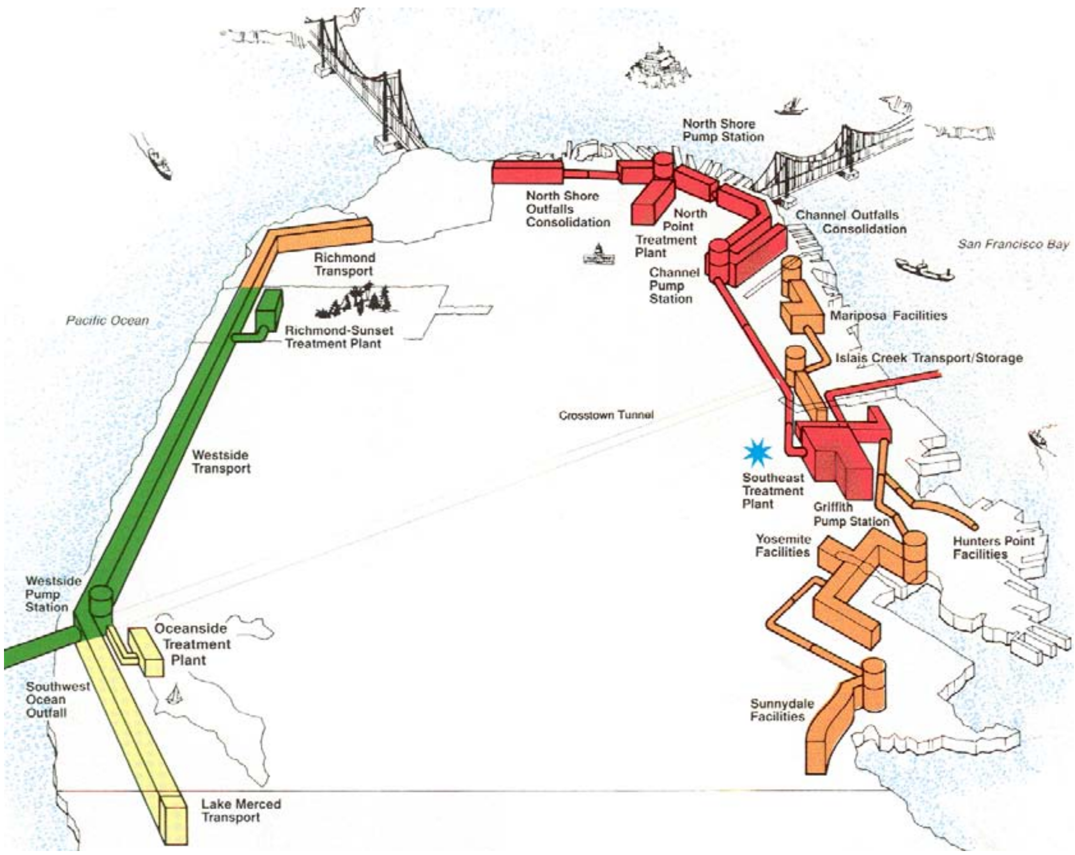
National Decentralized Water Resources
Capacity Development Project



Hunters Point Shipyard
Decentralized Wastewater Treatment Study

San Francisco Public Utilities Commission
San Francisco, California

October 2004

Hunters Point Shipyard Decentralized Wastewater Treatment Study San Francisco, California

Submitted by San Francisco Public Utilities Commission

NDWRCDP Project Number: WU-HT-01-34

National Decentralized Water Resources Capacity Development Project (NDWRCDP) Research Project

Final Report, October 2004

NDWRCDP, Washington University, Campus Box 1150
One Brookings Drive, Cupples 2, Rm. 11, St. Louis, MO 63130-4899

DISCLAIMER

This work was supported by the National Decentralized Water Resources Capacity Development Project (NDWRCDP) with funding provided by the U.S. Environmental Protection Agency through a Cooperative Agreement (EPA No. CR827881-01-0) with Washington University in St. Louis. This report has been reviewed by a panel of experts selected by the NDWRCDP. The contents of this report do not necessarily reflect the views and policies of the NDWRCDP, Washington University, or the U.S. Environmental Protection Agency, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

CITATIONS

This report was prepared by

Gregg E. Olson
San Francisco Public Utilities Commission (SFPUC)
1155 Market Street, 4th Floor
San Francisco, California 94103

The final report was edited and produced by ProWrite Inc., Reynoldsburg, OH.

This report is available online at www.ndwrcdp.org. This report is also available through the

National Small Flows Clearinghouse
P.O. Box 6064
Morgantown, WV 26506-6065
Tel: (800) 624-8301
WWCDMG34

This report should be cited in the following manner:

Olson, G. E. 2004. *Hunters Point Shipyard Decentralized Wastewater Treatment Study*. Project No. WU-HT-01-34. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by San Francisco Public Utilities Commission, San Francisco, CA.

ACKNOWLEDGEMENTS

Appreciation is extended to the following individuals for assistance in the preparation of this report:

Montgomery Watson Harza (MWH)
Erik Meserve and Simon Heart

SFPUC Technical Review Committee (TRC)

Blair Allen, RWQCB

Robert Gearheart, Ph.D.,
Humboldt State University

David Jenkins, Ph.D., UC Berkeley

Michael Josselyn, Ph.D.,
San Francisco State University

Joe Middlebrooks, Ph.D., University of Nevada

George Tchobanoglous, Ph.D., UC Davis

Appreciation is also expressed to the NDWRCDP for their support of this work:

Principal Investigator
Jay R. Turner, D.Sc., Washington University

Project Coordinator
Andrea L. Shephard, Ph.D.

NDWRCDP Project Steering Committee:

Coalition for Alternative Wastewater Treatment
Valerie I. Nelson, Ph.D.

Consortium of Institutes for Decentralized Wastewater Treatment
Ted L. Loudon, Ph.D., P.E.

Electric Power Research Institute
Raymond A. Ehrhard, P.E.
Tom E. Yeager, P.E.

National Onsite Wastewater Recycling Association
Jean Caudill, R.S.

National Rural Electric Cooperative Association
Steven P. Lindenberg
Scott Drake, P.E.

Water Environment Research Foundation
Jeff C. Moeller, P.E.

Members-At-Large
James F. Kreissl
Richard J. Otis, Ph.D., P.E.
Jerry Stonebridge

ABSTRACT

The San Francisco Public Utilities Commission (SFPUC) investigated various decentralized wastewater treatment technologies for use at Hunters Point Shipyard (HPS), a 500-acre redevelopment area in southeast San Francisco. The study concluded that, if decentralized wastewater treatment is pursued at HPS, a membrane bioreactor (MBR) satellite plant operating in a scalping mode would be the preferred alternative. An MBR plant could supply the redevelopment area with recycled water for in-building dual plumbing, landscape irrigation, and environmental enhancements (such as a water source for seasonal wetlands). The study provided important technical and cost information considered in the city-wide Clean Water Master Plan initiated in June 2004.

EXECUTIVE SUMMARY

Over the next 20 years, Hunters Point Shipyard (HPS) in San Francisco will be redeveloped according to the 1997 HPS Redevelopment Plan. This significant redevelopment project, which consists of approximately 500 acres of residential, commercial, light industrial, and open space areas, provides an opportunity for new and innovative wastewater and storm water treatment approaches.

Most of the City of San Francisco is served by a combined sewer system, where wastewater and storm water are collected in the same pipes and sent to two wastewater treatment plants for secondary treatment. The Southeast Water Pollution Control Plant (SEWPCP) serves the east side of the city and discharges to San Francisco Bay, and the Oceanside Water Pollution Control Plant (OSWPCP) serves the west side of the city and discharges to the Pacific Ocean.

The HPS Decentralized Wastewater Treatment Study explored a wide range of decentralized treatment alternatives for HPS, with possible benefits that include:

- **Combined Sewer Overflow (CSO) Volume Reduction—**When the flows collected during large storm events exceed the sewer system capacity, partially-treated discharges (typically composed of 6% sanitary sewage and 94% storm water) occur at one or more of the 36 CSO structures along the city shoreline.
- **Environmental Justice**—The SEWPCP treats approximately 80% of the wastewater generated in San Francisco, including most of the commercial (downtown) wastewater and the bulk of all industrial discharges. The Bayview Hunters Point community is impacted by this distribution of the city’s treatment burden.
- **Use of Recycled Water**—The ongoing Recycled Water Master Plan has identified a preliminary city-wide recycled water demand of 10 million gallons per day (MGD). Benefits of using recycled water include water conservation and environmental enhancements (such as wetlands).

At the outset of the study, the following assumptions were made:

- Wastewater flow at HPS at full build-out will be 4 MGD (the primary developer has estimated a range of 2 to 5 MGD).
- Decentralized systems will be designed to treat all flow on site (that is, no flow from HPS will be treated at SEWPCP).
- No new outfall for discharge to San Francisco Bay will be created, requiring onsite reuse of all treated wastewater and/or the use of the existing SEWPCP outfall.

- To maximize reuse opportunities, treated effluent must meet the disinfected tertiary treatment level specified for recycled water (treatment level and water quality requirements specified in Title 22).
- Sanitary sewage and storm water collection systems will remain separated.

In addition to the above assumptions, other scenarios were investigated as the study unfolded. Along with the 4-MGD designs, designs based on a 2-MGD buildout scenario were analyzed. The study also assessed a scalping mode of operation, where treatment would match recycled water demands and excess wastewater and all solids would be returned to the sewer system for eventual treatment at SEWPCP.

The study initially screened a total of 24 decentralized wastewater technologies. The 24 technologies were divided into three general approaches. Within each approach, the most promising and representative technology was selected for further analysis. The general approaches and selected technologies are summarized as follows:

Approach	Selected Technology for Detailed Analysis
Advanced Treatment Satellite Plant	Membrane Bioreactor (MBR)
Natural Treatment System	Free Water Surface (FWS) Constructed Wetland
Small Onsite/Cluster Treatment Systems	Large Septic Tanks and Biotextile Filters

Among the three technologies analyzed in detail, the MBR was the most favorable for reuse applications, effluent quality reliability, ease of implementation, land requirements, capital and operation and maintenance (O&M) costs, O&M demands, and community impacts (public health, public safety, and odors).

The primary developer estimates that HPS dry-weather flows could range from 2 MGD to 5 MGD at full build-out (Lennar/CH2M Hill 2002). A recycled water market analysis, conducted as part of this study (see Appendix D, TM4-1, *Water Reuse Alternatives*), found that recycled water could be used to satisfy the following approximate demands at HPS:

- In-building dual plumbing: 0.40 MGD
- Landscape irrigation (60 acres): 0.14 MGD
- Wetland creation/enhancement (40 acres): 0.09 MGD

To avoid San Francisco Bay discharge issues and mosquito-related issues, the wetland would have to have “no discharge” without wetland ponding or wetland flows. Offsite recycled water demands were also assessed. The offsite demands within a 2.5-mile radius of HPS ranged from 1.4 MGD to 4.0 MGD (depending on future demands from Potrero Power Plant).

Two sites for a three-acre MBR facility were identified: 1. A site in the light industrial area of Parcel E; 2. A site near the existing sanitary pump station (Building 819A) of Parcel A.

The most effective mode of operation for a decentralized system was determined to be a scalping mode, which involves treating only wastewater flows equivalent to the water reuse demand and returning all solids to the combined sewer system. This scalping mode of operation eliminated the need for onsite solids handling/treatment that would significantly increase costs, operational demands, and odor generation potential. A scalping mode of operation also avoids the need for onsite discharge of effluent.

Under a scalping scenario, SEWPCP would treat all HPS wastewater in excess of the recycled water demand and all solids generated at HPS. The costs and expected footprints for MBR satellite plants at 0.5-MGD, 2-MGD, and 4-MGD capacities are summarized as follows.

Capacity of MBR Scalping Plant (MGD)	Capital Cost* ($ million)	Annual O&M Cost* ($ million)	Net Present Value Cost 30-year Life Cycle ($ million)	Land Requirement (acres)	Area Served with Recycled Water
0.5	7.1	0.4	14.3	0.5	HPS
2.0	26.0	1.4	53.0	1.5	HPS + offsite
4.0	37.2	2.2	83.9	3.0	HPS + offsite

*Capital cost includes engineering and construction costs for the treatment facility in 2003 dollars. Collection system, recycled water storage, and recycled water distribution are not included. Annual O&M costs are in 2003 dollars.

A 0.5-MGD facility would meet the reuse demands at HPS. The larger options (2 and 4 MGD) could be pursued if the plant was to provide offsite recycled water demands.

The technical and cost information developed in this study will be incorporated in two San Francisco Public Utilities Commission (SFPUC) city-wide master planning efforts: 1. The update of the 1996 Recycled Water Master Plan and 2. The 2004 Clean Water Master Plan. Final decisions on the implementation of a decentralized treatment approach will require:

- Broad system-wide perspective
- Long-term vision and strategy for the management of San Francisco's wastewater and storm water
- Comprehensive analysis of
  - System deficiencies
  - Community impacts
  - Public interests
  - Future needs

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Decentralized wastewater treatment refers to onsite wastewater systems used to treat and dispose of relatively small volumes of wastewater, generally from dwellings and businesses that are located close together. These systems are typically encountered in low population rural areas. In an urban area like San Francisco, the definition of decentralized wastewater treatment can be extended to include small treatment systems that produce recycled water for onsite reuse.

Overview

The Hunters Point Shipyard (HPS) Decentralized Wastewater Treatment Study used a systematic approach to evaluate the site-specific applicability, benefits, and drawbacks of various wastewater treatment approaches for HPS. Specifically, the study used a number of evaluation criteria to compare a baseline centralized treatment approach to three decentralized treatment approaches, which were:

- Advanced treatment satellite plants
- Natural treatment systems
- Small onsite/cluster treatment systems

This report contains the results of the HPS Decentralized Wastewater Treatment Study, including the study approach and process, key technical and cost information, and lessons learned. A more comprehensive technical report has also been prepared, which is largely a collection of technical memorandums (TM). This comprehensive technical report also contains expanded analyses and more detailed summaries of study assumptions and calculations.

This report was prepared by the San Francisco Public Utilities Commission (SFPUC), with grant funding from the National Decentralized Water Resources Capacity Development Project (NDWRCDP), NDWRCDP Project No. WU-HT-01-34.

The project was officially initiated and a notice to proceed (NTP) was issued on February 18, 2003. The contract for consultant services ended on February 6, 2004, and the NDWRCDP grant period ended on May 31, 2004. The budget allocated to consultants for this project was \$151,000. Consultant services were funded using a \$75,000 grant from the NDWRCDP and a \$76,000 contribution from the SFPUC. At least ten percent and five percent of the project budget was allocated to minority business enterprises (MBE) and women business enterprises (WBE), respectively. The SFPUC also contributed additional funding (up to \$75,000) for professional services provided by a Technical Review Committee (TRC). The in-kind services donated by the SFPUC are estimated in excess of \$200,000.

Project Team

A number of organizations were involved with this project, including

- SFPUC
- NDWRCDP
- Montgomery Watson Harza (MWH)
- Hydroconsult Engineers (HCE)
- Wetlands and Water Resources
- Baseline Environmental Consulting
- A Technical Review Committee (TRC)
- The Mayor's Office of Economic Development (MOED)
- The San Francisco Redevelopment Agency (SFRA)
- Various community/environmental groups, including the Alliance for a Clean Waterfront (Alliance)

SFPUC assumed project management responsibilities and the NDWRCDP provided general project oversight. A team of consultants (mainly MWH and HCE), with assistance from a SFPUC project engineer, was responsible for conducting the study and producing project deliverables. The TRC, an independent panel of scientific/engineering experts, provided peer review assistance and as-needed consultation for the project. Members of the TRC include the following leading academic and regulatory experts in alternative wastewater technologies:

- Mr. Blair Allen (RWQCB)
- Dr. Robert Gearheart (Humboldt State University)
- Dr. David Jenkins (UC Berkeley)
- Dr. Michael Josselyn (San Francisco State University)
- Dr. Joe Middlebrooks (University of Nevada)
- Dr. George Tchobanoglous (UC Davis)

2 BACKGROUND

The use of recycled water can result in significant benefits including increased water supply, increased water supply reliability, and a reduction in fresh water diversions from important environmental habitats (such as the Bay/Delta system).

Decentralized Wastewater Treatment In Urban Areas

The recent California and nationwide desire to increase the use of recycled water will likely motivate cities to consider decentralized treatment alternatives capable of producing a high-quality effluent near the demand for recycled water.

In addition to recycled water/water conservation goals, decentralized wastewater systems in urban areas could be pursued for

- Environmental justice reasons (such as distributing treatment locations throughout a city rather than concentrating treatment locations in one area)
- The reduction of combined sewer overflows (CSOs)
- The enhancement of constructed wetlands projects during dry months (through the use of recycled water for wetland irrigation)
- An alternative to large treatment plant upgrades

San Francisco's Centralized Combined Sewer System

The City of San Francisco protects public health and the environment by collecting and treating the city's wastewater in a combined sewer system. Through a network of underground pipelines and structures, San Francisco's wastewater is pumped, treated, and discharged to the San Francisco Bay and the Pacific Ocean. A combined sewer system also collects and treats storm water and street runoff that would otherwise be discharged to the environment without treatment. Many large cities, including Boston, New York, and Philadelphia, use combined sewers. Although there are approximately 1,100 combined sewer systems nationwide, there are only two in California—San Francisco and Old Sacramento.

The Southeast Water Pollution Control Plant (SEWPCP) treats wastewater from the eastern side of the city, and the Oceanside Water Pollution Control Plant (OSWPCP) treats wastewater from the western side of the city. The North Point Wet Weather Treatment Facility operates only during wet weather to treat combined sanitary and storm flows.

SEWPCP treats wastewater generated by two-thirds of the city's population. The plant also treats most of the commercial (downtown) wastewater, as well as the bulk of the industrial discharges.

In 1972, the City of San Francisco initiated a Wastewater Master Plan (WWMP) to upgrade its combined sewer system and meet the more stringent requirements of the Clean Water Act. The city completed construction of the major components of the WWMP (with the exception of the Crosstown Tunnel) in 1997 at a cost of $1.4 billion, and by doing so achieved compliance with all regulatory requirements. The WWMP provided for upgrading SEWPCP from primary to secondary treatment; constructing OSWPCP; and constructing large storage sewers, called transport/storage facilities. Figure 2-1 is a schematic map of the system completed as part of the 1972 WWMP.

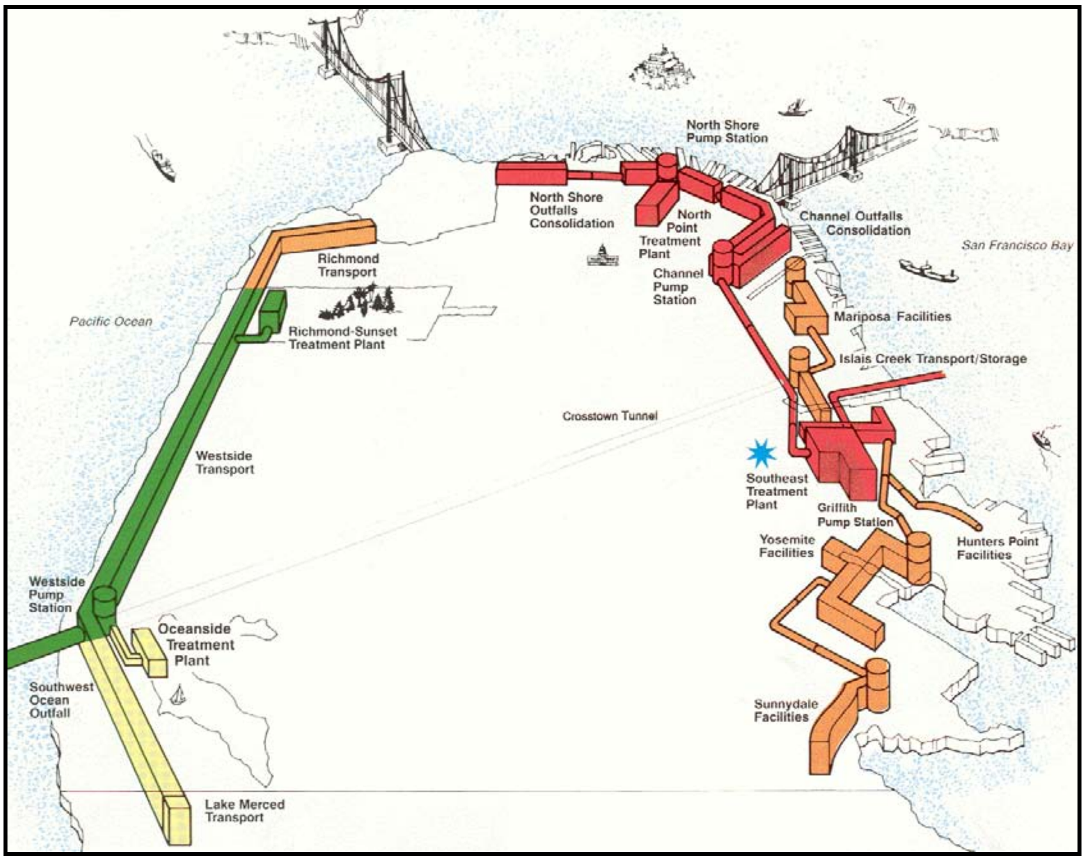


Figure 2-1
San Francisco Wastewater System

The City of San Francisco is initiating a second multi-year master planning process to ensure the long-term sustainability of the city's wastewater system. Entitled Clean Water Master Plan (CWMP), the effort will include new approaches to facility sites, asset management, and regulatory compliance to maximize the benefits of service to all areas of the city. Issues likely to be addressed in the 2004 CWMP include:

- Outfall to San Francisco Bay
- Odor problems from facilities on the eastern side of the city

- Solids processing at SEWPCP
- System reliability and redundancy
- Flooding on the eastern side of the city
- Aging infrastructure
- Water reuse

The mission statement for the new CWMP is as follows:

> "Provide reliable, operable and maintainable complete water, wastewater and recycled water systems for all seasons and all situations that protect the public health, public safety, and the environment through facilities that are a positive contribution in their location, all at a reasonable cost."

The CWMP, to be developed over the next three years, will provide a roadmap for capital improvements that will be implemented over the next 30 years. The CWMP will include three main components:

- Planning and engineering
- Environmental review
- Public participation

The Hunters Point Shipyard (HPS) Decentralized Wastewater Treatment Study, described herein, will provide supporting information for this plan.

Hunters Point Shipyard

In the 1860s the California Drydock Company purchased the tip of Hunters Point and built a large drydock. The California Drydock Company established the site as a ship repair facility—a role that the area maintained through the 1970s. In 1939, the U.S. Navy (Navy) purchased the site and leased it to the Bethlehem Steel Company. During World War II, the Navy took active possession of the site, acquired additional land for expansion, and developed it as an annex to the Mare Island Naval Base in Vallejo. More than 200 acres of new land were created by filling portions of San Francisco Bay using material excavated from Hunters Point Hill. The surrounding Bayview-Hunters Point (BVHP) community grew with the shipyard.

In 1974, after 100 years as an active ship repair facility, the Navy declared the shipyard as surplus and placed it into industrial reserve status. In 1976, the Navy leased most of the facility to Triple A Machine Shop, Inc. (Triple A), which operated it as a commercial shipyard. Triple A subleased many of the buildings on the base to small businesses and artists before the Navy terminated Triple A's lease in 1986.

HPS was included on the Department of Defense 1991 Base Realignment and Closure (BRAC) list. In 1993, the San Francisco Board of Supervisors designated the site as a Redevelopment Survey Area. Congress then authorized the Department of Defense to transfer the site to the city under special terms. In 1997, after an extensive multi-year community planning effort spearheaded by the Mayor's HPS Citizen's Advisory Committee (CAC), the Board of Supervisors adopted the HPS Redevelopment Plan.

The planning guidelines established by the CAC included:

- Create jobs for economic vitality
- Support existing businesses and artists' communities
- Create an appropriate mix of new businesses
- Balance development and environmental conservation
- Facilitate immediate access to shipyard facilities
- Integrate land uses into current plans for the Bayview area
- Acknowledge site history

The key features of the HPS Land Use Plan to be implemented by SFRA include:

- More than 200 acres of light industrial, research and development, and commercial/mixed-use land
- Up to 1,300 residential units with some live-work and multifamily units
- Approximately 500,000 square feet of education, training, entertainment, and cultural facilities
- About 300,000 square feet of arts-oriented commercial uses, including artist studios, galleries, and related pre-existing uses
- Approximately 200,000 square feet of retail development
- Approximately 130 acres of recreational and open space, accommodating a community recreation center, pedestrian plazas, a ferry landing, boat facilities, access to the Bay Trail system, with shoreline restoration and possible wetlands development

HPS Clean Water Strategy

HPS consists of approximately 936 acres, of which about 493 acres are dry land and approximately 443 acres are under water. Most of the existing infrastructure (building structures, roads, and utilities) is in a state of disrepair. The redevelopment plan for the shipyard assumes that all utility infrastructures will have to be replaced. This provides maximum flexibility for the development of an integrated clean water strategy, combining solutions for storm water, wastewater, and recycled water.

The sanitary sewage and storm water sewer systems at HPS are currently separated. The shipyard wastewater is collected in the sanitary sewer and pumped to SEWPCP for treatment. The storm water is collected in the storm sewer system and discharged to San Francisco Bay through a number of outfalls. The environmental impact report (EIR) approved for the redevelopment of HPS specifies that the two sewer systems should remain separated. This approach was selected to minimize the wet weather flow treated at SEWPCP and any increase in combined sewer overflows (CSOs) discharged to the bay.

The evaluation of decentralized treatment options needs to consider the requirements and projected demand for recycled water at HPS. The City Reclaimed Water Use Ordinance (Public Works Code, Article 22) requires development projects like HPS to provide for the construction of a reclaimed water system for irrigation and non-potable building uses (such as toilet flushing).

The final clean water strategy for HPS will be developed as part of the new CWMP that will be initiated in 2004. The HPS Decentralized Wastewater Treatment Study, described herein, will provide some of the technical facts necessary to develop that strategy and facilitate a policy decision on decentralized treatment at HPS.

3 THE DECENTRALIZED WASTEWATER TREATMENT STUDY

This chapter provides information about the decentralized wastewater treatment study at Hunters Point Shipyard (HPS), including:

- Objectives
- Key study assumptions
- Approach
- Evaluation criteria selection
- Decentralized wastewater treatment technologies selection

Objectives

The objectives of this study were to:

- Screen a variety of alternative wastewater treatment technologies based on their ability to protect public health, public safety, and the environment, and their applicability at HPS
- Identify the site-specific benefits and drawbacks of various decentralized wastewater treatment approaches at HPS
- Promote public input and participation, and address community concerns
- Provide some of the technical facts required to develop an integrated clean water strategy and make a policy decision on decentralized wastewater treatment at HPS

Key Study Assumptions

At the outset of the study, the following assumptions were made:

- Wastewater flow at HPS at full build-out will be 4 MGD (the primary developer has estimated a range of 2 to 5 MGD).
- Decentralized systems will be designed to treat all flow on site (that is, no flow from HPS will be treated at SEWPCP).
- No new outfall for discharge to San Francisco Bay will be created, requiring onsite reuse of all treated wastewater and/or the use of the existing SEWPCP outfall.

- To maximize reuse opportunities, treated effluent must meet the disinfected tertiary treatment level specified for recycled water (treatment level and water quality requirements specified in Title 22).
- Sanitary sewage and storm water collection systems will remain separated.

Although most of the detailed analyses were conducted for a wastewater flow of 4 MGD, the study also analyzed cost and footprint impacts from a 2-MGD wastewater flow (the low end of the projected HPS wastewater flows). As discussed in Chapter 7, *Refinement of the MBR System*, the study also investigated the use of a scalping system to meet only the recycled water demand at HPS.

Approach

The approach to the decentralized wastewater treatment study at HPS involved:

- A study plan that identified and defined 14 tasks
- Public outreach activities
- A six-step evaluation process

Study Plan

The study was divided into the following 14 tasks:

1. Study plan
2. HPS existing and projected environmental conditions
3. Regulatory requirements and treatment criteria
4. Reuse alternatives
5. Technical workshop
6. Investigation of decentralized wastewater treatment approaches
7. Investigation of centralized wastewater treatment approach
8. Site analysis
9. Cost analysis
10. Site-specific evaluation of wastewater treatment systems
11. Preliminary evaluation of storm water treatment systems
12. Public outreach

13. Technical report

14. NDWRCDP report

The study plan provided a clear rationale for each task and assigned the responsibility, a budget, and a schedule for each task. The study plan also specified necessary reviews for each task. The information from each task was summarized in 13 technical memorandums (TMs). Once finalized, the TMs were posted on the study web site (hunterspoint.sfwater.org). These TMs are also listed in Appendix D of this report and available electronically.

Public Outreach

In addition to the study web site, public outreach was accomplished through public presentations and fact sheets. Presentations were given at the following meetings:

- Bayview Hunters Point (BVHP) Project Area Committee (PAC)
- BVHP Project Area Committee (PAC)—Environment and Reuse Subcommittee
- Residents of the Southeast Sector (ROSES) Community Forum
- HPS Restoration Advisory Board (RAB)
- HPS Citizens Advisory Committee (CAC)

Three fact sheets were generated during the study. These fact sheets focused on:

- An introduction to the study
- The results of the TRC Workshop of March 31, 2003
- An historical fact sheet on HPS

The fact sheets were mailed to community leaders and organizations, distributed at public meetings, and were made available on the study web site.

Steps to Evaluate Decentralized Wastewater Treatment Systems

The study included the following six-step evaluation process:

- **Step 1—**Develop a comprehensive list of evaluation criteria
- **Step 2—**Develop a comprehensive list of decentralized technologies
- **Step 3—**Utilize the expertise of the TRC to refine the evaluation criteria and select the most promising and representative technologies for further analysis
- **Step 4—**Conduct supporting analyses including a regulatory review, market analysis for recycled water, and HPS site analysis for facility footprints

- **Step 5—**Evaluate the selected technologies based on the evaluation criteria and supporting analyses
- **Step 6—**Summarize the centralized treatment approach (SEWPCP) and compare the centralized approach to the preferred decentralized system

The results of Steps 1 through 5 are presented in the next three chapters of this report (Chapters 4, 5, and 6). Chapter 7, *Refinement of the MBR System*, provides a refinement of the preferred decentralized treatment technology. Chapter 8, *Centralized Wastewater Treatment Approach*, summarizes the current treatment approach for HPS wastewater flows, that is, an entirely centralized treatment approach at SEWPCP. Chapter 9, *Comparison of Decentralized and Centralized Treatment Approaches*, compares the use of SEWPCP to the use of SEWPCP with a decentralized system at HPS. Chapter 10, *Combination and Integration of Approaches*, discusses possible combinations of wastewater approaches and the integration of wastewater treatment with storm water treatment. Chapter 11 presents the conclusions of the study.

4 SELECTION OF EVALUATION CRITERIA

Based on past city studies, a preliminary list of evaluation criteria was compiled. This list was sent to the TRC and the Alliance for review. A more focused list of evaluation criteria was then selected at a March 31, 2003 Technical Workshop, with the TRC, SFPUC, consultants, and the Alliance. The selected evaluation criteria are listed in Table 4-1.

Table 4-1
Evaluation Criteria (based on input provided at March 31, 2003 Technical Workshop)

Criteria[1]	Description
1. Community and Environmental Enhancement	• Will the treatment system support sustainability goals by leading to water and energy conservation? • Will the treatment system provide environmental, educational, and/or recreational opportunities? • Will the treatment system accommodate a wide range of reuse applications?
2. Effluent Quality	• How reliably can the treatment system continuously provide high quality effluent for desired purposes (various reuse applications)? • Are data available from comparable facilities to demonstrate treatment performance?
3. Implementation	• How readily can the treatment system be implemented on site? • What are the significant permitting, environmental review, environmental cleanup, and/or constructability issues to be resolved? • What are the specific surface and/or subsurface conditions and topographic features required for the treatment system? • What is the treatment system's ability to accommodate a phased development approach?
4. Land Requirement	• How much land will be required for the treatment system to meet desired effluent water quality objectives?
5. Life Cycle Costs	• What are the expected capital and O&M costs over the life cycle (30 years, 50 years, or 75 years) of the treatment system? • What is the value of the recycled water to be produced by the treatment system (that is, value of recycled water produced and value of potable water made available)?

Table 4-1
Evaluation Criteria (based on input provided at March 31, 2003 Technical Workshop) (Cont.)

Criteria[1]	Description
6. Operation and Maintenance (O&M)	• Will the O&M of the treatment system be relatively straightforward and trouble-free under all seasons and under all conditions? • Will operation staff with an average level of training, knowledge, and expertise in wastewater treatment be capable to operate and maintain the treatment system? • Will the system require minimal maintenance?
7. Public Interests	• Will the project be a good neighbor to the Bayview Hunters Point (BVHP) community? • Will the project provide adequate public health protection? • Will the project preserve or improve public safety? • Will the project mitigate potential odor problems? • Will the project be aesthetically neutral or aesthetically positive? • Will the project provide employment opportunities for the BVHP community?

[1] Criteria No. 1, 6, and 7 are qualitative, whereas Criteria 2, 3, 4, and 5 are quantitative.

5 SELECTION OF DECENTRALIZED WASTEWATER TREATMENT TECHNOLOGIES

The study reviewed a broad spectrum of treatment options in each of three general decentralized treatment approaches:

- Advanced Treatment Satellite Plant
- Natural Treatment System
- Small Onsite/Cluster Treatment Systems

Within each approach, available technologies were identified and described in a comprehensive technical memorandum (TM) (see Appendix D, TM6-1, *Available Wastewater Technologies*). This TM was provided to the TRC and Alliance for review. At the March 31, 2003 Technical Workshop, TRC members selected the most promising and representative technology within each general approach. The TRC also provided guidance on sludge handling options. This comprehensive list of technologies and the technologies selected for further analysis are shown in Table 5-1. The membrane bioreactor (MBR), free water surface (FWS) wetlands, and large septic tanks with biotextile filters were selected for further analysis.

MBR was selected for the satellite plant approach due to its high-quality effluent and compact size. The MBR effluent meets the Title 22 standard of disinfected tertiary recycled water for unrestricted use; it would not need an additional filtration step. The FWS constructed wetland was chosen for the natural system approach due to its ancillary benefits (such as, environmental, aesthetic, and recreational benefits). The biotextile filter was selected for the onsite system approach because it is a promising new technology (currently under study at UC Davis) with a compact size and good-quality effluent. To meet the Title 22 standard of disinfected tertiary recycled water, the FWS wetland and septic tank/biotextile filter approaches would need an additional filtration step. All three approaches would require disinfection to meet Title 22.

Table 5-1
Decentralized Wastewater Treatment, Reuse, and Disposal Options for HPS

TYPE OF OPTIONS	DECENTRALIZED TREATMENT APPROACHES AT HPS		
	APPROACH 1 **Advanced Treatment Satellite Plant**	**APPROACH 2** **Natural Treatment System**	**APPROACH 3** **Small Onsite/Cluster Treatment Systems**
Wastewater Treatment Options	**System Selected** • Membrane Bioreactor (MBR)	**System Selected** • Free Water Surface (FWS) Constructed Wetland	**System Selected** • Large Septic Tanks and Biotextile Filters
	Systems Considered • Sequencing Batch Reactors (SBR) with Filtration • Actiflo™ High-Rate Clarification with Membrane	**Systems Considered** • Subsurface Flow (SF) Constructed Wetland • Floating Aquatic Plant System • Living Machine with Filtration	**System Considered** • Recirculating Granular-Medium Filters (RGMFs)
	Systems Removed from Consideration • Conventional Plug-Flow Activated Sludge with Filtration • Extended Aeration with Filtration • Oxidation Ditch with Filtration • Rotating Biological Contactors (RBCs) with Filtration • Trickling Filters with Filtration • Aerated and Facultative Lagoons with Filtration • Deep Shaft with Filtration	**Systems Removed from Consideration** • Slow Rate (SR) Land Treatment • Rapid Infiltration Land Treatment • Overland Flow Land Treatment	**Systems Removed from Consideration** • Package Plants (extended aeration, SBR, oxidation ditch) • Large septic tanks and leachfields • Intermittent sand filters (ISFs) • Anaerobic filters • Evapotranspiration systems
Treated Wastewater Reuse and Disposal Options	Maximize onsite and local reuse of recycled water. Reuse options include: (1) landscape/open space irrigation, (2) recreational/ environmental uses (such as wetland creation/restoration), (3) industrial reuse (cooling/process water), and (4) other non-potable urban uses (such as fire fighting, dual plumbing for toilet flushing). Options for disposing of excess treated wastewater include: (1) permitted outfall to San Francisco Bay and (2) connection to San Francisco's combined sewer system.		
Sludge Treatment and Disposal/ Reuse Options	Sludge handling options include: (1) sending sludge via the San Francisco combined sewer system to SEWPCP for treatment, (2) onsite storage in holding tank(s) with vacuum pumping and hauling to SEWPCP or Oceanside Water Pollution Control Plant (OWPCP) for treatment, and (3) onsite treatment of sludge at HPS (such as an enclosed composting facility).		

Assumptions

(1) Most of the treatment options listed above will require some level of primary treatment (such as screens, grit chambers, primary clarifiers, septic tanks, etc.).

(2) The effluent produced by the three decentralized treatment approaches must meet the treatment criteria specified in Title 22 (Section 60301.230) for disinfected tertiary recycled water. The selection of an approved disinfection method will take into consideration the type of reuse application(s).

6 SITE-SPECIFIC ANALYSIS OF THREE DECENTRALIZED TREATMENT SYSTEMS

This chapter provides information regarding site-specific analyses conducted on three decentralized treatment systems.

Supporting Analyses

To support the conceptual engineering designs of the various wastewater treatment approaches, the following supporting analyses were conducted:

- **Regulatory Analysis**—Analysis of relevant storm water, recycled water, and wastewater regulations
- **Market Analysis**—Analysis of the market for recycled water at HPS and adjacent areas
- **Siting Analysis**—Analysis of siting considerations for wastewater systems at HPS

Results from these supporting analyses are provided in the following sections.

Regulatory Analysis

Table 6-1 identifies regulatory requirements for storm water, recycled water, and wastewater for the discharge/reuse scenarios at HPS. An expanded analysis of these regulations is provided in Appendix D, TM3, *Regulatory Requirements and Treatment Criteria*.

Table 6-1
Summary of Regulatory Requirements for Storm Water Disposal, Recycled Water Use, and Wastewater Disposal

Disposal/Reuse Options	Requirements
Continued Storm Water Discharge to the Bay	• When conveyed to the city, must comply with Phase II MS4 NPDES permit. Best management practices (BMPs) must reduce pollutants in storm water to the maximum extent practicable (MEP).
Recycled Water Use—Industrial, Commercial, or Irrigation (landscape or wetland with no discharge)	• Requires Title 22 compliance for recycled water with management, monitoring, and reporting requirements • **Not a complete disposal option**; final disposal to bay or SEWPCP needed for excess flows and as a backup

Table 6-1
Summary of Regulatory Requirements for Storm Water Disposal, Recycled Water Use, and Wastewater Disposal (Cont.)

Disposal/Reuse Options	Requirements
Continued Wastewater Discharge to the Southeast Plant	• Scenario fits under existing NDPES permit for bay side
Wastewater Disposal to Wetlands or Wet Ponds **(Waters of the US)**	• NPDES permit required; must meet all Water Quality Standards (WQS) prior to discharge • May need waiver from Basin Plan Prohibition #1 (10:1 dilution; confined water) • Wetland/pond may require vector controls (with related ESA concerns) and access controls; treatment for vectors may require coverage under Aquatic Pesticide General Permit
Wastewater Disposal to Wetlands or Wet Ponds **(Not waters of the US; used for treatment)** (This option includes the open water used as an integral part of treatment in Oxidation Ditch + Free Water Surface (FWS) Wetland + Cloth Disk Filter)	• Wetland/pond may require vector controls (with related ESA concerns) and access controls; treatment for vectors may require coverage under Aquatic Pesticide General Permit • **Not a complete disposal option**; final disposal to bay or SEWPCP needed for excess flows and as a backup
Wastewater Disposal Downstream of SEWPCP, Through Southeast Outfall from New Onsite Treatment System—Discharge of Treated Wastewater to the Bay	• NPDES permit modification required (existing bay side permit)—must address all WQS and non-degradation requirements • Need to address 303(d) listed pollutants and TMDLs • CWA 404 permit required for construction impacts and CWA 401 water quality certification
*****Wastewater Disposal Through New Wastewater Outfall from New Onsite Treatment System—Discharge of Treated Wastewater to the Bay	• NPDES permit required—must address all WQS and non-degradation requirements • Need to address 303(d) listed pollutants and TMDLs • CWA 404 permit required for construction impacts and CWA 401 water quality certification • If discharge is at shoreline, may need waiver from Basin Plan Prohibition #1 (10:1 dilution)

* Additional alternative shown for comparison purposes. It is assumed that a new outfall would not be pursued.

City of San Francisco—Recycled Water Ordinances

In October 1991, the San Francisco Board of Supervisors passed two recycled water ordinances (390-91 and 391-91). These ordinances require dual plumbing at HPS and other specified areas in San Francisco for the following uses:

- New or remodeled buildings and all subdivisions (with the exception of condominium conversions) with a total area of 40,000 square feet or greater for irrigation, toilet flushing, and industrial processes
- New and existing landscaped areas of 10,000 square feet or larger for irrigation

Department of Health Services—Title 22 Regulations

The Department of Health Services Water Recycling Criteria are in Chapter 3 of Division 4: Environmental Health (section 60301 et seq.). The regulations, effective December 2, 2000, are based on Water Code Section 13521. The department’s regulatory criteria include

- Numerical limitations and requirements
- Treatment method requirements
- Provisions and requirements related to
    - Sampling and analysis
    - Engineering reports
    - Design
    - Operation
    - Maintenance
    - Reliability of facilities

Table 6-2 details Title 22 requirements with respect to recycled water use. “Secondary” refers to biological treatment, which is provided by most sewage treatment facilities. “Tertiary” in the Title 22 regulations refers to secondary effluent that has been filtered.

MBR membranes meet the Title 22 requirement for filtration. Therefore, to meet the “disinfected tertiary” standard, MBR effluent would only need disinfection. The FWS wetland approach and biotextile filter approach would need an additional filtration step and disinfection to meet the Title 22 “disinfected tertiary” standard.

Table 6-2
Treatment Required for Recycled Water Uses (simplified with non-relevant uses deleted)

Treatment Level	Allowable Uses
Undisinfected Secondary	**Other**—Flushing sanitary sewers
Disinfected Secondary–23	**Surface Irrigation**—Freeway landscaping, cemeteries, restricted access golf courses, ornamental nursery stock, and sod farms where access by the general public is not restricted, and any non-edible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground, or school yard **Landscape Impoundments**—Landscape impoundments (non-accessible) that do not utilize decorative fountains **Domestic**—None **Industrial/Commercial**—Cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist; industrial boiler feed **Other**—Nonstructural fire fighting; soil compaction; mixing concrete; dust control on roads and streets; cleaning roads, sidewalks, and outdoor work areas; industrial process water that will not come into contact with workers
Disinfected Secondary–2.2	**Surface Irrigation**—Areas that have restricted human access or contact, including some recreational impoundments, golf courses, landscaped freeway areas, ornamental nurseries, and sod farms; limited food crop irrigation (the edible portion is produced above ground and not contacted by the recycled water) **Recreational Impoundments**—Restricted recreational impoundments **Domestic**—None **Industrial/Commercial**—Same as for Disinfected Secondary–23
Disinfected Tertiary	**Surface Irrigation**—Food crops (with contact with edible portion), parks and playgrounds, school yards and playgrounds, residential landscaping, golf courses, and other accessible surfaces **Recreational Impoundments**—Unrestricted impoundments acceptable if the disinfected tertiary is subject to conventional treatment (or with special monitoring if non-conventional treatment); decorative fountains **Domestic**—Flushing toilets and urinals **Industrial/Commercial**—Cooling or air conditioning that involves the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist (if mist can come into contact with employees or members of the public, additional requirements apply); industrial process water that may come into contact with workers; commercial laundries; commercial car washes, including hand washes if the recycled water is not heated, where the general public is excluded from the washing process **Other**—Structural fire fighting

Market Analysis

The analysis of the market for recycled water at HPS and adjacent areas involved:

- Types of water reuse applications
- Recycled water users and demands in areas adjacent to HPS
- Customer-based water quality requirements

Types of Water Reuse Applications

According to the 1996 Master Plan, the city-wide average annual recycled water demand is 10.3 MGD, with an average day peak month demand of 15.6 MGD. Of this city-wide annual demand, approximately 72 percent is for landscape irrigation, 20 percent is for toilet flushing/office cooling systems, and 8 percent is for industrial uses (Montgomery Watson 1996).

Major recycled water uses are listed in Table 6-3.

Table 6-3
Major Potential Recycled Water Uses for San Francisco

Irrigation Uses	Non-Irrigation Uses
• Golf Courses • Parks • Schools • SF Zoo • Street Landscape	• Toilet Flushing • Cooling Tower Makeup • Washdown • Dust Control • Boiler Feedwater • Industrial Process Water • Lake Recharge (direct or indirect by aquifer recharge) • Wetlands Enhancement and Creation • Firefighting • Odor Control by Sewer Flushing

As part of this study, a recycled water market analysis was conducted for HPS and adjacent areas. This market analysis was based on the

- HPS Redevelopment Plan
- Primary developer’s projections for future water demands at HPS
- Adjacent land uses within a 2.5-mile radius of HPS

Based on the market analysis, recycled water could be used to satisfy the following potential demands at HPS:

- In-building dual plumbing demands of approximately 0.40 MGD
- Landscape irrigation demands (60 acres) of approximately 0.14 MGD
- Wetland creation/enhancement (40 acres) of approximately 0.09 MGD

The city-wide recycled water demands are shown in Figure 6-1. The recycled water demands at HPS are shown in Figure 6-2. The city-wide recycled water demands are primarily for landscape irrigation, while the HPS demands are primarily for dual plumbing (toilet flushing/office cooling). Since landscape irrigation demands are typically easier and less costly to implement than dual plumbing demands, the HPS reuse requirements can be described as relatively difficult and costly.

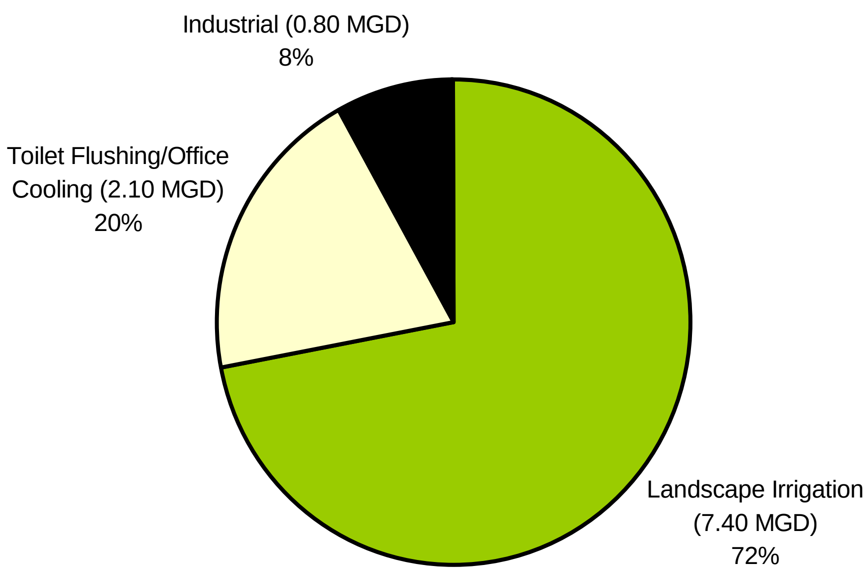


Figure 6-1
City-Wide Recycled Water Demands (Recycled Water Master Plan 1996)

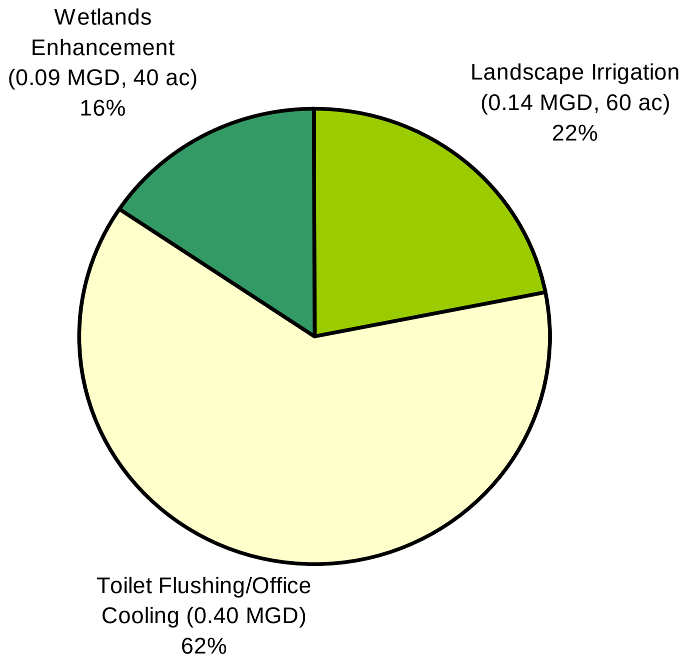


Figure 6-2
HPS Recycled Water Demands

Recycled Water Users and Demands in Areas Adjacent to HPS

In addition to HPS, a decentralized wastewater treatment facility could provide recycled water to adjacent areas. Table 6-4 summarizes potential recycled water demands in the southeastern area of San Francisco. To assess the feasibility of piping water to these areas, the approximate distance from HPS is provided.

Table 6-4
Potential Recycled Water Users in Areas Adjacent to HPS

Potential Recycled Water Users	Distance from HPS (miles)	Recycled Water Demand (Annual Avg in MGD)	Type of Demand
India Basin Shoreline Park*	0.5	0.02	Landscape irrigation (approximately 8 acres)
Yosemite Creek Corridor	0.5	TBD	Creek/wetland restoration
Candlestick Point State Recreation Area	1.0	TBD	Landscape irrigation; wetland restoration
Bay View Park*	1.5	0.03	Landscape irrigation
Woodrow Wilson High School*	1.5	0.01	Landscape irrigation (approximately 4 acres)

Table 6-4
Potential Recycled Water Users in Areas Adjacent to HPS (Cont.)

Potential Recycled Water Users	Distance from HPS (miles)	Recycled Water Demand (Annual Avg in MGD)	Type of Demand
Candlestick Park**	2.0	0.29	Irrigation = 0.12 MGD; Non-irrigation = 0.17 MGD
McLaren Park*	2.2	0.55	Landscape irrigation (approximately 239 acres)
Gleneagles Golf Course*	2.5	0.11	Landscape irrigation (approximately 46 acres)
New Mirant Power Plant or Peakers & Potrero Plant**	2.5	3.10 or 0.41	Cooling tower makeup; Boiler feedwater

Sources:
*Montgomery Watson 1996
**RMC 2003

Customer-Based Water Quality Requirements

This section discusses the customer-based (non-regulatory) water quality requirements associated with reuse applications at HPS (for example, salt levels in irrigation water). Table 6-5 shows acceptable water quality ranges for different applications. More detailed summaries are provided in the following documents:

- San Francisco Recycled Water Master Plan (Montgomery Watson 1996)
- Landscape Irrigation Pilot Study (SFPUC 1998)

Table 6-5
Customer-Based Water Quality Requirements

Recycled Water Use	Customer-Based Water Quality Requirements*			
	Constituent	**Acceptable**	**Marginal**	**Unacceptable**
Landscape Irrigation** (parks, golf courses, lawns)	Total Dissolved Solids (TDS)***, mg/L	<450	450–2,000	>2,000
	Sodium Adsorption Ratio (SAR)	<6	6–9	>9
	Boron, mg/L	<0.5	0.5–1.0	>1.0
	Chloride, mg/L	<140	140–250	>250
	Total Nitrogen, mg N/L	<5	5–30	>30
Toilet Flushing	Low-quality water is acceptable (TDS greater than 700 mg/L).			
Washdown	Low-quality water is acceptable (TDS greater than 700 mg/L).			
Dust Control	Low-quality water is acceptable (TDS greater than 700 mg/L).			
Sewer Flushing	Low-quality water is acceptable (TDS greater than 700 mg/L).			

Table 6-5
Customer-Based Water Quality Requirements (Cont.)

Recycled Water Use	Customer-Based Water Quality Requirements*
Cooling Tower Makeup Water	High-quality water is typically required. This use may require additional treatment, such as reverse osmosis or ion exchange. TDS limit for cooling tower makeup water is 500 mg/L (Water Pollution Control Federation 1989). In addition to TDS, other water quality parameters must be considered.
Boiler Feedwater	High-quality water is typically required. This use may require additional treatment, such as reverse osmosis or ion exchange. TDS limit is based on boiler pressure. TDS limits range from 200 mg/L (high-pressure systems) to 700 mg/L (low-pressure systems). In addition to TDS, other water quality parameters must be considered (EPA 1980).
Wetland Creation/ Restoration	Water quality requirements depend on the type of wetland created or restored (such as, salt-tolerant or salt-sensitive vegetation, seasonal or tidal wetlands, treatment or non-treatment).

Notes:
* In addition to customer-based water quality requirements, all uses must meet Title 22 health-based water quality requirements.
** Montgomery Watson 1996.
*** The Recycled Water Master Plan Update assumes that irrigation water is generally acceptable if the average TDS concentration is below 700 mg/L (RMC 2003).

Site Analysis

An HPS site analysis was conducted to determine suitable locations for a three-acre treatment plant and for a 40-acre treatment wetland. The factors considered in the site analysis included:

- Space for the treatment system
- Consistency with proposed land use (San Francisco Redevelopment Agency 1997)
- Proximity to water reuse applications
- Integration into the proposed infrastructure plan (wastewater backbone and main pump station at Building 819A)
- Environmental contamination/cleanup constraints
- Aesthetic impacts (odor, visual, and noise)
- Required site improvements
- Facility access

Figure 6-3 identifies two suitable sites for a three-acre MBR treatment plant (Sites 1 and 2) and two sites for a secondary treatment wetland (Sites 3 and 4). A third wetland area is identified within the inland portion of Parcel E (Site 5); however, a modification to the *Hunters Point Shipyard Redevelopment Plan* would be required.

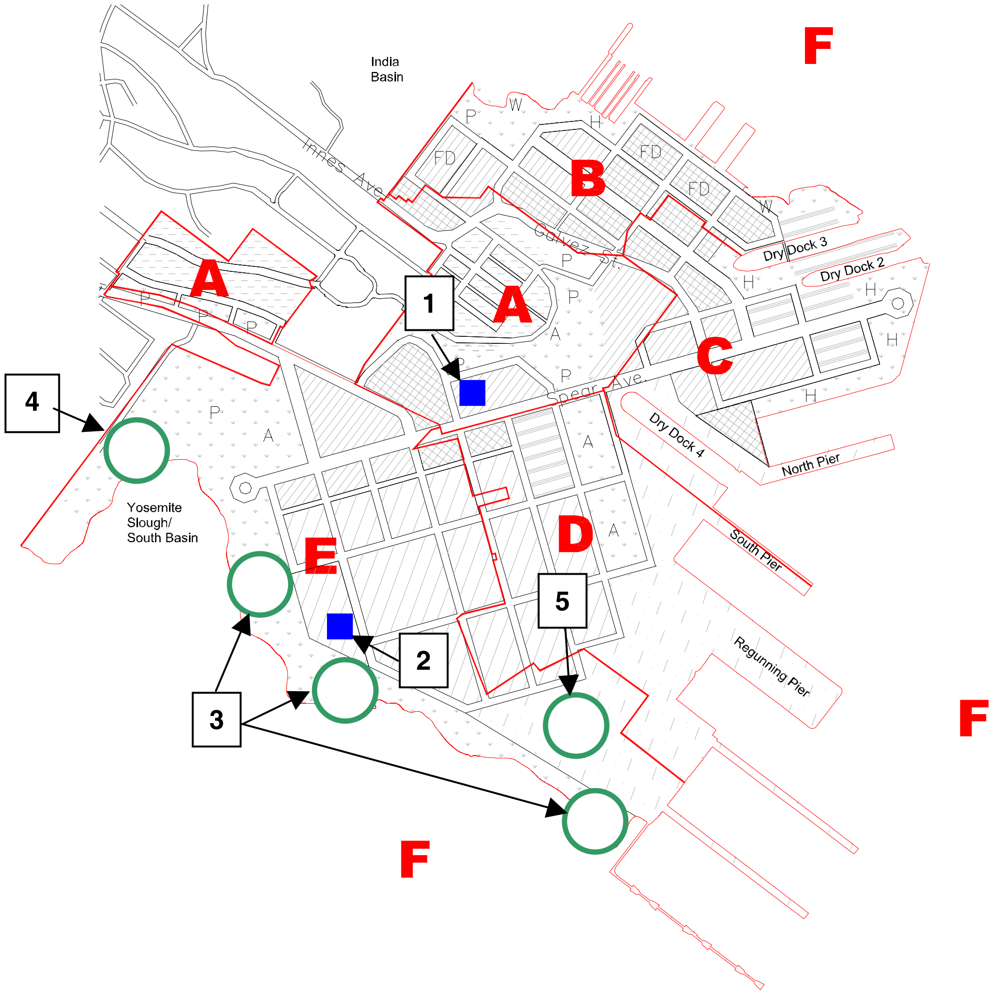


Figure 6-3
Potential Sites for a Decentralized Wastewater Treatment System at Hunters Point Shipyard

The factors with the greatest influence on the two MBR locations include:

- Land use compatibility
- Consistency with the utility backbone plan
- Project phasing (that is, environmental cleanup and development schedules)

There are approximately 25 acres in the Parcel E open space area southeast of the landfill and along the waterfront that could be used for a wetland project (Figure 6-3, Site 3). To the southwest of the landfill (near Yosemite Slough), there is an approximately 15-acre open space area that could be utilized for a wetland project (Figure 6-3, Site 4).

Although the redevelopment plan has designated a portion of Parcel E as maritime-industrial, it is unclear whether this area will be utilized for this purpose. This area could be converted (after community, SFRA, and developer acceptance) into wetlands. This Parcel E area is approximately 20 acres (Figure 6-3, Site 5).

Conceptual Engineering Designs

Future HPS wastewater flows at full build-out have been estimated by the primary developer to range from 2 MGD to 5 MGD (Lennar/CH2M Hill 2002). This study chose a design flow of 4 MGD. Because the feasibility of alternatives could be different for lower wastewater projections, this study also conducted an abbreviated assessment at 2 MGD. The 4-MGD design and the 2-MGD summary are provided in this section.

Key assumptions used to develop and evaluate the alternatives include the following:

- Each decentralized treatment alternative was designed to treat all of the wastewater expected to be generated onsite.
- Each treatment alternative was required to meet disinfected tertiary treatment Title 22 requirements.
- No new outfall to San Francisco Bay would be constructed for any decentralized treatment alternative. Any excess treated wastewater that could not be reused (due to recycled water demand shortfalls) would be discharged to San Francisco Bay through the existing SEWPCP outfall (downstream of SEWPCP). Detailed costs were not prepared for this project element.
- Each decentralized treatment alternative will generate wastewater solids requiring treatment and/or disposal. Solids handling alternatives, applicable to all alternatives, are briefly explored at the end of this section.

Collection system design alternatives and associated costs for the HPS site were not evaluated. The treatment technologies share the common influent design criteria listed in Table 6-6 and Table 6-7. Table 6-6 lists the assumed wastewater flows for HPS. The assumed influent wastewater characteristics are shown in Table 6-7. Table 6-8 summarizes the expected effluent discharge criteria from each system, and Table 6-9 summarizes the Title 22 requirements for recycled water use in California.

Table 6-6
Assumed Wastewater Flow

Criteria	Value (MGD)
Maximum Average Daily Flow	4
Peak Day Dry Weather Flow	5
Peak Day Wet Weather Flow	6

Table 6-7
Assumed Influent Wastewater Characteristics

Constituent	Average Value (mg/L)
BOD_5 (Biochemical Oxygen Demand)	300
TSS (Total Suspended Solids)	300
TKN (Total Kjeldahl Nitrogen)	45
NH_3-N (Ammonia Nitrogen)	30
TP (Total Phosphorus)	5

Note: HPS wastewater is assumed to be similar to influent at SEWPCP.

Table 6-8
Expected Effluent Wastewater Characteristics

Constituent	Average Value (mg/L)
MBR Effluent	
BOD_5	<5
TSS	<5
NO_3-N (Nitrate Nitrogen)	<10
NH_3-N	1
FWS Wetland Effluent	
BOD_5	10
TSS	10
NO_3-N	10
NH_3-N	1
Biotextile Filter Effluent*	
BOD_5	15
TSS	15
NO_3-N	10–15
NH_3-N	1

(Zenon 1999), (US EPA 2000b), (Crites and Tchobanoglous 1998)
* Residential strength influent

Table 6-9
Required Recycled Tertiary Effluent

Criteria	Average Value
Turbidity	<2 NTU
MPN (Most Probable Number)	<2.2 total coliform/100 mL

Nitrification and denitrification capabilities were incorporated into the treatment systems as a conservative approach in anticipation of potential nutrient removal and/or toxicity control requirements. A more detailed assessment of effluent requirements conducted as part of process pre-design might enable a process design without nitrification and denitrification.

The 4-MGD conceptual engineering designs considered include:

- Membrane Bioreactor (MBR)
- Free Water Surface (FWS) Wetland
- Septic Tanks/Biotextile Filters

The MBR and FWS wetland systems would process all HPS wastewater at one location, while the septic tank/biotextile filter system would handle portions of flow at several locations. An in-depth discussion of the flows to the septic tank/biotextile filter system is presented later in this section with the process-specific design criteria. All systems have been designed conservatively. The designs assume that flow will not be sent to SEWPCP during repairs (that is, all flow generated at HPS will be treated at HPS using decentralized treatment facilities).

Membrane Bioreactor—Advanced Treatment System (4 MGD)

The MBR treatment systems are gaining popularity for advanced treatment because they combine several wastewater treatment process steps into one and can reliably produce a high-quality effluent. Several systems have been installed in California, and the technology is in use throughout the world. The following sections provide information for an MBR installation at HPS, including:

- Process description
- Design criteria
- Facility sizing
- General arrangement and schematic profile
- Estimated cost

MBR Process Description

The MBR process is a suspended growth process in which wastewater and microorganisms are aerated in a reactor. The MBR process operates at significantly higher mixed liquor suspended solids (MLSS) concentrations than conventional activated sludge treatment systems. Rather than settling out the microorganisms in a separate clarifier following aeration, an MBR filters the water directly out of the reactor using submerged membranes.

The first steps in this process are to screen the wastewater and remove grit. Next the wastewater flows to denitrification basins where it combines with recycled mixed liquor under anoxic conditions to provide removal of the nitrate in the mixed liquor. After the denitrification basins, the wastewater flows into the aeration basins that contain the membranes. The membranes operate under vacuum and are continuously cleaned with air bubbles that create turbulence at the membrane surface to prevent solids accumulation. The membranes are periodically backwashed and chemically cleaned when operating vacuums become too high. The system automates backwashing and alerts the operator when a chemical cleaning is required. Four companies currently manufacture submerged membrane MBRs and have California Department of Health Services (DHS) approval for use in producing recycled water (California Division of Drinking Water & Environmental Management 2003):

- US Filter
- Zenon
- Mitsubishi
- Kubota

Wastewater is pumped out of the aeration basins into ultraviolet (UV) disinfection channels. After disinfection, the process is complete, and the tertiary treated wastewater is ready for reuse. Primary sludge is not produced by an MBR system with no primary clarifier. Waste activated sludge from the aeration basins requires treatment and disposal. A typical flow schematic for an MBR treatment system is shown in Figure 6-4.

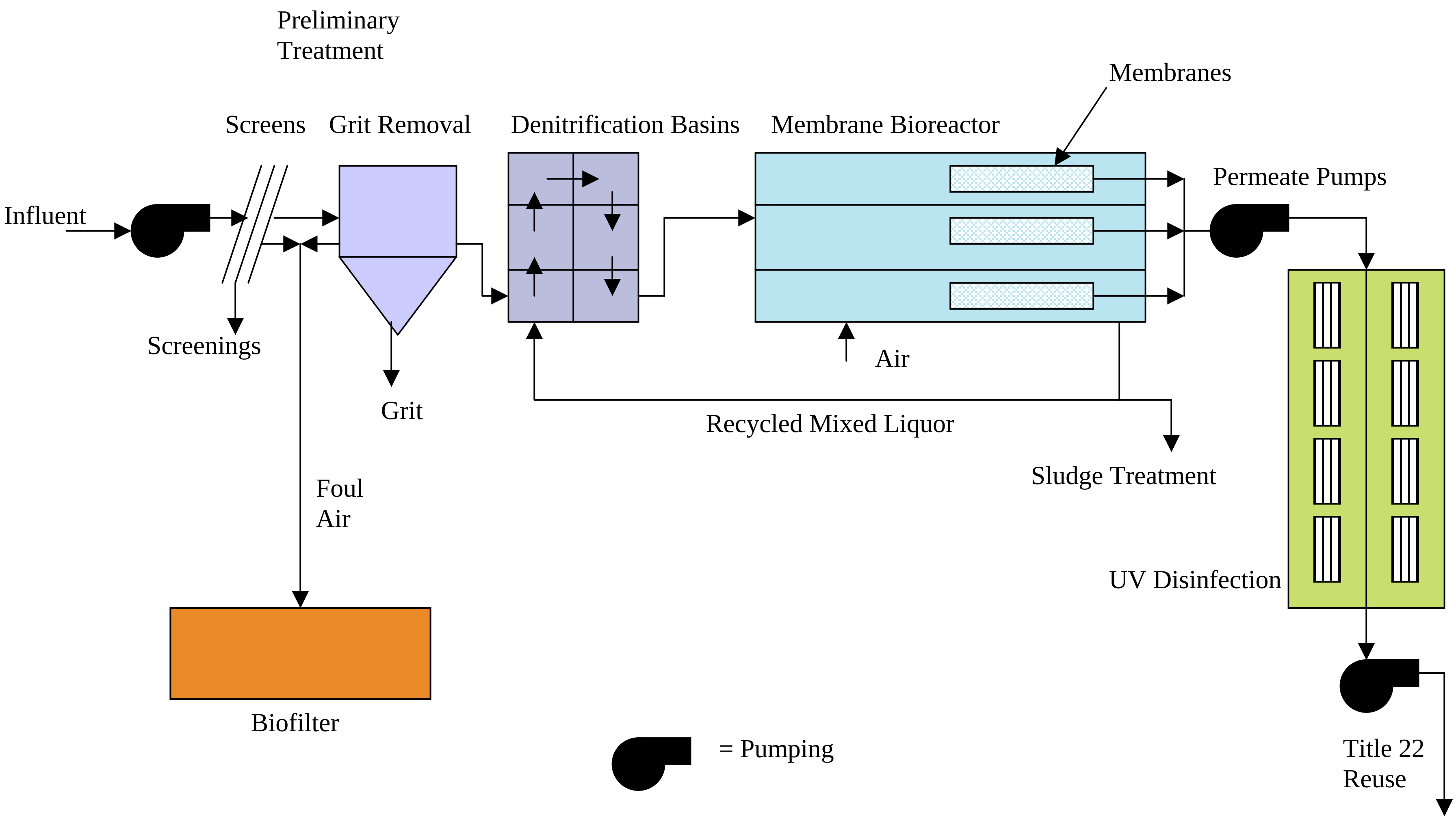


Figure 6-4
Membrane Bioreactor System Flow Schematic

MBR Design Criteria

Process-specific design criteria are presented in Table 6-10. Planning-level sizing calculations are provided in Appendix D, TM10-2, *Site-Specific Evaluation of Decentralized Wastewater Treatment*, which is available electronically.

Table 6-10
Assumed MBR Design Criteria for HPS Wastewater Treatment

Criteria	Value	Units
Flow	4.0	MGD
MBR		
MLSS	8,000.0	mg/L
Target MCRT (Mean Cell Residence Time)	13.0	d
Number of Basins	3.0	
Basin Volume	0.7	MG
Total Basin Volume	2.1	MG
Basin Side Water Depth	15.0	ft
Hydraulic Retention Time	12.6	h
Denitrification		
Number of Trains	3.0	
Basins per Train	2.0	
Basin Volume	0.1	MG
Total Basin Volume	0.6	MG
Basin Side Water Depth	15.5	ft
Hydraulic Retention Time	3.6	h
Aeration Requirements		
Oxygen Required for BOD	1.2	mg O_2/mg BOD_5
Oxygen Required for Nitrification	4.6	mg O_2/mg NO_3-N
Oxygen Returned from Denitrification	2.85	mg O_2/mg NO_3-N
Disinfection		
UV Dose	80.0	mW/cm^2
Number of Channels	2.0	

Table 6-10
Assumed MBR Design Criteria for HPS Wastewater Treatment (Cont.)

Criteria	Value	Units
Disinfection (Cont.)		
Number of Banks per Channel	4.0	
Standby Banks per Channel	1.0	
Odor Control		
Screening/Grit Area	56,160.0	ft^3
Screening/Grit Area Air Changes	12.0	ACH
Biofilter Loading Rate	2.0	$ft^3/m/ft^2$

MBR Facility Sizing

Using the design criteria presented in Table 6-10, conceptual-level sizing estimates were developed for a 4-MGD (maximum average flow) MBR treatment system at HPS. Table 6-11 presents the results of these calculations.

Table 6-11
MBR Facility Sizing

Component	Quantity	Area (ft^2)
Headworks/Influent Pump Station	1	200
Screening/Grit Facility	1	1,900
Denitrification Basins	6	675
Aeration Basins/MBR	3	5,750
Permeate Pump Station	1	4,000
Aeration Building	1	1,500
UV Disinfection	1	2,100
Effluent Pump Station	1	600
Biofilter	1	5,625
Operations/Lab Building	1	2,500
Maintenance	1	750
Electrical	1	750
Parking	1	5,000

MBR General Arrangement and Schematic Profile

Figure 6-5 shows a general layout for the MBR facility. The MBR facility requires an area of just over two acres.

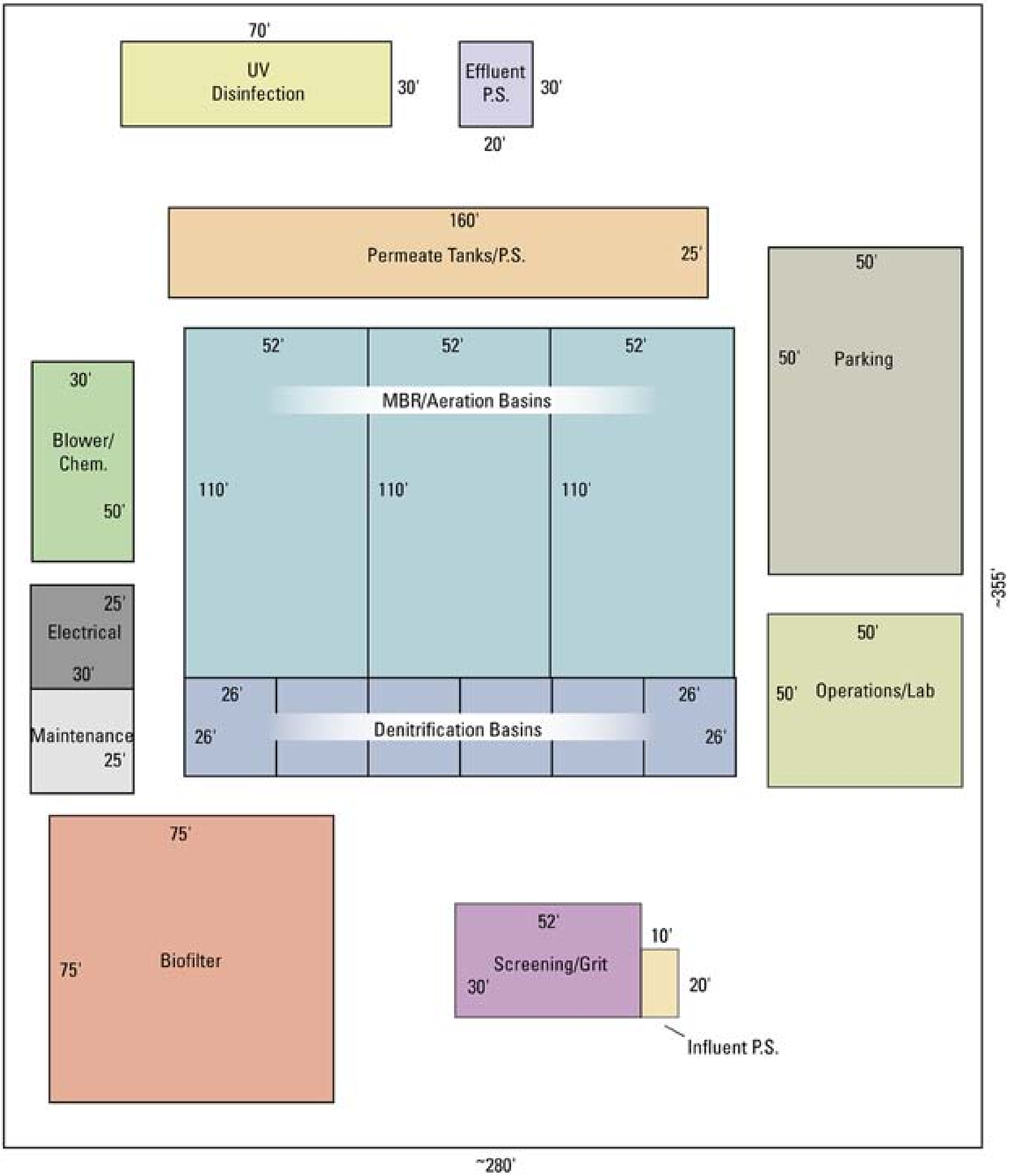


Figure 6-5
General Site Arrangement for Membrane Bioreactor System

Figure 6-6 is a schematic profile of the facility showing the hydraulic grade line through the plant and the elevation of each unit. No building is higher than two stories.

The site plan would be customized for HPS and the land requirements may increase or decrease somewhat. Facilities could be combined (for example, MBR tanks, permeate tanks, and blowers could be in one building); however, for this evaluation, the conservative assumption was made that they would be separate.

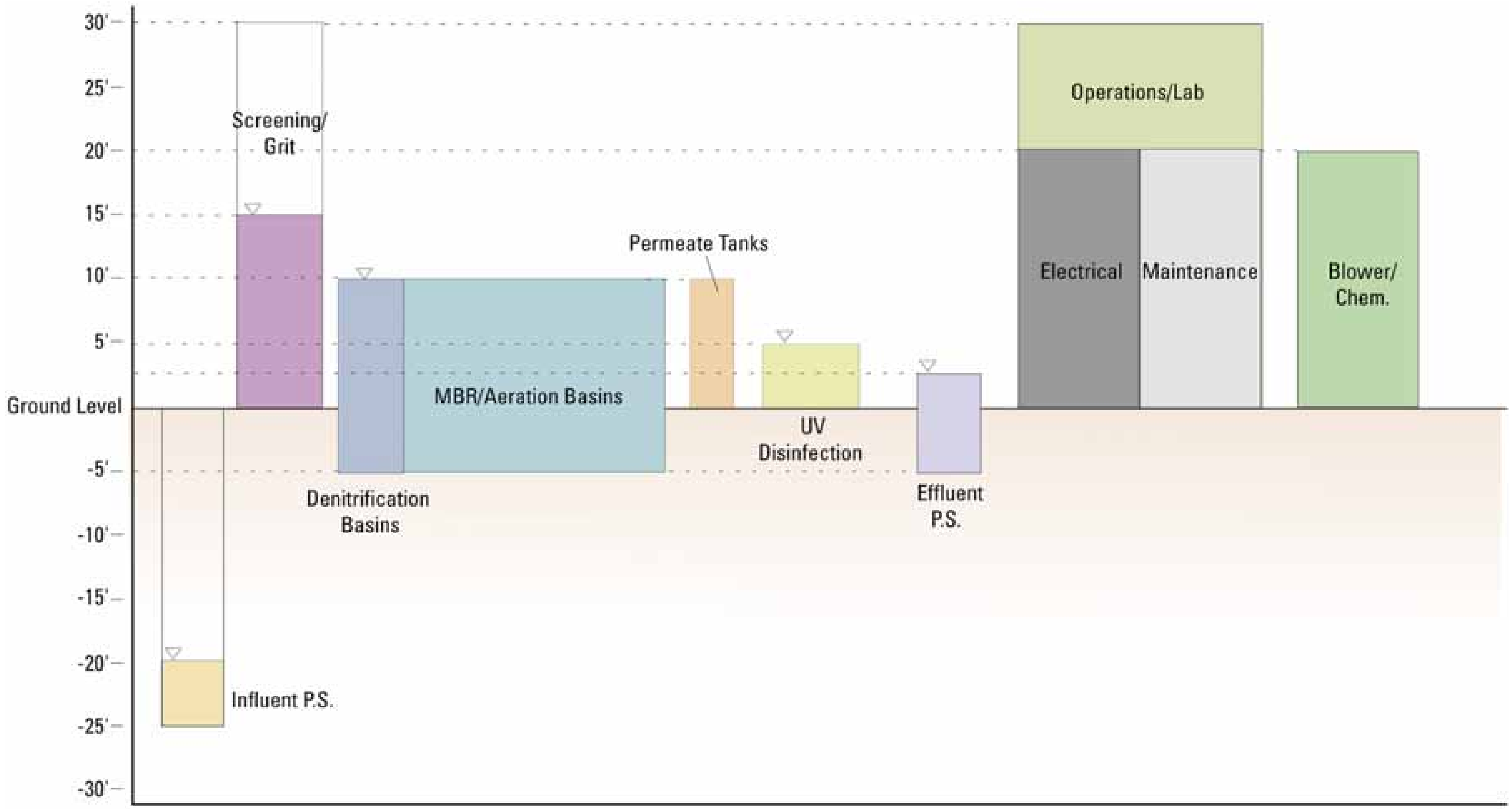


Figure 6-6
Schematic Profile of Membrane Bioreactor System

MBR Estimated Cost

Planning-level cost estimates are accurate to approximately +50% to −30% of the actual cost. The initial capital cost for the 4-MGD capacity MBR facility would be approximately $37.2 million. Equipment replacement costs were estimated assuming that mechanical and electrical equipment other than membranes would be replaced every 25 years. Membranes were assumed to have a life of eight years. O&M costs are estimated at $2.2 million per year.

The capital, O&M, and replacement cost estimates were used to calculate the net present value (NPV) estimate for a 30-year planning horizon with an escalation rate of 3% and a discount rate of 6% per year. The total 30-year NPV cost estimate of the MBR facility is approximately $83.9 million.

Free Water Surface Wetlands—Natural Treatment System (4 MGD)

FWS wetland systems are used in California and throughout the world for secondary, advanced secondary, and tertiary wastewater treatment processes. They can be designed to meet various levels of treatment. The following sections provide information for an FWS wetlands system installation at HPS, including:

- Process description
- Design criteria
- Facility sizing
- General arrangement and schematic profile
- Estimated cost

FWS Wetland Process Description

FWS wetlands were chosen to represent the natural treatment system approach, which is a treatment facility that utilizes natural (for example, vegetative) systems and operates passively. The process train initially evaluated for this approach was a facultative pond, followed by an oxidation pond, followed by the FWS wetland. This initial process train would provide both advanced secondary and tertiary treatment, and remove BOD, TSS, ammonia, and nitrate.

Sizing calculations performed for this process train using published removal rates and sizing methods (US EPA 2000a, Kadlec and Knight 1996) showed that more than 120 acres of land would be required. Depending upon the influent quality, an FWS wetland area of between 9 and 24 acres per MGD would be required to perform advanced secondary and tertiary treatment. Additional area (more than 40 acres) would be needed for the facultative pond and oxidation pond systems.

OD/FWS Wetland Process Description

To reduce the land area to a size that would fit in the area identified for wastewater treatment at the HPS, other treatment processes in addition to the FWS wetland are required. The following revised process procedures shown in Figure 6-7 were considered:

1. Secondary treatment in oxidation ditches (ODs) and secondary clarifiers

2. A 20-acre FWS wetland for denitrification, polishing, and some pathogen removal

3. A cloth disk filter

4. Ultraviolet disinfection

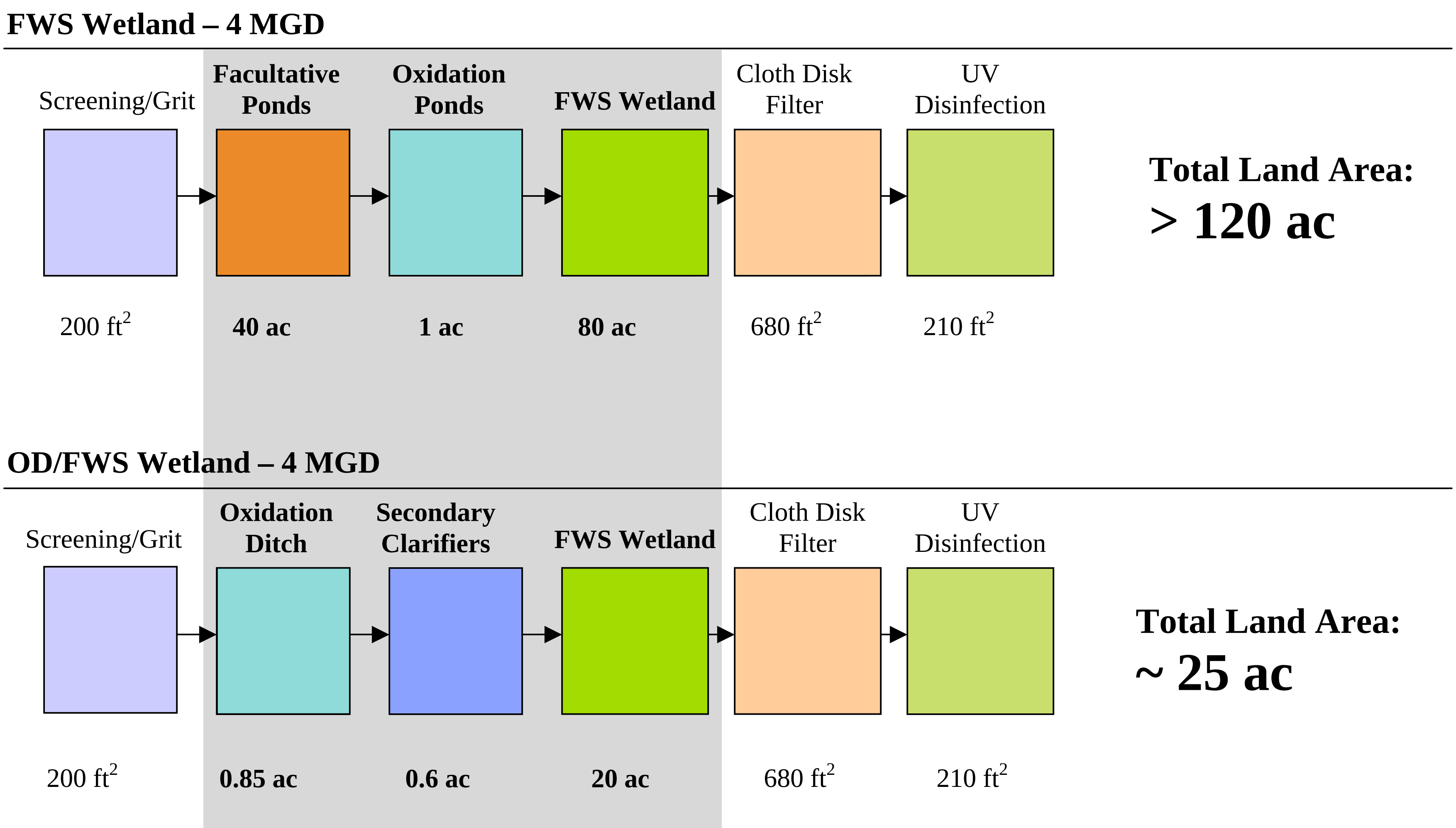


Figure 6-7
Land Area Comparison for FWS Wetland Systems

Oxidation ditches are suspended growth-activated sludge systems in which mixed liquor is circulated and aerated in a ring- or oval-shaped channel. This system would occupy about 25 acres and fit on two of the larger sites identified in the site analysis (see Figure 6-3). Though many wetland systems have been constructed for BOD, ammonia, and TSS removal, FWS wetlands do not always remove BOD and ammonia efficiently because there is insufficient dissolved oxygen for rapid BOD oxidation and nitrification. The ODs preceding the FWS wetland would provide for more efficient oxidation and removal of BOD and TSS, nitrification of ammonia, and some denitrification.

The OD would be preceded by screening and grit removal facilities. Post-treatment for small particle removal using cloth disk filters and removal of pathogens by ultraviolet disinfection would follow the FWS wetland. Initially, high-rate sand filtration was targeted for this process step; however, further review during this evaluation determined that cloth disk filtration should be used because of its smaller footprint. In a cloth disk filter, secondary effluent flows horizontally through a series of disks covered with a synthetic filter fabric. The disks rotate periodically and the dirty sections are backwashed and rinsed prior to being put back in service.

This system will be referred to as an oxidation ditch/free water surface wetland (OD/FWS wetland). The proposed process schematic for an OD/FWS wetland treatment system is shown in Figure 6-8. The FWS wetland would be partially accessible to the public because the wastewater that is received by the wetland would already have undergone secondary treatment and disinfection.

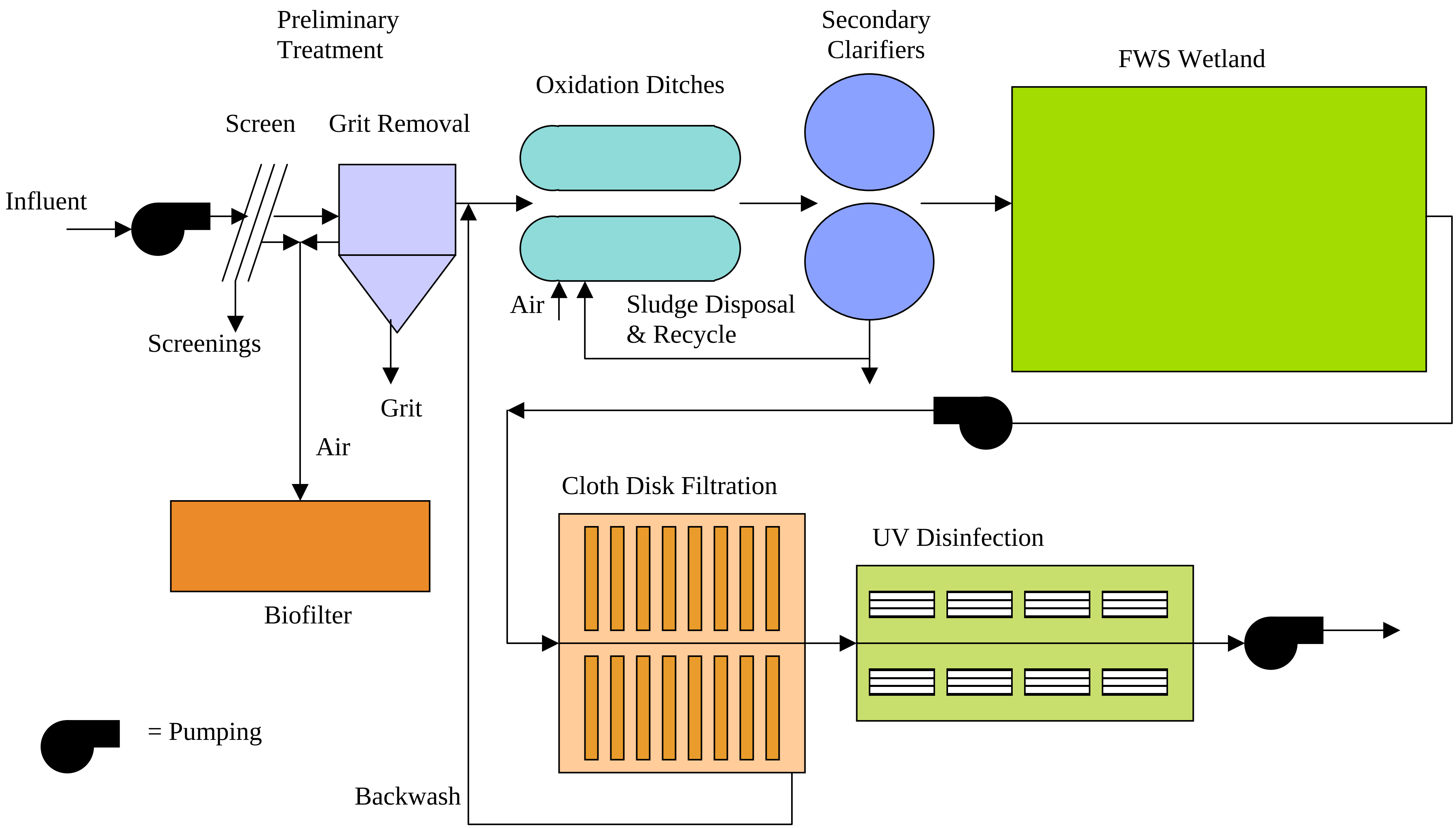


Figure 6-8
OD/FWS Wetland System Flow Schematic

OD/FWS Wetland Design Criteria

Design criteria for the OD/FWS wetland system are shown in Table 6-12.

Table 6-12
Assumed OD/FWS Wetland Design Criteria for HPS Wastewater Treatment

Criteria	Value	Units
Flow	4	MGD
Oxidation Ditch		
Number of Basins	2	
MLSS	3000	mg/L
Hydraulic Retention Time	24	h
Side Water Depth	15	ft
Length to Width Ratio	5:1	
Solids Residence Time	13	d
Secondary Clarification		
Number of Clarifiers	2	
Surface Loading Rate	300	gpd/ft^2
Side Water Depth	15	ft
Aeration Requirements		
Oxygen Required for BOD_5	1.2	mg O_2/mg BOD_5
Oxygen Required for Nitrification	4.6	mg O_2/mg NO_3-N
Wetlands		
Depth	1.6	ft
Areal Nitrate Removal Rate	4.5	lbs-N/ac/d
Influent Nitrate Concentration	15	mg/L
Cloth Disk Filters		
Loading Rate	3.25	gpm/ft^2
Filter Area per Disk	54	ft^2
Disinfection		
UV Dose	100	mW/cm^2
Number of Channels	2	

Table 6-12
Assumed OD/FWS Wetland Design Criteria for HPS Wastewater Treatment (Cont.)

Criteria	Value	Units
Disinfection		
Number of Banks per Channel	4	
Standby Banks per Channel	1	
Odor Control		
Screening/Grit Area	56,160	ft^3
Screening/Grit Area Air Changes	12	ACH
Biofilter Loading Rate	2	$ft^3/m/ft^2$

OD/FWS Wetland Facility Sizing

Conceptual-level design calculations and assumptions for the OD/FWS wetland treatment system are shown in Appendix D, TM10-2, *Site-Specific Evaluation of Decentralized Wastewater Treatment*, which is available electronically. Table 6-13 summarizes the results of these calculations. Approximately 16 to 36 acres of wetland would be needed to reduce the nitrate-nitrogen concentrations from 15 to 10 mg/L. Denitrification basins may need to be incorporated in the oxidation ditch.

Table 6-13
OD/FWS Wetland Facility Sizing

Component	Quantity	Area (ft^2)
Headworks/Influent Pump Station	1	200
Screening/Grit Facility	1	1,900
Oxidation Ditch	2	18,530
Secondary Clarifiers	2	13,330
Aeration Building	1	1,500
FWS Wetland	1	871,200
Wetland Pump Station	1	200
Cloth Disk Filtration	1	680
UV Disinfection	1	2,100
Effluent Pump Station	1	600
Biofilter	1	5,625
Operations/Lab Building	1	2,500

Table 6-13
OD/FWS Wetland Facility Sizing (Cont.)

Component	Quantity	Area (ft^2)
Maintenance/Electrical	1	750
Electrical	1	750
Parking	1	5,000

OD/FWS Wetland General Arrangement and Schematic Profile

Figure 6-9 shows a general arrangement of the OD/FWS wetland facility on the larger 25-acre site in Parcel E with the wetlands roughly matching the existing shoreline. The facility would use all of the available land on this site. Adding denitrification basins to the oxidation ditch could enable a smaller system to be designed. An FWS wetland of approximately 20 acres would have a detention time of approximately 2.7 d and would remove approximately 3 mg/L nitrate-nitrogen.

Figure 6-9 is a general site arrangement for the OD/FWS wetland treatment facility. The site plan would be customized for HPS. Facilities may be combined during design; however, this evaluation makes the conservative assumption that they will be separate.

A schematic profile (Figure 6-10) shows the hydraulic grade line through the plant and the elevations of the various structures. No structure is higher than two stories, although the only available site is close to the shoreline and these structures could block views of the bay.

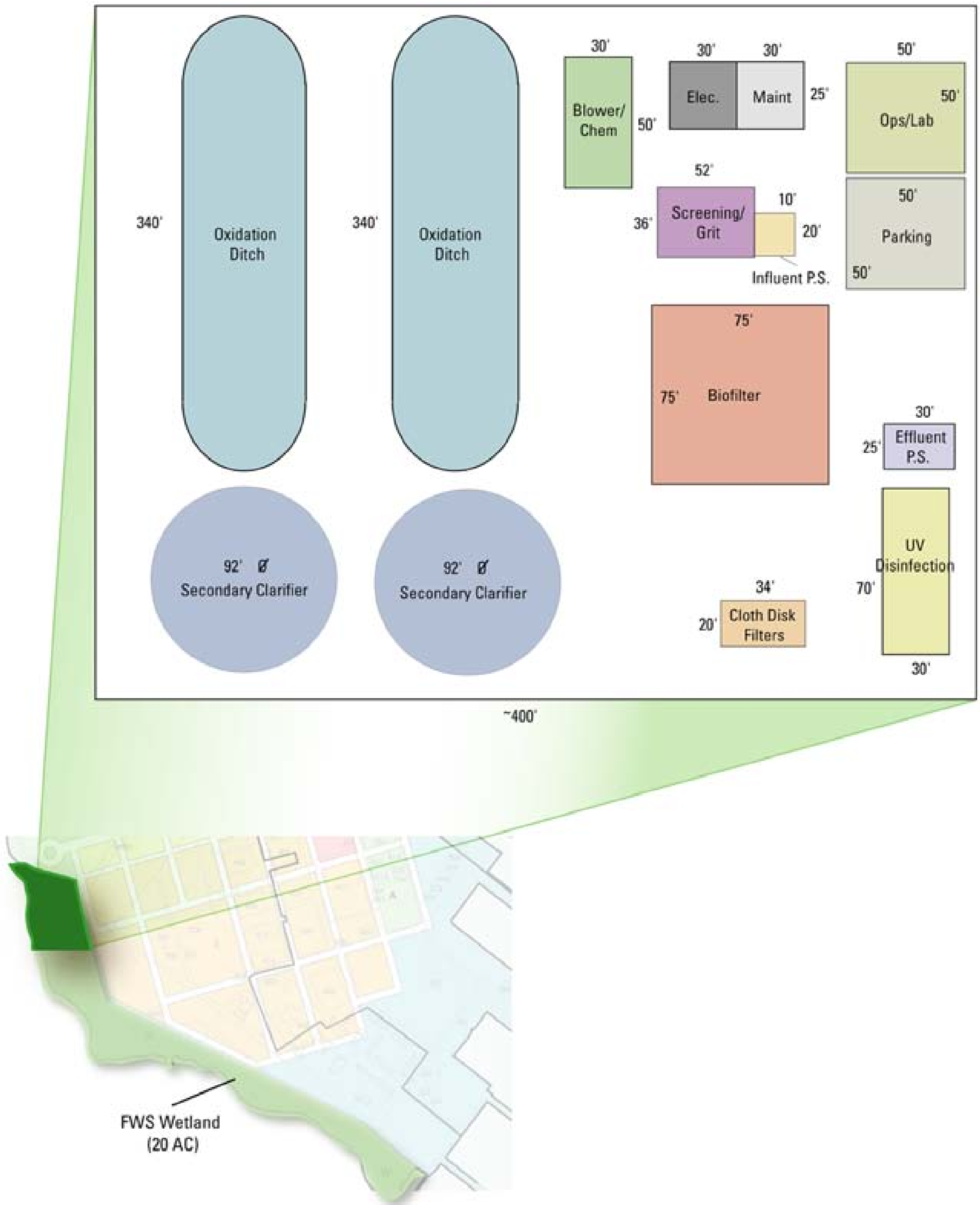


Figure 6-9
General Site Arrangement for OD/FWS Wetland System

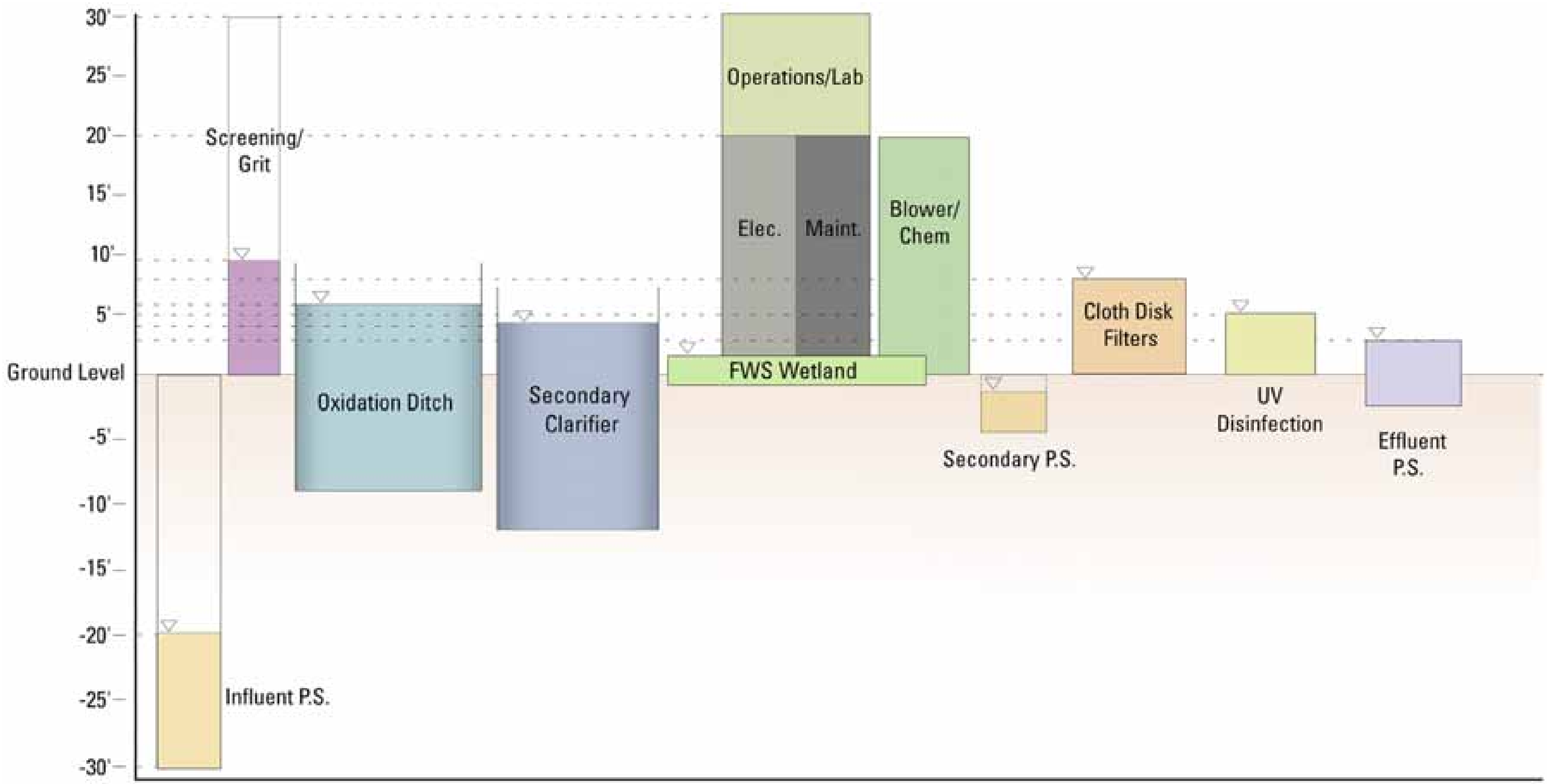


Figure 6-10
Schematic Profile of OD/FWS Wetland System

OD/FWS Wetland Treatment System Estimated Cost

Planning-level cost estimates for the OD/FWS wetland system are accurate +50% to –30%. The initial capital cost for the 4 MGD capacity OD/FWS wetland system would be approximately $37.8 million. Equipment replacement costs assume that mechanical and electrical equipment other than the cloth disk filters would be replaced every 25 years. The disks in the cloth disk filter units are assumed to have a useful life of five years. O&M costs are $1.9 million per year.

The capital, O&M, and replacement cost estimates were used to calculate the net present value (NPV) for a 30-year planning horizon with an escalation rate of 3% and a discount rate of 6% per year. The total 30-year NPV cost estimate of the OD/FWS wetland facility is approximately $75.3 million.

Septic Tank/Biotextile Filter—Small Treatment Systems (4 MGD)

Biotextile filters are a new technology primarily used for onsite treatment of residential septic tank effluents. These filters are starting to be used for treatment of septic tank effluent at larger sites such as campgrounds, shopping centers, roadside rest stops, clusters of houses, and small communities. The following sections provide information for a septic tank/biotextile filter system installation at HPS, including:

- Process description
- Design criteria
- Facility sizing
- General arrangement and schematic profile
- Estimated cost

Septic Tank/Biotextile Filter Process Description

The septic tank/biotextile filter is an anaerobic septic tank followed by a multiple-pass, packed-bed aerobic wastewater treatment process. The first step in this system is preliminary and primary treatment by a fine screen and a two-stage septic tank. The fine screen and septic tank provide screening, grit removal, primary settling, and partial anaerobic digestion of the raw wastewater. Effluent from the septic tank then flows to a recirculation/blending tank where it is blended with biotextile filter effluent. From the recirculation/blending tank, the wastewater is pumped to a distribution manifold on top of the biotextile filter and allowed to filter through it by gravity. The biotextile filter effluent is collected and split, with part being returned to the recirculation/blending tank and the remainder being discharged. To meet all Title 22 reuse requirements, the discharged wastewater needs to be further treated by cloth disk filtration and disinfection. The sludge that settles to the bottom of the septic tank needs to be removed periodically.

Biotextile filter technology has been developed within the past ten years and is manufactured by Orenco Systems Incorporated in Sutherlin, Oregon. While these systems have been installed primarily for residential applications, Orenco has recently begun to market a larger filter for commercial applications. This commercial filter was used for the sizing and cost analyses for this evaluation.

The proposed process schematic for a septic tank/biotextile filter system is shown in Figure 6-11.

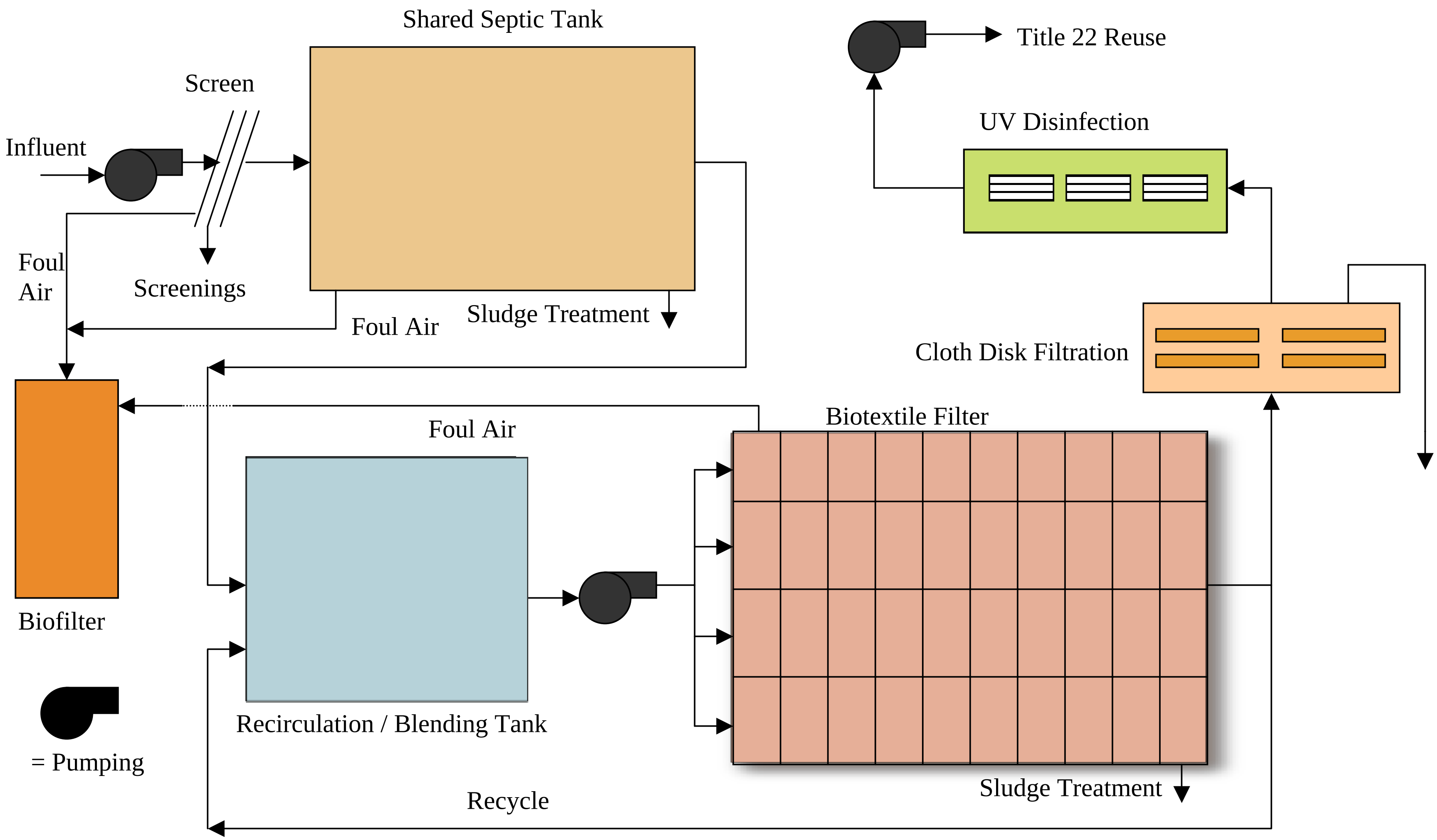


Figure 6-11
Septic Tank/Biotextile Filter System Flow Schematic

Septic Tank/Biotextile Filter Design Criteria

The specific process design criteria are listed in Table 6-14.

Table 6-14
Assumed Biotextile Filter Design Criteria for HPS Wastewater Treatment

Criteria	Value	Units
Flow	0.1	MGD
Septic Tank		
Length to Width Ratio	3:1	
Septic Tank Volume to Average Flow Ratio	5:1	
Biotextile Filter		
Loading Rate	25	gpd/ft^2
Filter Area per Unit	100	ft^2
Unit Length	16	ft
Unit Width	8	ft
Unit Height	4	ft
Recirculation Tank		
Volume to Average Flow Ratio	1:1	
Cloth Disk Filter		
Loading Rate	3.25	gpm/ft^2
Filter Area	12	ft^2/filter
Disinfection		
UV Dose	100	mW/cm^2
Number of Channels	1	
Number of Banks per Channel	3	
Standby Banks per Channel	1	
Odor Control		
Screening Area Volume	2,400	ft^3
Screening Area Air Changes	12	ACH
Septic Tank Volume	66,836	ft^3
Septic Tank Air Changes	1	ACH

Table 6-14
Assumed Biotextile Filter Design Criteria for HPS Wastewater Treatment (Cont.)

Criteria	Value	Units
Odor Control (Cont.)		
Biotextile Filter ft^3/m per Filter Unit	4	ft^3
Biofilter Loading Rate	2	$ft^3/m/ft^2$

Initially, these design criteria were used to develop a conceptual site layout for an average flow of 0.5 MGD, which would require eight systems. An average flow of 0.5 MGD requires a 2.5-million-gallon capacity septic tank and 25,600 square feet of biotextile filters, both of which were considered too large to be practical. Therefore, a conceptual layout for an average flow of 0.1 MGD, was developed and has been used in the following evaluation. For a wastewater flow of 4 MGD, HPS would require 40 of these 0.1 MGD-capacity systems.

Septic Tank/Biotextile Filter Facility Sizing

Table 6-15 shows the results of conceptual-level design calculations for the 0.1-MGD system. Note that the table presents the size of one 0.1-MGD module.

Table 6-15
Septic Tank/Biotextile Filter System Sizing for 0.1 MGD Flow

Component	Quantity	Area (ft^2)
Headworks/Influent Pump Station	1	120
Screening/Grit Facility	1	120
Septic Tank	1	2,730
Recirculation/Blending Tank and Pump Station	1	1020
Biotextile Filters	40	6,300
Cloth Disk Filtration	1	195
UV Disinfection	1	200
Effluent Pump Station	1	120
Biofilter	1	1,600
Maintenance	1	100
Electrical	1	150
Operations/Lab	1	150

Septic Tank/Biotextile Filter General Arrangement and Schematic Profile

A general arrangement for these facilities is shown in Figure 6-12.

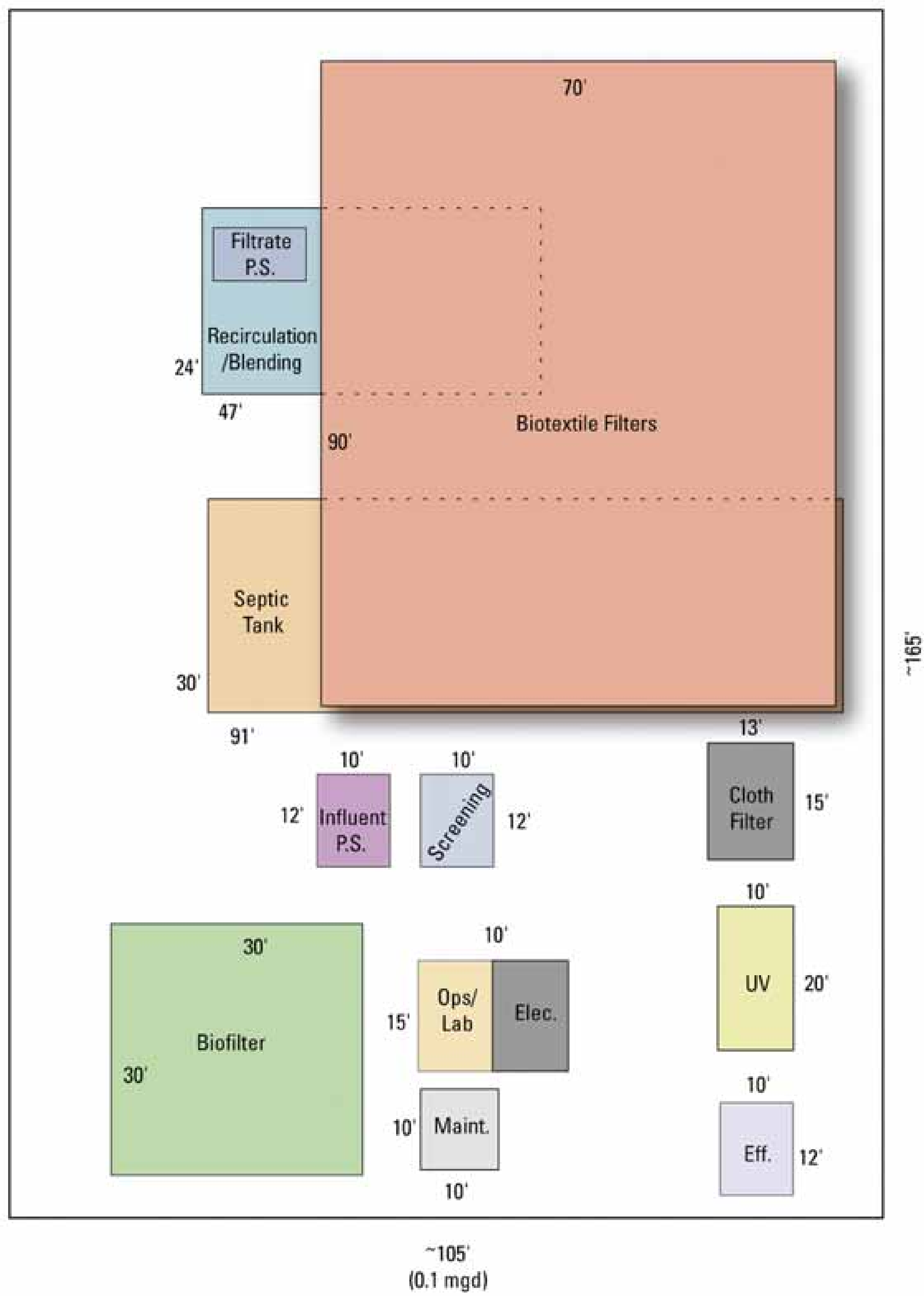


Figure 6-12
General Site Arrangement for Septic Tank/Biotextile Filter

A schematic profile that shows the hydraulic grade line and elevations of facilities is provided in Figure 6-13. Buildings at these facilities will be one story high.

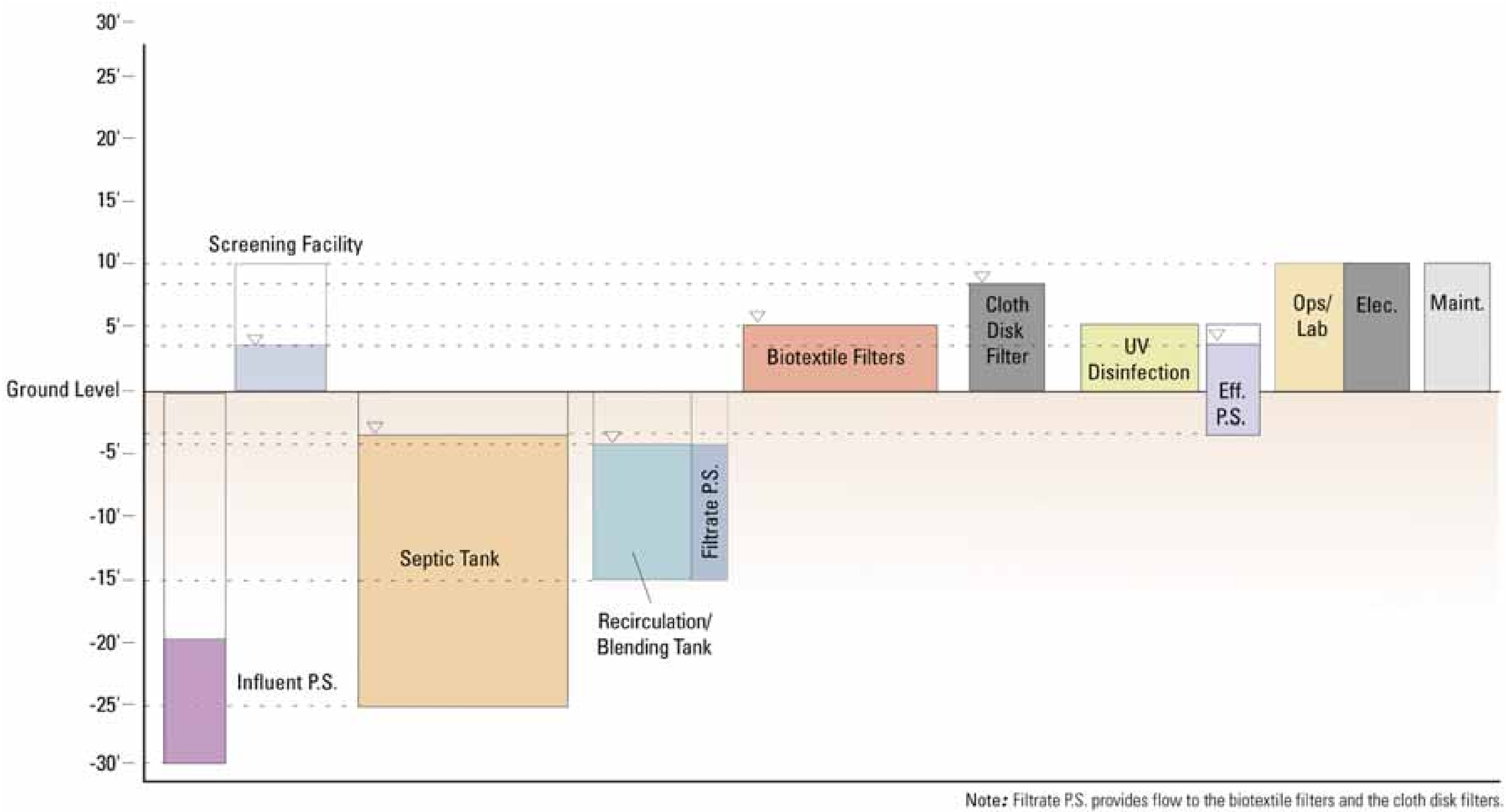


Figure 6-13
Schematic Profile of Septic Tank/Biotextile Filter

This general facilities site plan for a 0.1-MGD biotextile filter treatment facility was used mainly to identify the required areas. The site plan would be customized for HPS and the land requirements may change. Facilities may be combined in the final design; however, in this evaluation the conservative assumption was made that they will be separate.

The land area required for each of these facilities is 0.4 acre. Assuming 40 sites throughout HPS, the total land area requirement for the septic tank/biotextile filter systems would be 16 acres.

Septic Tank/Biotextile Filter Treatment System Estimated Cost

Planning level cost estimates for the septic tank/biotextile filter systems are accurate +50% to –30%. The estimated capital cost for a 0.1-MGD biotextile filter treatment system is $5.4 million, not including replacement equipment over the course of the system's lifetime. Equipment replacement costs assume that mechanical and electrical equipment other than cloth disk filters and biotextile filter material would be replaced every 25 years. The disks in the cloth disk filter units were assumed to have a useful life of five years, and the biotextile filter material a useful life of 15 years. O&M costs are $59,290 per year for a 0.1-MGD system.

The capital, O&M, and replacement cost estimates were used to calculate the net present value (NPV) over a 30-year planning horizon. An assumption of how the systems would likely be constructed was also used to determine this estimate. Unlike the MBR and OD/FWS wetland systems, the biotextile filters are more adaptable to phased development, so it was assumed that they would be built in tandem with HPS development.

The NPV estimate for the 40 systems required was calculated using an escalation rate of 3% and a discount rate of 6% per year over the 30-year planning horizon. The total 30-year NPV cost estimate is $196.4 million.

Evaluation of Treatment Systems (4 MGD)

This section compares the three decentralized wastewater treatment alternatives to the study evaluation criteria for a wastewater flow of 4 MGD and production of tertiary effluent. The results compare one MBR system, one OD/FWS wetland system, and 40 septic tank/biotextile filter systems. The study evaluation criteria include:

- Community and environmental enhancement
- Effluent quality
- Implementation
- Land requirement
- Life cycle costs
- Operation and maintenance
- Public interests

Community and Environmental Enhancement

The community and environmental enhancement criterion evaluates the treatment systems relative to how each will:

- Support sustainability goals by leading to water and energy conservation
- Provide environmental, educational, and/or recreational opportunities
- Accommodate a wide range of reuse applications

See Table 6-14 for the results of the evaluation for this criterion. A treatment system using an OD/FWS wetland would be the best with respect to this criterion since it would provide the most environmental, recreational, and educational opportunities. MBR facilities have high power usage, but would provide some educational opportunities and would provide a wide range of reuse opportunities. Septic tank/biotextile filters are largely passive and, in general, would neither support a wide range of reuse applications, nor provide environmental, educational, or recreational opportunities. However, this study assumed that filtration would be added to the OD/FWS wetland and septic tank/biotexile approaches, which would provide similar reuse opportunities for all options.

Effluent Quality

The effluent quality criterion evaluates the treatment systems relative to the

- Reliability of the treatment system to continuously provide high-quality effluent for desired purposes (various reuse applications)
- Availability of data from comparable facilities to demonstrate treatment performance

Of the systems evaluated, the MBR has the highest pollutant removal efficiency and has a successful track record of supplying recycled water in several installations. Long-term reliability data are not available for this technology. The OD/FWS wetland, with tertiary filtration and UV disinfection, supplies a high-quality effluent for reuse applications and also has several comparable installations. Long-term performance data are available for OD/FWS wetland systems. Because biotextile filters have not been used for municipal wastewater and are not expected to perform well with wastewater from commercial and industrial zones, this treatment system scores poorly with respect to the effluent quality criterion.

Implementation

The implementation criterion evaluates the treatment systems regarding:

- Ease with which the treatment system can be implemented onsite
- Significant permitting, environmental review, environmental cleanup, and/or constructability issues to be resolved

- The existence onsite of specific surface and/or subsurface conditions and topographic features required for the treatment system
- The treatment system's ability to accommodate a phased development approach

The MBR treatment system ranks highest with respect to the implementation criterion because it does not require significant permitting, does not require any special geotechnical features (such as impermeable soils), and could be designed to handle the various flow rates associated with the expected phased development.

The OD/FWS wetland scored exceptionally poorly under this criterion because of questions regarding subsurface conditions, lack of phasing opportunities, and inability to construct a system until near the end of development.

The septic tank/biotextile filter system scored neutral under this criterion. There are currently permitting questions for this type of system and for its discharge to the subsurface.

Land Requirement

The land requirement criterion evaluates the amount of land (surface and subsurface area) that is required for the treatment system to meet desired effluent water quality objectives.

Table 6-16 shows the land requirements of the three treatment systems.

Table 6-16
Total Land Requirement

	MBR	OD/FWS Wetland	Septic Tank/Biotextile Filter
Acres	2.2 (1 site)	25 (1 site)	16 (over 40 sites)
Rating	More Favorable	Less Favorable	Less Favorable

The MBR treatment system requires the least total area, even though the septic tank/biotextile filter systems require the least area per facility. However, the total area required by the biotextile filter systems is greater than that for the MBR. The relatively large land area per facility for the septic tank/biotextile filters brings into question the viability of this option. Forty different sites of 0.4 acre each are unlikely to be identified. Initial ideas of being able to place most of the systems underground proved incorrect because of the required post-treatment steps to meet the Title 22 reuse requirement. The OD/FWS wetland would require the most area (25 acres).

Life Cycle Costs

Life cycle costs, including capital, O&M, and the value of recycled water, were used to evaluate the treatment systems, including:

- Expected capital and O&M costs over the life cycle of the treatment system

- Value of the recycled water to be produced by the treatment system (that is, value of recycled water produced and value of potable water made available)

A 30-year planning horizon was used to evaluate the expected life cycle costs for the treatment systems described in this study. Table 6-17 summarizes the results of the evaluation.

Table 6-17
Life Cycle Costs

	MBR	OD/FWS Wetland	Septic Tank/Biotextile Filter
Capital & O&M Cost ($ million)	83.9	75.3	196.4
Rating	More Favorable	More Favorable	Less Favorable

There is not a significant difference between the costs of the MBR and OD/FWS wetland treatment alternatives. The septic tank/biotextile filters treatment systems would cost more than twice as much.

The value of recycled water for each of these systems was examined and is included in the technical report. Assuming that the revenue produced by recycled water would be 75% of that produced by potable water, the wholesale cost of recycled water to customers would be approximately $1.12 per 100 cubic feet based on current SFPUC rates of $1.49 per 100 cubic feet. If it is assumed that the actual demand for recycled water at HPS will be 0.45 MGD at full buildout, each of the treatment systems will be able to meet this demand. Assuming that all of the 0.45 MGD demand will be available immediately, the 30-year life-cycle revenue from recycled water is approximately $4.9 million. This value is small compared to the life-cycle capital and O&M costs and is not considered a differentiator between the three alternatives.

Operation and Maintenance

O&M is evaluated using the following criteria:

- The extent to which the operation and maintenance of the treatment system is relatively straightforward and trouble-free under all seasons and under all conditions
- The capability of operation staff with an average level of training, knowledge, and expertise in wastewater treatment to operate and maintain the treatment system
- A low level of maintenance is required for the system

This criterion favors an OD/FWS wetland system because it employs mostly conventional treatment processes. These processes result in straightforward and trouble-free operation and maintenance; average requirements for operator training, knowledge and expertise; and an average level of maintenance.

The MBR system scores well under this criterion, but requires a relatively high degree of operator training, knowledge and expertise.

Septic tanks/biotextile filters do not require above average operator knowledge and training, but would require high maintenance. Use of this type of system could result in significant administrative issues related to maintenance because there will be multiple facilities to maintain.

Public Interests

The ability of the three treatment systems to address public interests was also evaluated, including:

- Preserving or improving public health and safety
- Mitigating potential odor problems
- Being perceived as aesthetically neutral or aesthetically positive
- Providing employment opportunities for the BVHP community

The MBR and OD/FWS constructed wetland ranked similarly, with the MBR treatment system scoring slightly higher. The MBR is advantageous compared to the OD/FWS wetland in terms of public health and safety, while the OD/FWS wetland generally has more aesthetic value and could offer more employment opportunities if the educational opportunities of the system are fully realized.

The septic tank/biotextile filter scored poorly in this criterion because these systems would be located closer to residential neighborhoods than either the MBR or the OD/FWS wetland. The proximity to these neighborhoods would increase the risk to public health and safety and the potential for odors. Additionally, these systems do not offer any aesthetic benefits to the community.

Evaluation Summary

Table 6-18 summarizes the results of the study evaluation criteria. The ratings given to each technology are shown using the following symbols:

○ = More Favorable

◑ = Neutral

● = Less Favorable

Table 6-18
Comparison of Decentralized Approaches

Criteria	MBR	OD/FWS Wetland	Septic Tank/ Biotextile Filter
Community and Environmental Enhancement			
Sustainability Goals	●	◑	◑
Environmental, Educational, and Recreational Opportunities	◑	○	●
Reuse Applications	○	○	◑
Effluent Quality			
Reliability	○	○	●
Available Data	◑	○	●
Implementation			
Readily Implemented	◑	●	◑
Permitting, Environmental Review/Cleanup, and Constructability	○	◑	◑
Surface, Subsurface, Topographic Features	○	●	◑
Phasing	○	●	○
Land Requirement			
Land Required	○	●	●
Life Cycle Costs			
Capital and O&M Costs	○	○	●
Value of Recycled Water	◑	◑	◑
Operation and Maintenance (O&M)			
Straightforward and Trouble-free	○	○	◑
Staff Training, Knowledge, and Expertise	◑	◑	○
Low Maintenance	○	○	●

○ = More Favorable ◑ = Neutral ● = Less Favorable

Table 6-18
Comparison of Decentralized Approaches (Cont.)

Criteria	MBR	OD/FWS Wetland	Septic Tank/ Biotextile Filter
Public Interests			
Public Health	○	◑	◑
Public Safety	○	●	◑
Odor	○	◑	●
Aesthetics	◑	○	◑
Employment	◑	○	○

○ = More Favorable ◑ = Neutral ● = Less Favorable

Key Finding

The MBR is the preferred technology. The MBR alternative is more favorable with respect to reuse applications, effluent quality reliability, ease of implementation, land requirements, capital and O&M costs, O&M demands, and public interests (public health, public safety, and odors).

Cost and Footprint Comparison for 2-MGD and 4-MGD Systems

The primary developer has estimated HPS wastewater flows at full build-out to range from 2 to 5 MGD. To assess the low end of this projection, a 2-MGD scenario was also investigated. Cost data and system footprint acreage for 2-MGD and 4-MGD treatment systems are summarized in Table 6-19.

Table 6-19
Cost Data and Total Footprint (in acres) for 2-MGD and 4-MGD Treatment Systems—MBR Plant, OD/FWS Wetland System, and Septic Tank/Biotextile Filter Systems

Treatment System	Capital Cost* ($ million)	Annual O&M Cost** ($ million)	NPV Cost 30-year life cycle ($ million)	Total Footprint (acres)
2-MGD MBR	26.0	1.4	53.0	1.5
2-MGD OD/FWS Wetland	23.8	1.2	44.8	12
2-MGD Septic Tank/Biotextile Filter Systems***	113.5	1.2	100.1	8

Table 6-19
Cost Data and Total Footprint (in acres) for 2-MGD and 4-MGD Treatment Systems—MBR Plant, OD/FWS Wetland System, and Septic Tank/Biotextile Filter Systems (Cont.)

Treatment System	Capital Cost* ($ million)	Annual O&M Cost** ($ million)	NPV Cost 30-year life cycle ($ million)	Total Footprint (acres)
4-MGD MBR	37.2	2.2	83.9	3
4-MGD OD/FWS Wetland	37.8	1.9	75.3	25
4-MGD Septic Tank/Biotextile Filter Systems***	232.4	2.4	196.4	16

*Capital cost includes engineering and construction costs for the treatment system in 2003 dollars. Collection system, recycled water storage, and recycled water distribution are not included.

**Annual O&M costs in 2003 dollars.

***Septic Tank/Biotextile Filter Systems would be built as needed. At 2 MGD, 20 systems would be required. At 4 MGD, 40 systems would be required. Capital costs would be approximately $5.4 million per 0.1-MGD system. O&M costs would be approximately $59,000 per 0.1-MGD system.

7 REFINEMENT OF THE MBR SYSTEM

A refinement of the preferred decentralized system (MBR) must consider sludge handling/treatment options. A sludge overview, followed by a refinement of the MBR system is provided in this section.

Sludge Handling/Treatment Options

Three sludge handling options were discussed at the March 31, 2003 technical workshop:

- Sending sludge through the San Francisco combined sewer system to SEWPCP for treatment
- Onsite storage in holding tank(s) with vacuum pumping and hauling to SEWPCP, OSWPCP, or another local facility for treatment
- Onsite treatment of sludge at HPS with biosolids hauling

Specific advantages and disadvantages of sludge handling approaches for a decentralized system at HPS are summarized in Table 7-1.

Table 7-1
Summary of Sludge Handling Approaches Identified at TRC Workshop, for Decentralized Wastewater Systems at HPS

Sludge Handling Approach	Advantages	Disadvantages
Wasting Sludge to Combined Sewer	+ Minimization of cost + Ease of operation + Reduction of odor impacts associated with onsite solids handling facilities	– No significant change to the solids loading to the combined sewer system and SEWPCP
Onsite Storage and Sludge Hauling	+ Different sludge treatment location from SEWPCP	– Energy intensive due to the need for daily trucking – Local nuisance impacts associated with daily tanker trucks traveling through HPS (approximately 1 truck/h) – Even with controls, local sludge storage may create odor problems at HPS

Table 7-1
Summary of Sludge Handling Approaches Identified at TRC Workshop, for Decentralized Wastewater Systems at HPS (Cont.)

Sludge Handling Approach	Advantages	Disadvantages
Onsite Treatment and Biosolids Hauling	+ Different sludge treatment location from SEWPCP	– High capital and O&M cost – Demanding from an operations perspective – Could generate local nuisance impacts associated with odors and trucks traveling through HPS

Key Finding

Scalping is the preferred mode of operation. Wasting sludge to the combined sewer for eventual treatment at SEWPCP minimizes costs, operational demands, and local odor impacts associated with a small solids handling facility. A scalping mode of operation also avoids the need for onsite wastewater disposal.

Conceptual Design of MBR Scalping Plant (0.5 MGD)

A 0.5-MGD capacity MBR scalping plant was designed. A 0.5-MGD facility is approximately the size that would be needed to meet the projected recycled water demands at HPS, including in-building dual plumbing, landscape irrigation, and, if wetlands are constructed, wetlands enhancement. Some of the assumptions of this conceptual design include:

- The facility would only take wastewater as-needed from the collection system; excess flows would continue to SEWPCP untreated.
- This configuration has design ramifications with respect to equalization and redundancy requirements. The facility could be shut down without a discharge violation, and excess capacity would not be required to meet peak daytime or wet-weather flows.

In light of the reduced equalization and redundancy requirements, the 0.5-MGD configuration assumes a reduced number of aeration basins (from three to two) and denitrification basins (from six to four), compared to the 4-MGD configuration designed to handle all flows.

Figure 7-1 provides a flow schematic for a 0.5-MGD MBR scalping plant.

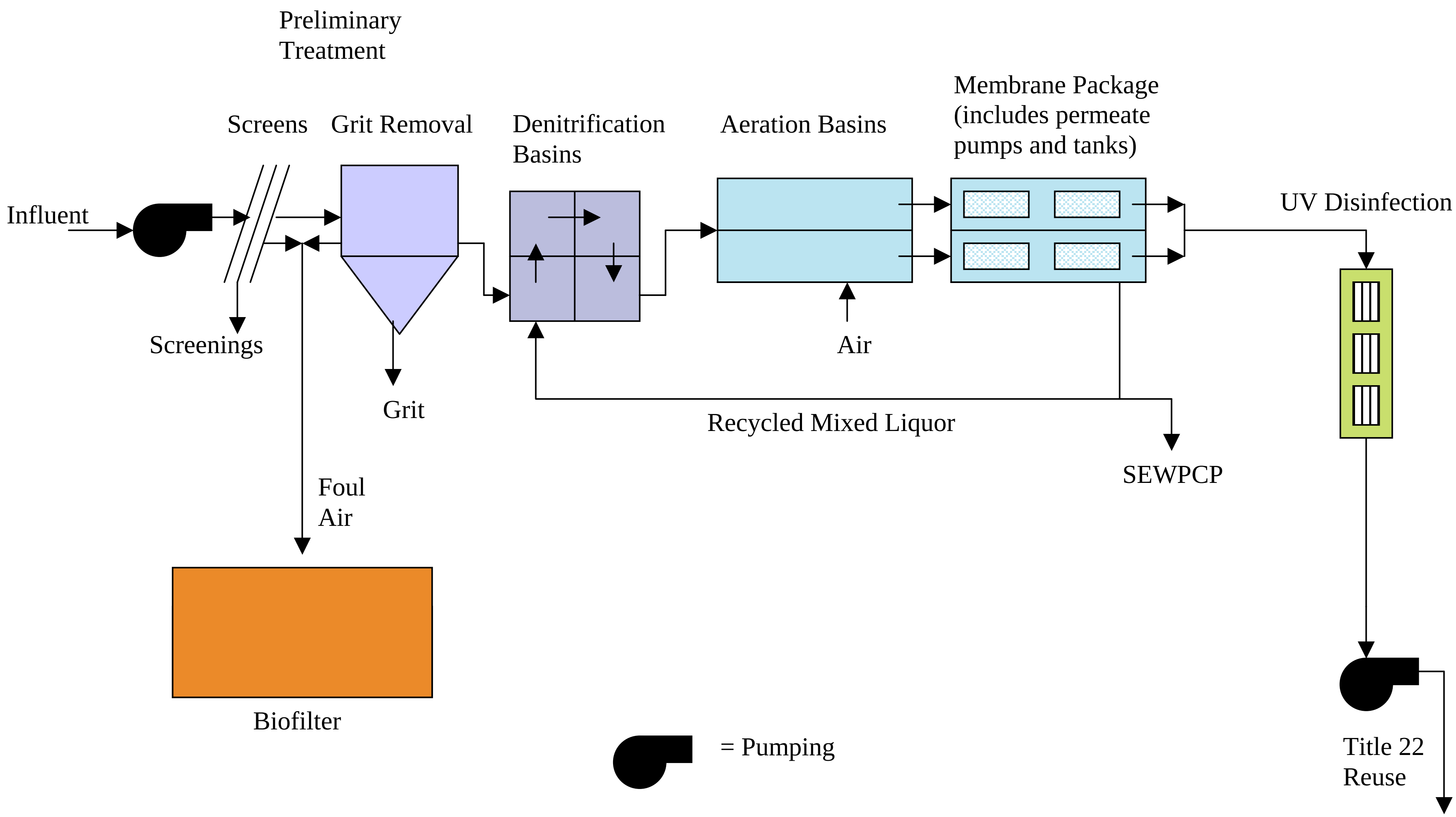


Figure 7-1
Flow Schematic for 0.5 MGD Membrane Bioreactor Scalping Plant

Figure 7-2 provides a general layout for the facility.

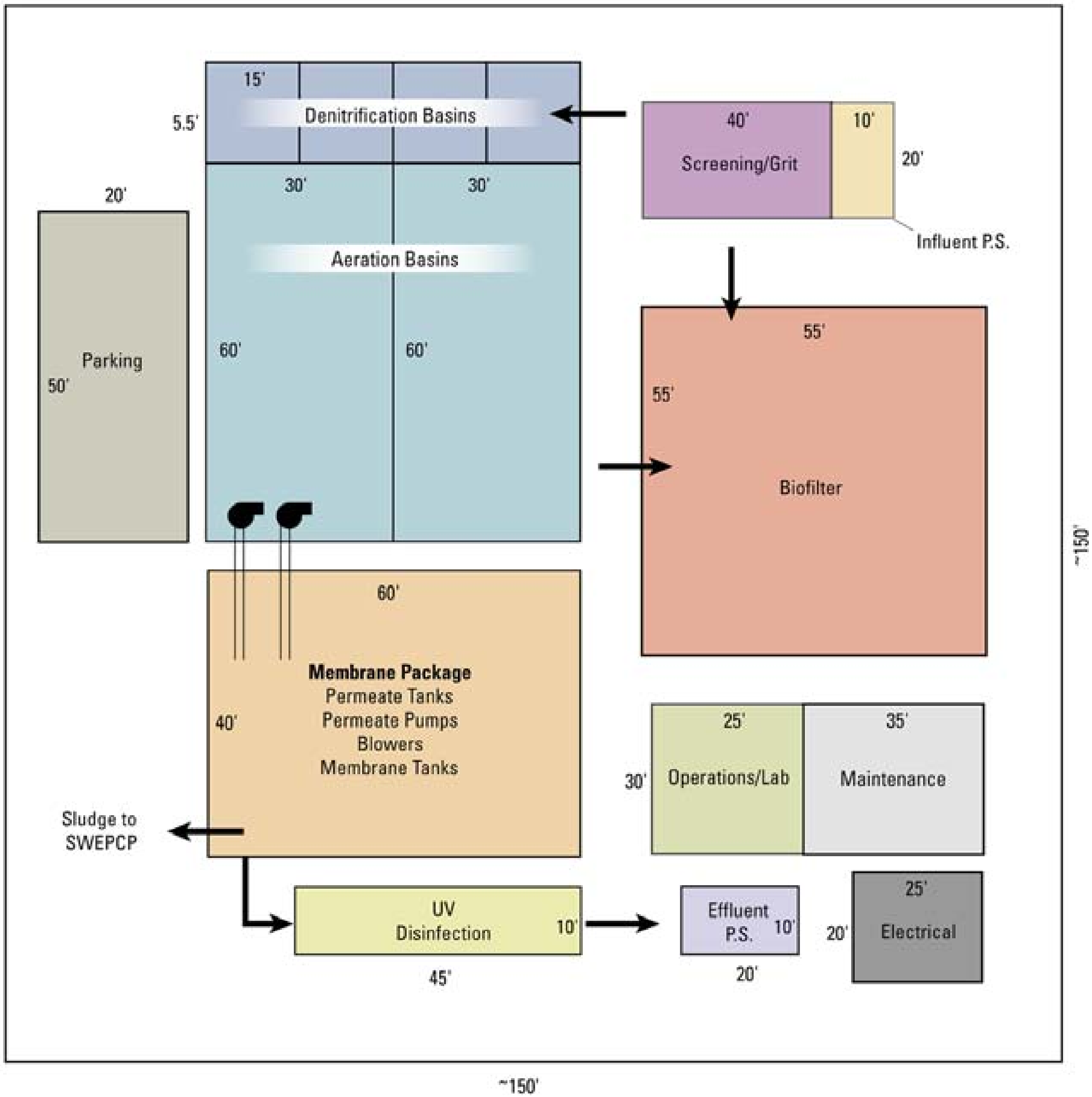


Figure 7-2
General Site Arrangement for 0.5-MGD Membrane Bioreactor Scalping Plant

Detailed cost estimates for capital, O&M, and equipment replacement are included in the technical report. The key findings of this cost evaluation can be summarized as follows:

- The net present value (NPV) cost would be approximately $14.3 million over a 30-year planning horizon.
- Initial capital costs would be approximately $7.1 million.
- Annual O&M costs would be approximately $400,000.

- An area of approximately 0.5 acres would be required.
- A "package" membrane system would likely be the most cost-effective approach.

Costs and expected footprints for MBR satellite plants at 0.5 MGD, 2 MGD, and 4 MGD are summarized in Table 7-2. A 0.5-MGD facility would meet the reuse demands at HPS. The larger options (2 MGD and 4 MGD) could be pursued if the plant was to provide offsite recycled water demands.

Table 7-2
Costs, Footprints, and Areas Served with Recycled Water for MBR Scalping Plants Sized at 0.5 MGD, 2.0 MGD, and 4.0 MGD

Capacity of MBR Scalping Plant (MGD)	Capital Cost* ($ million)	Annual O&M Cost** ($ million)	Net Present Value Cost—30-year Life Cycle ($ million)	Footprint (acres)	Area Served with Recycled Water
0.5	7.1	0.4	14.3	0.5	HPS
2.0	26.0	1.4	53.0	1.5	HPS + offsite
4.0	37.2	2.2	83.9	3.0	HPS + offsite

*Capital cost includes engineering and construction costs for the treatment system in 2003 dollars. Collection system, recycled water storage, and recycled water distribution are not included.

**Annual O&M costs in 2003 dollars.

8 CENTRALIZED WASTEWATER TREATMENT APPROACH

With the exception of HPS and a few other isolated areas, San Francisco wastewater is collected in a combined sewer system. In a combined system, wastewater and storm water are collected in the same pipes and conveyed to facilities for treatment.

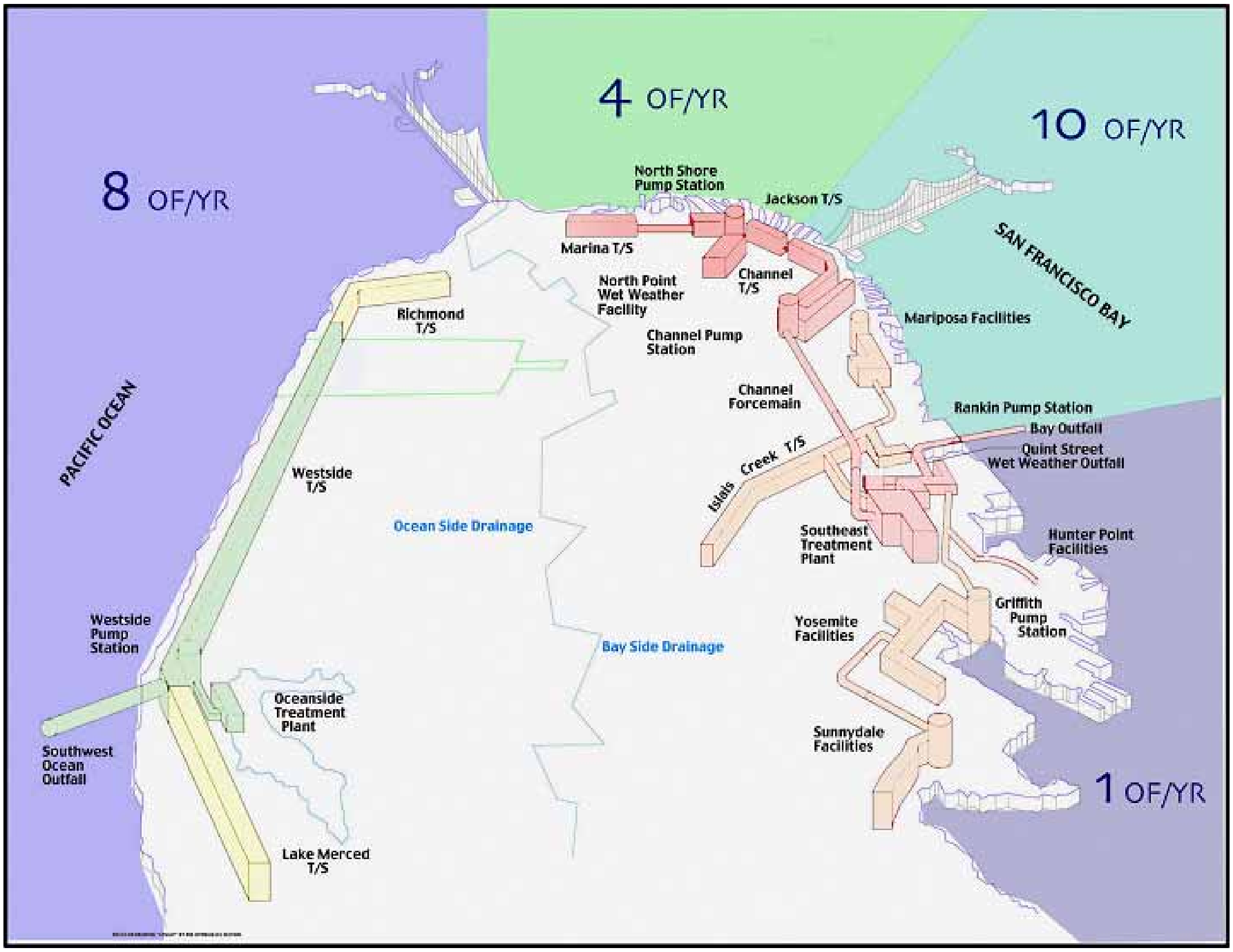
Overview of the City's Combined System

The City of San Francisco has three treatment facilities.

- **Oceanside Water Pollution Control Plant (OSWPCP)—**Treats wastewater flows from the west side of San Francisco (an average dry weather flow of 18 MGD or 21% of the city's dry weather flow) and discharges secondary effluent to the Pacific Ocean through the southwest ocean outfall
- **Southeast Water Pollution Control Plant (SEWPCP)—**Treats wastewater flows on the east side of San Francisco (an average dry weather flow of approximately 67 MGD or 79% of the city's dry weather flow) and discharges secondary effluent to San Francisco Bay through the southeast outfall
- **North Point Wet Weather Facility—**Operates during wet weather events and can provide 150 MGD of primary treatment with disinfection (RMC 2003)

Storage/transport structures around the perimeter of the city convey dry weather wastewater flows to OSWPCP and SEWPCP. During wet weather, these structures store and convey wastewater. The storage capacity of the collection system increases the ability of the plants to treat wastewater. During major storms, the storage capacity and treatment capacities of the system can be exceeded and discharges occur through combined sewer overflow (CSO) structures. There are 36 CSO outfalls around the city perimeter, 29 on the bay side and 7 on the west side.

The city has National Pollutant Discharge Elimination System (NPDES) permits for wastewater discharge to the Pacific Ocean and for wastewater discharge to San Francisco Bay. Under these permits, the city, on average, is allowed eight wastewater overflows per year on the ocean side of the city, four overflows per year on the northern shore of the city, ten overflows per year on the central waterfront of the city, and one overflow per year on the southeastern shore (Regional Water Quality Control Board 2002). Figure 8-1 shows the ocean side and bay side drainage basins, the storage/transport structures, the treatment facilities and outfalls, and the allowed overflows per year.



OF/YR = average permitted overflows per year

Figure 8-1
City of San Francisco Combined Sewer System and Wastewater Treatment Facilities

SEWPCP Treatment Process

SEWPCP occupies 49 acres in southeast San Francisco, near Evans Avenue and Phelps Street. SEWPCP has a secondary treatment capacity of 150 MGD. During wet weather, the plant can provide an additional 100 MGD of primary treatment with disinfection. An average dry weather flow of 67 MGD (RMC 2003) will be used for planning purposes, although recent data indicate that the average dry weather flow is 63 MGD, possibly due to the economic slowdown, water conservation, and a decrease in tourism (SFPUC 2003a).

The first stage of treatment (preliminary treatment) consists of physical/mechanical treatment units. Screens remove floating trash, rags, sticks, leaves, and other debris. Grit removal tanks remove gravel and sandy materials. After grit removal, the wastewater flows through primary clarifiers (primary treatment) where suspended solids are removed by settling. The settled material (sludge) is pumped to anaerobic digesters for solids stabilization and energy recovery.

After primary treatment, the wastewater flows into secondary biological treatment units. The liquid waste stream enters covered aeration tanks where it is mixed with pure oxygen and a microbial culture called activated sludge. The bacteria remove the organic pollutants and create settable solids. The wastewater then flows into secondary clarifiers where solids (secondary sludge) are removed by settling. Some of the secondary sludge is returned to the aeration tanks to maintain an active biological culture and the remainder is sent to dissolved air flotation thickeners, followed by anaerobic digesters.

After the secondary clarifiers, the secondary treated wastewater is disinfected with sodium hypochlorite (bleach). Chlorination kills the coliform bacteria in the secondary treated wastewater. Following disinfection, excess chlorine is neutralized with sodium bisulfate treatment. The treated effluent is then discharged to San Francisco Bay through the southeast outfall, approximately 800 feet offshore of Pier 80.

The biosolids produced by the anaerobic digestion of the primary and secondary sludges are beneficially recycled as alternative daily cover (ADC) or reused through land application in Marin and Solano Counties. During wet weather, all biosolids are transported to Hay Road Landfill where the material is stored during wet weather and then dried and mixed with compost and soil to create an engineered soil for use as cover at the landfill. During dry weather, the majority of the biosolids are land applied on agricultural fields in the Rio Vista area. The remaining material is transported to Redwood Landfill where it is used as ADC (SFPUC 2003a).

Figure 8-2 provides a flow diagram that illustrates the SEWPCP treatment process.

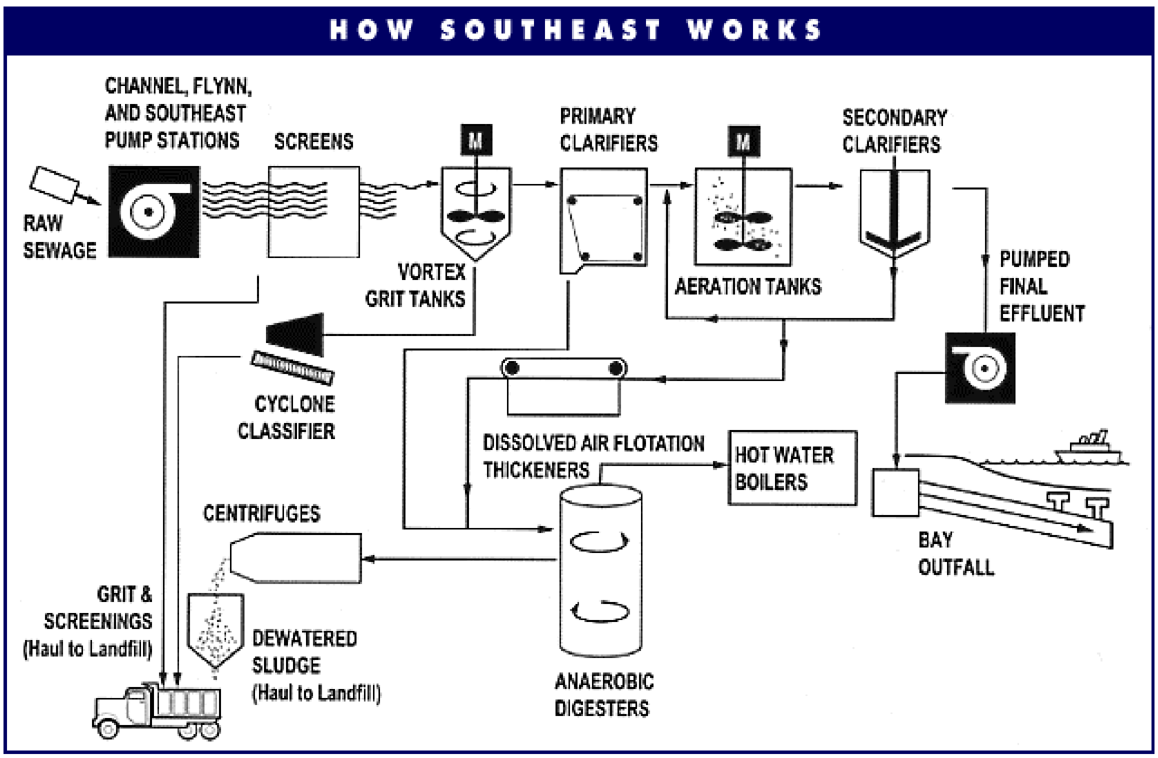


Figure 8-2
SEWPCP Process Flow Diagram

SEWPCP Effluent Quality

Table 8-1 summarizes biochemical oxygen demand (BOD_5), total suspended solids (TSS), total dissolved solids (TDS), and chloride (Cl^-) effluent data from SEWPCP, southeast outfall (dry weather).

Table 8-1
Effluent Data for the Southeast Outfall (dry weather)

Constituent	Average Effluent Concentration (mg/L)	Maximum Effluent Concentration (mg/L)
BOD_5	14.5	41
TSS	15.5	53
TDS	1,200	2,200
Cl^-	410	860

Notes:

Average and Maximum BOD_5 and TSS Data from NPDES Permit No. CA0037664 and based on monthly monitoring from January 1999 to December 2001.

BOD_5 and TSS dry weather effluent limit = 30 mg/L (monthly average)

BOD_5 and TSS dry weather effluent limit = 45 mg/L (weekly average)

TDS and chloride data from Water Pollution Control, 2003. Maximum TDS and chloride data are 99^{th} percentiles

The high TDS and chloride levels in the SEWPCP effluent are the result of saline groundwater infiltration into the sewer system. The high salt content of the SEWPCP effluent limits the feasibility of reclaiming this effluent. Sewer replacement projects and/or advanced treatment options (such as reverse osmosis) would be needed to produce good quality irrigation water. Filtered/disinfected SEWPCP effluent could be reused for irrigation after blending with a fresh water source. Alternatively, reclaimed effluent could be used for salt-tolerant plant irrigation, dust control, toilet flushing, or washdown water.

Table 8-2 compares guidelines for TDS and chloride levels in irrigation water with the average levels in SEWPCP effluent. With respect to the degree of restriction on use for irrigation, SEWPCP effluent falls within a “slight to moderate” category for TDS, and a “severe” category for chloride levels.

Table 8-2
Water Quality Guidelines for Irrigation, and SEWPCP Effluent Data for TDS and Chloride

Potential Irrigation Problem	Degree of Restriction on Use for Irrigation*		
	None	Slight to Moderate	Severe
TDS, mg/L (affects crop water availability)			
Guidelines	< 450	450—2,000	> 2,000
SEWPCP Effluent (average)		1,200	
Chloride, mg/L (affects sensitive crops)			
Guidelines: Surface Irrigation	< 140	140—350	> 350
Guidelines: Sprinkler Irrigation	< 100	> 100	–
SEWPCP effluent (average)			410

*(Metcalf & Eddy 1991)

Effect of HPS Flows on SEWPCP and the Combined System

This section describes the existing and future wastewater flows at HPS and the effect of these flows on SEWPCP and the combined treatment system.

Existing HPS Wastewater Flows

The sanitary and storm water collection systems at HPS have been separated. Under a general NPDES storm water permit for industrial operations, HPS storm water is discharged to San Francisco Bay through 33 storm water outfalls along the perimeter of HPS.

HPS wastewater is conveyed to the SEWPCP through a Crisp Avenue force main and then the city’s sewage collection system. Figure 8-3 shows that the monthly average wastewater flow at HPS from January 2000 to January 2003 was 180,000 gallons per day (GPD), with a monthly minimum of 95,000 GPD and a monthly maximum of 622,000 GPD (SFPUC 2003b).

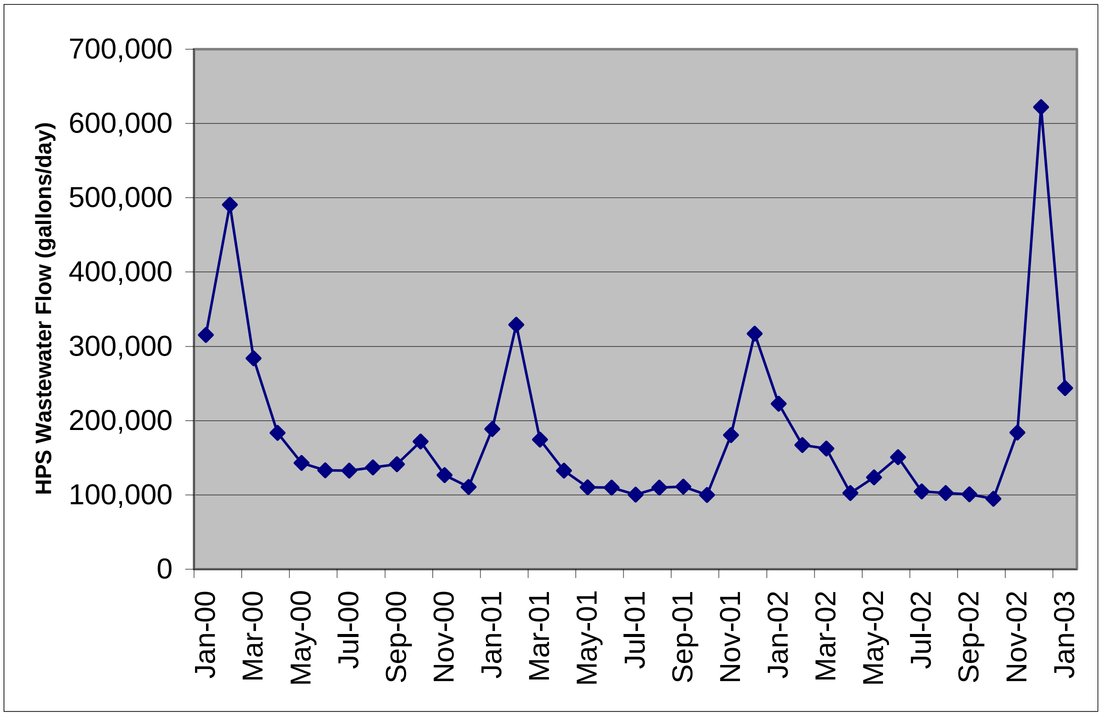


Figure 8-3
Monthly Wastewater Flow Rates at Hunters Point Shipyard from January 2000 to January 2003, Measured at Crisp Avenue (SFPUC 2003b)

There is significant groundwater infiltration into the HPS sewer system. Factors contributing to this infiltration are shallow groundwater, the age of the sewer system (constructed in the late 1940s), and the construction of the system on non-engineered fill. A 1988 utility assessment described the HPS sewer system as ranging from "good to very poor," and resembling a "heavily infiltrated system" (YEI Engineers 1988).

As shown in Figure 8-3, inflow and infiltration into the sewer system is more pronounced during winter (December to February). During winter, rainwater may enter the sewer system through manholes or other interconnections (YEI Engineers 1988). In addition to inflows, seasonal rises in the groundwater table may increase hydrostatic pressure and infiltration rates.

Future HPS Wastewater Flows

The wastewater and storm water collection systems at HPS will remain separated per the 2000 Environmental Impact Report. At full build-out, this study assumes that wastewater flows will be approximately 4 MGD. However, due to the uncertainty associated with redevelopment projects, the wastewater flow rate could be in the range of 2 MGD to 5 MGD at full build-out (Lennar/CH2M Hill 2002). The current and projected wastewater rates are shown in Figure 8-4.

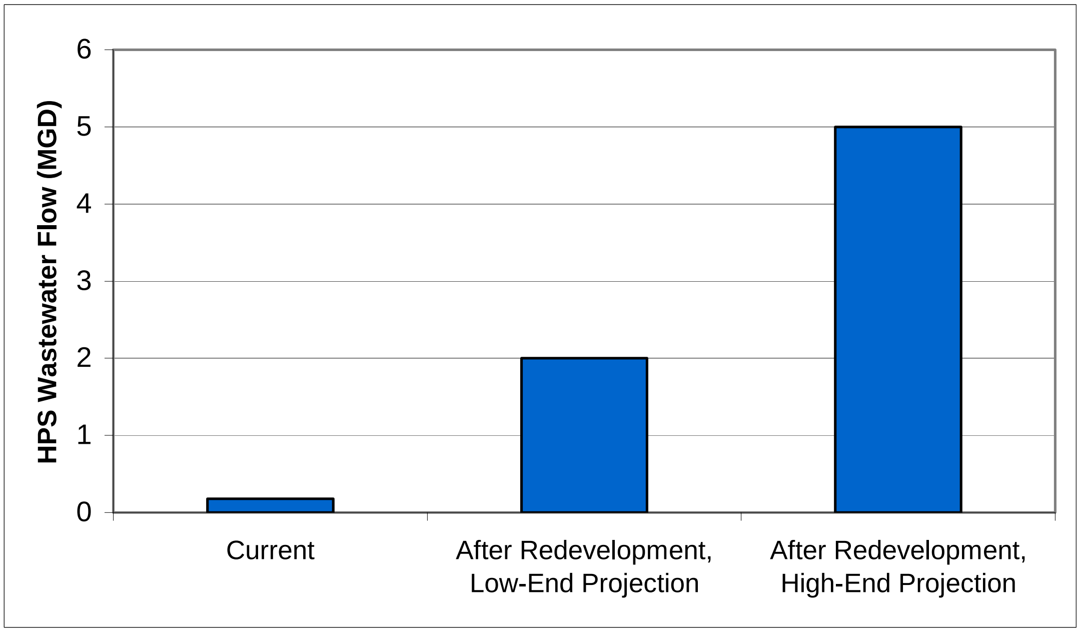


Figure 8-4
HPS Wastewater Flows—Current and After Redevelopment, Low-End and High-End Projections (SFPUC 2003b and Lennar/CH2M Hill 2002)

The design capacity of SEWPCP will easily allow the absorption of HPS flows of 2 to 5 MGD. SEWPCP was designed for an average dry weather flow of 85 MGD and the current average dry weather flow is only 67 MGD (ignoring the recent decline in flows).

The existing sewer system, between Crisp Avenue and the SEWPCP, is designed as a combined system (for sanitary and storm flows). An increase in dry weather flow of 2 to 5 MGD will have no impact on the functioning of the conveyance system because it is oversized for rain events. Sanitary flows of 2 to 5 MGD will have a slight effect on CSO events, between Crisp Avenue and the SEWPCP.

Combined Sewer Overflows (CSOs)

Because CSOs can occur in a combined sewer system, increasing the dry weather sanitary flows to SEWPCP will have a slight effect on the annual CSO volumes and durations. These effects (Table 8-3) show that for a full build-out flow of 4 MGD, the CSO volume would increase from 507 million gallons per year (MG/y) to 525 MG/y at the Islais Creek System (3.6%) and extend the duration from 52 hours per year (h/y) to 54 h/y (3.8% increase). No other watershed systems would be affected, and there would be no increase in CSO frequency. For the Islais Creek System, the average CSO frequency would remain within the NPDES permit allowance of 10 CSOs per year.

Table 8-3
CSO Modeling Results with HPS Dry Weather Flows of 2 MGD to 5 MGD, Islais Creek System

Dry Weather Flow Rate (MGD)	CSO Volume (MG/y)	CSO Duration (h/y)	CSO Frequency (number/y)
Base Case (0.0)	507	52	10
2	516	53	10
3	521	53	10
4	525	54	10
5	530	54	10

Notes:

Base case equals existing conditions plus development projects with a certified Environmental Impact Report, as of January 25, 2002.
(Hydroconsult Engineers 2002)

Cost of the Centralized Approach

In Fiscal Year 1997–1998 (FY97–98) (an El Nino year) the PUC plants treated 42 billion gallons of combined flows, which is equivalent to an annual daily average flow of 117 MGD. The FY97–98 city-wide centralized cost (including all O&M and capital debt costs) was approximately $155 million, resulting in a cost for centralized treatment of $1,183 per acre-feet (AF) (or $3,632 per million gallons).

In Fiscal Year 1998–1999 (FY98–99), a more typical flow year, the PUC plants treated 36 billion gallons of combined flows, which is equivalent to an annual average of 99 MGD. The FY98–99 city-wide centralized cost was approximately $146 million. The cost per unit volume for centralized treatment was $1,321 per AF (or $4,053 per million gallons).

Table 8-4 summarizes the FY97–98 and FY98–99 costs for centralized treatment and presents 2003 cost projections (based on a two-year average of Fiscal Years 97–98 and 98–99 and an escalation to 2003 using the *Engineering News Record* (ENR) cost index for San Francisco). The two-year average was conducted to balance the high El Nino flow rates of FY97–98. Escalation from FY97–98 and FY98–99 to 2003 was conducted because construction projects to meet all regulatory requirements were completed in April 1997 and a sewer rate freeze (Proposition H) was approved in 1998. Due to the rate freeze, the treatment costs over the last two years have been lower than the true cost. The projected treatment cost for September 2003 is $1,448 per AF (Table 8-4).

Table 8-4
Annual City-Wide Cost for Centralized Treatment, including Operation and Maintenance and Capital Improvement Debts

Fiscal Year	Volume Treated[1] (MG)	Annual Cost[2]	Cost per MG	Cost per AF[5]	ENR[4]
FY97–98	42,781	$155,385,940	$3,632	$1,183	
FY98–99	36,020	$146,005,239	$4,053	$1,321	
Average[3]				$1,252	6745
September 2003				$1,448	7802

Source: Water Pollution Control (Ahmad 2003)

Notes:

1. Volume treated is city-wide total, including: SEWPCP, OSWPCP, and North Point Wet Weather Facility.
2. The figures are from Clean Water Enterprise Final Budget Reports of FY98–99 and FY99–00, including O&M, debt service, PUC service, COWCAP, services of other departments, and revenue-funded capital projects.
3. Sewer rate freeze initiative approved by the voters in 1998 (Proposition H). The Clean Water Enterprise completed construction to comply with all the regulatory requirements in April 1997. The wet weather FY97–98 was the El Nino year, so the flow did not represent the typical wastewater flow. The average of FY97–98 and FY98–99 is used as the baseline.
4. ENR construction cost index for San Francisco for July 1998 and September 2003.
5. The calculated cost per AF for September 2003 is escalated using the ENR cost index for San Francisco.

9 COMPARISON OF DECENTRALIZED AND CENTRALIZED TREATMENT APPROACHES

The option of sending all HPS sewage to SEWPCP is compared to using both the SEWPCP and a decentralized MBR scalping plant at HPS in Table 9-1.

Table 9-1
Treatment of HPS Wastewater Flows: SEWPCP Compared to SEWPCP Plus a Decentralized Plant at HPS

Criteria	SEWPCP	SEWPCP + Decentralized Plant*
Community and Environmental Enhancement		
Sustainability Goals	●	○
Environmental, Educational, and Recreational Opportunities	●	○
Reuse Applications	●	○
Effluent Quality		
Reliability	◑	◑
Available Data	◑	◑
Implementation		
Readily Implemented	○	●
Permitting, Environmental Review/Cleanup, and Constructability	○	●
Surface, Subsurface, and Topographic Features	○	●
Phasing	○	●
Land Requirement		
Land Required	○	●

○ = More Favorable ◑ = Neutral ● = Less Favorable

Table 9-1
Treatment of HPS Wastewater Flows: SEWPCP Compared to SEWPCP Plus a Decentralized Plant at HPS (Cont.)

Criteria	SEWPCP	SEWPCP + Decentralized Plant*
Life Cycle Costs		
Capital and O&M Costs	○	●
Value of Recycled Water	●	○
Operation and Maintenance (O&M)		
Straightforward and Trouble-free	○	●
Staff Training, Knowledge, and Expertise	○	●
Low Maintenance	○	●
Public Interests		
Public Health	◑	◑
Public Safety	◑	◑
Odor	○	●
Aesthetics	◑	◑
Employment	◑	◑

○ = More Favorable ◑ = Neutral ● = Less Favorable
* A decentralized plant assumed to be a Membrane Bioreactor (MBR) scalping plant at HPS.

SEWPCP is a safe, reliable, cost-effective, and readily implemented treatment option. However, if properly sited and designed, an MBR scalping plant at HPS may provide a better opportunity for recycled water production and use. Water recycling has water conservation and water supply reliability benefits, and can provide an opportunity for environmental enhancements, such as wetlands creation.

Comments on all treatment approaches were provided by the Technical Review Committee (TRC) and the Alliance and are summarized in Appendices B and C. As described in these comments, there are advantages and disadvantages associated with centralized and decentralized treatment. There are also advantages and disadvantages associated with different decentralized system designs. For example, if recycled water is the primary goal, an MBR scalping plant is an especially desirable decentralized approach.

An MBR scalping plant would

- Provide a high-quality recycled water source
- Present a small footprint
- Eliminate the need for onsite solids treatment

With an MBR scalping plant, there would also be some solids reduction to the central system/SEWPCP due to biological conversions in the MBR process.

If the main driver for decentralized treatment is to reduce **all** solids loading to the central system (to eliminate any affect at SEWPCP or the CSO system), the most desirable decentralized system may have a different design. To avoid all solids loading to the central system, decentralized designs would need to focus on onsite solids treatment with no solids or sludge discharge to the city’s sewer system. The disadvantages associated with this completely decentralized approach would include higher capital and O&M costs (because solids treatment facilities would be necessary), possible local odor problems associated with solids treatment facilities at HPS, and increased operational challenges for SFPUC.

10 COMBINATION AND INTEGRATION OF APPROACHES

This chapter summarizes the combination and integration of treatment approaches for consideration at HPS.

Combination of Wastewater Treatment Approaches

A combination of various wastewater treatment approaches could be considered that would treat wastewater only to the level required for reuse or disposal. For example, if subsurface irrigation was feasible in a particular area at HPS, full treatment to the Title 22 disinfected tertiary standard could be avoided. This reduction in cost could increase the feasibility of this approach in suitable areas. A low-cost approach could be combined with a high-cost MBR plant that would serve contact users, such as recreational areas or in-building demands.

Integration of Storm Water and Wastewater Treatment Approaches

Construction of seasonal wetlands provides the greatest opportunity for the integration of storm water and decentralized wastewater technologies. During wet months, constructed wetlands could provide storm water treatment. During dry months, a decentralized wastewater facility could enhance constructed wetlands by irrigating the wetlands with recycled water.

As part of this study, site-specific storm water treatment approaches were investigated (see Appendix D, TM10-2, *Site-Specific Evaluation of Decentralized Wastewater Treatment*, which is available electronically). A summary of this analysis is provided in Appendix A.

11 CONCLUSIONS

At the outset of the study, the following assumptions were made:

- Wastewater flow at HPS at full build-out will be 4 MGD (the primary developer has estimated a range of 2 to 5 MGD).
- Decentralized systems will be designed to treat all flow on site (that is, no flow from HPS will be treated at SEWPCP).
- No new outfall for discharge to San Francisco Bay will be created, requiring onsite reuse of all treated wastewater and/or the use of the existing SEWPCP outfall.
- To maximize reuse opportunities, treated effluent must meet the disinfected tertiary treatment level specified for recycled water (treatment level and water quality requirements specified in Title 22).
- Sanitary sewage and storm water collection systems will remain separated.

In addition to the above assumptions, other scenarios were investigated as the study unfolded. Along with the 4-MGD designs, designs based on a 2-MGD buildout scenario were analyzed. The study also assessed a scalping mode of operation, where treatment would match recycled water demands and excess wastewater and all solids would be returned to the sewer system for eventual treatment at SEWPCP.

Although the study provided important technical facts for the Clean Water Master Plan (CWMP), more data and evaluations are necessary before making wastewater decisions at HPS. Findings from the HPS Decentralized Wastewater Treatment Study can be summarized as

- City-wide findings for future decentralized treatment systems
- Site-specific findings for decentralized treatment at HPS

City-Wide Findings for Future Decentralized Treatment Systems

The city-wide findings for future decentralized treatment systems include:

- Benefits of decentralized systems are evident
- A combination of treatment approaches may be appropriate
- System-wide planning is required prior to site-specific decisions on decentralized treatment

Benefits of Decentralized Systems

Decentralized treatment systems can provide several benefits including: production of recycled water, more equitable distribution of wastewater treatment impacts on the community (environmental justice), and a potential reduction in combined sewer overflows (CSOs). Strategically placed decentralized treatment systems can be a valuable component of a more sustainable approach to wastewater treatment.

Combination of Treatment Approaches

Title 22 recycled water requirements are tied to the recycled water use, so it may be appropriate to pursue a combination of decentralized wastewater treatment approaches. Decentralized treatment systems could be tailored to the water quality required by the various recycled water demands, which could lower treatment costs and minimize energy requirements.

System-Wide Planning Prior to Site-Specific Decisions

Prior to making decisions on specific decentralized treatment projects, the City of San Francisco must develop a city-wide approach for wastewater, storm water, and recycled water. Final decisions on the implementation of a decentralized treatment approach require:

- Broad system-wide perspective
- Long-term vision and strategy for the management of San Francisco wastewater and storm water
- Comprehensive analysis of
  - System deficiencies
  - Community impacts
  - Public interests
  - Future needs

Site-Specific Findings for Decentralized Treatment at HPS

The site-specific findings for decentralized treatment at HPS include:

- Both centralized and decentralized treatment approaches have unique advantages for HPS flows
- Demand for recycled water at HPS is low
- An MBR satellite plant is the preferred decentralized system at HPS
- Scalping is the most effective mode of operation
- A wastewater treatment wetland is unfeasible at HPS
- Biotextile treatment is unsuitable for HPS

- Long-term salinity impacts must be included in reuse plant design and siting
- The additional expense of a scalping facility would not offset SEWPCP costs
- A comprehensive storm water management program is necessary

Centralized and Decentralized Treatment Approaches for HPS Flows

The advantages of sending HPS wastewater flows to SEWPCP include

- Low capital and O&M costs
- Ease of implementation
- Well-established O&M requirements

The main advantage of a decentralized facility at HPS is the ability to generate an onsite source of recycled water. Recycled water has water conservation benefits when used to replace potable water demands for landscape irrigation, toilet flushing, and other uses. Recycled water can also be used to enhance a seasonal wetland (that is, provide an irrigation source during dry months). A decentralized treatment system at HPS could serve as a model for other decentralized wastewater treatment and water reuse projects in San Francisco.

Low Demands for Recycled Water at HPS

The recycled water demand is well below the projected dry weather wastewater flows at HPS (dry weather flows at build-out are estimated at 2 to 5 MGD). The following potential recycled water demands were estimated for HPS:

- In-building dual plumbing demands—approximately 0.40 MGD
- Landscape irrigation demands (60 acres)—approximately 0.14 MGD
- Wetland creation/enhancement (40 acres)—approximately 0.09 MGD

Offsite potential recycled water demands (within a 2.5-mile radius of HPS) range from 1.4 MGD to 4.0 MGD. However, most of the offsite potential demands are not immediately adjacent to HPS. The relatively large offsite demands, McLaren Park and Potrero Power Plant, are approximately 2 to 2.5 miles from HPS.

MBR Satellite Plant Is the Preferred Decentralized System

If decentralized treatment is pursued at HPS, an MBR satellite plant would be the preferred treatment system. Compared to the other two decentralized systems studied, the MBR alternative is most favorable with respect to

- Reuse applications
- Effluent quality reliability

- Ease of implementation
- Land requirements
- Capital and O&M costs
- O&M requirements
- Public interests (public health, public safety, and odors)

Scalping Is the Most Effective Mode of Operation

Wasting sludge to the combined sewer for treatment at SEWPCP minimizes costs, operational requirements, and local odor impacts associated with a small solids handling facility located at HPS. A scalping mode of operation also avoids the need for onsite wastewater disposal, because a decentralized system would only treat the amount of water needed for reuse.

A Wastewater Treatment Wetland Is Unfeasible at HPS

A secondary wastewater treatment wetland would require approximately 120 acres, an area that is not available at HPS. Furthermore, the presence of coliform bacteria in the secondary effluent and treatment processes of such a system would require public access restrictions and reduce the desirability of this type of wetland in a confined urban setting. Other wetland applications (for example, for storm water management) may be viable at HPS.

Biotextile Treatment Is Unsuitable for HPS

The high costs and operating challenges of multiple biotextile filters (a total of 40 separate treatment systems at HPS) eliminated this option for use on the entire site. Even on the Parcel A hilltop, the number and area requirements for biotextile filter systems make it an impractical choice.

Long-Term Salinity Impacts Must Be Included in Reuse Plant Design and Siting

A decentralized project focused on water reuse for landscape irrigation must consider the potential impact of salt water infiltration into the sewer system. Due to areas of high groundwater salinity and high inflow/infiltration rates within fill areas, reuse demands requiring low-salinity water will affect the design and siting of a decentralized facility.

The Additional Expense of a Scalping Facility Would Not Offset SEWPCP Costs

A decentralized MBR facility at HPS would likely operate in a scalping mode, sending solids and excess wastewater to SEWPCP. Since some of the HPS wastewater and all of the HPS solids would still be dependent on SEWPCP for treatment, a side-by-side comparison of the decentralized MBR treatment option and the SEWPCP centralized treatment option is difficult. Instead, the merits of a decentralized treatment scalping facility at HPS should be evaluated on the basis of the recycled water benefits and other benefits it could provide. The estimated capital and annual O&M costs for a 0.5-MGD MBR scalping plant at HPS are $7.1 million and $400,000 per year, respectfully (in 2003 dollars).

A Comprehensive Storm Water Management Program Is Necessary

To protect San Francisco Bay from storm water discharges and to comply with the Phase II Storm Water Rule, three storm water principles should be followed at HPS, including:

- Low impact design
- Source controls
- Structural treatment measures

With respect to treatment measures, a series of treatment systems might be the most effective method to treat storm water. The applicability and feasibility of an approach consisting of upstream treatment (for example, vegetated swales), followed by inline treatment (for example, vortex separators), followed by a seasonal wetland should be investigated further for HPS. Dry Dock 4 at HPS could be used as a large sedimentation pond or extended detention pond. However, the Dry Dock 4 approach would require approximately $18 million to rehabilitate the dry dock and install perimeter drains, equalization basins, and pump stations.

12 REFERENCES

Ahmad, M. 2003. Personal Communication. San Francisco Public Utilities Commission, Water Pollution Control Division.

California Division of Drinking Water & Environmental Management. 2003. *Treatment Technology Report for Recycled Water*. August 2003.

Crites, R., and G. Tchobanoglous. 1998. *Small and Decentralized Wastewater Management Systems*.

Hydroconsult Engineers, Inc. 2002. *Hunters Point Naval Shipyard Development, Hydrologic Modeling Study*. January 2002.

Kadlec, R. H. and R. L. Knight. 1996. *Treatment Wetlands*.

Lennar/CH2M Hill. 2002. *Hunters Point Shipyard Development Wastewater Treatment Options Analysis*. March 2002.

Metcalf & Eddy. 1991. *Wastewater Engineering: Treatment and Reuse*.

Montgomery Watson. 1996. *San Francisco Recycled Water Master Plan*. July 1996.

RMC. 2003. *Recycled Water Market Assessment—DRAFT*. Prepared for the San Francisco Public Utilities Commission, San Francisco, CA. August 2003.

San Francisco Public Utilities Commission (SFPUC). 2003a. *The Diminishing Wastewater of San Francisco by WPC*. August 2003.

SFPUC. 2003b. *BERM Metered Sewage Discharge, Hunters Point Shipyard*.

SFPUC. 1998. Landscape Irrigation Pilot Study.

San Francisco Redevelopment Agency (SFRA). 1997. *Hunters Point Shipyard Redevelopment Plan*. July 1997.

United States Environmental Protection Agency (US EPA). 2000a. *Constructed Wetlands Treatment of Municipal Wastewaters*. EPA/625/R-99/010. September 2000.

US EPA. 2000b. *Wastewater Technology Fact Sheet—Wetlands: Subsurface Flow*. September 2000.

Water Pollution Control Federation. 1989. *Water Reuse Manual of Practice SU-3*. Second Edition.

YEI Engineers. 1988. *Utilities Technical Study, Phase 2, Sanitary Sewer System*. July 1988.

Zenon. 1999. *Membrane Systems for Municipal Wastewater Treatment*.

13 ACRONYMS AND ABBREVIATIONS

ac	Acre
ACH	Air Changes per Hour
AF	Acre-Feet
BMP	Best Management Practice
BOD_5	Biochemical Oxygen Demand
BVHP	Bayview Hunters Point
Cl^-	Chloride
CSO	Combined Sewer Overflow
DHS	Department of Health Services
EIR	Environmental Impact Report
ENR	*Engineering News Record*
ft	Feet
ft^2	Square Feet
ft^3	Cubic Feet
ft^3/m	Cubic Feet per Minute
$ft^3/m/ft^2$	Cubic Feet per Minute per Square Feet
FWS	Free Water Surface
gpd	Gallons per Day
gpd/ft^2	Gallons per Day per Square Feet
gpm	Gallons per Minute
gpm/ft^2	Gallons per Minute per Square Feet
HPS	Hunters Point Shipyard
ISF	Intermittent Sand Filter
$lbs/d/1000ft^3$	Pounds per Day per 1000 Cubic Feet
lbs-N/ac/d	Pounds of Nitrogen per Acre per Day

MBR	Membrane Bioreactor
MCRT	Mean Cell Residence Time
MEP	Maximum Extent Practicable
MG	Million Gallons
mg	Milligram
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
mg N/L	Milligrams of Nitrogen per Liter
mg O_2/mg BOD	Milligrams of Oxygen per Milligram of BOD
mg O_2/mg NO_3-N	Milligrams of Oxygen per Milligram of Nitrate Nitrogen
mL	Milliliters
MLSS	Mixed Liquor Suspended Solids
MPN	Most Probable Number
mW/cm^2	Milliwatts per Square Centimeter
NH_3-N	Ammonia as Nitrogen
NO_3-N	Nitrate as Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
NTU	Nephelometric Turbidity Unit
O&M	Operations and Maintenance
OD	Oxidation Ditch
OSWPCP	Oceanside Water Pollution Control Plant
PUC	Public Utilities Commission
RBC	Rotating Biological Contractors
RGMF	Recirculating Granular-Medium Filter
s	Second
SBR	Sequencing Batch Reactor
SEWPCP	Southeast Water Pollution Control Plan
SF	Subsurface Flow
SFPUC	San Francisco Public Utilities Commission

SR	Slow Rate
SWMP	Storm Water Management Program
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TRC	Technical Review Committee
TSS	Total Suspended Solids
UV	Ultraviolet

A STORM WATER BEST MANAGEMENT PRACTICES FOR HPS

HPS represents an opportunity to enact a clean water strategy that optimizes the protection of public health, public safety, and the environment, combining solutions for storm water, wastewater, and recycled water.

Storm Water Treatment Systems

The new regulations associated with the Municipal General NPDES Storm Water Permit require permittees to develop a storm water management program (SWMP) designed to reduce the discharge of pollutants and to protect water quality.

Permittees must implement best management practices (BMPs) that reduce pollutants in storm water runoff to the technology-based standard of maximum extent practicable (MEP) to protect water quality. Furthermore, the general permit notes that "… [BMPs] are most efficient when they stress (i) low impact design; (ii) source controls; and (iii) treatment controls." Procedures detailed and recommended in the *California Storm Water Quality Association Storm Water Best Management Practice Handbook* were adopted in this memorandum to investigate the manner in which storm water runoff at HPS can best be treated so as to meet the requirements of the general permit.

Storm water management should be based on the following three principles:

- Low impact design (preservation of natural components in a storm water system, such as natural channels, wetlands, and other natural components)
- Source control (storm water quantity and quality controls within developed areas)
- Structural treatment control measures

This technical memorandum (TM) focuses on just one principle, that is, structural treatment controls applicable at the site. The following technologies are analyzed in this TM; however, other technologies not listed may be appropriate:

- Upstream treatments
  - Drain Inserts
  - Vegetated Swales
  - Vegetated Buffer Strips

- Inline treatments
  - Media Filter
  - Wet Vault
  - Vortex/Swirl Separator
- Downstream treatments
  - Wet Pond
  - Wetland

Structural treatment controls are generally designed to excel in one treatment area or address a specific storm water issue. Any one control alone may not have a broad effect on all the constituents of concern in urban storm water. Therefore, the application of more than one measure constructed in series throughout the catchment should be considered when designing a storm water treatment system.

A comparison of alternatives yielded the following findings:

Upstream Treatment Technologies

Each of these upstream measures has its place in different parts of the development, and because of their relatively low cost, should be considered where applicable. Specifically, the following concepts should be considered:

- Drain inserts for commercial/retail areas and for areas with steep slopes and identified pollutant generation potential.
- Grass swales for low-lying, flatter areas, and for streetscape and industrial park/commercial areas, which should integrate with landscape designs to maximize public amenity—perhaps creating a “meandering” effect through open-space areas.
- Vegetated buffer strips may have applications in areas adjacent to parking lots and perhaps treating surface runoff from steep areas. Vegetated buffer strips should form part of a more “site-specific” BMP design in conjunction with individual development sites. Additionally, vegetated buffer strips might be applicable in places along the perimeter of the site between the land/bay interface.

Inline Treatment Technologies

Inline treatment technologies are designed to remove finer sediments and attached pollutants. The BMP measures most applicable to HPS are either vortex-type swirl separators or wet vaults. Each of these belowground alternatives has the capacity to perform to similar standards. Given the additional space requirements and maintenance schedule of media filters compared with the belowground alternatives, media filters are not thought to be the better treatment alternative. More detailed investigation of construction costs is required to assess the relative merits of wet vaults and vortex separators.

The actual number of treatment devices will be determined by the drainage network layout. During the more intensive design investigation an assessment of the economic virtues of both wet vaults and vortex separators should be made.

Downstream Treatment Technologies

The primary objective of downstream treatment controls is to enhance sedimentation and filtration, as well as to facilitate biological uptake. In this way, downstream treatment options target nutrients and heavy metals, both of which are typically difficult to remove with either upstream or inline treatment controls. Anecdotal evidence suggests that wetlands outperform wet ponds in nutrient and heavy metal uptake. In the instance of HPS, wetlands are more suited primarily due to their fit with existing development plans and their natural occurrence around San Francisco Bay.

If either a wetland or a wet pond were to be used as the sole structural treatment control, there would be a need to install trash and sediment removal structures at the inlet to the wetland/wet pond. Without such management the performance of these structures would be seriously compromised.

Two reports, one for Parcel B and one for Parcel E, have already investigated development of wetlands. These concepts could form the basis of more intensive design investigation. The possibility of using recycled water to irrigate the wetlands during the drier months should also be considered.

For discussion purposes, a preliminary conceptual layout for storm water treatment controls was developed (see Appendix D, TM11-2, *Storm Water Treatment Approaches and Systems*, which is available electronically). A preliminary cost estimate for such works was also calculated and estimated at $12 million. An actual BMP system would need multi-departmental approval, as well as discussions with the Regional Board and future developers. Furthermore, a complete BMP approach would include both source controls and treatment controls.

After a BMP approach is adopted, the specific BMP measures should be incorporated into the drainage layout for the proposed final site plan, and should be integrated into the development process as early as possible.

Use of Dry Dock 4 for Storm Water Retention and Treatment

Concurrently, and in an associated investigation, the feasibility of converting Dry Dock 4 to an extended detention basin was explored. In such a scenario, storm water generated across the site would be routed to the dry dock by way of perimeter collection drains. Due to the flat nature of the site, it is likely that this perimeter drainage would also require perhaps two booster pump stations. The collected storm water would be routed to the dry dock, which would be drawn down at the beginning of the rainy season. By adjusting discharge rates from the dry dock to the bay and the draw down at the start of the wet season, it would be possible to operate the system as a very large sedimentation pond or extended detention pond. Conceivably this arrangement may satisfy the BMP treatment of storm water required under the auspices of the general permit.

Kennedy Jenks Consultants, in a technical memorandum dated January 23, 2004, describe some of the replacement/repair estimates that would be needed to convert the dry dock into a detention basin. Largely the rehabilitation issues relate to the mechanical equipment and caisson, which separates the dock from the bay. A preliminary cost estimate for the rehabilitation of the dry dock is estimated at $10 million. The construction of an appropriate perimeter drain, equalization basins, and pump stations is estimated to cost a further $8 million. Ongoing management of such a BMP would require periodic draining of the dry dock/detention basin and sediment removal.

Integration of Storm Water Treatment and Decentralized Wastewater Treatment

Construction of seasonal wetlands provides the greatest opportunity for the integration of storm water and decentralized wastewater technologies. During wet months, constructed wetlands could provide storm water treatment. During dry months, a decentralized wastewater facility could enhance constructed wetlands by irrigating the wetlands with recycled water.

B TECHNICAL COMMITTEE REVIEW COMMENTS ON DRAFT REPORT (2/27/04)

Major Technical Review Committee (TRC) comments on the Draft Report (2/27/04) are summarized by SFPUC in Table B-1. Actual TRC comments are provided following the table.

Table B-1
Summary of Major Comments by TRC Members on Draft Report (2/27/04)

TRC Member	Major Comments*
Mr. Blair Allen (RWQCB)	No comments.
Dr. Robert Gearheart (Humboldt State University)	• An onsite treatment system should treat all wastewater generated at HPS and, if necessary, return excess **treated** wastewater to SEWPCP. • The city and citizens of HPS would be best served by severing the connection between HPS and SEWPCP. • There should be a discussion of the ancillary benefits (open space, parks, habitat restoration) of a natural system. • Oxidation ditch (OD) system is not a natural system. • No sludge or solids should leave HPS. Solids should be treated at HPS with onsite reuse of biosolids.
Dr. David Jenkins (UC Berkeley)	• The comparison between SEWPCP and decentralized treatment approaches at HPS shows that the use of SEWPCP to treat all HPS flows is far more desirable than using even the most favorable decentralized option at HPS.
Dr. Michael Josselyn (San Francisco State University)	• An HPS treatment system should have enough storage so that solids do not contribute to CSO events. • The city's overall wastewater system should move towards no CSO discharges.
Dr. Joe Middlebrooks (University of Nevada)	• Include a brief statement of the impact on SEWPCP if all HPS solids are sent there. • Should analyze the option of reclaiming water at SEWPCP and sending to HPS for reuse.

* TRC comments summarized by SFPUC

Dr. Robert Gearheart (Humboldt State University)

General Comments Appropriate to All Alternatives

It seems to me that in the initial documents the design flow for the decentralized wastewater treatment system for Hunter's Point was 2.0 MGD. The question is, what is the basis for the 4.0 MGD design flow? Using conserved flows, which I assume will occur due to recycle and appropriate technology, the average per capita flow should be about 50 gpcd, which would result in a population equivalent of 40,000 people at the 2.0 MGD flow and 80,000 people at the 4.0 MGD flow. I am sure there are other sources of flow but they are not explicitly identified. This document should include all the assumptions that went into determining the design maximum flow of 4.0 MGD.

I assume that all alternatives are treating the design flow (4.0 MGD) for the Hunter's Point Shipyard Redevelopment project rather than only treating the potential recycle scalped flow. The reality is that by the time the development occurs and the treatment system is constructed the reuse opportunities will have increased. The plan should be to treat all wastewater coming to the treatment. Unused recycled treated effluent can be released to the SE WWTP, if necessary. Better yet part of the restoration plan for the site should include the development of an estuary which could include the blending of high quality freshwater with bay water. It is totally unsatisfactory to send raw or partially treated wastewater back to the SE WWTP. With the present conditions of the SE WWTP with its odor problems, its solids handling problems, and its inability to treat all flows I believe the City and the citizens of Hunters Point would be best served by severing the connection.

While are bio-filters considered for odor control at the influent of the treatment given the fact that the collection time is relatively short and the marine temperate climate is not necessarily conducive to volatile solids breakdown in the collection system?

What are the variables that account for the cost estimate variation to range from –50% to +30%? Are these due to increase in cost of the construction (equipment complexity, inflation, labor negotiations, etc.) or due to lack of engineering detail, for example? What is the database for determining the long term O and M cost for MBRs considering the fact that they are relatively new on the scene and that technology is changing very quickly in the sector.

What is the fate and transport of the screened material for all of the alternatives? If that cost is considered, what is the cost of solids management for each of the alternatives?

Is there an opportunity for using treated effluent for horticultural watering around the homes and businesses?

Membrane Bio-reactor Comments

Some general questions concerning the flow diagram. How is the recycled mixed liquor flow returned to the denitrification unit (is it gravity fed)? How are solids removed, and how much, from the bio-reactor? Experience on the North coast has shown that color becomes a potential problem in the permeate and this particular case requires activated carbon adsorption prior to using to flush toilets (check with Winzler and Kelly Engineers in Eureka).

Choosing MBR has the method choice limits the future expansion of wastewater treatment/reuse to the smallest footprint. This I think, is a planning mistake not necessarily a technical problem with the technology. Normally you would think about utilizing small print system as retrofit and treatment units when space becomes limiting.

There isn't an O and M cost items for solids handling or any detailing of the characterization and amount of the solids in the system.

Oxidation Ditch/Free Water Surface Wetland Comments

From a planning, land use, and community involvement point of view I feel that the natural alternative leaves a lot to be desired. There is an opportunity with this alternative to integrate other land use activities, such as open space, parks, habitat restoration, etc. into the wastewater infrastructure investment. Many of the planning guidelines listed on page 9 can also be met with the use of a natural system. There is no discussion of any of these quote ancillary benefits in the study. I am not at all satisfied with this aspect of the study and strongly recommend that it be amended to include these factors. I am assuming the preparers of the study do have the background and or experience in developing the ancillary benefits for this alternative. I recommend that a landscape architect, a wetland ecologist, and an urban recreation specialist be asked to participate in this effort.

I am not at all satisfied with the system that is proposed for the natural alternative. An oxidation ditch is not a natural system. The OD is a form of activated sludge (extended aeration). The facultative pond affords pre-treatment and partial secondary treatment and also affords some storage and flow modulating prior to wetland polishing and UV disinfection. I can' t determine if the UV sizing and cost has been adjusted for the flow modulation that would occur through the pond/wetland system. All I can find in the study is that the areal requirement would be the same for MBR and OD/FWS.

The design criteria for the pond and wetland systems are not given in the study so it is impossible to evaluate this portion of the report. An addendum to the study should also include specific design criteria for pond and wetland component of this alternative.

Earlier I had suggested that the consultant consider UASB as a pretreatment/primary treatment. I would still like to see the consultants develop this alternative for several reasons.

1. There will a need for composted soil amendments at the HPS site in its redevelopment cycle.
2. There will be green waste generated at the site that can be used in co-composting sludge.
3. No sludge or solids should leave the HPS site, in fact there should be a demonstration that biosolids are valuable and can play role in the development of the site

Therefore there should be a low technology option for treating wastewater (not totally unlike the septic tank option) that would allow for solids to be treated, collected, and static pile composted for use on-site. The upflow anaerobic sludge blanket (UASB) system is an appropriate system which has been shown to remove 50 to 60% of the BOD and TSS in a closed systems for gas capture and or odor control. Solids can be removed, dried and blended with green waste to produce an approved biosolid that can be used in urban applications. More important the bio-solids can be use in bioremediation applications. The system (for a design flow of 4.0 MGD) might consists of an UASB, a oxidation pond of about 25 acres, and a wetland of 35 acres.

The wetland treatment system, at the levels suggested in the study will produce an effluent of a quality listed below (reference EPA Wetland Design Manual).

BOD—5 mg/l

TSS—5 mg/l

NO3—5 to 10 mg/l

NH4—1 mg/l in the summer and 5 mg/l in the winter

Perhaps another approach would be to layout the pond/wetland (UASB option also considered) on the development plan taking advantage of the fact that the system could be integrated into the open spaces and edges (bay margin). It would also be interesting to see an option which would include an estuarine / brackish water marsh development to reuse some of the treated effluent as the freshwater supply.

Dr. David Jenkins (UC Berkeley)

Summary of Substantive Comments on the HPS Report

p.37 I am concerned that there has been limited use of the Biotextile filter in full-scale installations and that there currently appears to be only one supplier. This would make any installation using these difficult to recommend.

p.47 Table 16. I think you should include a summary scorecard for each criterion (ie number of more favorable, neutral and less favorable for each alternative).

p.61 Section 10. The section on the comparison of centralized and decentralized systems does not have any conclusions. You need to conclude something. I understand that this is a political minefield but the objectives of this study are technical not political. If the technical facts show that a decentralized system is not technically/economically favorable compared to a centralized approach then you must conclude this on purely technical grounds. After that you can let the politics do what it will with your decision. At least you will have done a credible technical job. As it stands now you have a fine technical report that hedges the obvious technical conclusion that decentralized treatment for reclaimed water is a poor alternative for HPS.

I would support language in Section 10 stating that the MBR scalping plant is the best decentralized option for treating some of the dry weather HPS flows to meet reclamation demands. However I would also conclude that even the best dry-weather flow decentralized plant at HPS is vastly more uneconomical than centralized treatment at SEWPCP.

p.65 Conclusions.

I suggest that you add these conclusions:

"10. Standing alone, this study shows that the overall technical and economic benefits and advantages of treating all HPS dry weather wastewater at SEWPCP far outweigh those of treating any or all of the HPS wastewater at HPS by any of the decentralized treatment alternatives considered.

A final decision on whether decentralized treatment of HPS wastewater is available alternative should await the conclusions of the current City-wide Wastewater Master Plan Study."

Dr. Michael Josselyn (San Francisco State University)

With the transfer of solids in the combined system back to the SE Plant for treatment, the potential for CSO discharges (with potentially higher concentrations of solids) is not reduced. I do not agree that staying the same or within the allowed 10 CSO discharge limit is acceptable. I think that the HP decentralized treatment facility should have some storage capacity (say 24 hours) so that during rainstorms this additional load to the combined system is not occurring. I am concerned that both the Griffith pump station and the Islais CSO discharge occur in shallow waters and affect the ecosystem in these areas. As you know, I am particularly concerned about the potential CSO discharges into Yosemite Channel, especially when this area is proposed for a major cleanup and restoration.

I therefore, recommend that the PUC consider its objective as to not just remain within limits on CSOs, but to move towards no CSO discharges. I recommend that you state the in order for the City to reduce CSO discharges that on-site storage of solids may be required to avoid placing the materials into the combined sewer system during storm events or when a CSO is imminent.

Dr. Joe Middlebrooks (University of Nevada)

General Comments

The report is a clear and concise summary of the HPS studies. I would suggest that the reference in the text to the web site be expanded to include the entire search scheme. Anyone not familiar with Internet searches may have trouble finding the TMs. Including the web site information in the Executive Summary would be helpful to people reading only the Summary.

Because several documents are referenced in the text, I would encourage you to include a Reference list at the end of the report.

Following are specific comments that may or may not be useful.

Executive Summary

A brief explanation of what the 36 CSO structures are may be helpful to readers of only the Executive Summary.

A brief synopsis of what environmental justice improvements, if any, have been made in the Bayview Hunters Point community would be informative.

Page 5, 3rd paragraph. A brief statement as to what impact would occur with the solids transfer to the Southeast plant.

1. Introduction

Report Overview

Last Paragraph: It is customary to spell out the organization before inserting an acronym. Use "Technical Review Committee (TRC)"

Project Team

Page 7, 4th line, insert "and engineering" after scientific.

Page 7, 8th line, Middlebrooks is retired and no longer at the University of Nevada; however, I see no problem leaving it as is.

4. Study Assumptions and Study Approach

Key Study Assumptions

Should the second assumption be expanded to include a statement about the transfer of solids produced to the SEWPCP?

Public Outreach

First full paragraph, first sentence. Sheet should read "Sheets"

7. Site-Specific Analysis of Three Decentralized Treatment Systems

Customer-Based Water Quality Requirements

Page 21, 5th line from bottom of page. Sentence would be better if it read "Acceptable water quality ranges for different applications are shown in Table 6."

Tables do not do anything.

Conceptual Engineering Designs

Page without number, first paragraph, 3rd line, probably would be better to punctuate and restructure as follows: "MGD; however,"

Third bulleted item. It would be helpful to reader to say north or whatever rather than "downstream of SEWPCP."

It appears to me that not including cost of handling solids materially distorts the cost figures. For example, using the lagoon alternative would result in significantly less solids disposal costs. Probably would have little effect, if any, on final results.

Table 11: Assumed MBR Design Criteria for HPS Wastewater Treatment Criteria

It appears to me that the only source of nitrate entering the denitrification basins is in the recycled mixed liquor; therefore, it would be desirable to include the solids return ratio for the MBR system. This has a significant impact on the sizing of the plant and should be made available for independent evaluation by picky people like me.

Figure 8: Land Area Comparison for FWS Wetland Systems

As I pointed out during the review of the Technical Memorandum, the use of term "facultative ponds" is not accepted usage. The system was aerated and should be called a "partial mixed aerated pond" or an "aerated facultative pond", or a "complete mix pond" which ever is correct. A truly facultative pond would be over 250 acres. If the partial mixed pond had been designed as a CM pond, it would have produced a comparable effluent quality and would have occupied 2 or 3 acres. With the wetland dominating, the pond design will have little effect on the conclusions, but it would be nice if the consultants were more careful.

Evaluation of Treatment Systems (4 MGD)

Implementation

Page 43, line 10, Why would phasing of the OD/FWS system not score as well as the MBR?

Public Interests

Second paragraph, 3rd line. Why is the MBR better than the OD/FWS in terms of public health and safety? The same question applies to Table 16 where Implementation is give a low rating.

Combined Sewer Overflows (CSOs)

Page 59, first line below CSOs, strike "can."

Cost of Centralized Approach

First paragraph, last line, insert "(AF)" after acre-foot

10. Comparison of Decentralized and Centralized Treatment Approaches

Page 61. Was consideration given to reclaiming water at the SEWPCP and returning it to the HPS for reuse? Realize that salinity was an issue, but costs may turn out different than those evaluated.

12. Conclusions

If the scalping operation at 0.5 MGD is used, there may be a need to reevaluate the use of ponds and wetlands, particularly from an esthetic point of view.

Dr. George Tchobanoglous (UC Davis)

Based on my review of the Hunters Point Shipyard Decentralized Wastewater Treatment Study I offer the following comments:

1. It is important to consider water reuse for the Hunters Point Shipyard development as part of a long-range program for the sustainable management of water.
2. Consideration of decentralized wastewater treatment and reuse is appropriate for the Hunters Point shipyard.
3. The treatment options evaluated Hunters Point Shipyard development were appropriate and reasonable.
4. By properly selecting the location within the development where the wastewater to be treated would be withdrawn, the total dissolved solids (TDS) of the reclaimed water would be low, as the TDS of the drinking water is very low.
5. In time, all wastewater collection systems will leak. The possible increase in TDS due to infiltration can be avoided by proper location and selection of the collection system to be used as the source of wastewater for the decentralized treatment facility.
6. Although reclaimed water could be provided from the southeast WWTP, additional treatment beyond microfiltration would be required to remove the salinity resulting from infiltration to provide the same quality of water as can be produced locally.
7. Although excess biological solids will be returned to the southeast WWTP, the overall solids loading will be reduced because of the biological conversion in the decentralized treatment facility.

In summary, the proposed Hunters Point Shipyard development represents a significant and important opportunity for the city to demonstrate its commitment to the concept of localized water reuse and decentralized wastewater management. Further, the lessons learned from such installation would be useful in other installations, as plans are developed for the long-term management of water resources.

C ALLIANCE FOR A CLEAN WATERFRONT COMMENTS ON DRAFT REPORT (2/27/04)

Major comments by the Alliance for a Clean Waterfront (Alliance) on the Draft Report (2/27/04) are summarized by SFPUC in Table C-1. Actual Alliance comments are provided after the table.

Table C-1
Summary of Major Comments by Alliance on Draft Report (2/27/04)

Major Comments*
• Withdraw recommendation that, if decentralized system is pursued at HPS, MBR scalping plant is preferred over other decentralized systems.
• Should have "zero discharge" to SEWPCP. HPS should consist of complete onsite treatment with complete onsite or nearby use of recycled water.
• HPS could be a model for other sites in San Francisco which could lead to environmental justice outcomes (less sewage flows to SEWPCP).
• Include lessons that could be applied to city-wide approach, including CSOs and environmental justice.
• In addition to MBR, consider less costly subsurface approaches.
• If decentralized treatment at HPS is pursued, should use a combination of approaches, not just one treatment plant at HPS.
• Revisit study objectives at the end of the report (i.e., recycled water, environmental justice, and CSOs).

* Alliance comments summarized by SFPUC

Jeff Marmer (Alliance for a Clean Waterfront)

The Alliance is pleased to submit its comments on the HPS Decentralized Wastewater Treatment Study. We are very glad to have the first, serious, in-depth site-specific consideration of alternative wastewater strategies and technologies conducted by the PUC and its independent consultants Montgomery Watson since we began requesting such analysis nine years ago. We are also very grateful to the NDWRCDP for both their initial support, which precipitated the study, and for their patience with the lengthy period it took to get the project up and running.

Much credit goes to the PUC's recent general manager Pat Martel and the project manager, Julie Labonte, for responding positively to Alliance comments about the limitations of the first scope and proceeding to expand the review of technologies; integrate the discussion of wastewater options with water and stormwater; inject key, long-ignored public issues of sustainability and environmental justice into the analysis, and Fit in with larger vision recognition of the larger planning process, not dealt with in isolation. We also greatly appreciate the PUC contribution of funds and significant staff time to make this study a serious one. Further we are glad that the Technical Review Committee (renamed now the Technical Advisory committee) has received support and encouragement…We appreciate the consultants' very thorough and logical analysis. We find this report a very solid initial basis for analysis. The Technical Memos provide a solid and thorough reference source. We also found them open and responsive.

The Alliance also appreciated the recent lengthy meeting with PUC staff and the consultants.

It was particularly helpful to have a face to face, in depth, roundtable discussion in order to clarify many of the preliminary questions we had. It enabled us to clear some "brush," have a discussion about remaining issues, and enable us to better distill the key issues that need addressing…We would recommend this be part of the ongoing protocol in reviewing such documents. The only thing lacking was the TRC perspective at this point. This is a very critical perspective and we will repeat our recommendation that the TRC have its own coordinator who can represent, especially the alternative views at this key discussion point. That high level key perspective missing at the table.

As stated, a number of our concerns were addressed in this important meeting. We will repeat some of them so we are on record about some of the subjects. The major areas of our comments and concern are: questions about key numerical assumptions, questions about discrepancies with past reports, inadequate application of alternative strategies, inadequate application of key criteria, and expansion of lessons for the larger picture.

Our major key finding is that the key finding of this report - that a .5 MGD Scalping Plant is prematurely drawn and should be withdrawn, until adequate additional analysis is done. A scalping plant that only takes the initial estimates of .5 MGD (point 5) is unjustified at this time because it fails a key environmental justice test. It sends 75 % of the sewage back to the central plant. Further, the study does not go far enough to explore a wider array of beneficial reuses on <u>and</u> near the base, to attain a higher level of sustainability. While the recycled uses listed at .45 push the limits of the standard recycled water uses on the base – toilet flushing, industrial processes, and landscape irrigation - they do not explore the full opportunity for sustainability. There is no reason to out of hand declare that (relatively) nearby, offsite reuse is too far away for consideration. Current Recycled water master Plans envision much longer distribution systems.

The study on page 63 and in Appendix A actually begins to address one scenario that integrates Stormwater and Wastewater treatment - the creation of stormwater treatment wetlands to treat all or a large majority of the flows (coupled with additional upstream and in-line technologies) but no estimation is given in terms of recycled water use. Other scenarios include additional greenspace design and bay discharge (no, not through an outfall)

It is our recommendation that 2 scenarios be further assessed: full reuse (or zero discharge to the Southeast Plant) for on–base, and for on base + supply of nearby users. The .5 scenario should be put in the mix as a scenario if further analysis is unable to find uses for the 1.5 MGD

According to the Report, and as expressed by the alliance and other community and environmental concerns, two of the major reasons to explore decentralized wastewater options were (1) combined Sewer overflow Reduction and (2) Environmental Justice. "The SEWPCP treats 805 of the wastewater generated in San Francisco…The Bayview hunters point community is impacted by this inequitable distribution of the city's treatment burden." (p.4)

In addition to being one of the primary concerns, and possible benefits of the study, "environmental justice" should be listed explicitly as a criteria – page 13. Does this scenario aid in creating a more environmentally just system? Actually, it's a bit ironic that the recommendation of another smaller system could be considered part of the environmental justice remedy because as PUC staff pointed out, the recommendation would really be proposing a new plant in Bayview Hunters Point. PUC staff felt that for that reason, environmental justice should not be on the list. Its not reducing the amount of sewage treated in the neighborhood. The Alliance feels that E. J. should in fact be an explicit criteria,

Regardless. It is an issue, and should be a criteria. The alliance feels strongly that treating and recycling water at HPS is in fact improving the environmentally unjust burden because it is a) reducing the burden on the Southeast Plant, and b) demonstrating for the larger City how it can be done.

By injecting a maximum on-site recycled water scenario, this report can show how it can also be done in Mission Bay, at Rincon Hill, in the Presidio, and elsewhere. Implementation of an HPS Decentralized Plant can and will be linked to the same implementation in other parts of the city.

Thus, it would, if implemented with other similar plants, be contributing to the reduction of sewage at the Southeast Plant.

The criteria of environmental justice should be carried through whole report, including the recommendations and conclusions.

Further, there should be a section that relates to the larger plan, something like lessons for the larger plan—as we discussed in the meeting with PUC staff and the consultants. An example would be the value of the decentralized scenario in reducing CSOs and making the system more environmentally just. Another example was to state that the differences in the City breakdown of recycled water user (20 % toilet flushing, 72% landscape irrigation) verses the breakdown at HPS (72% toilet flushing, 22% landscape) may be grounds for reconsidering the one-size-fits-all scenario and looking seriously at less costly subsurface methods. Given the importance and timing of the CW Master Plan, it is important to these kinds of implications.

We have/had a number of concerns related to key numerical assumptions that could significantly affect the report outcomes. In addition, we are trying to sort out some discrepancies between numbers in this report and previously submitted reports.

As mentioned, many of our concerns were answered in the recent meeting we had with the PUC staff and consultants. We think it is important to at least note some of the more salient issues in order to have our concerns on record, and note those remaining.

Numerical Assumptions / Discrepancies

1. 4 MGD of sewage generation is too high….2 MGD is the agreed upon estimate. We expressed our alarm at the use of 4 MGD. We believe that was a serious overstatement of the expected development -3–4X our best guess—which had been in the 1–1.5 MGD range. No

real number was given – the EIR referred to an expected increase of .67 over previous use. PUC staff has clarified that that was .67 over historical use—which has not been identified.

Current use averages .18 MGD. Another estimation strategy was extrapolation from the Mission Bay development which estimated its sewage generation at 2.5 MGD and had more than twice the residential development, plus commercial and industrial development, including a new UCSF campus. Thus half the development = 1.25 MGD.

PUC staff expressed confidence that the number was more realistically 2 MGD and based on this had asked the consultants to do some calculations of cost, siting, etc. based on that number. We are in agreement that 2 MGD is a more realistic number, though we would like some attention to solving the inconsistency between the Mission Bay and HPS numbers.

2. Recycled Water Estimates—3X higher in 1996 Recycled Water Master Plan (RWMP)

We expressed concern that the 1996 Recycled Water Master Plan had significantly higher recycled water estimates for HPS and Candle Stick Park.

1996 RWMP estimated annual demand—	HPS	1.56 MGD
Current Report	HPS	.63
RWMP estimated annual demand—	Candlestick Park	.6
Current Report	Candlestick Park	.29

Again PUC staff reported that they did their own calculations and expressed confidence in their numbers for the HPS proper—noting that the '96 RWMP had several numbers in parenthesis—referring to sub-sites. We didn't get to the Candlestick Park differences.

We accept the PUC staff calculations for the projected development, but it would be helpful to review numbers from the '96 report to make sure we aren't missing some valid use estimates that were calculated in that report. These two examples alone represent a difference of nearly 1.25 MGD.

There are additional numbers for the Candlestick Point Recreation Area (TBD) and a projected stormwater wetland for HPS on Parcel E with an early estimation of between .2 and .4 MGD use. Has there been any effort to estimate potential need for all the relocated concrete, aggregate, and related businesses moving into the Pier 90-96 areas on the north and south shore of Islais Creek due to the Mission Bay development?

3. Additional discrepancies on MBR siting requirements; from the Crites/Mission Bay Report

The Crites Report estimated the siting of a 1 MGD MBR plant for Mission Bay at .5 acres.

Consultants and PUC agreed siting could be condensed, though they felt that the difference wouldn't change siting issues much as they were determined by closeness to the utility hub and distance from the residences. ACW pointed out that there were new plants, which were designed into the natural landscape and very near residences with no major issues.

4. The Crites Technical Memorandum on Mission Bay looked at the comparative costs for recycled water systems for Mission Bay. They were expressed in $ / acre-foot. An MBR unit

for 1 MGD was calculated at $1096 / acre-foot, and subsurface irrigation system was calculated at $255 / acre-foot.

We would appreciate staff or consultants adding a new column to the cost estimates for these systems expressed in acre-feet so we can have a common denominator reference for easier cost comparison analysis.

Alternative Strategies

Perhaps the biggest area where we believe more work needs be done is in the expansion of the concept of both alternative strategies and sustainability.

This report laid an excellent basis of comparison of 3 decentralized systems. But it is limited by several assumptions.

A one technology fits all approach. / One level of treatment for all recycled water:

The report chooses a one-shot technology answer. Opportunities to better match a combination of technologies to appropriate use / level of treatment are missed.

Additionally it might be wise to strategically match choice and size of technology with phasing of volume and type of development.

For example, the Crites/Mission Bay Report discussed a scenario for sub-surface irrigation that cost less than 25% that of the Membrane Bio-Reactor. ($255/acre foot vs. 1096/acre foot). At HPS, 22% of use is projected to be for landscape irrigation. An analysis should be done to see if there are cost savings that are worth getting by looking at different scenarios, i.e., using the cheaper sub-surface method to create the source for the landscape irrigation component. In addition this scenario could have reduced distribution system costs since you may be able to obtain both source and application nearby.

As we discussed at the meeting, this scenario increases exponentially when one looks at the recycled water use picture for the whole city, which has a much higher percentage of use going for landscape irrigation. Thus while cost savings in HPS redevelopment may not be that significant, it should be analyzed for viability at this site, and implications drawn for the citywide application. In addition, this implies bringing back to the fore the most appropriate technology to accomplish this.

At the end of the report (page) there is a reference to looking at combinations of technologies. We think this approach needs additional, serious consideration.

A point brought up by some staff or consultants at the meeting was that the reason to go to high level Title 22 was that the public in some places had trouble accepting high levels of reclaimed water, much less lower levels; thus, let's treat everything to the highest levels. However, this is true some places, but not others. If it is, in the scientific abstract, a viable scenario to use lower end reclaimed water for sub-surface irrigation, then we think this option should be out on the table- again - especially because of the favorable ratio of landscape irrigation to toilet flushing/industrial reuse in the city at large (72% to 28%).

Sustainability

Additionally, the report, we believe, does not go far enough with the concept of sustainability. A cornerstone of sustainability here is to view both sewage and stormwater as a resource. To that end we believe the envelope should be stretched in finding beneficial uses for the reclaimed water.

The big caveat here is that this report and its assessment of the options for HPS will / must be thrown into the mix of the larger picture – the ensuing clean water Master Plan. Assuming for sake of argument that the one-solution MBR is the way to go – how big the unit is might depend on whether the larger plan decides that the HPS unit is the supply for outlying / nearby recycled water needs. In this scenario, there would be no more left over for additional used on the base beyond the needs identified.

If one looks at the base on its own, the question arises – are there other beneficial uses that have been overlooked?

We think this project should attempt to reach “zero discharge” to the central system while simultaneously striving for maximum beneficial reuse.

- Are there additional ways to extend permeable greenspace?
- In the larger picture, in our view, the separated stormwater should be treated before being released.
- Can recycled water be used to support enough stormwater treatment wetlands so that all or a much higher proportion of stormwater can be treated. We heard at the meeting that the developer is considering installing the same kind of treatment as the Mission Bay development – vortex separator – type treatment. While we applaud that additional treatment, we do not think it is sufficient. Separators provide a valuable level of treatment but do not get out all particles—and what of the solubles? HPS should model a separated but clean stormwater release. What is the additional value to the community, developer and homeowners, for creating more wetlands, more habitat.
- There is also the possibility of using recycled water for bay recharge. If there is “excess” could this water be strategically released to the bay not through an outfall, but a series of seeps or through a wetlands release.

Again, the integrated sewage / stormwater scenario is suggested at the end of the report—stormwater (p63) and appendix A. We believe this is the direction that further analysis should go.

Key Difference with the Report Conclusions

> **THE KEY FINDING THAT SCALPING IS THE PREFERRED MODE (P49) IS, AT THIS JUNCTURE, PREMATURE, AS IS THE CONCLUSION THAT (P64) THERE IS A LOW DEMAND FOR RECYCLED WATER AT HPS.**

This conclusion is made without adequate analysis of a more robust attempt to find sustainable uses on the base. Similarly a more robust effort should be made to find additional offsite uses.

Relatively nearby uses (of between 1.4 – 4 MGD) are reported as being “not immediately adjacent” and the tone is that the 2-2.5 mile radius is too far to go. Efficiency and capacity arguments are made for a .5 Scalping unit, but the basic environmental justice argument of reducing flows to the Southeast Plant are not carried forward from the beginning of the document and go unaddressed at this point (p.49 & pgs. 53-60).

Discussion of the need for further analysis of reuse potential was made in the above section on Sustainability. The discussion of the potential for additional offsite need/uses was discussed in the section on recycled water.

The discussion about the 2. 5 mile radius for addition recycled water demand should be put in a more neutral context, not used (at least not at this point) as an argument for a scalping plant. It may be that when put in the larger context of the citywide Clean Water Master Plan (CWMP) and the Revised Recycled Water Master Plan (RWMP) that there is a decision to provide a source of recycled water nearer to these sites McLaren Park, for example). However, if the decision is made to devise a cluster system, with a few strategically located recycled water treatment facilities around the city, then in fact the HPS plant may become the mini-regional supply source. The RWMP now contains scenarios which contemplate treatment on the west side and distribution to the east side of the City. Another scenario has been the location of a recycled water treatment facility at the S.E. Plant. Given those scenarios, a 2.5 mile radius is quite reasonable. If HPS were to supply recycled water for those offsite uses, the goal of total reuse of the HPS sewage would be much closer to a zero discharge one.

Instead, arguments were made in this latest draft for a scalping system based on efficiency of the system and the ability of the S.E. Plant and the CSO system to absorb the additional flows “with no impacts” : “ the design capacity of SEWPCP will easily allow it to absorb HPS flows of 2 to 5 MGD” ; “…an increase in dry weather flow of 2 to 5 MGD would have no impact on the functioning of the conveyance system because it is oversized for rain events.” In all nine pages were added about the central system: “the effect of HPS Flows on SEWPCP and the Combined System”, Future HPS Wastewater Flows, cost of the Centralized Approach.”

We are not opposed to this analysis being included. However, they are made in the absence of a discussion of the environmental justice context that was mentioned in the beginning of the report. From an environmental justice context, this scenario goes in the wrong direction, i.e., more sewage being sent to the central plant. While the first argument may be technically true, the environmental justice issue is not about the capacity of the S. East Plant, it is about reducing the volume and total percentage that goes to that plant.

It also goes in the wrong direction from a sustainability point of view, as more volume and sewage are added to the overflows.

Again we are not opposed to the addition of this analysis, but there should have been an equal effort to flesh out a more robust sustainable scenario-both on base and near base.

While a wetlands opportunities scenario for treating stormwater was listed in the October 2003 draft (p39) as having potential for future study, additional discussion was relegated to the TM11 and not brought forward in the final Feb 2003 body of the draft.

Another recommendation for further analysis of “Combinations of Wastewater Treatment Technologies” (p.63) was not further assessed. But a lot was added about the advantages of the

Central system. Until an extended analysis is done to explore a greater reuse potential, we believes that conclusions can not be drawn that recycled water demand is low at HPS and that anything over and above the current estimated use must go back to the central system.

By retracting the .5 MGD Scalping Plant recommendation and fully exploring a "most sustainable' plan, this report can chart the way not only for a more sustainable, and environmentally just design of the HPS development, but can have great impact on the Master Plan as a whole. We look forward to working constructively to create a document of vision for the city of San Francisco at this critical juncture.

D TECHNICAL MEMORANDUMS

The following technical memorandums are available electronically on the CD and online at www.ndwrcdp.org.

Study Technical Memorandums

- **TM2-1: Environmental Conditions**
- **TM3-1: Regulatory Requirements and Treatment Criteria**
- **TM4-1: Water Reuse Alternatives**
- **TM6-1: Available Wastewater Technologies**
- **TM6-2: Wastewater Treatment Approaches and Systems**
- **TM7-1: Centralized Wastewater Treatment Approach**
- **TM8-1: Site Analysis**
- **TM9-1: Cost Analysis (see TM10-2, Appendix D)**
- **TM10-1: Sludge Management Options for Decentralized Wastewater Treatment Systems**
- **TM10-2: Site-Specific Evaluation of Decentralized Wastewater Treatment**
- **TM11-1: Available Storm Water Technologies**
- **TM11-2: Storm Water Treatment Approaches and Systems**

Additional Technical Memorandums

- **2.0 MGD Treatment Alternatives**
- **0.5 MGD Membrane Bioreactor (MBR) Scalping Plant Treatment Alternative**

WU-HT-01-34

NDWRCDP
Washington University, Campus Box 1150, One Brookings Drive, Cupples 2, Rm. 11, St. Louis, Missouri 63130-4899 • USA

This report is available online at www.ndwrcdp.org. This report is also available through the
National Small Flows Clearinghouse • West Virginia University/NRCCE, P.O. Box 6064, Morgantown, WV 26506-6064 • USA
Tel: (800) 624-8301 • WWCDMG34