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Prepared for: City of Sunnyvale, California

Project Title: Sunnyvale Strategic Infrastructure Plan for the WPCP

Project No: 135083

Sunnyvale WPCP Strategic Infrastructure Plan

Subject: Technical Memorandums Guide

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To: Lorrie Gervin, Environmental Division Manager – Sunnyvale WPCP

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Overview

Needed improvements at the City of Sunnyvale Water Pollution Control Plant (WPCP) are being evaluated with a Strategic Infrastructure Plan (SIP). The SIP will evaluate overall strategic alternatives for renewal of aged facilities and will recommend a specific plan for executing the selected alternative for facilities renewal. The overarching approach of the SIP is to compare the broad alternative of renovating and optimizing the existing plant facilities against the broad alternative of generally replacing the existing facility with new treatment processes.

Organization and Description of SIP Technical Memorandums

Decision Making	
Title	Technical Memorandum Description
Business Case Evaluation of Plan Alternatives	Layout of a Business Case Evaluation (BCE) of the various alternatives. The purpose of the BCE is to develop a rationalized selection of a specific strategic alternative upon which to plan a plant modernization program. Provides the ultimate recommendations of the Strategic Infrastructure Plan
Business Case Evaluation Decision Making Methodology	Describes a structured framework for decision making to guide an “Expert Panel” of City staff, managers, and consultants to develop appropriate decision criteria, to develop decision alternatives that address the criteria, and to select which alternative best meets the criteria. The framework and process are developed to create an alternative selection that can be rationally justified to “customers” with interests in the consequences of executing the alternative.
Level of Service (LOS) Measures	Presents the results of several Expert Panel workshops that were conducted to define the structured decision making criteria. LOS are a collection of measures intended to align the decisions related to capital projects with the values and expectations of the “customers” the project intends to serve. “Customers” can include the rate-payers, the regulators, any project partners, and the community-at-large. The LOS were organized under, first, regulatory and then three broad non-regulatory interest categories that comprise “Triple Bottom Line” analysis; “Financial”, “Environmental”, and “Social”. Development of alternatives descriptions are based on LOS guidance.
Alternatives Development	
Title	Technical Memorandum Description
Plant Rehabilitation Alternative Summary	<p>Describes the entire alternative plan associated with the scenario that rehabilitates the existing plant processes. The following objectives are addressed:</p> <ul style="list-style-type: none"> • Describe what facilities are planned to be replaced and / or rehabilitated. • Describe the schematic arrangement of the processes • Describe design and sizing criteria for the processes • Describe the proposed layout on the plant site for the processes • Describe the sequence of construction and recommended construction packages. • Present the estimate of probable construction cost. • Estimate the major operational costs for the processes. • Describe the sustainability related characteristics of the alternative.

<p>Plant Replacement Alternative Goals, Objectives, and Technology Screening Review</p>	<p>Screens a range of process technologies that may be candidates for inclusion in the Plant Replacement Alternative. Goals and objectives in this TM were consistent with those formed in the initial TMs. Also makes recommendations for new treatment processes based on comparison of proven technologies using the following criteria:</p> <ul style="list-style-type: none"> • Projected life cycle cost • Projected footprint requirements • Projected resource consumption <p>For each of these criteria, a rating of “low”, “medium”, or “high” was provided for each technology being evaluated, based on experience with the technology in similar applications. Recommendations for liquid-phase processes and solid-phase processes were made and have been carried forward into this TM. Process schematics for both liquid- and solid-phase flows were also produced in the Technology Screening Review TM and have also been incorporated into this TM.</p>
<p>Plant Replacement Alternatives Summary</p>	<p>A comprehensive description and evaluation of the Plant Replacement Alternatives. Two “sub-alternatives” of the Plant Replacement Alternative are considered in this evaluation: Alternative A, which includes conventional activated sludge for secondary treatment and Alternative B, which includes a membrane bioreactor (MBR) for secondary treatment. Alternative B was formulated because it has a more compact footprint, to be considered should the City decide that there are significant issues associated with footprint for the (much more land-intensive) Alternative A.</p> <p>describe the entire alternative plan associated with the Plant Replacement Alternative, which is based on new secondary and new or rehabilitated tertiary treatment plant processes. The following objectives are addressed in the TM:</p> <ul style="list-style-type: none"> • Describe what facilities are planned to be replaced and / or rehabilitated. • Describe the schematic arrangement of the processes • Describe design and sizing criteria for the processes • Describe the proposed layout on the plant site for the processes • Describe the sequence of construction and recommended construction packages. • Present the estimate of probable construction cost. • Estimate the major operational costs for the processes. • Describe the sustainability related characteristics of the alternative.
Special Planning	
Title	Technical Memorandum Description
<p>Early Execution Projects</p>	<p>An evaluation of very critical, higher risk improvement needs that could be candidate projects to execute in advance of final completion of the SIP. Process facilities meeting the following criteria were candidates for early execution:</p> <ul style="list-style-type: none"> • Process facilities known to be significantly deteriorated and at higher risk of unanticipated failures. • Processes that would be included in either of the major plant rehabilitation scenarios. • Processes that could be located in the same location, regardless of which major plant rehabilitation scenario is selected in the SIP. <p>The processes that were recommended for early execution, along with a proposed layout, were:</p>

	<ul style="list-style-type: none"> • Raw sewage screening and screenings processing • Raw sewage pumping • Grit removal and grit processing • Primary sedimentation and primary sludge pumping • Primary effluent pipeline • Main plant electric switchgear center and diesel standby power facility • Primary sludge thickening
Headworks and Primary Sedimentation Upgrades Alternatives Evaluation	A supplementary extension of the Early Execution Projects TM that examines strategic planning for the recommended renewal of the headworks and primary sedimentation processes. The alternative of rehabilitating the existing building and structures associated with the existing headworks and primary processes versus an alternative of constructing all new process related structures and equipment at a new location on the site. A recommendation to build new structures at a new location on the site is ultimately developed.
Fundamental Information	
Title	Technical Memorandum Description
Influent Flows and Loads	An establishment of current and projected plant flow rates and pollutant loading rates that are fundamental to the physical sizing of key unit processes for wastewater treatment.
Solids Loads	An establishment of current and projected residual biosolids production rates that are fundamental to sizing of solids thickening processes, solids stabilization processes, solids dewatering processes, and off-site biosolids reuse / recycling programs.
Regulatory Framework	A summary review of the overriding and detailed laws, agencies, and regulations that establish the ultimate legal treatment performance requirements of the WPCP. Background information is also provided contributing to insights on potential future changes in regulatory requirements that may influence decision making in major treatment process modifications or improvements.
Seismic Performance Goals	A presentation and establishment of post earthquake performance goals for the WPCP.
Electric Power System Level of Service	A discussion of reliability goals for provision of electric power for wastewater treatment processes at the WPCP. Goals for redundant power circuit designs and for reliable emergency on-site power generation are established. The role of continuous on-site power generation from biofuels is also discussed.
Condition Assessment and Unit Process Performance Review	Prior condition evaluation assessments by other consultants formed the basis of condition assessment for the SIP and the salient conclusions of those assessments are summarized by treatment process area. Also included in this TM are conclusions about existing unit process performance drawn from both data review and interviews of plant staff with respect to specific performance and operational issues and their interests in process improvements. This review forms the much of the basis for a list of recommended improvement projects for the existing treatment processes. Further basis for improvement project recommendations was drawn from Unit Process Improvement TMs.

Unit Process Improvement Studies	
Title	Technical Memorandum Description
Nitrification System Improvements	Recognizing that a draft discharge permit renewal was proposing winter season ammonia nitrogen discharge limits that the WPCP had historically been unable to achieve, this TM evaluated the potential for optimizing the existing process configuration to achieve the limits and contrasted those optimizations with a proposed hybrid oxidation pond / conventional activated sludge process that would be expected to reliably meet the more stringent requirements while retaining some benefits of the oxidation ponds as a secondary treatment process. Process modeling, performance evaluation, and comparison to other nitrifying fixed growth reactors performance levels indicated a significant potential, with some recommended process modifications (that need to be tested for confirmation), that the proposed more stringent winter performance requirements could be achieved. Comparatively, the hybrid process alternative involved capital investments and strategic changes that rivaled the overall strategic alternative of complete plant process renewal. Accordingly, an immediate testing program to demonstrate the performance of optimization improvements was recommended and it was determined that the strategic alternative of renewing the existing treatment plant processes would be based on the assumed success of the recommended optimization improvements. Subsequently, the ultimate permit renewal included less stringent winter ammonia nitrogen discharge requirements, but the concern about future tightening of requirements for this contaminant remains.
Evaluation of Dewatering Alternatives	Recognizing the current gravity drainage bed method of dewatering digested sludge as overly consumptive of valuable plant site area and operationally inefficient, this TM evaluated alternative technological approaches for replacing the beds with a mechanical dewatering system that would consume much less site area and could dewater biosolids with less manual operational labor requirements. Screw presses and centrifuges were deemed favorable over belt filter press systems, with centrifuges recognized as more favorable in the event of increasing costs for off-site sludge reuse and if there is a desire to avoid 24 x 7 operation of the dewatering equipment (i.e. day shift only operation).
Upgrade Alternatives for the Air Flotation Tanks (AFTs)	Recognizing that liquids / solids separation of algae from oxidation pond effluent with AFTs is one of the most energy, chemical, and labor intensive processes at the WPCP, this TM evaluated alternative methods of addressing liquids / solids separation and for optimizing thickening of the residual algal float product. Review of current technologies that might replace AFT (sedimentation, ballasted sedimentation, and membranes) resulted in a conclusion that AFT remains the most efficient separation and thickening process for the oxidation pond effluent. Replacement of the existing AFTs with a more modern, high efficiency AFT process was recommended in order to reduce site area required for the unit process and to achieve a more consistently thickened algal float product, suitable for stabilization and bioenergy extraction in the anaerobic digestion process.

<p>Anaerobic Digestion of Algae</p>	<p>Recognizing that the current practice of returning algal float from AFTs to the oxidation ponds (without harvesting) resulted in a lost opportunity for additional bioenergy production and was likely detrimental to the long term sustainability of oxidation ponds, this TM assessed the viability of instituting a continuous program of routing algal float to the existing anaerobic digestion process and post digestion solids handling facilities. The initial change of routing algal float to anaerobic digestion creates significantly more operational costs for treatment and reuse of additional digested biosolids than is returned by the offsetting value from additional digester gas production. However the analysis was broadened to compare only alternatives that ultimately harvested all biosolids production from the plant on a perpetual basis, unlike the current practice of allowing accumulation of returned biosolids in the ponds. In the broader analysis, the most economically favorable practice was determined to be digesting both primary sludge and algal float in the anaerobic digesters and then discharging the digested biosolids to the ponds (or, ultimately, to dedicated extended sludge stabilization ponds) for additional stabilization, along with a permanent dredge harvesting program to continuously remove dredged biosolids for dewatering and off-site reuse.</p>
<p>Recycled Water Treatment Alternatives</p>	<p>Recognizing that the current practice of producing recycled water for City use by regularly and frequently reconfiguring the entire tertiary treatment process to meet the differing requirements for Bay discharge and for recycled water production was operationally inefficient and tended to create performance risks for both modes of discharge, this TM assessed alternative technology approaches for providing a recycled water production process scheme that could operate in parallel with and generally independent from the process treating most of the effluent for Bay discharge. For the overall strategic alternative of renewing the existing treatment processes, the recommended parallel treatment system includes separate and dedicated process units for dissolved air flotation, dual media filtration, and hypochlorite disinfection of oxidation pond effluent in order to meet the stricter quality requirements for recycled water production. For the overall strategic alternative of replacing the existing treatment plant processes, an alternative configuration was recommended that includes cloth media filters and UV disinfection of conventional activated sludge treatment process effluent.</p>