Chapter 4
Treatment, Biosolids, and Energy

The City of San Francisco owns and operates three wastewater treatment facilities: (1) the Southeast Water Pollution Control Plant (SEP), (2) the North Point Wet-Weather Facility (NPF), and (3) the Oceanside Water Pollution Control Plant (OSP). Each treatment facility has one or more outfalls for dispersing the treated effluent into San Francisco Bay and the Pacific Ocean. The treatment facilities have received numerous awards including the 2004 U.S. Environmental Protection Agency National Clean Water Act Recognition Award for Operations and Maintenance Excellence at the Oceanside Water Pollution Control Plant. An integral part of wastewater treatment is the production of biosolids and the utilization and production of energy, both of which are critical elements in the development of the Sewer System Master Plan (SSMP). The challenges and planning recommendations for the treatment facilities, biosolids management, and energy usage and production are presented and discussed in this chapter. The proposed plans for implementing the recommendations presented in this chapter are discussed in Chapter 5.
Wastewater Treatment Facilities

Treatment Facilities Challenges
Both the SEP and the NPF were built over 50 years ago and many of the challenges are related to aging infrastructure. Based on the useful life industry standard estimates for treatment plant components given in Table 4-1, several of the key process units at these facilities are in need of complete replacement. Some of the technology employed by these processes are outdated and the structural integrity of some of the units is compromised. The design standards that governed the construction of the SEP did not take into account current concepts for mitigating negative impacts on the surrounding community. Even the OSP, which is the most recently-constructed treatment facility in the city, is experiencing the effects of deferred maintenance and its operational efficiency and reliability are being impacted.

Southeast Water Pollution Control Plant
The three major challenges at the SEP are: (1) aging infrastructure (especially the biosolids digester facility) (Figure 4-1), (2) operational efficiency (anaerobic digester capacity, Class B biosolids compliance, and the biogas system), and (3) community impacts (odors, visual impact). Each of these challenges is considered in the following discussion.

Aging Infrastructure
Most of the components of the current SEP biosolids digester facility have been in service for nearly 60 years, which is well beyond their expected mechanical and structural life. This aging infrastructure clearly poses a very significant threat to regulatory compliance.

Operational Efficiency
Operating equipment installed during the expansion of the SEP in the early 1980’s has reached the end of its expected useful life and needs to be replaced within the next five to 10 years. Problems that have surfaced recently include:
- Screenings capture is incomplete and leads to debris accumulation in the anaerobic digesters.
- Grit removal is poor. Grit passes through the grit removal process into the primary sedimentation tanks where it causes excessive wear on process equipment and leads to frequent process stoppages from plugged lines.
- Oxygen-generation equipment, although operating satisfactorily uses energy inefficiently. It is anticipated that its maintenance costs will increase substantially in the near future.
- The antiquated secondary clarification equipment is inefficient, unreliable, and must be replaced soon to ensure continued serviceability of these essential units.

<table>
<thead>
<tr>
<th>Component</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures</td>
<td></td>
</tr>
<tr>
<td>Plant buildings, concrete process tankage, pump stations</td>
<td>40 – 60</td>
</tr>
<tr>
<td>Process Equipment</td>
<td></td>
</tr>
<tr>
<td>Mechanical equipment (pumps, bar screens etc)</td>
<td>15 – 25</td>
</tr>
<tr>
<td>Electrical Equipment</td>
<td></td>
</tr>
<tr>
<td>Motor control center, substations</td>
<td>15 – 25</td>
</tr>
<tr>
<td>Variable frequency drives</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Auxiliary Equipment</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Outfalls</td>
<td></td>
</tr>
<tr>
<td>Cement-lined ductile iron</td>
<td>50 – 100</td>
</tr>
<tr>
<td>Reinforced concrete</td>
<td>50 – 100</td>
</tr>
</tbody>
</table>

Source: Code of Federal Register: 40 CFR Chapter 1 (7-1-00 Edition) foot 35, subpart E, Appendix A
The existing chlorination/dechlorination system does not allow for the reliable continuous monitoring of final effluent chlorine residual, which may be required by the San Francisco Bay Regional Water Quality Control Board (RWQCB) in future National Pollutant Discharge Elimination System (NPDES) permits. Further, the use of chlorine-based disinfectants can result in the formation of disinfection byproducts some of which are known to have negative human and environmental impacts. The costs of sodium hypochlorite and sodium bisulfite, the chemicals used in the disinfection process, have risen significantly and, during the last few years, hypochlorite procurement from local vendors has become less reliable.

Ensuring fully compliant anaerobic digestion requires constant staff attention and effort. Lack of automation, remote temperature sensing, and the deteriorated state of the mechanical and structural equipment, as well as the frequent need for cleaning, means that operating crews are constantly reacting to crises just to maintain the current modest sludge treatment goals.

The biosolids centrifuges must be frequently taken off line for maintenance. This, together with the poor reliability of ancillary equipment such as feed pumps, limits the number of operable centrifuges available.

Community Impacts

When the SEP commenced operation in the early 1950’s, the surrounding neighborhood had many more industries, including slaughterhouses and tanneries. The character of the neighborhood was not inappropriate for locating a sewage treatment plant. Today, the SEP is surrounded by a much changed neighborhood consisting of a mixture of light industry and residential development (Figure 4-2). The negative impacts of the SEP are now significant and include:

Figure 4-1. Collapsed Digester Cover
- Plant odors have a major negative community impact and their control is a major operating issue at the SEP. Odors are the most frequent neighborhood complaint.
- Noise, including plant alarms, the intercom system, and truck traffic has been a source of complaints from the SEP neighbors.
- The main visual impacts from the SEP facilities are from the anaerobic digesters and the flare stack in the biosolids digester facility. These digesters are located directly across the street from houses. The SEP can be seen from nearby hillside neighborhoods and its “industrial appearance” is a constant reminder that there is a sewage treatment plant in the vicinity.

North Point Wet-Weather Facility

The NPF was constructed at about the same time as the SEP and it shares the same problems of aging infrastructure and outdated equipment. The community impacts (e.g., odor, noise, and truck traffic), while similar to the SEP, are limited since the NPF is a wet-weather-only facility, it does not have secondary treatment or solids handling processes, and NPF only operates 30 times per year (450 hours).

Oceanside Water Pollution Control Plant

Even though the OSP is the newest of the City’s treatment facilities, it is beginning to experience condition-related maintenance and operational problems. The OSP

Figure 4-2. Southside SEP and Surrounding Industrial and Residential Neighborhoods
is located adjacent to the Pacific Ocean and some of the structures, such as the anaerobic digesters, are exposed to salt-laden marine air. This has caused premature corrosion. Together, a lack of routine preventative maintenance (caused in part by serious underfunding during a 6-year rate freeze), and the harsh marine environment have started to take their toll on both the mechanical and the electronic equipment. This is making day-to-day plant operation more and more difficult. The OSP was designed to have minimal community impacts and, for the most part, it has performed up to expectations. Odors and noise primarily impact the health and safety of the on-site employees (San Francisco Public Utilities Commission, 2003).

**Recommendations**

The recommendations for the City’s three treatment facilities include both infrastructure and management improvements. The implementation of these improvements will ensure seismic and operational reliability, adequate redundancy, increased automation, and sustainable operations.

**Southeast Water Pollution Control Plant**

The SSMP recommendations for the SEP center on capital projects that address the aging infrastructure and operational efficiency so that the plant will be returned to a state of good repair. In addition, odor control and architectural improvements will be instituted to address community impacts. By addressing the SEP’s most pressing needs, it is anticipated that the SSMP objectives related to community impacts and aging infrastructure will be met. The recommended upgrades include:

- Replacement of aging major process equipment, which has exceeded its useful life, with modern, more efficient, easily maintainable, and reliable equipment. The oxygen-generation system and the head-works are especially in need of attention.
- Odor control improvements to minimize fugitive odors that can negatively impact the surrounding community.
- Architectural and landscaping improvements to reduce the negative visual impact of the SEP and establish it as a community amenity.
- Evaluation of the replacement of secondary effluent chlorine-based disinfection with effluent pasturization or other non-chlorinated by-product disinfection to reduce the use of sodium hypochlorite in the plant and the presence of chlorination byproducts in the dry-weather effluent, and improve the overall sustainability of the system.
- Seismic and structural upgrades throughout the plant to minimize damage due to an earthquake.
- Electrical upgrades and energy-efficient equipment selection to reduce energy use and increase operational flexibility.
- Upgrades to the SEP biosolids digester facility are described in the Biosolids Management section on page 4-7.

**North Point Wet-Weather Facility**

NPF should be rehabilitated to ensure its continued service for wet-weather treatment. Recommended improvements to the NPF include:

- Refurbishment of primary clarifiers
- New chemical facilities
- Odor control improvements
- Electrical upgrades and energy efficient equipment selection to reduce energy use and increase operational flexibility
- Seismic and structural upgrades to minimize damage due to an earthquake

**Oceanside Water Pollution Control Plant**

The SSMP recommended improvements to the OSP are needed to maintain the facility and its equipment in a state of good repair and to provide ease of operation. The recommendations include:
• Pretreatment process upgrade to provide additional grit removal so the system can continue to operate at its maximum capacity during wet weather.
• Refurbishment of the oxygen-generation facility.
• Rehabilitation of the gas handling system to ensure continued compliance with the air discharge permit.
• Electrical upgrades and energy efficient equipment selection to reduce energy use and increase operational flexibility.
• Upgrades to the OSP sludge handling facilities are described on page 4-7.

Treatment Plant Management Improvements

Effective treatment plant management requires expenditures for support staff in Operations, Maintenance, Engineering, Laboratory, and Administration. It is very important to provide adequate funding for these activities, since they are essential for an efficient and compliant operation.

Comparison to Goals and Objectives

The treatment facility needs are centered on the rehabilitation of aging and seismically vulnerable infrastructure and the reduction of negative community impacts, especially with respect to odors. The SSMP recommendations address all of the immediate infrastructure needs required to ensure continued compliant and reliable performance of the treatment facilities. Execution of the SSMP recommendations will address the goals and objectives of improving seismic reliability and flexibility and will reduce negative impacts on surrounding communities. The replacement of outdated equipment with modern energy efficient models will reduce facility energy demands and in turn enhance the sustainable use of natural resources and promote environmental stewardship. Key facility improvements will serve to protect worker health and safety by improving indoor air quality, by reducing exposure to treatment chemicals, and by replacing antiquated equipment with models that are easier to maintain. All of these recommendations will help to maximize the use and extend the life of existing facilities so that the financial impact on the ratepayers will be minimized.

Deepwater Outfalls

Deepwater Outfall Challenges

The challenges associated with the effluent outfalls are summarized in this section. Useful life industry standard estimates for the outfalls are presented in Table 4-1.

Southeast Bay Outfall

The Southeast Bay Outfall (SEO) is the main outfall for the SEP and has been in operation since 1969. It was originally designed for an average flow of 20 mgd and a peak flow of 70 mgd. In wet weather, up to 110 mgd (over 1.5 times the design capacity) is discharged through the SEO. Specific concerns with the SEO are:

• By the year 2030, the SEO will be over 60 years old. Based on U.S. Environmental Protection Agency guidelines, the nominal life of a marine outfall is 50 years. With proper maintenance, it has been observed that outfalls can remain in service beyond 50 years (BCM Joint Venture, 2009c).
• The SEO current condition requires a thorough assessment. Deferring replacement or substantial rehabilitation by an indefinite period beyond 2030 could pose a substantial risk to reliable performance.

North Point Outfalls

The North Point Outfalls (NPOs) are normally used when the NPF is activated during wet weather to discharge primary effluent into the bay. The four outfalls have been in service for over 50 years and their age is an ongoing concern.

Southwest Ocean Outfall

The Southwest Ocean Outfall (SWO) was put into service in 1986. It was sized to allow discharge of effluent from the entire city (590 mgd) into the bay. The outfall is currently experiencing high levels of discharge due to the aging pipe and its operations. A thorough assessment is required to determine the remaining useful life of the outfall and to determine the feasibility of rehabilitation or replacement.
mgd). The SWO currently is used only for Westside Watershed discharge (maximum flow in wet-weather operations is 175 mgd). Specific concerns with the SWO are:

- The deposition of sediments in the diffuser section of the pipeline (as a result of the lower-than-expected flows) has reduced its capacity.
- Inflow of seawater to the diffuser section has exacerbated the problems of attached marine growth and sediment accumulation.

Recommendations

All of the outfalls should be inspected and evaluated to assess their condition and determine the need for repairs. Specific recommendations to ensure continued function through 2030 include:

- Near-term repair of the existing SEO
- Rehabilitation of NPOs if indicated by inspection
- Installation of backflow prevention devices on the active SWO diffusers to reduce seawater inflow
- Evaluate the rehabilitation or replacement of the SEO capacity near the end of the SSMP planning period

Comparison to Goals and Objectives

Returning the deepwater outfalls to a state of good repair will continue to promote environmental stewardship and maintain system reliability by ensuring deepwater dispersal of treated effluent and will extend the life of existing facilities so that the financial impact on the ratepayers will be minimized.

Biosolids Management

Biosolids are the solid material remaining after anaerobic digestion of the residuals produced by primary and secondary treatment. Currently, most wastewater agencies recycle biosolids through land application. This practice demonstrates the San Francisco Public Utilities Commission commitment to recycling and helps meet the California Integrated Waste Management Board requirements and City goals for diversion of waste from landfills (California Integrated Waste Management Board, 2009; San Francisco Board of Supervisors, 2002). The outlook for the continued use of land application for biosolids recycling is becoming increasingly uncertain, because of social, environmental, and regulatory concerns regarding this practice. The challenges and recommendations inherent to biosolids management are addressed in this section.

Biosolids Management Challenges

San Francisco’s current biosolids recycling practices face several challenges including:

- The anaerobic digesters that serve the SEP facility have been in service for well beyond their expected mechanical and structural life. Because of their condition, the SEP is at risk of not meeting Class B treatment (40 CFR 503) as required by its NPDES permit for reuse.
- As final effluent limits become more stringent, it is possible that the pollutant loading in the biosolids could reach levels that would further limit the options available for its reuse.
- Regulatory and environmental pressures on the practice of applying Class B biosolids to agricultural land application are increasing to the point where it may not be possible to continue current practices through 2030.
- The increasing regulatory pressures on the land application of biosolids will most likely lead to an increased demand for limited landfill space and increased costs.

Recommendations

The underlying principles of an effective and sustainable biosolids management program are to provide reliability and flexibility, to practice environmental stewardship, and to protect the public health and the environment. Implementation of the following recommendations will allow the San Fran-
San Francisco Public Utilities Commission (SFPUC) to achieve such a program:

- Construct a new biosolids digester facility to replace the antiquated SEP facility. This facility would produce high quality biosolids (Class A), enhance energy recovery, and meet the sustainability goal of the SSMP.
- Upgrade the OSP biosolids digester facility to produce Class A biosolids.
- Investigate new opportunities for the reuse of Class B biosolids.
- Increase the flexibility of biosolids disposal/reuse by using advanced biosolids processing methods, such as thermal drying.
- Expand ongoing regulatory compliance, training, and public outreach activities.
- Continue to participate in regional biosolids associations to keep abreast of new technology and innovation.
- Develop and implement a comprehensive Biosolids Environmental Management System.
- Continue to participate in the development of a regional biosolids project that would evaluate a number of different processing methods, including some of the more recent waste-to-energy technologies.
- Provide adequate funding for the materials, support staff, and operating costs required to conduct an effective biosolids management program. These areas include operations, maintenance, engineering, laboratory, administration, chemicals, power, hauling, and reuse.

Comparison to Goals and Objectives

Current SFPUC biosolids management strategies are not sustainable. Implementation of the biosolids management recommendations, which include adoption of the management strategy and replacement of the SEP biosolids digester facility, will effectively address all of the major SSMP goals and objectives. A new facility will continue to meet the goals of protecting public health and the environment. It will be consistent with the goal of enhancing environmental stewardship while, at the same time, providing improved system reliability and flexibility and guaranteeing enhanced biosolids processing. A new facility will reduce adverse community impacts through a significant and consistent reduction in odor while replacing the most seismically vulnerable facilities at the SEP. Replacement of the antiquated SEP digesters and ancillary equipment will help protect worker health and safety by reducing the risks associated with the aging facility. Finally, while a new facility will have significant capital costs, prompt implementation of the recommendations and serious consideration of alternative locations for the facility will minimize the impacts on the ratepayers.

Energy and Power Management

The SFPUC Wastewater Enterprise’s (WWE) current energy and power management program consists of maximizing the renewable power produced by cogeneration facilities at the biosolids digester facility sites, installing solar photovoltaic cells on the roofs of WWE facilities, and implementing energy efficient lighting retrofits throughout all of its facilities.

Current and Future Challenges

The principal power and energy management challenge is to develop a systemwide plan that will minimize the energy use for and maximize the energy production from wastewater treatment.

Recommendations

The SSMP recommends that the WWE develop a comprehensive power and energy management program that builds on the current efforts to save power while exploiting its unique power generation
opportunities. The proposed program should have two main components.

1. Maximize on-site renewable energy generation opportunities. The following activities are envisioned for all facilities:
   - Optimize operations to increase the production and use of anaerobic digestion biogas (methane).
   - Formalize a bioenergy subprogram for the development of renewable/alternative energy projects (i.e., Yellow Grease Collection Program, Brown Grease to Biodiesel, Organic Waste Digestion, Alternative/Renewable Energy Sources). This effort will have the added benefit of protecting the collection system infrastructure by retaining its capacity and reducing the frequency of blockages (Chapter 3, Operational Efficiency section on page 3-4).
   - Reduce fossil fuel consumption.
   - Create “green” jobs where possible.

2. Maximize energy efficiency at all facilities, in coordination with the SFPUC Power Enterprise. The principal steps that must be undertaken to implement this program are:
   - Use asset management to identify, prioritize, and replace aging, inefficient equipment at all WWE facilities.
   - Make information on energy consumption available to WWE staff through implementing an energy management system.
   - Employ Best Practices for design decisions and make energy efficiency a priority when evaluating technologies for all projects at WWE facilities. Equipment and lighting designs will balance maintenance, capital, and operating life cycle costs.
   - Use Leadership in Energy and Environmental Design (i.e., LEED) certification for all new buildings constructed and for existing buildings where feasible.

Comparison to Goals and Objectives

Implementation of the Energy and Power Management recommendations will support the SSMP goal of promoting environmental stewardship and enhancing sustainable use of natural resources by minimizing the use of grid power and the associated production of greenhouse gases.