diversions have been in place: 2 years

Size (area) of stormwater service area: 66 acres and 20 acres

Capacity of stormwater system: Don't know - one is 4x6 ft underground channel, other is 48 inch CMP

Estimated annual flow sent to wastewater treatment plant by diversions: 3-4 gpm when operating, and they operate most of the time

Capacity of receiving wastewater treatment plant:
14 mgd design and permitted capacity. Current average annual flow is 9.3 mgd.

INSTITUTIONAL ISSUES

What was the regulatory impetus to implement the diversions? No, just serving community and economic interest of city because each of the storm drains discharge at popular beach.

Please describe the roles of the stormwater and wastewater agencies in planning and implementing the diversions (if applicable). Richard had to interact a lot with POTW, and had to take a lot of input so operators would feel comfortable with direct connection. There was a lot of opposition. Single hardest thing was working with operator. POTWs get a lot of pressure to help bail out general fund, and they need to be defensive so they're not pressured into doing something that will compromise their main priority. No formal agreement to reverse diversions if POTWs have future regulatory/capacity problems.

Did the wastewater agency receive any regulatory concessions or protections (i.e. to prevent permit violations) from the Regional Board in exchange for accepting the stormwater flows? No, but they probably didn't ask for any. They talked with Regional Board. Filed a Mitigated Negative Declaration because of archaeological considerations.

TECHNICAL ISSUES

What were the water quality benefits the diversions were designed to achieve?
Getting discharges off of popular beach. Ocean water quality testing for bacteria (AB 411 testing), but aesthetic considerations most important. One of stormdrains was 50-100 years old that stagnated and became malodorous. The other stormdrain discharged to the beach and would puddle in a prime tourist area. This site attracted rodents.

Have the diversions achieved those goals? No decrease in number of days of beach closures because it's mostly related to rainfall.

How have the diversions affected wastewater treatment operations or effluent quality, if at all? The operator has had concerns since they've gone in.

How is stormwater quality monitored? Difficult to do. Measure at bottom of sump, but water there is stagnant, so generally worse than is truly representative. Didn't get into much detail in testing individual compounds. County (Ventura County Watershed Protection District) website may have test result data.

How is flow monitored? Flow meter, don't know what kind.

How is stormwater flow to the wastewater treatment plan controlled (manual, automatic, remote, passive)?
Attached to SCADA. Have them year round, deactivated automatically by rain gauges, then need to be turned back on by staff. When triggered, the system turns off pump in catchment. They're programmed to come back on after time after rainfall, but overridden by staff if I/I. They also have maximum volume - 40 gpm initially, reduced to 5 gpm, because POTW didn't want such high flows. When they get to 5gmp now, they shut off.

Do you know whether diverting flows had an affect on water quality or flows in neighboring streams or creeks? Not applicable - they were beach discharges.

ECONOMIC ISSUES

How are the costs for the diversions allocated between the stormwater and wastewater agencies (if applicable)? Most other cities don't pay POTWs, but Ventura payed $200K in connection fees and industrial charges per gallon for treatment costs - based on industrial rates. Connection fees money came from general fund. Stormwater paid for the physical connections.

Was the wastewater agency able to recoup any costs incurred by implementing the project? From whom?

Are costs available for either/both project costs or O&M costs for the diversions? For construction $200K for design (for both), and $400K to construct each. Approx $10-20K for both in O&M for maintenance and pump replacement.

OTHER

Are there other aspects of your diversion project that are important to note? The SW and sanitary collection system connection points were close together.

They looked at other coastal communities (10 to 15 other agencies). City of LA and Orange County to begin with.

UV/Ozone onsite treatment may be preferable if POTW is very difficult (Encinitas, Oceanside).

BACWA Stormwater Diversion White Paper
Case Studies Reporting Form

Agency: East Bay Municipal Utility District

Name of Respondent: Nadia Borisova

Job Title of Respondent:

Contact Information:
Phone: (510) 287-1065
Email nborisov@ebmud.com

GENERAL

Are there any available documents on your stormwater diversion project?

Data are currently being compiled on dry weather, wet weather and first flush samples.

Number of diversions (first flush versus dry weather flows):

As part of this pilot project, 75 gpm dry weather urban runoff and some first flush flows from Alameda County Flood Control District pump station (Ettie Street Pump Station) are being diverted to a wastewater treatment plant.

Number of years diversions have been in place:

1.5

Size (area) of stormwater service area:

EBMUD's wastewater system serves approximately 650,000 people in an 88-square-mile area of Alameda and Contra Costa counties along the Bay's east shore, extending from Richmond on the north, southward to San Leandro.

Capacity of stormwater system:

Diversion pump or Ettie Street

Actual capacity of the pilot project watershed if currently being assessed

Estimated annual flow sent to wastewater treatment plant by diversions:

Approximately 100,000 gallons per day of dry weather and some first flush flows

Capacity of receiving wastewater treatment plant:

Design capacity = 120 MGD

INSTITUTIONAL ISSUES

What was the regulatory impetus to implement the diversions?

- Environmental Enhancement Project: pilot project to satisfy Wet Weather NPDES permit requirements.
- Supplemental Environmental Project resulted from a non-compliant event. This project provides increased monitoring at the Ettie Street Pump Station, beyond the EBMUD Wet Weather NPDES Permit's Environmental Enhancement Project. This project also provides identification and monitoring an additional site for urban runoff flows.

Please describe the roles of the stormwater and wastewater agencies in planning and implementing the diversions (if applicable).

Pilot project coordinated among the California Regional Water Quality Control Board, Alameda County, City of Oakland and EBMUD.

Did the wastewater agency receive any regulatory concessions or protections (i.e. to prevent permit violations) from the Regional Board in exchange for accepting the stormwater flows?

No

Has there been a change in the POTW permit status as a result of accepting stormwater diversions (i.e. regulated as a CSO versus an SSO?)

No

Is there an agreement between the stormwater and wastewater agencies to terminate the diversion program/system? If so, what are the conditions for terminating the stormwater diversion program/system?

Yes. Short-term pilot to end in 2010.

TECHNICAL ISSUES

What were the water quality benefits the diversions were designed to achieve?

Diversion of dry weather urban runoff and some first flush flows to wastewater treatment plant for treatment.

What criteria were use to determine the diversion location and volume?

- Site Access
- Level of contamination

Have the diversions achieved those goals?

Yes

How have the diversions affected wastewater treatment operations or effluent quality, if at all?

To be determined

How is stormwater quality monitored?

Samples analyses and data review

How is flow monitored?

Automatically. SCADA system tracks and records diversion volume.

How is stormwater flow to the wastewater treatment plan controlled (manual, automatic, remote, passive)?

Remote turn on/off

ECONOMIC ISSUES

How are the costs for the diversions allocated between the stormwater and wastewater agencies (if applicable)?

Not applicable

Was the wastewater agency able to recoup any costs incurred by implementing the project? From whom?

Not applicable

Are costs available for either/both project costs or O&M costs for the diversions?

Capital project

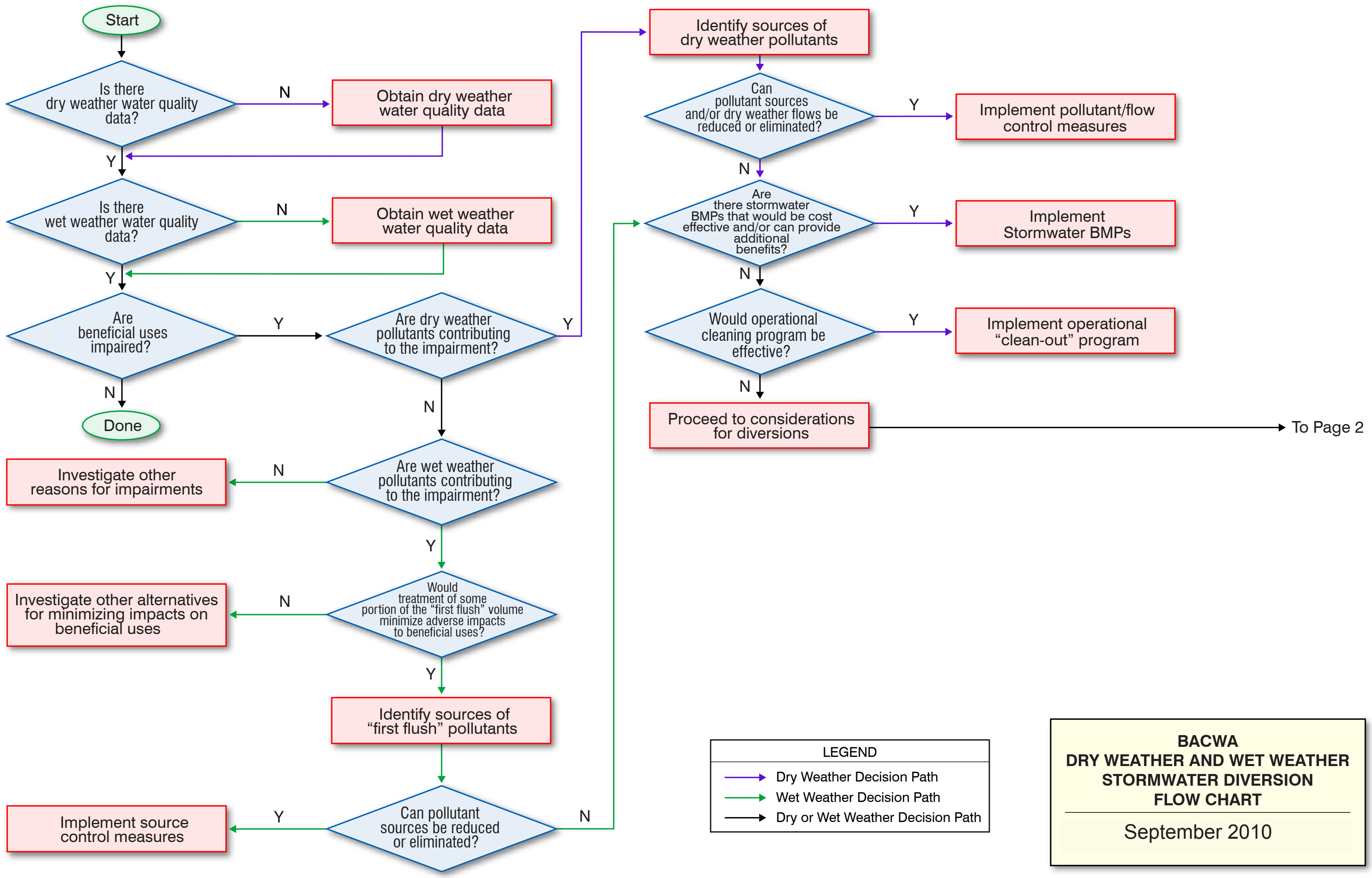
OTHER

Are there other aspects of your diversion project that are important to note?

Pilot/short term project

Are there other stormwater and/or wastewater agencies in California or other states, that you think could provide information for this study?

APPENDIX D – DECISIONS CHECKLIST/ FLOW DIAGRAM



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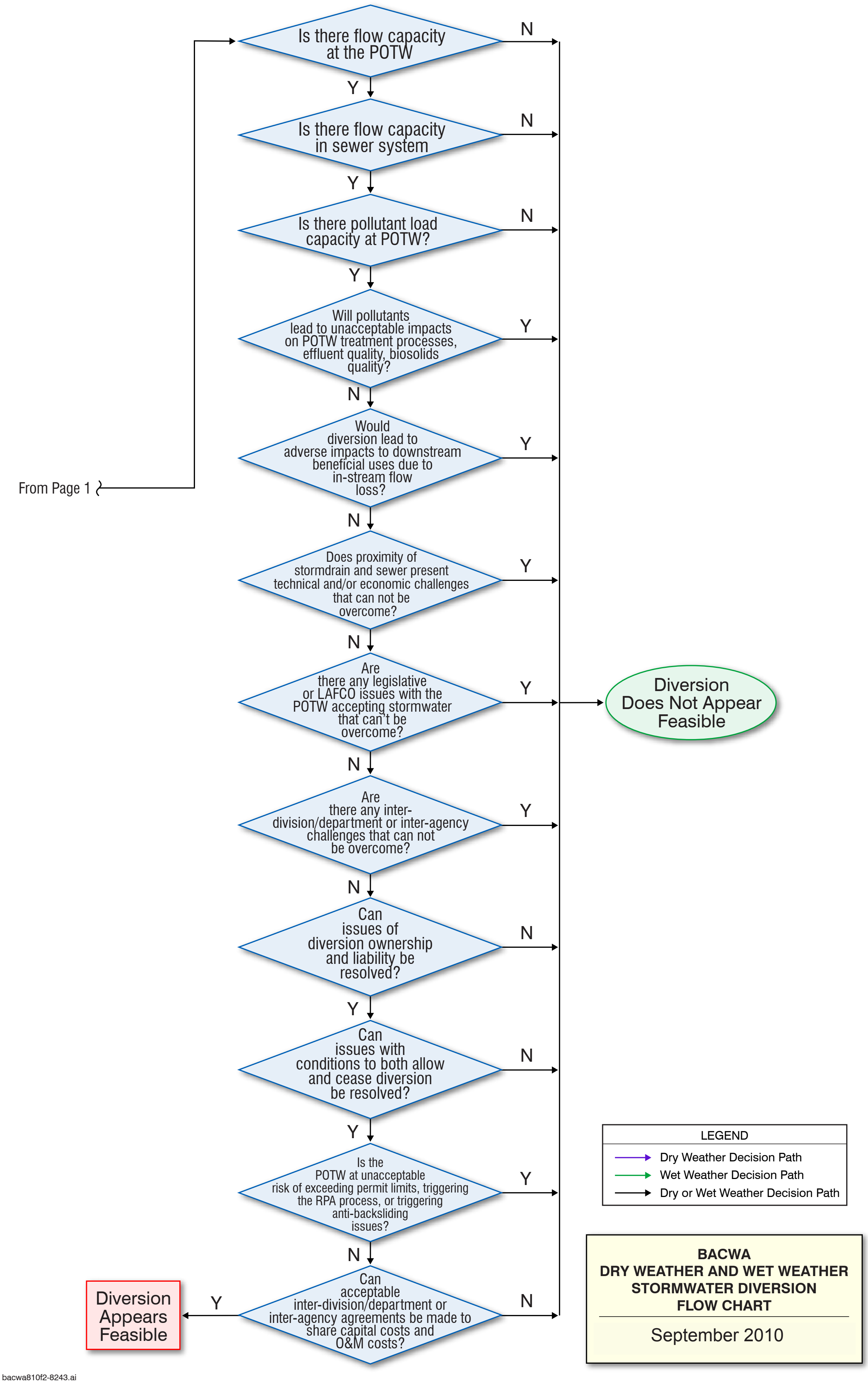
Is there flow capacity at the POTW
N
Y
Is there flow capacity in sewer system
N
Y
Is there pollutant load capacity at POTW?
N
Y
Will pollutants lead to unacceptable impacts on POTW treatment processes, effluent quality, biosolids quality?
Y
N
Would diversion lead to adverse impacts to downstream beneficial uses due to in-stream flow loss?
Y
From Page 1
N
Does proximity of stormdrain and sewer present technical and/or economic challenges that can not be overcome?
Y
N
Are there any legislative or LAFCO issues with the POTW accepting stormwater that can't be overcome?
Y
Diversion Does Not Appear Feasible
N
Are there any inter-division/department or inter-agency challenges that can not be overcome?
Y
N
Can issues of diversion ownership and liability be resolved?
N
Y
Can issues with conditions to both allow and cease diversion be resolved?
N
Y
Is the POTW at unacceptable risk of exceeding permit limits, triggering the RPA process, or triggering anti-backsliding issues?
Y
N
Can acceptable inter-division/department or inter-agency agreements be made to share capital costs and O&M costs?
N
Y
Diversion Appears Feasible
LEGEND
Dry Weather Decision Path
Wet Weather Decision Path
Dry or Wet Weather Decision Path
BACWA
DRY WEATHER AND WET WEATHER
STORMWATER DIVERSION
FLOW CHART
September 2010
bacwa810f2-8243.ai

APPENDIX E – JURISDICTIONAL TABLE

Bay Area POTWs	Related Stormwater Entity/ Affiliation
Central Contra Costa Sanitary District Martinez Clyde Pacheco Concord Pleasant hill Clayton Walnut Creek Lafayette Orinda Moraga Alamo Danville San Ramon	Individual cities responsible for stormwater. Most are part of CCCWP.
San Francisco Public Utilities Commission (SFPUC)	SFPUC responsible for stormwater.
San José / Santa Clara Water Pollution Control Plant	City of San José responsible for stormwater. Part of SCVURPPP.
East Bay Dischargers Authority City of Hayward City of San Leandro Oro Loma Sanitary District Union Sanitary District Castro Valley Sanitary District Dublin Pleasanton Livermore	Individual cities responsible for stormwater. Most are part of ACCWP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
East Bay Municipal Utility District Albany Berkeley Emeryville Piedmont Oakland Alameda	Individual cities responsible for stormwater. Most are part of ACCWP.
Central Marin Sanitation Agency San Rafael Sanitation District Sanitary District No. 1 of Marin County Sanitary District No. 2 of Marin County City of Larkspur	See Sanitary District No. 1 of Marin County and Sanitary District No. 2 of Marin County for more information. City of San Rafael responsible for stormwater. Part of MCSTOPPP. City of Larkspur responsible for stormwater. Part of MCSTOPPP.
City of Livermore	City of Livermore responsible for stormwater. Part of ACCWP.
City of Palo Alto	City of Palo Alto responsible for stormwater. Part of SCVURPPP.
City of San Mateo	City of San Mateo responsible for stormwater. Part of SMCWPPP.
City of Sunnyvale	City of Sunnyvale responsible for stormwater. Part of SCVURPPP.
Delta Diablo Sanitation District Antioch Baypoint Pittsburgh	Individual cities responsible for stormwater. Antioch and Pittsburg part of CCCWP.
Dublin-San Ramon Services District	City of Dublin responsible for stormwater. Part of CCCWP. City of San Ramon responsible for stormwater. Part of ACCWP.
Fairfield Suisun Sewer District	City of Fairfield responsible for stormwater. Part of FSURMP. City of Suisun City responsible for stormwater. Part of FSURMP.
Napa Sanitation District	City of Napa responsible for stormwater. Part of NCSWPPP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
Sacramento Regional County Sanitation District City of Sacramento City of West Sacramento City of Rancho Cordova City of Citrus Heights City of Elk Grove City of Folsom	Individual cities responsible for stormwater. Cities are part of the Sacramento Stormwater Quality Partnership (SSQP).
South Bayside System Authority Belmont Redwood City Menlo Park Portola Valley East Palo Alto Woodside Unincorporated areas of San Mateo County	Individual cities responsible for stormwater. Cities are part of SMCWPPP.
South San Francisco /San Bruno WQCP	South San Francisco and San Bruno responsible for stormwater. Both cities part of SMCWPPP.
Vallejo Sanitation and Flood Control District City of Vallejo Unincorporated area in greater Vallejo area	Vallejo Sanitation and Flood Control District responsible for stormwater.
West County Agency City of Richmond West County Wastewater Services District	Individual cities responsible for stormwater. City of Richmond part of CCCWP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
City of American Canyon	City of American Canyon responsible for stormwater. Part of NCSWPPP.
City of Belmont	City of Belmont responsible for stormwater. Part of SMCWPPP.
City of Benicia	City of Belmont responsible for stormwater.
City of Berkeley	City of Berkeley responsible for stormwater. Part of ACCWP.
City of Brisbane Public Works	City of Brisbane responsible for stormwater. Part of SMCWPP.
City of Burlingame WWTP	City of Burlingame responsible for stormwater. Part of SMCWPP.
City of Fairfield	City of Fairfield responsible for stormwater.
City of Milbrae	City of Milbrae responsible for stormwater. Part of SMCWPP.
City of Milpitas	City of Milpitas responsible for stormwater. Part of SCVURPPP.
City of Petaluma	Sonoma County Water Agency responsible for stormwater..
City of Piedmont	City of Piedmont responsible for stormwater. Part of ACCWP.
City of Pleasanton	City of Pleasanton responsible for stormwater. Part of ACCWP.
City of Redwood City	City of Redwood City responsible for stormwater. Part of SMCWPP.
City of Richmond WPCP	City of Richmond responsible for stormwater. Part of CCCWP.
City of St Helena	City of St Helena responsible for stormwater. Part of NCSWPPP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
City of San Carlos	City of San Carlos responsible for stormwater. Part of SMCPPP.
Las Gallinas Valley Sanitation District Las Gallinas Santa Venetia	Individual cities responsible for stormwater.
Mt View Sanitary District	City of Mountain View responsible for stormwater. Part of SCVURPPP.
North San Mateo Sanitation District	City of San Mateo responsible for stormwater. Part of SMCWPPP.
Novato Sanitary District	City of Novato responsible for stormwater. Part of MCSTOPPP.
Pinole/Hercules WPCP	City of Pinole responsible for stormwater. Part of CCCWP. City of Hercules responsible for stormwater. Part of CCCWP.
San Francisco International Airport	
San Mateo County, Department of Public Works	City of San Mateo responsible for stormwater. Part of SMCWPPP.
Sanitary District of Marin County No 1 City of Larkspur Kentfield Greenbrae Ross San Anselmo Fairfax San Quentin Prison Unincorporated areas of Marin County	Individual cities responsible for stormwater. Part of MCSTOPPP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
Sanitary District of Marin County No 2 Corte Madera	Individual cities responsible for stormwater. Part of MCSTOPPP.
Sanitary District of Marin County No 5 City of Belevedere Tiburon peninsula	Individual cities responsible for stormwater. City of belvedere part of MCSTOPPP.
Santa Clara County Sanitation District No 2-3	City of Santa Clara responsible for stormwater. Part of SCVURPPP.
Sausalito/Marin City Sanitary District (SMCSD)	Individual cities responsible for stormwater. City of Sausalito part of MCSTOPPP.
Sewage Agency of Southern Marin Mill Valley	Mill Valley responsible for stormwater. Part of MCSTOPPP.
Sewer Authority Mid-Coastside Half Moon Bay Grenada and Montara Sanitary Districts	Individual cities responsible for stormwater. City of San Mateo part of SMCWPPP.
Sonoma County Water Agency	Sonoma County Water Agency responsible for stormwater.
Stege Sanitary District El Cerrito Richmond Kensington	Individual cities responsible for stormwater. City of El Cerrito and Richmond part of CCCWP.

Bay Area POTWs	Related Stormwater Entity/ Affiliation
Tamalpais Community Services District (TCSD) Sausalito Mill Valley	Sausalito responsible for stormwater. Part of MCSTOPPP. Mill Valley responsible for stormwater. Part of MCSTOPPP.
Town of Yountville	Town of Yountville responsible for stormwater. Part of NCSWPPP.
West Bay Sanitary District Menlo Park Atherton Portola valley East Palo Alto Woodside Unincorporated areas of San Mateo and Santa Clara Counties	Individual cities responsible for stormwater. Most cities part of SMCWPPP.
West Valley Sanitation District Campbell Monte Sereno Los Gatos Saratoga	Individual cities responsible for stormwater. Part of the West Valley Clean Water Program.
Abbreviations: ACCWP = Alameda Countywide Clean Water Program CCCWP= Contra Costa Clean Water Program FSURMP = Fairfield-Suisun Urban Runoff Management Program MCSTOPPP = Marin County Stormwater Pollution Prevention Program SMCWPPP = San Mateo Countywide Water Pollution Prevention Program SCVURPPP = Santa Clara Valley Urban Runoff Pollution Prevention Program NCSWPPP=Napa County Stormwater Pollution Prevention Program	

APPENDIX D - SIP EXCERPT – PLANT REPLACEMENT ALTERNATIVE SUMMARY

SIP Excerpt - Plant Replacement Alternative Summary (Attachment D)

Summary of Project Costs for Plant Replacement Alternatives

Process Location Number	Revised Name	Plant Replacement Alternative A				Plant Replacement Alternative B		
		Bid Pkg 1	Bid Pkg 2 - Ph 1	Bid Pkg 2 - Ph 2	Bid Pkg 3	Bid Pkg 1	Bid Pkg 2	Bid Pkg 3
		2/15/11 - 2/15/14	2/15/14 - 2/15/16	2/15/16 - 2/15/18	2/15/18 - 2/15/22	2/15/11 - 2/15/14	2/15/14 - 2/15/19	2/15/19 - 2/15/24
1100	Civil/Site Work Existing Plant Area		2,400,749				2,907,666	
1101	Raw Sewage Pumping Station	5,923,861				5,906,960		
1102	Screening	3,652,447				3,647,811		
1103	Grit Removal	4,328,267				4,326,582		
1105	Landfill Gas Booster and Flare System	842,495				841,983		
1106	Primary Sedimentation Tanks	15,431,188				15,427,159		
1107	New Administration Building		3,060,977					4,527,814
1108	Area Substation - Headworks/Primaries	4,005,055				4,005,055		
1109	Demolition - Auxilliary Pump Station	3,371,008				3,371,008		
1110	Demo - Sludge Dewatering Bins	3,935,186				3,935,149		
1111	Demo - Primary Sedimentation Tanks 1-5	1,406,093				1,406,093		
1112	Demo - Primary Sedimentation Tanks 6-10	1,230,819				1,230,819		
1113	Primary Effluent Pipeline	2,619,003				2,619,003		
1114	Demo - 66" RCP	47,521				47,519		
1115	Demo - 24" and 30" Pipe	143,956				143,945		
1116	Demo - Primary control Building	1,736,672				1,736,257		
1117	Relocated Utilities Building	1,527,349				1,522,060		
1118	Area Substation - Tertiary				4,379,335			4,891,543
1120	Community Improvements - On-Site Features				274,048			306,056
1121	Community Improvements - Off-Site Features				99,238			110,266
1128	Area Substation - Biological		3,651,599				4,066,581	
1129	Maintenance Building		1,282,090				1,405,657	
1130	Demo - DAFT Area				1,656,704			1,762,978
1131	Demo - Chlorination Building			544,628				672,633
1132	Demo - Dechlorination Building			195,763				241,442
1133	Demo - Chemical Storage Area			577,078				711,469
1134	Demo - Float Pumping Station				1,129,948			1,222,940
1135	Demo - FGR Pump Station				1,313,793			1,419,220
1136	Demo - Existing Administration Building		272,262					366,606
1137	Demo - Maintenance Building and Garage		291,469				311,039	
1138	Demo - Fixed Growth Reactors				3,478,513			3,713,838
1139	Demo - Tertiary Facility							5,858,035
2103	Pond Effluent Pump Station		3,357,248				3,636,683	
2109	Dual Media Filtration				4,533,112			
2110	Chlorine Contact Reactors		904,860					
2111	Disinfectant Management		2,620,901					
2118	Main Power Distribution Center	2,713,040				2,713,040		
2119	Biogas Power Generation				12,361,532			13,812,682
3001	Stormwater Equalization				18,753,766			20,881,075
3002	Diurnal Equalization				7,265,674			7,991,344
3003	Pond Water Control Structures				4,098,907			4,521,515
3004	Pond Earthwork				647,456			693,648
3005	Pond Dredging				9,123,250			9,924,301
3102	Rotary Drum Thickeners			4,493,045			4,324,657	
3103	Thickened Sludge Storage			7,158,306			6,880,317	
3104	Anaerobic Digesters				22,776,694			24,858,765
3105	Pasteurization Tanks				25,669,771			28,133,506
3106	Un-Thickened Sludge Storage			429,359			414,353	
3107	Gas Storage				5,102,535			5,740,268
3108	Gas Moisture Reduction				1,456,965			1,621,468
3109	Gas Purification				1,163,276			1,301,440
3110	Gas Compressors				482,658			535,704
3111	Boilers				645,676			714,764
3112	Digester Gas Flares				2,870,229			3,189,175
3114	Screw Press			19,209,519			18,494,410	
3118	Area Substation - Solids Handling			3,113,199			3,002,138	
3119	Digested Sludge Storage				4,636,694			5,057,464
4101	Aeration Basins		27,554,716					
4102	Secondary Clarifiers			15,690,617				
4103	Recycled Water (Cloth Filters, Cl2)				4,800,370			
4105	Recycled Water (UV only)							4,891,020
5101	Membrane Bioreactor						94,267,362	
5102	UV Disinfection							3,331,574
Subtotal		52,913,960	45,396,871	51,411,514	138,720,144	52,880,443	139,710,863	163,004,553
Total		**288,442,489**				**355,595,859**		

SIP Excerpt - Plant Replacement Alternative Summary (Attachment D)

Total = $194,307,000

Total = $272,014,000

From Summary Sheet:

Year of analysis	2009
Escalation rate	6.20%
Discount rate	7.20%

Risk adjustments (+/- percent):

Benefits	
Capital costs	
Running costs	

City of Sunnyvale
Strategic Infrastructure Plan
Life Cycle Alternative Cost Analysis ($000s)
Alternative 3 - New Plant - Conventional A.S.

Year

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Expressed in 2009 dollars, unescalated															
Capital Outlays															
Design / ER		3,238	3,238	3,238	3,238	3,238	3,238	3,238	3,238	3,238					
Improvements			1,973	3,693	6,746	11,794	19,115	27,476	33,375	33,158	26,974	18,597	11,406		
Construction Contingency			1,766	1,766	1,766	1,766	1,766	1,766	1,766	1,766	1,766	1,766	1,766		
Construction Management			1,413	1,413	1,413	1,413	1,413	1,413	1,413	1,413	1,413	1,413	1,413		
Project / Program Mgmt & Fees		1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133		
Other															
Total capital outlays		4,371	9,523	11,243	14,296	19,344	26,665	35,026	40,925	40,708	31,286	22,909	15,718		
Benefits:															
Other															
Other															
Other															
Total benefits															
Annual Running Costs:															
Annual Consumables Costs		3,900	3,910	3,920	3,930	3,940	3,950	3,960	3,970	3,061	3,069	3,076	3,084	3,092	3,100
Labor Premium										200	200	200	200	200	200
Odor Control						366	366	366	366	366	366	366	366	366	366
UV Disinfection Delta										(400)	(400)	(400)	(400)	(400)	(400)
Other															
Other															
Other															
Other															
Total running costs		3,900	3,910	3,920	3,930	4,306	4,316	4,326	4,336	3,227	3,235	3,242	3,250	3,258	3,266
R&R Costs:															
Other															
Other															
Other															
Other															
Other															
Total refurbishments															
Net Benefit/(cost)		(8,271)	(13,433)	(15,163)	(18,226)	(23,650)	(30,981)	(39,351)	(45,261)	(43,935)	(34,521)	(26,151)	(18,968)	(3,258)	(3,266)
Expressed in escalated dollars with sensitivity adjustments															
Capital Outlays															
Design / ER		3,439	3,652	3,878	4,119	4,374	4,645	4,933	5,239	5,564					
Improvements			2,225	4,423	8,582	15,933	27,424	41,862	54,003	56,978	49,226	36,042	23,477		
Construction Contingency			1,992	2,115	2,246	2,386	2,534	2,691	2,858	3,035	3,223	3,423	3,635		
Construction Management			1,594	1,692	1,797	1,909	2,027	2,153	2,286	2,428	2,579	2,738	2,908		
Project / Program Mgmt & Fees		1,203	1,278	1,357	1,441	1,531	1,625	1,726	1,833	1,947	2,068	2,196	2,332		
Other															
Total capital outlays		4,642	10,740	13,466	18,186	26,132	38,255	53,365	66,220	69,952	57,095	44,399	32,352		
Benefits:															
Other															
Other															
Other															
Total benefits															
Annual Running Costs:															
Annual Consumables Costs		4,142	4,410	4,695	4,999	5,322	5,666	6,033	6,423	5,260	5,600	5,962	6,348	6,758	7,196
Labor Premium										344	365	388	412	437	464
Odor Control						494	525	558	592	629	668	709	753	800	850
UV Disinfection Delta										(687)	(730)	(775)	(823)	(874)	(929)
Other															
Other															
Other															
Other															
Total running costs		4,142	4,410	4,695	4,999	5,817	6,191	6,591	7,015	5,545	5,903	6,284	6,690	7,121	7,581
R&R Costs:															
Other															
Other															
Other															
Other															
Other															
Total refurbishments															
Net escalated benefit/(cost)		(8,784)	(15,150)	(18,161)	(23,184)	(31,949)	(44,447)	(59,956)	(73,235)	(75,497)	(62,998)	(50,683)	(39,041)	(7,121)	(7,581)
Life cycle cost analysis															
PVs in 2009		(8,194)	(13,183)	(14,742)	(17,556)	(22,567)	(29,287)	(36,853)	(41,991)	(40,381)	(31,433)	(23,590)	(16,951)	(2,384)	(2,864)
NPV as of 2009	(343,124)														

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Expressed in 2009 dollars, unescalated															
Capital Outlays															
Design / ER															
Improvements															
Construction Contingency															
Construction Management															
Project / Program Mgmt & Fees															
Other															
Total capital outlays															
Benefits:															
Other															
Other															
Other															
Total benefits															
Annual Running Costs:															
Annual Consumables Costs	3,108	3,115	3,123	3,131	3,139	3,147	3,155	3,163	3,171	3,179	3,187	3,195	3,203	3,211	3,219
Labor Premium	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Odor Control	366	366	366	366	366	366	366	366	366	366	366	366	366	366	366
UV Disinfection Delta	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)	(400)
Other															
Other															
Other															
Other															
Total running costs	3,274	3,281	3,289	3,297	3,305	3,313	3,321	3,329	3,337	3,345	3,353	3,361	3,369	3,377	3,385
R&R Costs:															
Other															
Other															
Other															
Other															
Other															
Total refurbishments															
Net Benefit/(cost)	(3,274)	(3,281)	(3,289)	(3,297)	(3,305)	(3,313)	(3,321)	(3,329)	(3,337)	(3,345)	(3,353)	(3,361)	(3,369)	(3,377)	(3,385)
Expressed in escalated dollars with sensitivity adjustments															
Capital Outlays															
Design / ER															
Improvements															
Construction Contingency															
Construction Management															
Project / Program Mgmt & Fees															
Other															
Total capital outlays															
Benefits:															
Other															
Other															
Other															
Total benefits															
Annual Running Costs:															
Annual Consumables Costs	7,661	8,157	8,684	9,246	9,844	10,481	11,159	11,880	12,649	13,467	14,338	15,265	16,253	17,304	18,423
Labor Premium	493	524	556	591	627	666	707	751	798	847	900	956	1,015	1,078	1,145
Odor Control	902	958	1,018	1,081	1,148	1,219	1,294	1,375	1,460	1,550	1,647	1,749	1,857	1,972	2,095
UV Disinfection Delta	(986)	(1,047)	(1,112)	(1,181)	(1,254)	(1,332)	(1,415)	(1,502)	(1,596)	(1,695)	(1,800)	(1,911)	(2,030)	(2,155)	(2,289)
Other															
Other															
Other															
Other															
Total running costs	8,070	8,591	9,146	9,736	10,364	11,033	11,746	12,504	13,311	14,170	15,085	16,059	17,095	18,199	19,373
R&R Costs:															
Other															
Other															
Other															
Other															
Other															
Total refurbishments															
Net escalated benefit/(cost)	(8,070)	(8,591)	(9,146)	(9,736)	(10,364)	(11,033)	(11,746)	(12,504)	(13,311)	(14,170)	(15,085)	(16,059)	(17,095)	(18,199)	(19,373)
Life cycle cost analysis															
PVs in 2009	(2,844)	(2,824)	(2,805)	(2,785)	(2,766)	(2,747)	(2,728)	(2,709)	(2,690)	(2,671)	(2,653)	(2,634)	(2,616)	(2,598)	(2,580)
NPV as of 2009															

Total = $320,175,000

Total = $434,804,000

APPENDIX E - SIP CONSTRUCTION COST SUMMARY

Sunnyvale - SIP Cost Reconciliation				
Backup for Table 4				
May-13	Construction			
	$ Escalated	Assumed	Adjusted	
Item	**To Midpoint**	**Midpoint**	**June-14**	**Comments**
Headworks/Primary Sed Basins				
Raw Sewage Pumping	$ 5.9	July-12	$ 6.3	
Screening	$ 3.7	July-12	$ 3.9	
Grit Removal	$ 4.3	July-12	$ 4.6	
Landfill Gas Booster & Flare System	$ 0.8	July-12	$ 0.8	
Primary Sed Tanks	$ 15.4	July-12	$ 16.3	
Area Substation	$ 4.0	July-12	$ 4.2	
Primary Effluent Pipeline	$ 2.6	July-12	$ 2.8	
Demo 66", 24" & 30" Pipelines	$ 0.2	July-12	$ 0.2	
Relocated Utility Bldg.	$ 1.5	July-12	$ 1.6	
Main Power Distribution/Stdby Power	$ 2.7	July-12	$ 2.9	
Subtotal	$ 41.1		$ 43.6	
Site Demo & Restoration - Hdwks & Primary				
Demo - Aux Pump Station	$ 3.4	July-12	$ 3.6	
Demo - Sludge Dewatering Beds	$ 3.9	July-12	$ 4.1	
Demo - Primary Sed Basins	$ 2.6	July-12	$ 2.8	
Demo - Primary Control Bldg.	$ 1.7	July-12	$ 1.8	
Civil / Site Work	$ 0.8	January-15	$ 0.8	
Subtotal	$ 12.4		$ 13.1	
Secondary Treatment				
Aeration Basins	$ 27.6	January-15	$ 27.1	Assumes conventional activated sludge
Secondary Clarifiers	$ 15.7	January-17	$ 14.6	Assumes conventional activated sludge
Primary Effluent Equalization - Peak Flows	$ 18.8	January-20	$ 16.5	
Primary Effluent Equalization - Diurnal Flows	$ 7.3	January-20	$ 6.4	
Pond Effluent Pump Station	$ 3.4	January-15	$ 3.3	
Pond Restoration	$ -	January-20	$ -	$13.9 MM included in SIP but excluded from $318 budget
Area Substation	$ 3.7	January-15	$ 3.6	
Civil / Site Work	$ 0.8	January-15	$ 0.8	
Subtotal	$ 77.3		$ 72.4	

May-13	Construction			
	$ Escalated	Assumed	Adjusted	
Item	**To Midpoint**	**Midpoint**	**June-14**	**Comments**
Filtration/Disinfection				
Dual Media Filters Upgrades	$ 4.5	January-15	$ 4.6	Not sure what improvements were included
Disinfection Management	$ 2.6	January-15	$ 2.6	
Chlorine Contact Reactors	$ 0.9	January-15	$ 0.9	
Area Substation	$ 4.4	January-20	$ 3.8	
Subtotal	$ 12.4		$ 11.9	
Sludge Thickening				
Unthickened Sludge Storage	$ 0.4	January-17	$ 0.4	
Rotating Drum Thickeners	$ 4.5	January-17	$ 4.2	
Thickened Sludge Storage	$ 7.2	January-17	$ 6.7	
Subtotal	$ 12.1		$ 11.2	
Support Facilities				
Admin Bldg Demo	$ 0.3	January-15	$ 0.3	
New Admin Bldg.	$ 3.1	January-15	$ 3.0	
Maint Bldg & Garage Demo	$ 0.3	January-15	$ 0.3	
New Maintenance Building	$ 1.3	January-15	$ 1.3	
Subtotal	$ 5.0		$ 4.9	
Dewatering				
Digested Sludge Storage	$ 4.6	January-16	$ 4.4	
Dewatering Facilities - Screw Press	$ 19.2	January-16	$ 18.4	
Area Substation	$ 3.1	January-17	$ 2.9	
Subtotal	$ 26.9		$ 25.7	
Digestion				
Existing Digester Rehab	$ 22.8	January-20	$ 20.0	Not sure what improvements were included
Conversion to TPAD	$ 25.7	January-20	$ 22.5	
Subtotal	$ 48.5		$ 42.5	
Digester Gas Management				
Gas Storage	$ 5.1	January-20	$ 4.5	
Gas Moisture Reduction	$ 1.5	January-20	$ 1.3	
Gas Purification	$ 1.2	January-20	$ 1.1	
Gas Compressors	$ 0.5	January-20	$ 0.4	
Boilers	$ 0.6	January-20	$ 0.5	
Gas Flares	$ 2.9	January-20	$ 2.5	
Biogas Co-Generation	$ 12.4	January-20	$ 10.9	
Subtotal	$ 24.2		$ 21.2	

May-13	Construction			
	$ Escalated	Assumed	Adjusted	
Item	To Midpoint	Midpoint	June-14	Comments
Misc. Plant Improvements				
Recycled Water	$ 4.8	January-20	$ 4.2	Cloth filters & Hypo
Odor Improvements	$ 11.9	January-10	$ 11.9	Unescalated allowance (headworks, PSTs, AS tanks, thickening/dewatering)
Demo DAFT	$ 1.7	January-20	$ 1.5	
Demo Chlorine Bldg.	$ 0.5	January-17	$ 0.5	
Demo DeChlor Bldg.	$ 0.2	January-17	$ 0.2	
Demo Chemo Storage Area	$ 0.6	January-17	$ 0.6	
Demo Float Pumping Station	$ 1.1	January-20	$ 1.0	
Demo FGR Pump Station	$ 1.3	January-20	$ 1.1	
Demo FGRs	$ 3.5	January-20	$ 3.0	
Misc. Civil / Site Work	$ 0.8	January-15	$ 0.8	
Community Improvements	$ 0.4	January-20	$ 0.3	Not specified
Subtotal	$ 26.8		$ 25.0	
Total	$ 286.7		$ 271.5	