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Technical Memorandum 5.0

Implementation Plan

Prepared for: San Jose/Santa Clara Water Pollution Control Plant

Project Title: FOG Evaluation, Digester Rehabilitation and Gas Line Replacement

Project No: 136242-005

Technical Memorandum 5.0

Subject: Implementation Plan

Date: September 15, 2011

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1. EXECUTIVE SUMMARY

1.1 Purpose of Technical Memorandum 5.0

Technical memorandum (TM) 5.0 presents a summary of recommendations from the previous TMs that were developed in Task 4. It also summarizes results from the dissolved air flotation thickener (DAFT) business case evaluation (BCE) from Task 7. A project description and basis of design are included, along with discussion of miscellaneous project elements such as site grading and civil improvements, miscellaneous mechanical and electrical improvements, safety improvements, and constructability. The elements of the project description focus on those improvements necessary to provide reliable capacity without precluding viable future digestion process options evaluated in the San Jose/Santa Clara Water Pollution Control Plant (WPCP) Master Plan. A discussion of contract packaging alternatives and recommendations, a construction cost estimate, and a recommended project schedule are provided.

1.2 Summary of Recommended Project

This project includes upgrades to the WPCP anaerobic digesters, digester tunnels and appurtenances, and DAFT systems to improve digester capacity, safety, and performance. Several construction packaging approaches are available for this project. All major project elements could be included in a single construction contract and allocated to a single general contractor. Construction projects of this size are commonly delivered by a single contract. With this approach, mixer pre-purchasing would be recommended to allow specific negotiations with sole source suppliers and to afford the ability to conform the final design to approved submittal information.

Alternatively, multiple contract packages can be used to divide up the work and accelerate the schedule for completion of design and commencing construction. Multiple contracts are more complex and costly to administer, and can create contractor overlap and work area conflicts. However, they can afford the ability to accelerate some components through design to improve the schedule. With one reasonable multiple contract alternative, there are potentially five construction packages and two pre-purchase contracts listed below. Splitting Construction Contract No. 1 and No. 2 can result in accelerating commissioning of the new digester gas manifold and tunnel improvements by about 3 months over the single contract approach. If this extra implementation time for this project element can be tolerated by the City, the single contract approach could result in a much easier to administer project.

- Construction Contract No. 1 – Digester Gas Manifold and Tunnel Improvements – This contract includes a new above ground gas manifold, removal of other hazardous piping from the tunnels, sealing the tunnels from other classified areas, and relocating some ventilation intakes. It includes minor improvements to individual digester gas piping to improve safety and condensate removal (all digesters but 5, 6, 7, and 8 being modified in Contract No. 2)
- Construction Contract No. 2 – Digester Cover and Mixing Upgrades – This contract includes installing new submerged fixed covers and new mixers on Digesters 5, 6, 7, and 8.
- Pre-Purchase Contract No. 1 – Digester Mixing Equipment 1 – This contract includes pre-purchase of sole-source digester mixing equipment the City wishes to pilot test. This could include focused flow mixers and/or linear motion mixers
- Pre-Purchase Contract No. 2 – Digester Mixing Equipment 2 – This contract includes pre-purchase of other digester mixing equipment, notably mechanical draft tube mixers.
- Construction Contract No. 3 – DAFT Final Upgrades – DAFT final upgrades will allow for co-thickening of primary and secondary sludge.
- Construction Contract No. 4 – Digester Heating Upgrades – This contract makes piping, equipment and control modifications to the individual digester heat supply system.
- Construction Contract No. 5 – Struvite Control Chemical Feed – This contract would be implemented only if pilot testing confirmed the performance of proprietary chemicals for struvite control.

The City is currently exploring another contract with a private FOG (fats, oils, and grease) handling company to build and operate a pilot FOG receiving station that will be used to test FOG feed to the digestion system. The private company will likely be responsible for delivering the FOG and operating the receiving and FOG feed system. The recommended project work will be configured and scheduled to accommodate this pilot FOG receiving plan.

1.3 Summary of Master Plan Biosolids Implementation Plan

As part of the WPCP Master Plan, a draft Biosolids Implementation Plan was developed. This digester project includes the objective of maintaining consistency with the recommendations of the Master Plan, which the City is currently in the process of reviewing and adopting. The recommendations of the Biosolids Implementation Plan that are directly relevant to this digester project include the following:

- Adopt a Biosolids Management Program that provides flexibility in implementation, operation, beneficial use/disposal, and incorporation of future technologies.
- Implement a phased rehabilitation of the existing mesophilic digesters.
- Implement improved thickening that increases the digester feed concentration from under 4 percent to 5 to 6 percent. This reduces the number of digesters needed, providing a significant amount of digester volume for imported material. Imported feedstocks could include FOG, food waste, and/or solids from other wastewater treatment plants.
- Provide flexibility to incorporate raw sludge pre-processing, thermal processing, on-site composting, dryers, and other future technologies into the biosolids program.
- Conduct pilot/demonstration projects for co-thickening in DAFTs, digestion processes, import materials, and digester mixing technologies.
- Explore and develop facilities for importing materials such as FOG, food and food processing wastes, raw solids from surrounding areas, and other import materials to enhance digester gas production.

This digester project provides flexibility in its implementation schedule and the ability to incorporate new pre-and post–digestion technologies in the future. It provides the first phase of rehabilitation for the mesophilic digesters along with recommendations for scheduling the follow-on phases. In addition, it includes final upgrades of the DAFTs to allow co-thickening and improving solids concentrations fed to the digesters. Finally, it provides upgrades to the digestion and gas systems to allow pilot testing and ultimately full implementation of FOG co-digestion.

1.4 Summary of Schedule and Costs

The estimated total project cost for the project elements described above is $61.7 million. The recommended schedule for design and construction of the various elements of this digester project is coordinated with pilot testing efforts recommended to refine design criteria and equipment selection. The schedule will allow for commissioning of gas manifold and tunnel upgrades, digester heating improvements, DAFT co-thickening upgrades, and potentially a chemical feed system for struvite control, all in 2013. Commissioning of the digester cover and mixing upgrades is scheduled for 2015.

Pilot testing of struvite chemicals, digester heating capacity, and the DAFT saturation system is scheduled for 2011. Pilot testing of co-digestion with low FOG load is scheduled to begin in 2012. Pilot testing of digester mixers is scheduled to start in 2015 after commissioning of the final digesters. Pilot testing of the high-load FOG co-digestion is scheduled to start in early 2015, following commissioning of initial two digester cover and mixing upgrades.

2. INTRODUCTION

TM 5.0 is the final of a series of TMs provided under Service Order No. 1 for the San Jose/Santa Clara WPCP FOG Program Evaluation and Enhancement Study, Pre-design Study of Digester Rehabilitation, Modifications and Gas Line Replacement, and Implementation Plan. The primary goal of Service Order No. 1 is to evaluate the 16 existing digesters and develop an implementation plan for digester modifications that rehabilitates digesters needed for reliable service through the 2030 planning period in a way that will not limit long-term options for future digestion processes that may be used at the WPCP. The number of digesters that will be modified will be determined based on the plan for future digestion processes and the selected digester active volume and loadings for this project. Initially, two of the digesters will be configured for full-scale pilot testing.

This TM (TM 5.0) serves as the project deliverable for Task 5 of Service Order No.1. The primary purposes of TM 5.0 are:

- to present a summary of recommendations from the previous TMs that were developed in Task 4;
- summarize results from the DAFT BCE from Task 7;
- provide a project description with discussion of miscellaneous project elements such as site grading and civil improvements, miscellaneous mechanical and electrical improvements, safety improvements, and constructability;
- and to provide a discussion of contract packaging alternatives and recommendations, a construction cost estimate, and a recommended project schedule.

The elements of the project description focus on those improvements necessary to provide reliable capacity through the design year 2030 without precluding viable future digestion process options evaluated in the San Jose/Santa Clara WPCP Master Plan.

Our approach on this project is to identify the physical modifications to the digesters necessary to either put them back in service, or keep them in service for the next 20 to 30 years, and to do so in such a way that the modifications can accommodate any process alternative forecasted or recommended by the Master Plan. A significant element of this approach is to plan for design of all individual digester elements and auxiliary systems based on the ultimate or maximum capacity of each digester vessel. This provides the most flexibility going forward. By upgrading the digesters in a phased approach and maximizing the capacity of each digester, the City can determine the ultimate number of digesters to be upgraded based on the results of the Master Plan and projections of alternate feedstock acceptance. A first phase of upgrading some of the digesters can proceed immediately to address reliability and performance issues without needing to decide on the ultimate number of digesters needed. The remaining volume, if any, is what is available for alternative feedstocks, such as FOG and food and food processing waste.

The following TMs are included as part of Service Order No. 1 and are summarized in this Implementation Plan:

- TM 3.3 – Design Criteria for Digester Modifications and Gas System Improvements
- TM 4.1 - Structural Evaluation, Corrosion Protection and Concrete Rehabilitation
- TM 4.2 - Cover and Mixing System Selection
- TM 4.3A – Digester Piping Gallery Ventilation and Drainage
- TM 4.3B – Digester Heating and Mechanical Modifications
- TM 4.4 – Gas Piping Connections/Modifications
- TM 4.5 – Electrical and Instrumentation/Control Systems
- TM 4.6 – Struvite Formation and Control
- TM 5.0 – Implementation Plan
- TM 7.1 – Dissolved Air Flotation Co-Thickening Alternatives Business Case Evaluation

Concurrently with the digester rehabilitation/modification pre-design study, a FOG Program Evaluation and Enhancement Study was completed in Task 2. The work product for Task 2 is a report, which includes discussion of

existing source control (FOG control) program; estimation of FOG waste volume; evaluation of FOG waste disposal practices; evaluation of alternate FOG waste disposal options; evaluation of current FOG outreach efforts; evaluation of FOG related grants and loans; final recommendations. In addition, under Task 6, FOG receiving requirements were addressed and a schematic FOG and other organic waste receiving facility schematic was prepared and incorporated in TM 3.3. The City is currently negotiating with a private FOG processing firm to design, build, and operate a pilot FOG receiving and digester feed station.

3. SUMMARY OF TECHNICAL MEMORANDA

A summary of the conclusions from the TMs addressing specific digestion criteria, components, and related systems that were prepared as a part of this project and that are relevant to the implementation plan are presented below.

3.1 TM 3.3 – Design Criteria for Digester Modifications and Gas System Improvements

The primary purpose of TM 3.3 was to define the design and operational criteria for future digester operation, including defining digester process configurations that are relevant for possible future implementation. Appropriate digestion alternatives are identified from the Master Plan and relevant criteria are developed for design, including the recommended loading rates and estimate digester performance. Historical data, computer modeling, and information from the Master Plan are used to develop the projected loadings for 2030 and the design criteria. The flow and load design basis considered the potential for a fully implemented program for importing co-digestion feedstocks, with FOG and plant scum and grease being the principal feedstocks assumed. Finally, design considerations for alternative feed stocks, such as FOG, are presented. In addition, this TM applies anticipated performance and projected gas production volumes for each of the Master Plan alternatives.

3.1.1 Existing Performance

The analysis included in TM 3.3 shows that the current digester mixing system has resulted in a significant loss of active volume. Upgrading the mixing system would restore active volume, allow for higher volatile solids (VS) loading, and more digester gas production. The current data collection is inadequate to reliably determine digester volatile solids loading. It is recommended that primary and secondary sludge sampling and gas and sludge flow measurement be improved. Based on data available and additional process modeling, we have concluded that the current volatile solids reduction (VSR) and gas production values are within range of typical municipal anaerobic digester processes. The current digester temperature varies depending on the time of year and between individual units. It is recommended that better temperature control be implemented to provide a more stable condition for the digesters.

At current peak sludge flow and load, nine digesters (existing volume) are required to meet the 15-day HRT criterion plus two redundant digesters. With higher volume digesters (see TM 4.2) fewer digesters would be required. For a period in 2010, the Plant operated successfully with 8 digesters on line. There is evidence that currently, active volume in a given digester may be greater with eight digesters operating than with eleven due to potentially better mixing from hydraulic load and higher VS load generating more gas in a given digester, which contributes to mixing.

3.1.2 Design Basis

The City is currently exploring proceeding with a demonstration FOG co-digestion program and it is likely that the WPCP will receive import materials in the future. It is recommended that the design basis that includes the design import materials is used for this project. Table 3-1 presents the design basis for 2030. It is possible to operate a digester at up to 30 percent of the VS loading originating from FOG import materials. It is recommended that upgraded digesters be designed for this condition.

Table 3-1 Design Basis for Primary and Secondary Sludge and Design Import Materials at 2030		
Parameter	**TS content, lb/d**	**VS Content, lb/d**
Primary Sludge Loading		
Annual Average	232,700	197,800
Peak Month	295,100	250,900
Peak 2 Week	326,500	277,500
Peak Week	338,300	287,600
Peak Day[a]	357,700	304,000
TWAS Loading		
Annual Average	144,600	108,200
Peak Month	202,700	151,600
Peak 2 Week	210,400	157,400
Peak Week	219,400	164,100
Import Materials	83,000	78,800
Combined		
Annual Average	460,300	384,800
Peak Month	580,800	481,200
Peak 2 Week	619,900	513,700
Peak Week	640,600	530,400
Peak Day	660,100	546,900

[a] Peak day loadings are calculated using peak day primary sludge production and peak week secondary sludge production. Peak week secondary sludge production is used because a peak day loading event would not impact secondary sludge production due to the long SRT (i.e. >6 days).

3.1.3 Preliminary Screening of Alternatives

Table 3-2 presents the number of digesters that would be necessary for each process option assuming new digesters were equipped with floating steel covers (same volume as current). The digester volume with the existing floating covers was used to calculate the number of digesters that would be necessary. It should be noted that after the cover evaluation (TM 4.2), it was determined that submerged concrete covers could be used that would provide greater capacity, requiring fewer digesters.

The Cambi™ process (primary and secondary sludge) would require the fewest number of digesters, but would require considerable and costly ancillary facilities for pretreatment that are commonly justified based on space constraints and reduced cost of building new digesters. Since there are no space constraints or cost benefit from new digester construction at the WPCP, designing for the Cambi™ process is not recommended.

The digesters that are rehabilitated will most likely be operated as mesophilic digesters in the near term. However, the gas systems should be designed to allow for series thermophilic operation in the future. This means that the gas system manifold would be sized for peak instantaneous gas flow rate for that process. The digesters that are rehabilitated should have sufficient heating for mesophilic conditions. However, the option to upgrade to thermophilic digestion in the future should be accommodated in the layout of process and heating piping.

Table 3-2. Summary of Digester Requirements in Design Year 2030 Including Design Import Materials[a,b]

Alternative	Sub-Alternatives	Feed Sludge, percent TS	Feed Sludge, percent VS	Max 2-week Flow, mgd	Max 1-week Flow, mgd	Min. HRT, d (1st Stage)	Min. HRT, d (2nd Stage)	Max. Org. Load, lb VS/cf/d	No. of 1st Stage Digesters (HRT Criterion)	No. of 2nd Stage Digesters (HRT Criterion)	No. of 1st Stage Digesters (VS Load Criterion)	Total	Total w/ Redundancy
Mesophilic	Complete Mix	3.5	2.9	2.12	2.19	15	---	0.20	11.0 (13.9)	---	6.9 (8.7)	11 (14)	14 (17)
Mesophilic	Complete Mix	5.5	4.6	1.35	1.40	15	---	0.20	7.0 (8.9)	---	6.9 (8.7)	7 (9)	9 (11)
Cambi™	WAS Only	6.5 [c]	5.4	1.14	1.18	15	---	0.25	5.9 (7.5)	---	5.5 (7.0)	6 (8)	8 (10)
Cambi™, [d]	Primary and WAS	9.5	7.8	0.72	0.75	12	---	0.50	3.0 (3.8)	---	2.5 (3.2)	3 (4)	4 (5)
Thermophilic	Complete Mix	5.5	4.6	1.35	1.40	15	---	0.35	7.0 (8.9)	---	3.9 (5.0)	7 (9)	9 (11)
Thermophilic	Series	5.5	4.6	1.35	1.40	8	7	0.35	3.7 (4.9)	3.3 (4.1)	3.9 (5.0)	7 (9)	9 (11)
Preprocessing w/ Mesophilic	Many	5.5	4.6	1.35	1.40	15	---	0.20	7.0 (8.9)	---	6.9 (8.7)	7 (9)	9 (11)

[a] Number of digesters based on 2.89-MG active volume of 110-foot diameter digesters equipped with submerged fixed covers; values in parentheses represent number of digesters if floating covers were retained (2.29-MG active volume)

[b] All first stage digesters are loaded with design flow and load of FOG, scum, and grease up to a maximum of 30 percent of VS load except Cambi™ to a maximum of 10 percent of VS load

[c] Combined concentration of Cambi™ WAS and primary sludge thickened in primary clarifiers

[d] Import materials represents 10 percent of average VS loading for Cambi™ (primary and WAS), only

3.1.4 Additional Considerations

The Master Plan recommends adding a new primary and secondary sludge fine screening facility. This project team concurs and supports this recommendation to further develop a sludge fine screening facility project. It is also recommended that the City determine the on-going ability to dampen diurnal peaks of solids loads within the liquid stream. Currently, secondary sludge is pumped relatively uniformly throughout the day based on an SRT control system. Primary sludge flows vary however. If dampening primary sludge flows within the primary sedimentation process is possible, the City should continue to optimize this practice. If this is not possible, thickened sludge equalization/blend tanks should be considered for sludge load equalization and blending.

3.2 TM 4.1 – Digester Structural Evaluation

The purpose of this TM was to discuss the results of the digester structural evaluation and to determine whether they are capable, either in their existing or modified state, of structurally accommodating steel, concrete, aluminum, or composite material fixed covers, including submerged and non-submerged fixed covers. The existing 16 digesters were evaluated by grouping them into three categories to conduct structural computer modeling. Results are also presented of a visual corrosion inspection of five digesters that are currently not in service.

The structural evaluation was completed on three different digesters (Digesters 1, 4, and 12) at various water surface elevations, internal gas pressures, and sludge temperatures. Digester 1 is representative of Digesters 1 through 3. Digester 4 is representative of Digesters 4 through 11 and Digester 12 is representative of Digesters 12 through 16.

Digesters 1 through 3 do not have any additional structural capacity to accommodate a new concrete fixed cover or to increase the current water surface elevation. Since these digesters are the oldest and smallest of the digesters and rehabilitation is cost prohibitive, Brown and Caldwell recommends that these digesters continue to operate at their original design water surface elevation. Digester 4 through 11 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires more rehabilitation than the non-submerged cover, because of the higher water surface elevation and weight of the cover. Digester 12 through 16 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires structural rehabilitation; while the non-submerged fixed cover scenario requires no structural rehabilitation.

Installation of submerged fixed covers would require that each digester have four concrete support columns, equally spaced inside the digester; the concrete columns will be supported on a new pile cap supported by drilled piers. In addition underpinning using micropiles would be necessary around the interior perimeter of the digester wall, unless a new geotechnical investigation indicates that the soil bearing capacity criterion can be increased from prior reports because of soil compaction.

The exterior concrete walls of the digesters above grade are in good condition and the tops of the walls appear to be in good structural condition for installing new fixed covers. The interior of the digesters can be coated to increase the life from 15 to 20 years (without coating) to 35 to 40 years (with coating). If the existing steel covers are re-used or if they remain in service for an extended period of time, they should be rehabilitated with an abrasive blast to near white metal, structural repair, and recoated with a high build epoxy coating system.

All digesters are equipped with pressure relief valves (PRV) in the bottom slab and some of the digesters are also equipped with under drainage systems. The PRVs and the under drainage systems have worked well based on the fact that none of the digesters have been damaged due to groundwater uplift pressures. BC recommends inspecting the PRVs during digester maintenance and unclogging valves as required.

3.3 TM 4.2 – Digester Cover and Mixing System Selection

The purpose of TM 4.2 was to evaluate cover and mixing alternatives for the WPCP digester upgrades. The TM compares steel, concrete, aluminum, and composite material cover types for submerged and non-submerged fixed covers and evaluates new floating covers and rehabilitation of the existing floating covers, including converting the floating covers to fixed covers for the existing 16 digesters. An important consideration of the cover selection and design is the type of mixing to be employed; and therefore, this TM also includes the evaluation of digester mixing alternatives. The need for digester mixing upgrades was addressed in TM 3.3. After screening alternatives, remaining options were evaluated in more detail with a cost benefit analysis of short-listed cover and mixing systems.

The covers shortlisted for the digester upgrades included submerged fixed concrete; standard, non-submerged fixed steel; and rehabilitated and replaced Downes-type floating covers. The mixing systems short-listed for the existing digesters included new gas mixing; internal (roof-mounted) mechanical draft tube (RDT) mixers; external pumped mixing; vortex ring/linear motion (LM) mixers; and focused flow mixers.

Although submerged fixed covers have a higher capital cost per digester compared to other alternatives, they require fewer digesters to be upgraded. The retrofits would increase the volume of each digester; therefore, the number of digesters needed is reduced by two for the design condition, from 11 to 9, inclusive of redundant digesters. Submerged fixed concrete covers have the lowest net present value of the alternatives, because of the reduced number of digesters required and the lower maintenance costs associated with new covers. Submerged fixed covers are the recommended cover technology for any new covers. The recommendation is made even stronger based on the fact that the submerged fixed covers will last considerably longer than other systems (whose replacement was assumed to be outside of the considered present worth time frame).

Digesters that are upgraded should have a new mixing system installed. If the City does not implement struvite mitigation measures as discussed in TM 4.6, confined gas mixing using draft tubes is the best apparent technology. Alternatively, RDT mixers could be pilot tested with the objective of determining the possible benefit of struvite mitigation in mixer design (such as draft tube lining and mixer coating with Kynar). If struvite mitigation measures are

implemented, RDT mixers could be implemented immediately without any pilot testing of mixing systems. Both the focused flow mixers and LM mixers could be less costly than either RDT or gas mixing, and potentially have less struvite buildup than RDT mixers. In addition, LM mixers have the potential for using less energy. It is recommended that the City consider pilot testing either or both of these technologies.

Currently, four existing digesters are recommended to be upgraded with two assigned as pilot digesters. We recommend installing submerged fixed concrete covers on all four of these digesters.

Brown and Caldwell recommends confined gas mixing be initially installed in the two non-pilot digesters. This provides the greatest assurance of success with respect to avoiding struvite formation. We recommend that one pilot digester be upgraded with RDT mixers that are designed with specific struvite mitigation measures, such as Kynar lining and coating. Further we recommend that the second pilot digester be designed with either focused flow or LM mixers. Of the two technologies, we believe that the focused flow mixers have a higher probability of success at the size of digester being upgraded for San Jose. However, the LM mixers, if successful, have a lower potential cost. The submerged fixed concrete covers could be designed so that RDT mixers, focused flow mixers, LM mixers, and confined gas mixing could be accommodated with appropriate cover access and mixer mounting requirements. This would allow the City some flexibility in pilot testing within two tanks with submerged fixed cover retrofits.

3.4 TM 4.3A – Digester Piping and Tunnel Ventilation

TM 4.3A evaluates the adequacy of the existing ventilation system and piping within the existing digester piping tunnel. The digester piping tunnels contain sludge gas piping, natural gas piping, and fuel oil piping. These tunnels are not physically separated from the other tunnels in the plant-wide tunnel system that also contain hazardous substances, nor from the MCC room near Digester 10. The existing ventilation system and other conditions are not sufficient to exempt these spaces from being classified by NFPA 820 as Class I Division I hazardous areas based on explosion potential. In addition, most of the electrical equipment in the area is not rated for use in areas with this classification and, for this reason, the WPCP tunnels do not conform to the National Electrical Code (NEC). Brown and Caldwell recommends declassifying the digester piping tunnels by removing all hazardous fluid piping from the digester piping tunnels; constructing physical barriers between the digester tunnels, the MCC room, and the other connecting tunnels; and completing modifications to move ventilation intakes away from classified areas next to the digesters. Do to the hazardous nature of the current operation, Brown and Caldwell recommends proceeding with these improvements as soon as practical. In the mean time we recommend that the City's safety engineer establishes and monitors safe operating practices for the tunnels until such time as the modifications can be made.

3.5 TM 4.3B – Digester Heating Modifications

TM 4.3B evaluates the existing facilities and operational data, and identifies and recommends improvements to the heating system for both mesophilic and thermophilic digestion process options. The digester heating system has been noted by operations staff as a significant problem. Reported difficulties include maintaining digester temperatures throughout the complex.

Review of the operation of the existing heat distribution system revealed limitations in the hydraulic operation and configuration of the system. The system operates in an unbalanced configuration and the control capability of three-way valve heat controllers is non-functional. Brown and Caldwell recommend implementing an automatic flow rate controller configuration at each digester load circuit location. Brown and Caldwell also recommend replacing the hydronic distribution pumps in the Blower Building in order to provide equipment more closely matched to the flow and pressure characteristics of the hydronic system.

In general, the existing digester heating components appear to be adequately sized to serve future sludge loadings for mesophilic digestion scenarios. However, if submerged fixed covers are installed, the existing heat exchangers may not be sufficient and additional capacity may be necessary; therefore, a pilot test is recommended to assess capability of the heat exchangers with higher hot water temperatures. Thermophilic scenarios significantly increase the requirements for heat exchanger and hydronic distribution capacity. If thermophilic operation capability is designated

for a future phase of digestion improvements, existing systems can be designed to optimize for mesophilic requirements, while at the same time preserving the capability to easily convert to thermophilic operation at some future time.

In order to optimize sludge digestion heating systems (and processes) in the future, Brown and Caldwell recommends implementing diurnal sludge equalization and blending system (blended sludge storage tank or equivalent) with a continuous digester feeding system that feeds all digesters simultaneously and proportionally based on individual digester volume.

3.6 TM 4.4 – Gas Piping System Connections and Modifications

The objective of TM 4.4 was to address the modifications needed for upgrading the existing low-pressure gas system around the digesters to meet projected future gas flows, provide safe and reliable service, and provision for connecting the gas system to new or renovated digester covers. Using the design gas flows in TM 3.3, several future operating conditions were used to determine gas flow projections. The range of gas flows was used to perform a sensitivity analysis of the required lateral pipe size that would be necessary over the range of possible scenarios. In addition, the projected gas flows were used to determine the size of a new gas manifold.

The gas system piping and cover protection equipment are inadequate for 2030 design-year operating scenarios. Only the waste gas flares have adequate capacity for the predicted design flows. For digesters with new or rehabilitated covers, new redundant PRV and flame arrester assemblies are recommended. For Digesters 4 to 16, 16-inch diameter laterals are recommended. All new laterals should have an isolation valve at the digester cover and a flow meter. For digesters that are not upgraded, new redundant PRVs and flame arresters should be installed. The manual condensate drip traps should be replaced with automatic barometric traps and condensation removal should be provided at all low points.

A new gas manifold is required for future gas flows. A dual-pipe system with two, 30-inch pipes is recommended for the gas manifold piping to cogeneration facilities and gas storage for the design condition. Initially, only one 30-inch pipe could be constructed, with a second line added in the future as sludge and FOG loads increase. This preserves the ability to recheck and validate the size of the second manifold line in the future when future load conditions become better known. There are also two, 24-inch gas manifold branch lines to specific digester areas that connect to the main manifold pipes. Eventually, these may also need to be dual pipes as well; for the interim, each branch line would consist of one pipe. All pipes should be located above ground in a pipe rack system as shown in Figure 3-1.

It should be noted that these recommended lateral and manifold sizes are conservatively large as they are based on the assumptions that the system will continue to operate at the current digester gas pressure and that future gas volumes will be increased by high FOG loads to the digesters. The submerged fixed cover will allow higher operating pressures and there is an opportunity to downsize gas piping with alternative, less conservative assumptions. Optimization of gas piping sizes should be conducted in the early phases of detailed design, including consideration of any updated information on the future and timing of the FOG co-digestion program.

3.7 TM 4.5 – Existing Electrical Evaluation

This TM estimates the power requirements based on existing power demand and the proposed new equipment (e.g. mixing, heating, etc.) based on the results of TMs 4.2, 4.3, and 4.4. The existing electrical equipment in the digester area is also reviewed. Recommendations for replacement of electrical equipment, if required, are made including motor control centers (MCCs), conduit, and wire in conjunction with modifications to the 16 existing digesters.

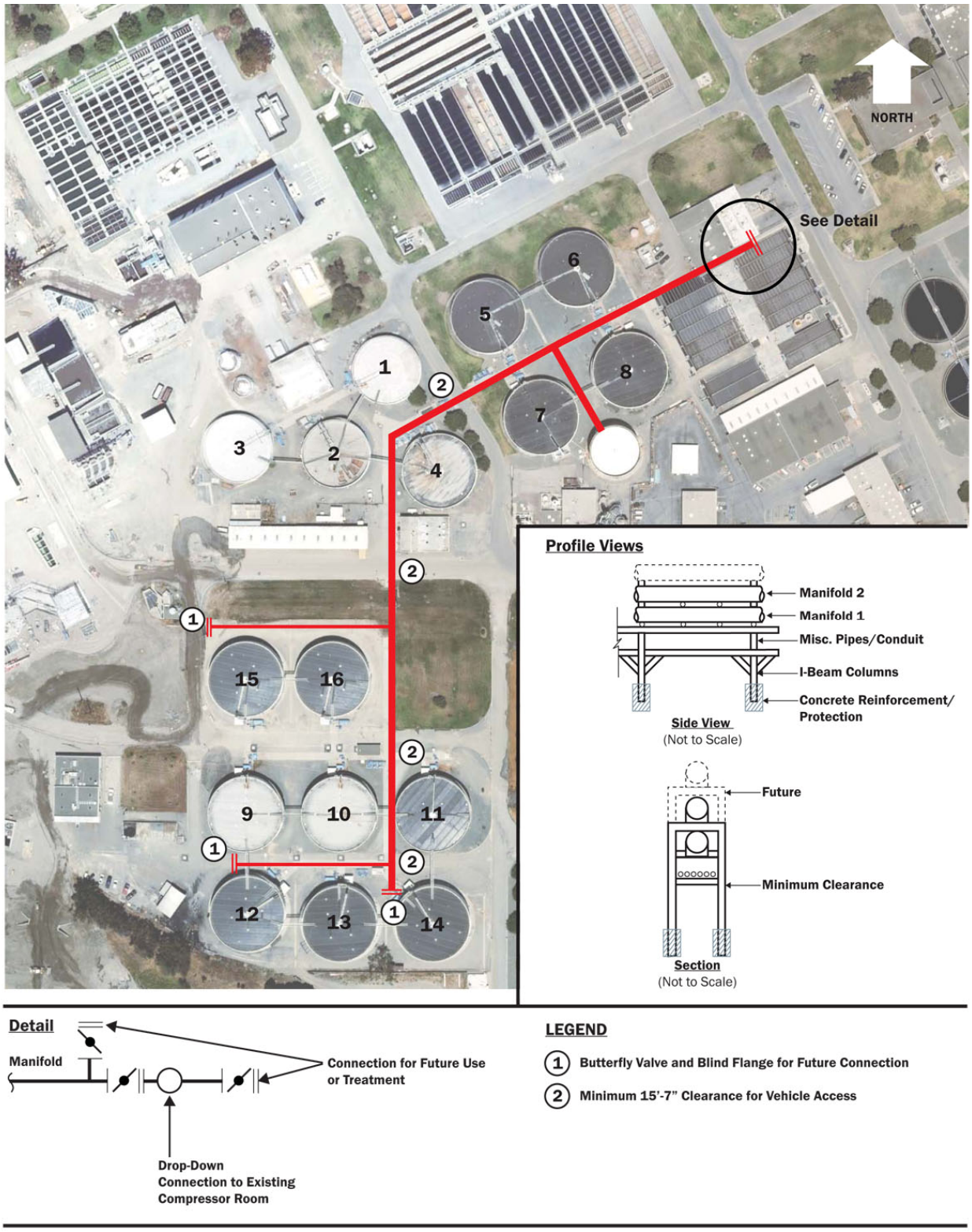

Figure 3-1. Above ground gas manifold alignment.

3.8 TM 4.6 – Struvite Formation and Control

Water chemistry modeling was performed using data from two separate sampling events. Data collected during the sampling events indicated high levels of magnesium, phosphorus and ammonia in the digester feed, digested sludge and lagoon supernatant. The average magnesium concentration in plant influent wastewater was more than twice the concentration of the drinking water concentration. Plant influent phosphorus concentration was also higher than average for municipal wastewater.

Several alternatives that could be implemented to mitigate struvite formation were evaluated using the water chemistry model. An alternative analysis was performed which involved a preliminary screening of viable alternatives. A cost estimate was performed on the alternatives that were identified to be viable solutions for full-scale implementation. In terms of present worth, addition of anti-scaling chemicals is the lowest cost alternative and has a comparable present worth to current costs associated with struvite. However, anti-scaling chemicals are not commonly added directly to anaerobic digesters, and may not work. Bench-scale and full-scale trials would be necessary to confirm anti-scaling chemicals as a viable solution. The other alternatives were significantly more expensive in terms of present worth value. Ferric chloride ($FeCl_3$) addition upstream of the primary clarifiers is the only alternative that would increase liquid stream secondary capacity and would reduce hydrogen sulfide (H_2S) in the digester gas. If anti-scaling chemicals are concluded to be inadequate for struvite prevention, we recommend that $FeCl_3$ is considered for full-scale implementation. However, continuous $FeCl_3$ could form excessive vivianite formation in the digester recirculation system and heat exchangers. If $FeCl_3$ is implemented, we recommend frequent inspection of digester recirculation piping and heat exchangers.

3.9 TM 7.1 – DAF Co-Thickening Business Case Evaluation

The primary purpose of TM 7.1 was to evaluate upgrading the existing DAFT system operation through the use of polymer and through simultaneously co-thickening both primary and secondary sludge, and to recommend a DAFT alternative based on a BCE process.

Based on pilot testing conducted by the WPCP staff and operations from across the industry, Brown and Caldwell recommends assuming an average co-thickening DAFT solids loading rate of 50 pounds per day per square foot (ppd/sq ft) for this evaluation. This loading rate is viewed as being conservative, given the higher, more aggressive range of loadings than traditional that are now being discussed and tested in the industry. Testing and future experience may allow taking advantage of even higher loading rates. Current peak day conditions can be accommodated with just 5 tanks under this loading criterion.

The alternatives in the BCE included:

- Alternative 1 – Thickening status-quo. No upgrades or changes to the thickening facilities are included in this alternative. There is no reduction in required digester volume.
- Alternative 2 – Status-quo with polymer. No modifications to primary sludge thickening facilities are included but polymer facilities are added to the DAFT area. There is some reduction in required digester volume due the improvements in WAS thickening performance.
- Alternative 3 – Co-thickening without odor control - Modifications to the DAFT area are included to allow for co-thickening. There is a reduction in required digester volume due the improvement in thickening performance.
- Alternative 4 – Co-thickening with odor control - Modifications to the DAFT area are included to allow for co-thickening and odor containment and treatment. There is a reduction in required digester volume due the improvement in thickening performance. There are two sub alternatives in Alternative 4.
- Alternative 4a includes odor containment and stack discharge only.
- Alternative 4b includes odor containment and treatment.

In all alternatives, digester upgrades are necessary at the level required to support associated 15-day HRT for maximum two-week flows. By improved thickening, the number of digesters requiring modification is reduced and this results in a net cost benefit to the City.

The results from the net present value analysis showed that there are economic benefits to improvements in thickening. By simply adding polymer to existing WAS thickening, multiple digesters can be eliminated from service. Further upgrading the system to co-thickening brings additional benefit in cost savings. Within the three co-thickening alternatives, the one with no odor control brings the highest benefit. However, this alternative also bears the highest odor risk. Based on the results of the BCE, Brown and Caldwell recommend Alterative 4b. This alternative maximizes the cost savings while minimizing the odor risk.

4. PROJECT DESCRIPTION

The project elements are identified in this section and discussion is provided relevant to site grading and civil requirements, constructability, and safety considerations. The detailed description of how each project element is grouped into construction contracts is presented in Section 6.

4.1 Recommended Project Elements

The project elements can be categorized as: gas piping and tunnel ventilation modifications; digester upgrades; improvements to digesters that are not upgraded; DAFT modifications; heating improvements; and improvements to mitigate struvite formation. These elements are further described below:

4.1.1 Gas Piping and Tunnel Ventilation Modifications

The existing digester tunnels have been determined to not meet NFPA 820 classification requirements and as such are considered an explosion hazard. As such, these modifications are considered to be the most urgent of the project and are identified independently from other modifications.

The gas piping and tunnel ventilation modification include the following elements:

- Construct above ground pipe rack system suitable for two, 30-inch digester gas manifold pipes;
- Install one, 30-inch manifold pipe that would connect to all digester gas manifolds;
- Install two, 24-inch branch line manifold pipes that would connect to the gas manifold;
- Relocate flammable and hazardous material piping from the piping tunnel to the pipe rack;
- Seal access from digester tunnel to other classified tunnels;
- Relocate ventilation intakes that are closer than 10 feet from digester walls or other gas appliances.

It should be noted that these recommended manifold are sized conservatively as they are based on the assumptions that the system will continue to operate at the current digester gas pressure and that future gas volumes will be increased by high FOG loads to the digesters. The submerged fixed cover will allow higher operating pressures and there is an opportunity to downsize gas piping with alternative, less conservative assumptions. Optimization of gas piping sizes should be conducted in the early phases of detailed design, including consideration of any updated information on the future and timing of the FOG co-digestion program. In addition, the City has expressed interest in having an artist develop layouts and arrangements of the overhead pipe rack system for digester gas, natural gas and fuel oil piping racks.

4.1.2 Upgraded Digesters

Although nine digesters are required to be upgraded by 2030 with submerged fixed covers, the City has decided to begin with upgrading four initially. This decision was made considering City budget limitations, the desire to pilot test some digester features (mixing) before committing to upgrades on all nine, and the dependence on development of an uncertain FOG collection and co-digestion program in the near term, limiting digester loads and gas production. In addition, future upgrades will require initial upgrades to be operational to assure sufficient available digestion capacity at all times. Digesters 5, 6, 7, and 8 were selected for the initial four digesters to be upgraded. This considered that three of these four are already off line due to corroded covers. Upgrades will return these digesters to availability. In addition, these four digesters are close to the DAFTs, making testing of co-thickening and initial implementation of dedicated co-thickened sludge feed to upgraded digesters an easier task.

The upgrading of digesters 5, 6, 7, and 8 include the following elements:

- Replace existing floating covers with concrete, submerged fixed covers;
- Install micropiles to support columns and foundation;
- Install dedicated feed pumps (1 duty/1 standby);

- Replace existing gas mixing system with new mixers;
- Replace existing 10-inch hose lateral piping with 16-inch stainless steel lateral piping;
- Construct redundant PRV and flame arrester assemblies;
- Install new condensate tanks;
- Internal coating system.

Brown and Caldwell recommends confined gas mixing be initially installed in the two non-pilot digesters. This provides the greatest assurance of success with respect to avoiding struvite formation. We recommend that one pilot digester be upgraded with RDT mixers that are designed with specific struvite mitigation measures, such as Kynar lining and coating. Further we recommend that the second pilot digester be designed with either focused flow or LM mixers. Of the two technologies, we believe that the focused flow mixers have a higher probability of success at the size of digester being upgraded for San Jose. However, the LM mixers, if successful, have a lower potential cost. The submerged fixed concrete covers could be designed so that RDT mixers, focused flow mixers, LM mixers, and confined gas mixing could be accommodated with appropriate cover access and mixer mounting requirements. This would allow the City some flexibility in pilot testing within two tanks with submerged fixed cover retrofits.

Similar to the manifold sizing, the recommended lateral sizes are conservatively large as they are based on the assumptions that the system will continue to operate at the current digester gas pressure and that future gas volumes will be increased by high FOG loads to the digesters. The submerged fixed cover will allow higher operating pressures and there is an opportunity to downsize gas piping with alternative, less conservative assumptions. Optimization of gas piping sizes should be conducted in the early phases of detailed design.

4.1.3 Digesters That Are Not Upgraded but Will Remain In Operation

Digesters that are not upgraded but will remain in operation require the following gas lateral upgrades:

- Install new 16 inch gas lateral to new above-ground manifold (Note: this lateral size could be reduced until such time as these digesters are upgraded. In addition lateral sizing optimization during detailed design may allow smaller lateral size.)
- Install redundant PRV and flame arrester assemblies;
- Replace manual condensate drip traps with automatic barometric traps;
- Install condensation removal at all low points.

4.1.4 DAFT Modifications

The DAFT modifications involve the upgrade of six DAFT units and will include the following elements:

- New feed pumps;
- New float pumps;
- Retrofits for a blend tank system;
- New polymer system;
- Saturation system upgrades;
- Piping modifications associated with all upgrades;
- Aluminum covers for upgraded DAFT tanks;
- Piping and associated pumps and fittings to route thickened sludge directly to Digesters 5, 6, 7 and 8;
- Fans, foul air ducting, and treatment system(s) for odor control;
- During modifications of the DAFT tanks, a temporary polymer addition system to enhance solids sludge thickening and solids capture should be considered;
- Perform DAFT saturation testing;

- Provide recommendations for analysis of viable alternative saturation devices;
- Perform an analysis of results of additional testing to confirm co-thickening design criteria.

The existing equipment, sludge collectors, concrete surfaces of the DAFT tanks, and other components and related equipment were not thoroughly inspected as part of this project. Therefore, as part of the 10 percent design phase for the new DAFT improvements, the existing DAFT facilities, structures, equipment, and appurtenances should be assessed. Following this condition assessment, a recommendation shall be made to the City on potential modifications to aging DAFT facilities, structures, equipment, piping, valving, and other appurtenances. The City will then make decisions based on this recommendation as to how to proceed. The chosen direction may be incorporated into the Digester and DAFT Upgrades/Modifications Project.

4.1.5 DAFT Odor Control Assessment

A project memorandum associated with the Plant Master Plan (PMP) recommended a two-stage odor control system for the DAFT: packed tower chemical scrubbers followed by activated carbon adsorption. This two-stage system was selected for the final version of the PMP to address potential future non-methane hydrocarbon (NMHC) air emission regulations, given an assumption that the two-stage system described above would provide better treatment of NMHC emissions than a single-stage bulk media biofilter.

After further review of the odor control options for the upgraded DAFT system, the following conclusions and steps to be taken prior to final design of the DAFT odor control system have been identified:

- The two-stage odor control system recommended in the final version of the PMP (packed tower chemical scrubbing followed by activated carbon) would be a fairly costly option based on a life-cycle cost estimate made as part of the PMP. The higher cost is associated with increased operation and maintenance attention associated with a two-stage system, cost of chemicals, higher power requirements, and other factors.
- A single-stage bulk media biofilter would be a less costly option based upon the same life-cycle cost estimate referred to above. However, this option would not be able to fully address potential future NMHC regulations, even with the most advanced internal components incorporated into the biofilter design.
- It is possible to design bulk media biofilters such that they could be retrofitted in the future by installing covers, an additional (or upgraded) exhaust fan, and a second stage of activated carbon so as to address potential future NMHC regulations, if required.
- The design of the DAFT modifications should evaluate the potential viable odor control alternatives and make a recommendation to the City as to which alternative should be implemented. Alternatives to be included shall be the following: (1) Packed tower chemical scrubbers followed by activated carbon adsorption (two-stage system), (2) Bulk media biofilter (single-stage system), and (3) Bioscrubber followed by activated carbon adsorption (two-stage system).
- The City shall make a decision relative to the selected course of action, based on the analysis of the three odor control alternatives described above and associated recommendations.
- The DAFT upgrade odor control design shall incorporate the City's decision, and if a single stage system such as bulk media biofilter is chosen, should include provisions for future additions of covers, an additional or upgraded fan, and second stage of odor treatment.

This odor control assessment should be incorporated into the project elements for this work, and shouldbe completed prior to detailed design of the new DAFT odor control system.

4.1.6 Heating Improvements

Heating improvements include the following elements:

- Install individual flow controllers at each digester load circuit;
- Remove flow restriction orifices in the common pipes of each load circuit;
- Replace the hydronic distribution pumps to match flow and head requirements

4.1.7 Improvements to Mitigate Struvite

Improvements to mitigate struvite formation include the following elements:

- Install chemical metering pumps;
- Install chemical storage tank.

In addition, any new sludge piping will use long radius, smooth lined elbows. Also, piloting of RDT mixers with smooth liners and coatings is recommended id struvite control chemicals are not proven effective.

4.2 Site Grading and Civil

The 2007 Condition Assessment report by CH2M Hill evaluated and recommended grading, pavement, and hardscaping improvements. The following summarizes the evaluation and provides recommended improvements:

Digesters 1, 2, and 3

- The grading, pavement, and hardscaping in the area of Digesters 1, 2, and 3 is in fair condition.
- Ponding of water and drainage toward structures was noted.
- Recommendation: If digesters are upgraded, modify grading and pavement to remove ponding.

Digester 4

- The area is subject to ponding,
- An underground vault is subject to flooding.
- Hardscaping is significantly damaged by burrowing animals and settlement.
- Recommendation**:** If digester is upgraded, modify grading and pavement to remove ponding, slope area away from vault to prevent vault flooding, and repair damaged hardscaping from burrowing animals and settlement.

Digesters 5, 6, 7, and 8

- Grading, pavement, and hardscaping are in fair condition.
- Ponding of water and drainage toward structures were noted.
- Recommendation: When digesters are upgraded, modify grading and pavement to remove ponding.

Digesters 9, 10, and 11

- Grading, pavement, and hardscaping are in good condition.
- Nuisance ponding of water and drainage toward structures was noted.
- Recommendation: When digesters are upgraded, modify grading and pavement to remove ponding.

Digesters 12, 13, 14, 15, and 16

- Grading and drainage are generally flat, and electrical vaults are prone to flooding.
- Hardscaping and gutters are in good condition.
- Paving is significantly degraded.
- Recommendation: When digesters are upgraded, modify grading and pavement to remove ponding, flooding of vaults, and repair pavement that is degraded.

Digesters 5 through 8 are recommended for upgrading and significant damage will occur to paving during construction of this project. Modification of grading, if necessary, and repaving to eliminate ponding in this area is recommended. Areas around other digesters are not severe enough to warrant repaving at this time, unless damaged by during this construction project.

4.3 Safety Considerations

4.3.1 Explosion Hazard Prevention

Design features for the digesters that will be provided to protect against potential digester gas explosion hazards include:

- Appropriate NFPA 820 classification of areas around digesters, with required classified equipment, such as explosion proof motors in Class I Division 1 areas (i.e. on top or next to digesters, etc.).
- Physical separation of digester gas pipes onto an outdoor overhead pipe rack and equipment (gas sediment traps, boilers, etc.) from other equipment, to limit potential for sparks in high risk areas.
- Air monitoring for lower explosive limit in areas where digester gas could concentrate, in order to detect methane gas leaks.
- Air flow switch in any ventilation systems for classified areas to detect failure of ventilation systems.
- Flame arrestors on PRVs to protect the digesters from ignition during venting.
- Digestion tanks designed with gas dome purge connections to allow maintenance staff to purge digester headspace with nitrogen or other inert gas during tank filling and emptying.

4.3.2 High Pressure or Vacuum Hazard Prevention

In general, overpressure hazards can be prevented by ensuring that gas or liquid can exit the digester before tank pressures exceed the design pressure of the structure, and by control interlocks that can stop or relieve the source of over-pressurization. Vacuum hazard can be prevented by ensuring that gas can enter the digester when a vacuum is created, and by appropriate control interlocks.

4.3.3 Instrumentation and Control Safety Features

This section summarizes the instrumentation and control requirements for the construction contracts. Fail-safe operational philosophies and soft sensors will be incorporated into the control narratives.

4.3.3.1 Gas Pressure

- Gas pressure sensors will be installed in the gas dome of each digester and in the common digester gas header at the digester gas piping interconnects of all digesters. This design provides instrumentation redundancy and reliability.
- A high gas pressure would trigger the shut down of all digester feed, transfer, and sludge circulation pumps capable of pumping to the digester.
- A low gas pressure would trigger the shut down of all withdrawal, transfer, and sludge circulation pumps capable of pumping from the digester.
- An interlock will prevent associated feed and withdrawal pumps and all transfer and circulation sludge pumps from operating if a pressure signal from a tank is not present.

4.3.3.2 Liquid Level

- Digester liquid level measurements will be provided by two pressure-based sensors and a radar level sensor. The liquid level sensors are differential pressure sensors that compensate for gas pressure and provide analog signals. The two digester level sensors are mounted on the digester side wall near the bottom and located on opposite sides of the digesters. The radar sensor is located on the top of the digester to detect surface level.
- A high liquid level switch, providing a discrete signal, will be installed in each digester gas dome.
- Normal operation would be within a fixed liquid level band, and deviation from that level band would trigger a warning.

- A low liquid level reading on one of the two digester level sensors would shutdown the bottom withdrawal pump and the sludge circulation pumps for the respective digester. This interlock could be overridden during tank draining events. Note that if the pressure was to drop below the low pressure set point, the pumps would shut off from the gas pressure interlock described above.
- At above normal high liquid level, three analog signals (from the pressure based liquid level sensors), and two discrete signals (from the switch and radar level sensor) will be available to the process logic controller (PLC). In order to prevent false alarms triggering an unnecessary shut down of the pumps, the control strategy could be based on having two of the three analog signals out of the normal range before triggering the shut down procedure. The discrete high level switch would initiate shutdown on its own.
- The pressure-based level sensors could fail to provide an accurate measurement if the valve between the tank and the sensor was inadvertently closed. A position switch could be installed on the valve to identify an inadvertently closed valve.

4.3.4 Mechanical Safety Features

- Condensate traps in gas piping low spots will be sized conservatively to prevent moisture accumulation from plugging gas piping.
- Foam prevention to avoid entrainment in gas piping is achieved by the submerged fixed cover via constant confined surface sludge withdrawal and gas dome recirculation sludge pumping. In addition, foam generation is minimized by a well-designed heating system, the ability to adjust mixing energy with mixer variable frequency drives (VFDs), and the ability to feed the digester at uniform load.
- Gas piping outlet will be positioned at the highest point of the gas dome.
- Dual gas PRVs will be provided for each digester to ensure that gas is released to the atmosphere if the pressure rises above the high pressure set point or that air is allowed into the tank if the pressure drops below the low pressure set point. These valves operate based on a counterweight system and do not rely on instrumentation or other powered control. Three-way isolation valves are used on the dual relief valve assemblies permitting one of the two to be operational at any point in time, but assuring that both cannot be isolated from use at any time. A pressure/vacuum relief open alarm sensor will be provided.
- An emergency overflow system will utilize a double u-tube trap system for redundancy—one trap can be cleaned while the other is functional. The emergency overflow system is piped to discharge to an overflow location with no valves installed in the line. The overflow is sized to accommodate gravity transfer of flows in excess of the maximum feed or transfer flow rates. The emergency overflow is normally designed for liquid removal only, with the trap water column greater than the digesters gas pressure rating. However the drain system is properly vented to assure gas is appropriately handled if it does enter the drain system. The emergency overflow does not rely on instrumentation, pumps, or other powered control.
- A final pressure relief device that includes a hatch that is counterweighted specifically to open at a high pressure setpoint above that of the gas pressure relief valve, thus allowing gas or liquid to exit the digester after all other pressure relief mechanisms have failed will be installed.

4.3.5 Structural Safety Features

- The resistance to positive or negative pressure, gravity, and seismic loads, will be developed using all of the structural elements including wall, roof slab, columns, piers, and micropiles, and footings. The liquid and gas pressures result in hoop tensile stresses in the wall that are resisted by the hoop reinforcing in the wall. The roof slab resists upward pressure through concrete mass.
- The roof slab will be designed with two mats of fully developed reinforcing.

4.4 Constructability

There are a number of constructability issues for the recommended project, which are discussed below:

- Consideration should be given to position the mobilization areas for multiple construction contractors at the WPCP site.
- The upgraded digesters will be fitted with new submerged fixed concrete covers. This will require that the existing covers be removed and there be sufficient lay down area adjacent to the digesters for setting the cranes and putting down the existing covers for demolition. If there is not enough space to put the digester covers down, the Contractor will have to partially demolish the cover in place and the digester floor will need to be protected from falling debris.
- The new submerged fixed concrete covers will be supported by the existing digester walls and by new columns that will be located inside the digester. The columns are required to carry the majority of the cover weight to minimize extensive retrofitting of the digester wall footings. Based on previous geotechnical investigation reports, the soils around the digesters have insufficient strength to support column footings and the columns will need to be founded on a deep foundation system such as drilled piers. The pier drilling rig will need to be mobilized by a large crane placed outside the digester.
- The construction of the new submerged fixed concrete cover will require formwork and shoring. The shoring system will need to be designed such that pressure exerted on the digester floor slab does not exceed the slab and soil capacities. The cover can be poured monolithically, in half, or in quadrants. The fewer the construction joints the lower potential for leakage but the higher potential for shrinkage cracking. To minimize shrinkage cracking the concrete cover can be designed as a pre-stressed concrete structure or shrinkage compensating admixtures can be added to the concrete mix design. A monolithic pour requires a major coordination with concrete supplier and pumping requirements.
- The upgraded digesters will have a larger capacity than the existing digesters. The additional liquid weight and the new concrete cover weight increase the wall footing bearing pressure. Therefore, underpinning around the interior perimeter of the digester wall will be required. Underpinning can be achieved by using micropiles or minipiles, which are less disruptive than piles or drilled piers because of the small equipment required to install the piles. Underpinning may not be required if a new geotechnical investigation indicates that the soil bearing capacity criterion can be increased because of soil compaction.
- The replacement of the existing digesters access manways with larger manways will require modification of the existing pre-stressing rods on the outside face of the digesters walls. The process is delicate since these rods are tensioned with large forces and the snap of any rod may cause material damage and/or personnel injuries. Typical procedures for installing new manways on post-tensioned tanks require either jacking apart the rods or installing new spreader bars to maintain the support of existing post tensioning. This type of work has to be done by experienced and qualified contractors.
- The increased capacity of the new digester will require hoop strengthening of the existing digester walls. The strengthening can be accomplished by adding post-tensioning monostrands over the length of the wall requiring strengthening. Two layers of sheathing protect the monostrands, but a layer of shotcrete over the monostrands is recommended for added protection, aesthetics, and insulation value.
- To maintain operation of the digestion process, construction needs to commence in a manner that minimizes the number and duration of any digester outages. With four digesters undergoing major rehabilitation, the construction should be staged so that the time that all four are off line is minimized. This can include a construction schedule that leaves two available for operation while the first two undergo all structural modifications. This sequencing also has the benefit of staging scaffolding and other structural equipment and crews. For modifications to all digesters not undergoing extensive rehabilitation (e.g. gas lateral and heating system modifications) construction should take place so that no more than one digester is off line for these modifications at any one time.
- The pipe rack system may be constructed by a different contractor than the one installing the new digester gas laterals. Therefore, construction schedules will need to be coordinated between contractors where appropriate.

5. PILOT TESTING PROGRAM

There are several pilot projects discussed in the various TMs that would provide valuable information to the City. The City intends to utilize or pilot test facilities with a definite chance of success and to avoid experimenting with the equipment having little or no chance for success. Data gathered from these projects would provide site specific information that could potentially reduce construction and/or operations and maintenance costs.

5.1 Struvite Mitigation

Struvite has been identified as a significant issue at the WPCP. The alternative evaluation performed as a part of TM 4.6 identified the lowest net present value alternative to be adding anti-scaling chemicals to the digesters. However, anti-scaling chemicals are not commonly added directly to anaerobic digesters, and may not work. Bench-scale and full-scale trials are recommended to confirm that anti-scaling chemicals are a viable solution.

5.2 Digester Heating

The existing heat exchangers may not be sufficient for the rehabilitated digesters because the total digester volume will increase, resulting in a higher load and heating requirement for each digester. The capacity of the existing heat exchangers can be evaluated by a pilot test to determine if the heat exchangers would need to be replaced or a second one added. This testing would involve increasing the hot water temperature from 160 degrees F to 180 degrees F and measuring the heat output from the heat exchangers. It is recommended that the heat exchangers are tested before beginning of the design phase to assure their ability to handle required heat

5.3 DAFT Co-Thickening

The benefits of co-thickening depend on the performance of the DAFT system. A well performing DAFT will maximize float concentration, minimize underflow concentration, and minimize power consumption. The underflow concentration and the power consumption depend heavily on the air-to-solids ratio and the efficiency of the saturation system. The ability to thicken float depends on the sludge itself, the SVI, and the operation of the float collection system. Most parameters that control performance of the co-thickening DAFTs are operational adjustments that do not require pilot testing; they can be tested and adjusted for optimization when the full scale system comes on line. These include such things as polymer type and dose, float scrapper speed, sludge load, and air-to-solids ratio.

One system that would require pilot testing is an innovative saturation system that has the potential for reducing energy input by as much as 65 percent. DAFT systems operate by the precipitation of air that has been dissolved at high pressure. Typically, pressures in DAFT saturation systems may be from 50 psi to 80 psi. The energy expended in DAFT systems arises principally from the pressurization pump that lifts recycled water from essentially atmospheric pressure, to saturation pressure. Therefore, the pumping head of these pumps can be from 125 ft to 200 ft.

Recognizing the significant amount of energy expended for waste sludge thickening by conventional DAFT systems, the concept introduced in TM 7.1 is to significantly reduce the pumping energy for saturation by recycling water under pressure, but having the suction and discharge sides of the pump at essentially the same pressure. The concept involves two interconnected loops, operated intermittently. During an initial cycle, the first loop operates under pressure and water is cycled around the loop with a retention vessel and compressed air injection. After saturation, a switchover allows the pump to convey and displace the pressure-saturated water in the loop to the DAFT unit. Since this concept has not been installed to date at full scale, pilot testing is recommended to prove the concept prior to full scale design.

5.4 FOG Digestion

In preparation for a fully implemented FOG digestion program, the City would benefit from a pilot study to determine the gas production and VSR possible with FOG addition. The City is currently in negotiations with a private FOG handler to construct and operate a pilot FOG receiving and digester feed facility. The gas production and VSR can be measured to determine both the additional VSR possible with co-digestion and the specific gas production of FOG. In addition, the maximum FOG loading that is possible while preventing digester upset can be determined. These data will provide the City with information to estimate additional revenue possible from FOG digestion because of increased gas production.

Once the heating improvements are completed, one or potentially more digesters can be fed with FOG to determine process performance. At this condition, the FOG loading should not exceed 3,000 to 9,000 gallons per day. After mixing upgrades are completed on the pilot digesters (No. 5 or 6), the VS associated with FOG can be up to 30 percent of the annual average VS loading.

5.5 Digester Mixing

The digester mixing technology that was selected for full-scale implementation includes installing gas lances inside draft tube assemblies lined with Kynar or similar material (inside only). This gas lance draft tube technology was selected because evidence at other full-scale facilities suggests that this application will have minimal impact from struvite. However, LM mixers were shown in TM 4.2 to potentially have the lowest net present value. There is uncertainty whether or not these mixers are able to keep grit in suspension, which is a primary objective in digester mixing, and if they will be impacted by struvite. If this technology is successful, it would represent a significant cost savings. If the City chooses to investigate these technologies further, a pilot test is recommended.

Another benefit of a pilot study would be to determine if struvite would be an issue with RDT mixers. Struvite has been shown at other facilities to accumulate on mechanical draft tube mixers and in draft tubes. Pilot testing RDT mixers would afford the opportunity to test a variety of struvite mitigation ideas including Kynar liners on draft tubes, Kynar or Teflon coatings on impellers, etc. If anti-scaling chemicals prove impractical or ineffective (TM 4.6), a pilot testing program is recommended to evaluate if struvite formation is an issue on any of the mixer technologies and what if any mitigation methods related to specific mixers are effective at reducing or eliminating struvite issues. An investment in this pilot study could result in the identification of struvite mitigation measures that could decrease (or eliminate) the current costs associated with struvite formation.

5.6 Potential Master Plan Related Pilot Studies

There are several pilot studies directly or indirectly related to digestion that the Plant Master Plan suggested that the City may wish to consider in the future. These include:

- Pilot testing sludge screens to determine effectiveness to remove debris from primary sludge;
- Sludge preprocessing technologies (prior to digestion) to determine cost effectiveness;
- Dewatering technologies;
- Drying technologies such as thermal drying and greenhouse;
- Onsite composting

The first two have the potential for improving digestion performance. It is recommended that if the City wishes to perform these tests, they schedule them for after the new mixing systems come on line in the upgraded digesters.

6. IMPLEMENTATION OF RECOMMENDED PROJECT

This section provides recommended construction contract packaging for the project, as well as project cost and schedule. The work may include coordination between multiple design consultants and multiple contractors. As such, coordination between consultants and contractors will need to be considered and planned for.

6.1 Construction Contracts

Several construction packaging approaches are available for this project. All major project elements could be included in a single construction contract and allocated to a single general contractor. Construction projects of this size are commonly delivered by a single contract. With this approach, mixer pre-purchasing would be recommended to allow specific negotiations with sole source suppliers and to afford the ability to conform the final design to approved submittal information.

Alternatively, multiple contract packages can be used to divide up the work and accelerate the schedule for completion of design and commencing construction. Multiple contracts are more complex and costly to administer, and can create contractor overlap and work area conflicts. However, they can afford the ability to accelerate some components through design to improve the schedule. With one reasonable multiple contract alternative, there are potentially five construction packages and two pre-purchase contracts listed below. Splitting Construction Contract No. 1 and No. 2 can result in accelerating commissioning of the new digester gas manifold and tunnel improvements by about 3 months over the single contract approach. If this extra implementation time for this project element can be tolerated by the City, the single contract approach could result in a much easier to administer project. Details of select project components are provided in Attachment A.

- Construction Contract No. 1 – Digester Gas Manifold and Tunnel Improvements - This contract includes a new above ground gas manifold, removal of other hazardous piping from the tunnels, sealing the tunnels from other classified areas, and relocating some ventilation intakes. The new gas manifold system will include installing one 30-inch manifold pipe that will connect to all digester gas laterals. In addition, there will be two, 24-inch branch lines that connect to the gas manifold pipe. It includes minor improvements to individual digester gas piping to improve safety and condensate removal (all digesters but 5, 6, 7, and 8 being modified in Contract No. 2). These improvements include constructing redundant PRV and flame arrester assemblies, replacing manual condensate drip traps with automatic barometric traps, and adding condensation removal at all low points.
- Construction Contract No. 2 – Digester Cover and Mixing Upgrades –This includes installing new covers and new mixers on Digesters 5, 6, 7, and 8. The digester upgrades will consist of replacing existing floating covers with concrete, submerged fixed covers, installing gas lances, draft tube assemblies lined with Kynar (inside only), new compressors, replacing the existing 10-inch hose lateral piping with 16-inch stainless steel lateral piping, constructing redundant PRV and flame arrester assemblies; and installing new condensate tanks. One of the pilot digesters (number 5 and 6) will be constructed with RDT mixers (some or all draft tubes will be lined on the inside with Kynar) and the other pilot digester will be equipped with LM mixer.
- Pre-Purchase Contract No. 1 – Digester Mixing Equipment 1 - This includes pre-purchase of sole-source digester mixing equipment the City wishes to pilot test. This could include focused flow mixers and/or linear motion mixers. At this time, it is assumed that LM mixers will be installed in one of the pilot digesters.
- Pre-Purchase Contract No. 2 – Digester Mixing Equipment 2 - This includes pre-purchase of other digester mixing equipment, notably mechanical draft tube mixers.
- Construction Contract No. 3 – DAFT Final Upgrades – Six of the existing DAFT units will be upgraded and odor containment and treatment will be provided. The thickening modifications include new DAFT feed pumps, new float pumps, retrofits for a blend tank system, new polymer system, saturation system upgrades, and piping modifications associated with all upgrades. The odor containment modifications include covers for DAFT tanks, air ducting, and fans. The odor treatment includes addition of a biofilter. The saturation system upgrades include a cost for six new saturation pressure tanks. The tank covers for the odor control system will be aluminum panels that are easy to remove for tank maintenance purposes. During modifications of the DAFT tanks, a temporary

polymer addition system to enhance solids sludge thickening and solids capture should be considered. In addition, DAFT saturation testing should be performed, protocols developed for additional tests, and the results reviewed prior to recommending improvements to the saturation system. Alternative saturation devices could be considered for full-scale implementation.

- Construction Contract No. 4 – Digester Heating Upgrades – This contract makes piping and equipment and control modifications to the individual digester heat supply system. This includes installing individual flow controllers at each digester load circuit and removing flow restriction orifices in the common pipes of each load circuit.
- Construction Contract No. 5 – Struvite Control Chemical Feed – This contract would be implemented only if pilot testing confirmed the performance of proprietary chemicals for struvite control.

The City is currently exploring another contract with a private FOG handling company to build and operate a pilot FOG receiving station that will be used to test FOG feed to the digestion system. The private company will likely be responsible for delivering the FOG and operating the receiving and FOG feed system. The recommended project work will be configured and scheduled to accommodate this pilot FOG receiving plan.

6.2 Schedule

Figure 6-1 provides a Network Diagram of the schedule for the digester upgrades assuming the multiple construction contract approach discussed above. Figure 6-2 presents the associated Gantt schedule. The Network diagram shows linkages between individual project tasks and elements and provides the foundation for overall project scheduling.

Figure 6-3 shows a Network Diagram for a single contract alternative, where all construction is consolidated into a single construction contract. This approach adds about 3 months to the commissioning of the new digester gas manifold and tunnel improvements. This delay results from the longer design period required for the larger, all inclusive, single contract.

Figure 6-4 provides a Gantt schedule for the single contract approach to the project.

All construction activities are scheduled to be complete by May of 2015, followed by performance and additional testing. All activities are scheduled to be complete by June 2016.

The following assumptions were included in the project scheduling:

1. Because of the condition of the digester gas manifold, the digester gas manifold piping would be completed as soon as practical.
2. Since Digesters 5 and 6 are out of service, these digesters would be completed first followed by Digesters 7 and 8. This will minimize the time that digesters are not available.
3. The DAFT upgrades would complete in parallel to Digesters 5 and 6 to allow these digesters to pilot thickened sludge.

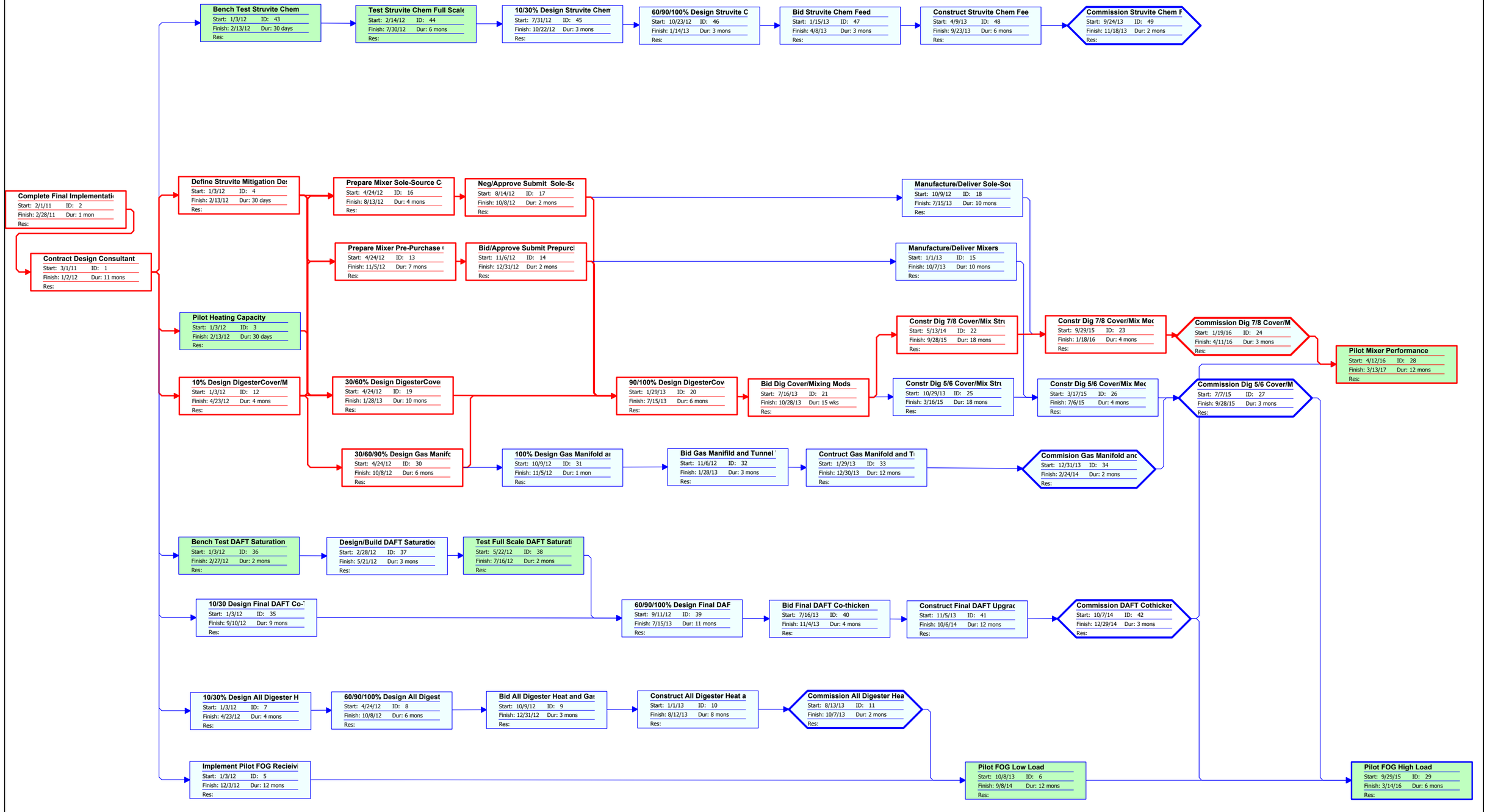

Figure 6-1. San Jose Digester Rehabilitation Project Network Diagram - Multi Construction Contract Alternative (v11)

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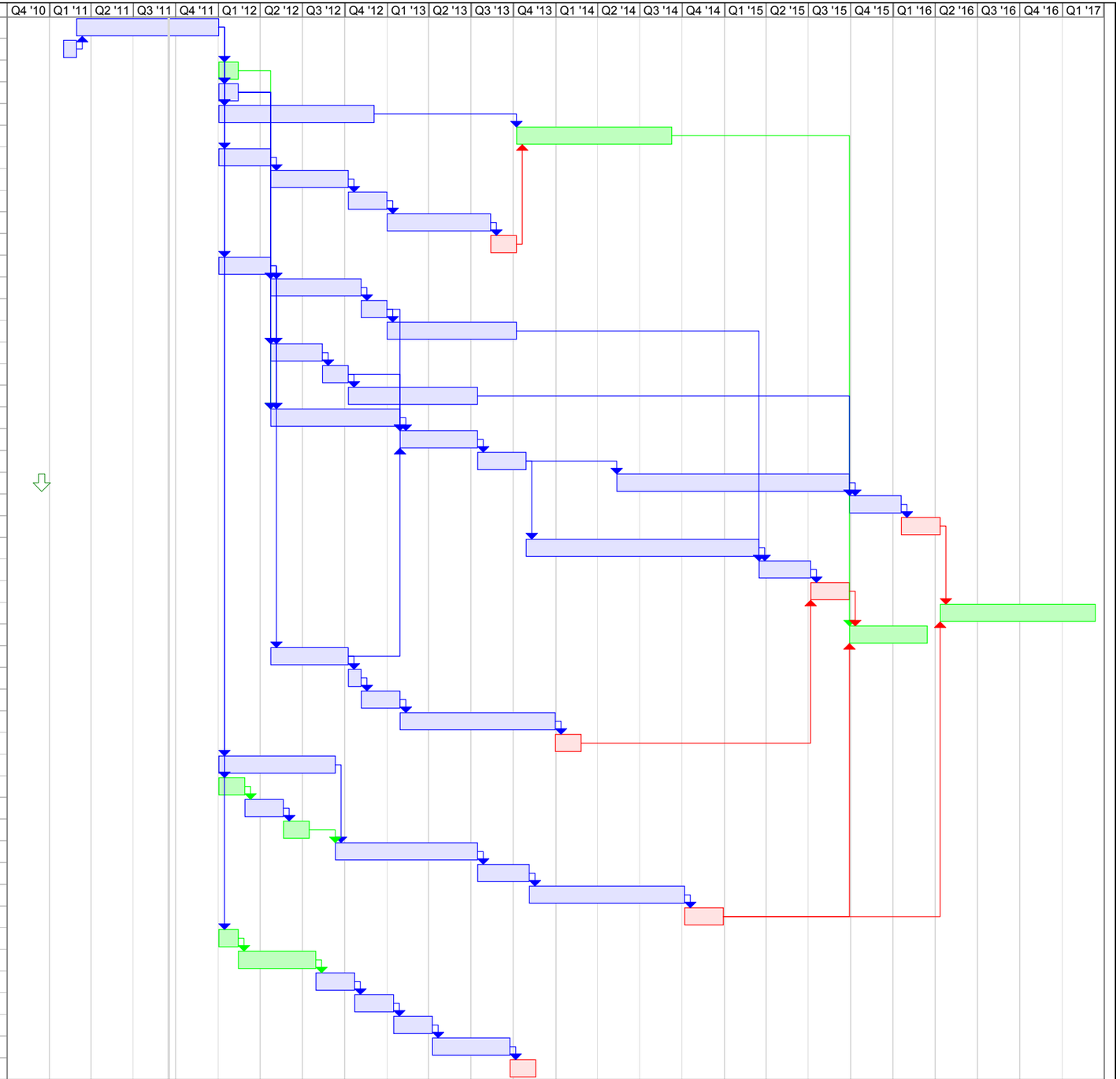
ID	Task Name	Duration	Start	Finish	Predecessors
1	Contract Design Consultant	11 mons	Tue 3/1/11	Mon 1/2/12	2
2	Complete Final Implementation Plan	1 mon	Tue 2/1/11	Mon 2/28/11	
3	Pilot Heating Capacity	30 days	Tue 1/3/12	Mon 2/13/12	1
4	Define Struvite Mitigation Design Measures	30 days	Tue 1/3/12	Mon 2/13/12	1
5	Implement Pilot FOG Recieiving	12 mons	Tue 1/3/12	Mon 12/3/12	1
6	Pilot FOG Low Load	12 mons	Tue 10/8/13	Mon 9/8/14	5,11
7	10/30% Design All Digester Heat and Gas Mods	4 mons	Tue 1/3/12	Mon 4/23/12	1
8	60/90/100% Design All Digester Heat and Gas Mods	6 mons	Tue 4/24/12	Mon 10/8/12	7
9	Bid All Digester Heat and Gas Mods	3 mons	Tue 10/9/12	Mon 12/31/12	8
10	Construct All Digester Heat and Gas Mods	8 mons	Tue 1/1/13	Mon 8/12/13	9
11	Commission All Digester Heat and Gas Mods	2 mons	Tue 8/13/13	Mon 10/7/13	10
12	10% Design DigesterCover/Mixing Mods	4 mons	Tue 1/3/12	Mon 4/23/12	1
13	Prepare Mixer Pre-Purchase Contract	7 mons	Tue 4/24/12	Mon 11/5/12	12,4
14	Bid/Approve Submit Prepurchase Mixer Contract	2 mons	Tue 11/6/12	Mon 12/31/12	13
15	Manufacture/Deliver Mixers	10 mons	Tue 1/1/13	Mon 10/7/13	14
16	Prepare Mixer Sole-Source Contract	4 mons	Tue 4/24/12	Mon 8/13/12	12,4
17	Neg/Approve Submit Sole-Source Mixers	2 mons	Tue 8/14/12	Mon 10/8/12	16
18	Manufacture/Deliver Sole-Source Mixers	10 mons	Tue 10/9/12	Mon 7/15/13	17
19	30/60% Design DigesterCover/Mixing Mods	10 mons	Tue 4/24/12	Mon 1/28/13	12,4,3
20	90/100% Design DigesterCover/Mixing Mods	6 mons	Tue 1/29/13	Mon 7/15/13	19,30,14,17
21	Bid Dig Cover/Mixing Mods	15 wks	Tue 7/16/13	Mon 10/28/13	20
22	Constr Dig 7/8 Cover/Mix Structural Mods	18 mons	Tue 5/13/14	Mon 9/28/15	21FS+7 mons
23	Constr Dig 7/8 Cover/Mix Mech/Elec Mods	4 mons	Tue 9/29/15	Mon 1/18/16	22,18
24	Commission Dig 7/8 Cover/Mixing Mods	3 mons	Tue 1/19/16	Mon 4/11/16	23
25	Constr Dig 5/6 Cover/Mix Structural Mods	18 mons	Tue 10/29/13	Mon 3/16/15	21
26	Constr Dig 5/6 Cover/Mix Mech/Elec Mods	4 mons	Tue 3/17/15	Mon 7/6/15	25,15
27	Commission Dig 5/6 Cover/Mixing Mods	3 mons	Tue 7/7/15	Mon 9/28/15	34,26
28	Pilot Mixer Performance	12 mons	Tue 4/12/16	Mon 3/13/17	24,42
29	Pilot FOG High Load	6 mons	Tue 9/29/15	Mon 3/14/16	27,6,42
30	30/60/90% Design Gas Manifold and Tunnel Mods	6 mons	Tue 4/24/12	Mon 10/8/12	12
31	100% Design Gas Manifold and Tunnel Mods	1 mon	Tue 10/9/12	Mon 11/5/12	30
32	Bid Gas Manifild and Tunnel Vent	3 mons	Tue 11/6/12	Mon 1/28/13	31
33	Contruct Gas Manifold and Tunnel Mods	12 mons	Tue 1/29/13	Mon 12/30/13	32
34	Commision Gas Manifold and Tunnel Mods	2 mons	Tue 12/31/13	Mon 2/24/14	33
35	10/30 Design Final DAFT Co-Thickening Upgrades	9 mons	Tue 1/3/12	Mon 9/10/12	1
36	Bench Test DAFT Saturation	2 mons	Tue 1/3/12	Mon 2/27/12	1
37	Design/Build DAFT Saturation Mods	3 mons	Tue 2/28/12	Mon 5/21/12	36
38	Test Full Scale DAFT Saturation	2 mons	Tue 5/22/12	Mon 7/16/12	37
39	60/90/100% Design Final DAFT Co-Thickening Upgrades	11 mons	Tue 9/11/12	Mon 7/15/13	38,35
40	Bid Final DAFT Co-thicken	4 mons	Tue 7/16/13	Mon 11/4/13	39
41	Construct Final DAFT Upgraders	12 mons	Tue 11/5/13	Mon 10/6/14	40
42	Commission DAFT Cothickening	3 mons	Tue 10/7/14	Mon 12/29/14	41
43	Bench Test Struvite Chem	30 days	Tue 1/3/12	Mon 2/13/12	1
44	Test Struvite Chem Full Scale	6 mons	Tue 2/14/12	Mon 7/30/12	43
45	10/30% Design Struvite Chem Feed	3 mons	Tue 7/31/12	Mon 10/22/12	44
46	60/90/100% Design Struvite Chem Feed	3 mons	Tue 10/23/12	Mon 1/14/13	45
47	Bid Struvite Chem Feed	3 mons	Tue 1/15/13	Mon 4/8/13	46
48	Construct Struvite Chem Feed	6 mons	Tue 4/9/13	Mon 9/23/13	47
49	Commission Struvite Chem Feed	2 mons	Tue 9/24/13	Mon 11/18/13	48



Project: Schedule Network Diagram (v
Date: Thu 9/15/11

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 6-2. San Jose Digester Rehabilitation Project Schedule - Multi Construction Contract Alternative (v11)

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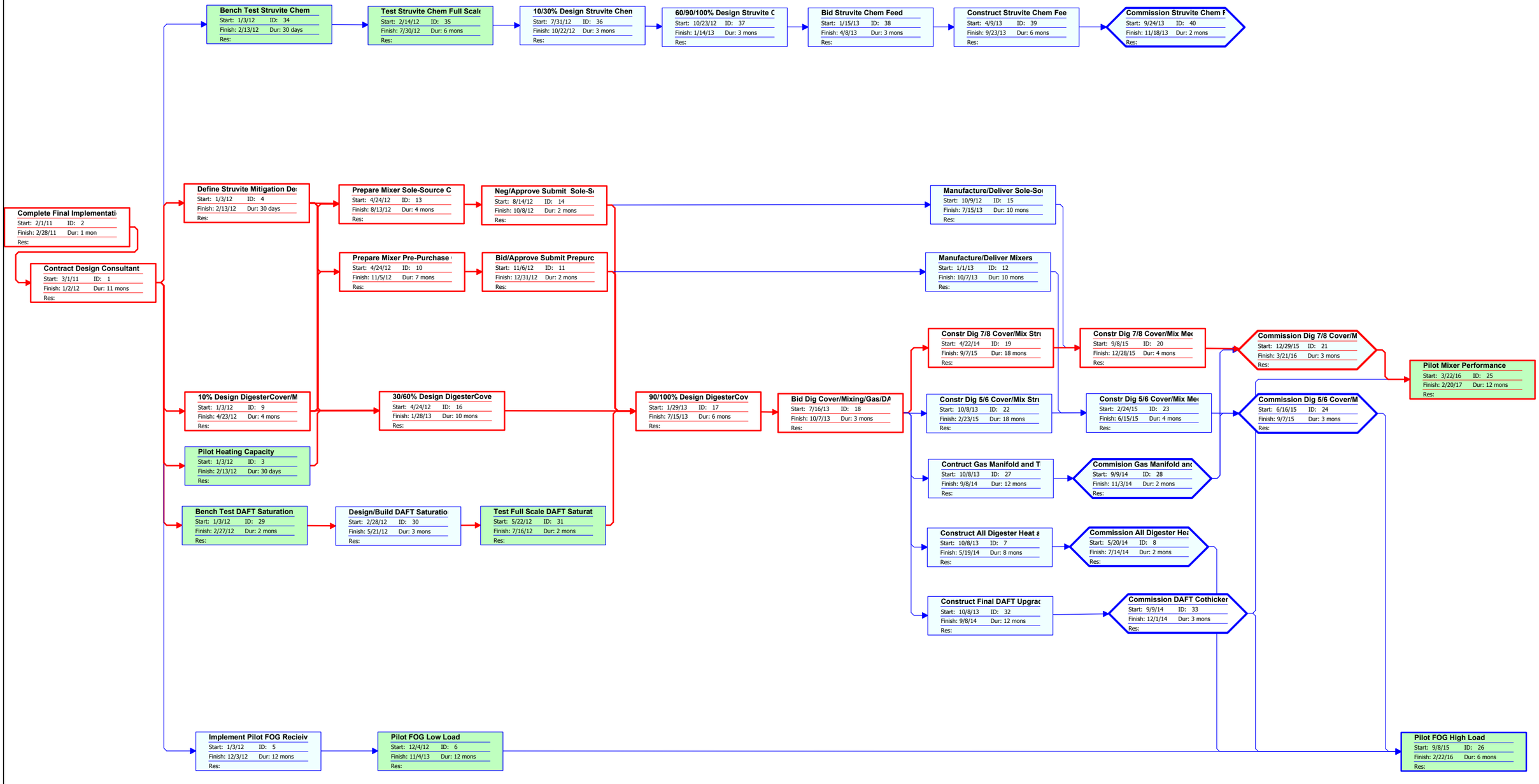

Figure 6-3. San Jose Digester Rehabilitation Project
Network Diagram - Consolidated Construction Contract Alternative (v11)

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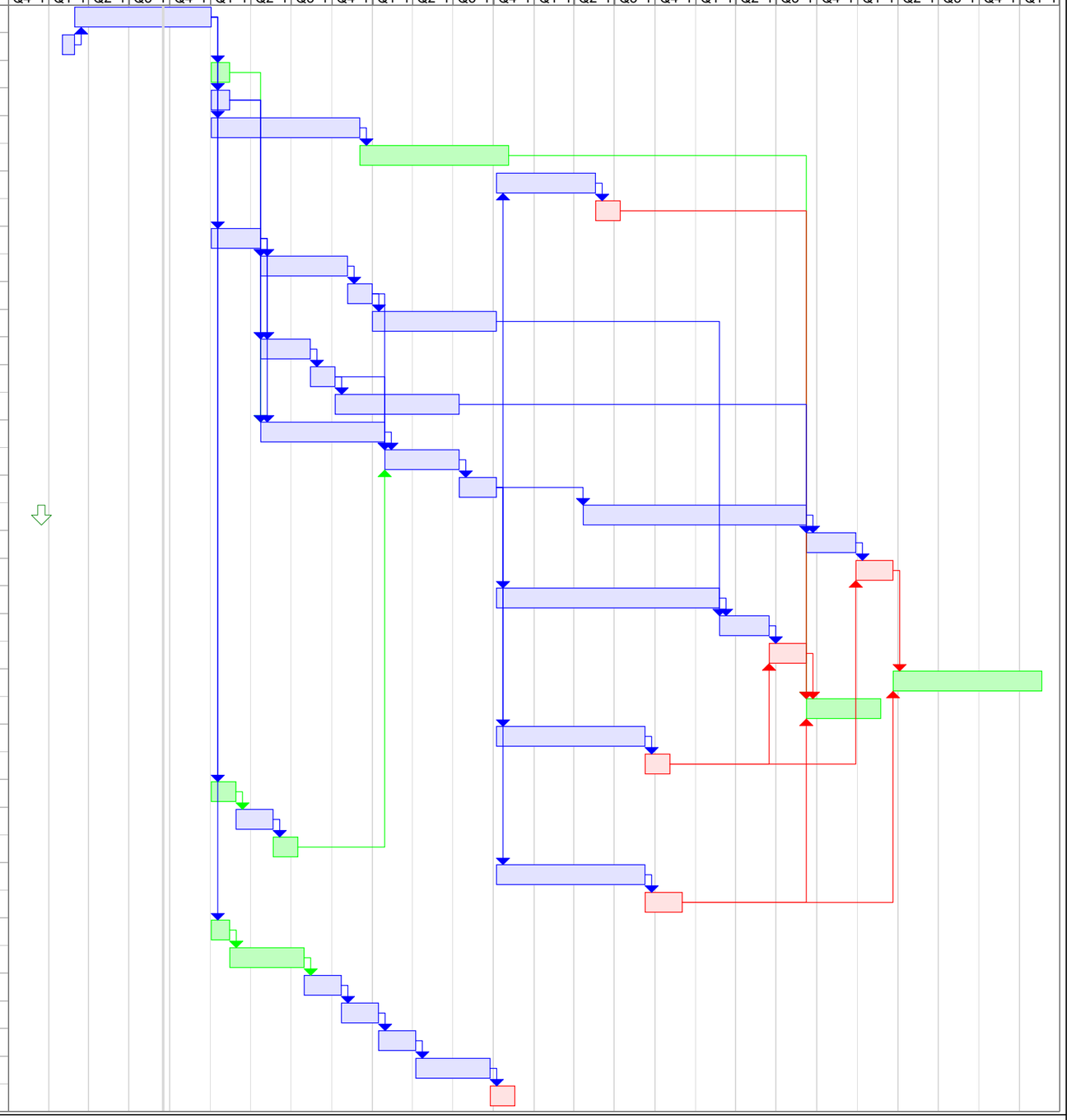
ID	Task Name	Duration	Start	Finish	Predecessors
1	Contract Design Consultant	11 mons	Tue 3/1/11	Mon 1/2/12	2
2	Complete Final Implementation Plan	1 mon	Tue 2/1/11	Mon 2/28/11	
3	Pilot Heating Capacity	30 days	Tue 1/3/12	Mon 2/13/12	1
4	Define Struvite Mitigation Design Measures	30 days	Tue 1/3/12	Mon 2/13/12	1
5	Implement Pilot FOG Recieiving	12 mons	Tue 1/3/12	Mon 12/3/12	1
6	Pilot FOG Low Load	12 mons	Tue 12/4/12	Mon 11/4/13	5
7	Construct All Digester Heat and Gas Mods	8 mons	Tue 10/8/13	Mon 5/19/14	18
8	Commission All Digester Heat and Gas Mods	2 mons	Tue 5/20/14	Mon 7/14/14	7
9	10% Design DigesterCover/Mixing/Gas/DAFT Mods	4 mons	Tue 1/3/12	Mon 4/23/12	1
10	Prepare Mixer Pre-Purchase Contract	7 mons	Tue 4/24/12	Mon 11/5/12	9,4
11	Bid/Approve Submit Prepurchase Mixer Contract	2 mons	Tue 11/6/12	Mon 12/31/12	10
12	Manufacture/Deliver Mixers	10 mons	Tue 1/1/13	Mon 10/7/13	11
13	Prepare Mixer Sole-Source Contract	4 mons	Tue 4/24/12	Mon 8/13/12	9,4
14	Neg/Approve Submit Sole-Source Mixers	2 mons	Tue 8/14/12	Mon 10/8/12	13
15	Manufacture/Deliver Sole-Source Mixers	10 mons	Tue 10/9/12	Mon 7/15/13	14
16	30/60% Design DigesterCover/Mixing/Gas/DAFT Mods	10 mons	Tue 4/24/12	Mon 1/28/13	9,4,3
17	90/100% Design DigesterCover/Mixing/Gas/DAFT Mods	6 mons	Tue 1/29/13	Mon 7/15/13	16,11,14,31
18	Bid Dig Cover/Mixing/Gas/DAFT Mods	3 mons	Tue 7/16/13	Mon 10/7/13	17
19	Constr Dig 7/8 Cover/Mix Structural Mods	18 mons	Tue 4/22/14	Mon 9/7/15	18FS+7 mons
20	Constr Dig 7/8 Cover/Mix Mech/Elec Mods	4 mons	Tue 9/8/15	Mon 12/28/15	19,15
21	Commission Dig 7/8 Cover/Mixing Mods	3 mons	Tue 12/29/15	Mon 3/21/16	20,28
22	Constr Dig 5/6 Cover/Mix Structural Mods	18 mons	Tue 10/8/13	Mon 2/23/15	18
23	Constr Dig 5/6 Cover/Mix Mech/Elec Mods	4 mons	Tue 2/24/15	Mon 6/15/15	22,12
24	Commission Dig 5/6 Cover/Mixing Mods	3 mons	Tue 6/16/15	Mon 9/7/15	28,23
25	Pilot Mixer Performance	12 mons	Tue 3/22/16	Mon 2/20/17	21,33
26	Pilot FOG High Load	6 mons	Tue 9/8/15	Mon 2/22/16	24,6,33,8
27	Contruct Gas Manifold and Tunnel Mods	12 mons	Tue 10/8/13	Mon 9/8/14	18
28	Commision Gas Manifold and Tunnel Mods	2 mons	Tue 9/9/14	Mon 11/3/14	27
29	Bench Test DAFT Saturation	2 mons	Tue 1/3/12	Mon 2/27/12	1
30	Design/Build DAFT Saturation Mods	3 mons	Tue 2/28/12	Mon 5/21/12	29
31	Test Full Scale DAFT Saturation	2 mons	Tue 5/22/12	Mon 7/16/12	30
32	Construct Final DAFT Upgraders	12 mons	Tue 10/8/13	Mon 9/8/14	18
33	Commission DAFT Cothickening	3 mons	Tue 9/9/14	Mon 12/1/14	32
34	Bench Test Struvite Chem	30 days	Tue 1/3/12	Mon 2/13/12	1
35	Test Struvite Chem Full Scale	6 mons	Tue 2/14/12	Mon 7/30/12	34
36	10/30% Design Struvite Chem Feed	3 mons	Tue 7/31/12	Mon 10/22/12	35
37	60/90/100% Design Struvite Chem Feed	3 mons	Tue 10/23/12	Mon 1/14/13	36
38	Bid Struvite Chem Feed	3 mons	Tue 1/15/13	Mon 4/8/13	37
39	Construct Struvite Chem Feed	6 mons	Tue 4/9/13	Mon 9/23/13	38
40	Commission Struvite Chem Feed	2 mons	Tue 9/24/13	Mon 11/18/13	39



Project: Schedule Network Diagram (v
Date: Thu 9/15/11

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 6-4. San Jose Digester Rehabilitation Project Schedule - Consolidated Construction Contract Alternative (v11)

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6.3 Project Cost Estimate

The basis of the cost estimates and the detailed cost estimates are provided in Attachment B. A summary of the preliminary project costs is provided in Table 6-1. The total project cost is estimated to be $61.7 million. All costs include escalation to midpoint of construction. An estimator's construction contingency is included in the cost estimate. In addition, engineering, legal, and administration costs of 35 percent and O&M training of 2 percent are included.

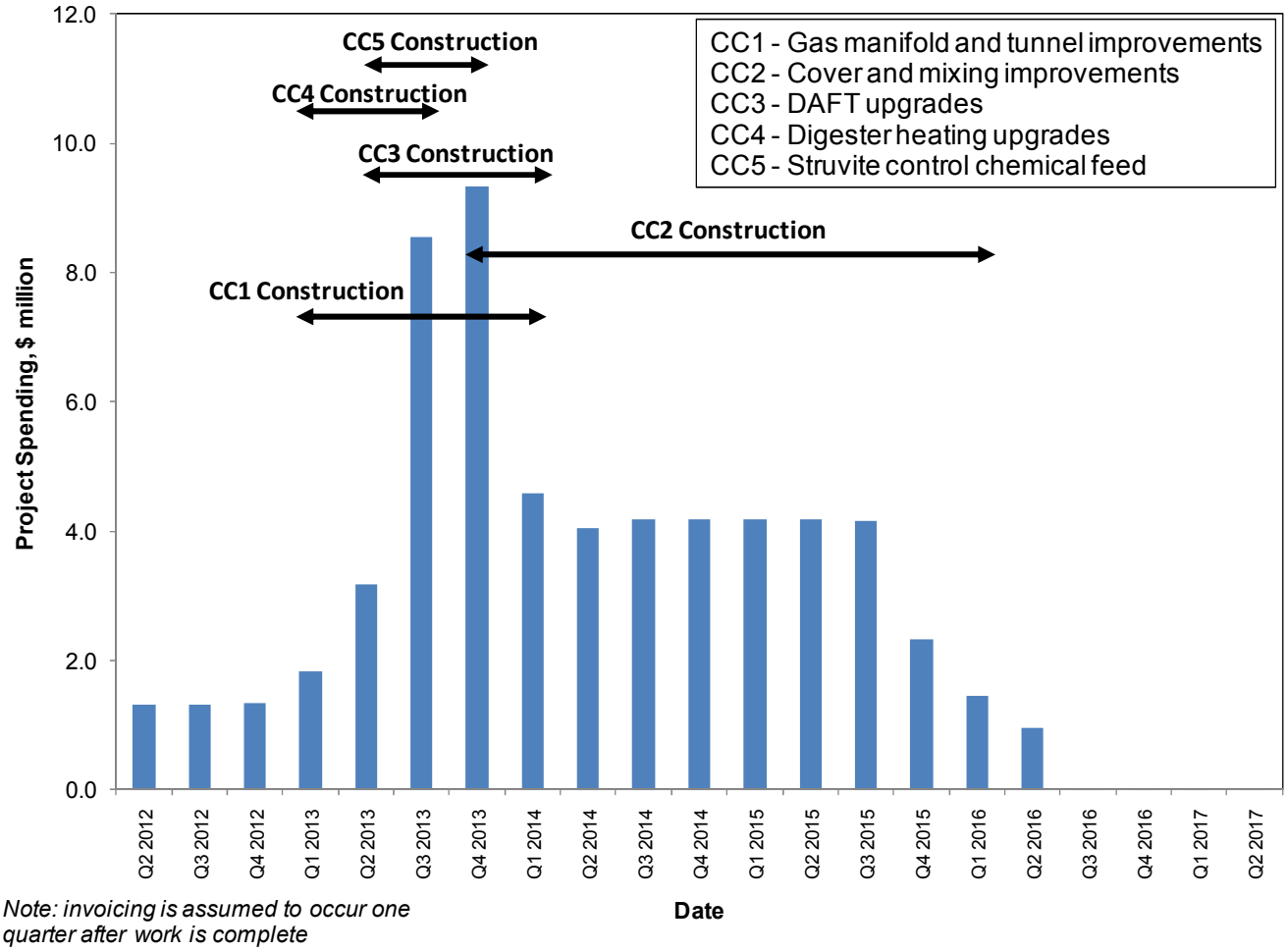
Figure 6-5 presents an overview of project cash flow for all construction and pre-purchase contracts. The engineering and construction costs were segregated and construction cost spending was developed by assuming a typical S-curve for construction activity (i.e. low activity at project commencement, followed by a uniform period preceded and followed by modest ramp up and ramp down periods, respectively). Project invoicing was assumed to occur the quarter after the quarter the work was performed. Figure 6-5 shows the highest spending occurring in the first and second quarters of 2013 due to the simultaneous construction of construction contracts 1, 3, 4 and 5. This peak could be reduced by offsetting the timing of the projects.

Table 6-1. Summary of Preliminary Project Costs – Multiple Construction Contract Alternative

Project Phase	Project Cost	Description
Construction Contracts		
Construction Contract No. 1	$18.5 million	Construct new above ground gas manifold, remove other hazardous piping from the tunnels, seal tunnels from other classified areas, and relocate some ventilation intakes. Also included are minor improvements to individual digester gas piping to improve safety and condensate removal (all digesters but 5, 6, 7, and 8 being modified in Contract No. 1.)
Construction Contract No. 2	$33.2 million	Install new submerged fixed covers and new mixers on Digesters 5, 6, 7, and 8. (RDT and LM mixers will be pre-purchased)
Construction Contract No. 3	$7.33 million	Incorporate findings from DAFT testing to implement full co-thickening.
Construction Contract No. 4	$1.0 million	Piping and equipment and control modifications to the individual digester heat supply system.
Construction Contract No. 5	$0.32 million	Install chemical metering system for struvite inhibition chemical. Implemented if pilot testing confirmed the performance of proprietary chemicals for struvite control.
Pre-Purchase Contracts		
Pre-Purchase Contract No. 1	$0.48 million [a]	Pre-purchase of sole-source digester mixing equipment for one digester for pilot testing.
Pre-Purchase Contract No. 2	$0.83 million [b]	Pre-purchase of other digester mixing equipment for three digesters, notably mechanical draft tube mixers.
Total Project Cost	$61.7 million	

[a] *pre-purchase of 1 LM mixer*

[b] *pre-purchase of 4 mechanical draft tube mixers*



Note: invoicing is assumed to occur one quarter after work is complete

Figure 6-5. San Jose Digester Rehabilitation Project Estimate of Project Cash Flow

7. PHASING OF FUTURE PROJECTS

This section describes how this project is coordinated with the Plant Master Plan effort. The Plant Master Plan schedule of digester upgrades is presented.

7.1 Scheduling Future Digester Upgrades

A total of 9 digesters will require upgrade to satisfy the 2030 flow and load conditions. Of these 7 digesters, two will serve as redundant units. Following discussion between the City's staff and consultants, the schedule of upgrades is as follows:

- Phase 1 – Upgrade 4 digesters (complete by 2015)
- Phase 2 – Upgrade 4 digesters (complete by 2021)
- Phase 3 – Upgrade 2 digesters or 1 digester (complete by 2025)

This schedule is projected to comply with the City's planning objectives. An accelerated schedule could be achieved, if necessary. An example of where this may be necessary is if the City were to increase import materials such as food waste of sludge from another City. The following represents an accelerated schedule:

- Phase 2 – Upgrade 4 digesters (complete by 2019)
    - Design - April 2014 – February 2016
    - Bidding – March 2016 – June 2016
    - Construction – July 2016 – December 2019
- Phase 3 – Upgrade 2 digesters or 1 digester (complete by 2023)
    - Design - September 2019 – August 2020
    - Bidding – September 2020– December 2020
    - Construction – January 2021 – December 2023

7.2 Master Plan Coordination and Schedule

Under separate contract and parallel to this project, a Plant Master Plan for the San Jose/Santa Clara WPCP is being developed. Several tasks in the Plant Master Plan effort are related to the anaerobic digester facilities including developing overall planning goals and objectives, establishing reliability and redundancy criteria, review of historical WPCP operating data, and projection of flow and loads. The information from the Plant Master Plan has been used in developing recommendations for digester improvements. As more detailed information in the digester pre-design report was developed, the Plant Master Plan recommendations were updated to reflect the new information.

8. ALTERNATIVE DELIVERY METHODS

Alternative delivery options for the project, including design-bid-build, design-build, general contractor construction manager (GCCM), pre-purchasing and negotiated contract are discussed in this section. The advantages and disadvantages of each type of delivery method are provided and recommendations made for delivery of the various project contracts.

8.1 Description of Alternative Delivery Options

8.1.1 Design-Bid-Build

The most widely used method in delivering wastewater treatment improvement projects is the traditional design-bid-build method. Under this approach, the steps are sequential and there are multiple parties and contracts with the owner. The construction contract is typically awarded to the lowest bidder. The typical contracting and communications relationships in a traditional design-bid-build process are shown in Figure 8-1.

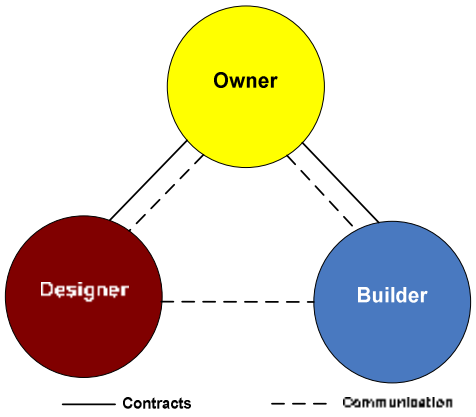


Figure 8-1. Design-Bid-Build relationships between key entities.

The design-bid-build method of project delivery is characterized by three phases: (1) The owner engages the designer to prepare construction documents, (2) The construction documents are used for bidding by a contractor, and (3) The owner hires the contractor to build the project. This conventional approach is appropriate for public utilities that are legally required to select a low-bid contractor.

The primary advantages of the traditional design-bid-build method of project delivery are as follows:

- It has widespread use and owners are typically most familiar with this method versus alternate forms of project delivery.
- Clear roles are assigned to each of the three entities involved (Figure 8-1).
- Design options are thoroughly investigated to a full level of development before construction begins.
- The process is linear, which makes the project delivery easier for owners to manage.

The following disadvantages are commonly associated with the traditional design-bid-build method of project delivery:

- Linear phasing makes construction schedules longer than most alternate delivery methods.
- Separation of design and construction into two distinct phases often restricts useful communication, and precludes input from the contractor into the design.
- The owner typically has less control over the selection of equipment or materials.
- Change orders and delay claims are more likely than in alternate delivery methods.

Typical perspectives on the merits of the traditional design-bid-build approach are depicted in Figure 7-2. Note that all three entities tend to think that quality is best in this approach.

8.1.2 Design-Build

The design-build alternative delivery method includes a fourth entity, the design-builder, who engages in relationships and contracts with the owner, designer, and builder as shown in Figure 8-2. Variations occur where either the designer or the builder take on the contractual role as the design builder. In a design-build arrangement, the owner executes only one contract with the design-builder, who is then fully accountable and responsible to the owner for all the design and construction. Bridging (sometimes referred to as design assist) can be considered a form of design-build. The bridging method has the owner first hiring its own designer to develop the preliminary design and performance specifications for the project. This designer also normally serves as the owner's representative throughout the course of the entire project. After developing the preliminary design to a level satisfying the owner, the project is bid to design-build entities that are able to execute the work. After selection of a design builder, the design builder completes the detailed design and becomes the engineer of record. After a final price is determined, construction begins.

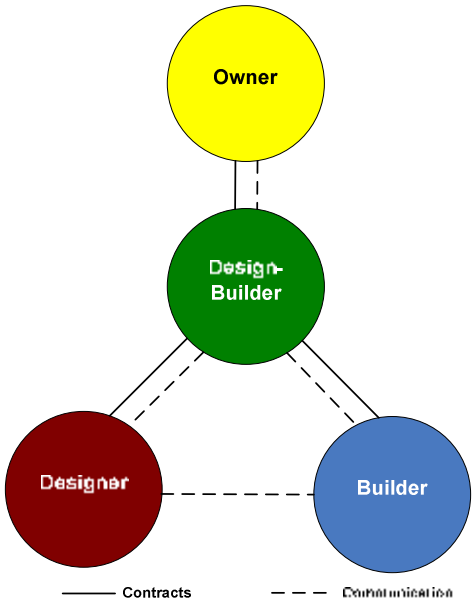


Figure 8-2. Design-Build relationships between key entities.

This alternative project delivery method developed from the traditional approach as a way of bringing design and construction in closer alignment and obtaining contractor input during design. Such contractor input during design is often referred to as preconstruction services. These services include constructability reviews of the design, cost estimating, schedule estimating, and application of value engineering techniques whose intended effect is to reduce costs or accelerate the schedule. The intent of this approach is to foster a collaborative relationship between the owner, engineer, and builder.

Typically, design-build projects can be implemented quicker and more cost effectively than traditional design-bid-build projects. The single point of accountability also can provide an owner with an enhanced risk allocation for the project. Noted advantages of the design-build method of delivery are as follows:

- With both design and construction in the hands of a single entity, there is a single point of responsibility and accountability for performance, quality, cost, and schedule.
- Because design and construction activities are overlapped and because bidding periods and redesign are eliminated, total design and construction time can be significantly reduced. Materials and equipment procurement and construction work can begin before the construction documents are fully complete. In recent projects that BC has

been involved, overall time savings have been noted to range from 10 percent to 30 percent. A corresponding cost savings has frequently been noted in these projects. Note this savings is only the case when the owner has limited specific requirements beyond project performance. When the owner has extensive specific requirements, the owner's representative usually completes the design up to about the 30 percent level and defines these specific requirements. This can add to the design schedule and negate any time savings.

- Change orders are typically eliminated because the design-builder has responsibility for developing the plans and specifications as well as constructing a fully-functioning project.
- With only one contract and one responsible party, the owner is not required to invest resources to coordinate and arbitrate between multiple contracts and parties.
- Singularized responsibility inherent in design-build can serve as a motivation for the design-builder to increase quality and proper project performance.
- With design-build, the owner has the obligation to define requirements and expectations in performance terms, and it is the responsibility of the design-builder to produce the desired results. The design-builder will warrant to the owner that it will produce design documents that are complete and free from error. In the design-bid-build approach, it is the *owner's* warranty to the builder that the design is complete and free from error. This traditional warranty results in the owner implementing restrictive language, audits, and inspections in the construction contract to ensure project quality.
- Guaranteed construction costs are known earlier than the traditional design-bid-build approach. In the design-build arrangement there is potential that the guaranteed construction cost received by the owner will be the final project cost.

The following disadvantages are commonly associated with the design-build method of project delivery:

- The design-build method is more complex than traditional methods, especially for owners that have not engaged in a design-build process previously.
- There is no normally direct connection between the owner and the designer. All communications occur through the design-builder, thus the owner may have less input into design considerations.
- There is a potential for cost-savings strategies, such as value engineering efforts and builder compromising on quality where not specified to save money, to erode design and construction quality.

High marks are usually given to the design-build approach for schedule, cost control, and legal liability, including the highest possible evaluation from the perspective of the owner. Schedule can be the fastest from the perspective of both the owner and the builder because the design development period occurs simultaneously with the construction period. Cost control is high from the owner's perspective because the owner is dealing with a single entity that will not take issue with construction documents and produce costly change orders. Finally, legal liability is greatly improved with the design-build alternative delivery approach as the requirement is given to the design-builder to warrant the quality of the design and the construction of the project, rather than the requirement being placed on the owner. Overall quality of design build projects can suffer from the perspective of meeting owner's expectations unless the time and effort are invested by the owner up front to delineate those requirements.

8.1.3 GCCM – General Contractor Construction Manager

The GCCM approach has the same contractual and communication relationships as shown in Figure 8-1, however, the method of contractor procurement differs in that the contractor is selected early in t he design process through a qualifications based selection process, the contractor then works with the designer providing constructability input and cost estimating during design, and a final negotiated construction cost is agreed to with the owner after design is complete. At that point contract packages are bid to the market by the GCCM contractor and the GCCM contractor is allowed to bid on and self perform some or all of the construction. This method allows contractor input during the design and can reduce change orders and provide a more constructible and less expensive project. The contractor negotiated price however can reduce competitive bidding.

8.2 Description of Equipment Procurement Options

Table 8-1 presents a summary of possible procurement alternatives for major equipment. In general, owner selection of equipment by sole-source, negotiated price, or pre-purchase rather than by inclusion within the general construction contract may be preferred if the application and process requirements can only be met by one manufacturer, schedule drivers cannot be met with a competitive bid, or the price may increase because of outside forces.

If pre-purchase options are considered, a performance guarantee is recommended to protect the City from some of the liabilities a contractor may bear for equipment acquisition. A performance guarantee from the vendor is recommended in the purchase of new technologies.

Table 8-1. Procurement Alternatives

Procurement Alternatives	Process Description	Opportunities	Challenges
Competitive bid equipment specification as part of the larger construction contract	Detailed specification written around required equipment allowing competition for equal manufacturers.	Competition in equipment can mean lower cost. Competitive bidding may be a legal requirement, agency policy, or may require significant effort to justify sole-source or pre-purchasing of equipment. Delivery time and damage risk is the responsibility of the general contractor.	Owner and Engineer have less control over equipment selection. In a competitive bid, a manufacturer without adequate experience may provide equipment that is not suited well for the application. Higher probability of necessary change orders to accommodate alternate suppliers - Rotary press manufacturers have different configurations requiring coordination with ancillary equipment during construction. Possible protests from un-named manufacturers. May be scheduling issues with long lead time equipment Design of multiple comparable systems can lead to higher design and construction costs
Sole-source specification as part of the larger construction contract	Detailed specification written around required equipment not allowing for competition from similar manufacturers.	No surprise manufacturers at bid time - there are a limited number of manufacturers with limited full scale operational history. In a competitive bid situation, a manufacturer without pilot testing may provide equipment that is not suited well for the application. Designing around sole-sourced equipment may reduce design, and construction costs because information on the sole–source equipment configuration will be readily available. With owner selection of minor ancillary components, minimizes the number of manufacturers of fittings, valves¸ and electrical equipment thereby providing a maintenance benefit once construction is complete	Possible protests from un-named manufacturers. Possibly higher initial cost due to lack of competition. May not meet legal or agency requirements for competitive bids.

Table 8-1. Procurement Alternatives

Procurement Alternatives	Process Description	Opportunities	Challenges
Negotiated price as part of the larger construction contract	Owner negotiates price and options with the manufacturer prior to bidding, and requires confirmation of negotiated price in final bidding documents	Facilitates sole source purchase Obtain long-lead time equipment and materials sooner because shop drawing review time will be shorter – could save up to one month. Allows designer to review submittals directly with selected manufacturer, thereby confirming that equipment will meet the design intent and facilitating changes resulting from submittal review. Fabrication and manufacturing can commence earlier, which could save up to one month Can expedite construction and maintain quality control because coordination of ancillary equipment can be completed earlier. Eliminates bid shopping and substitutions of equipment With owner selection of minor ancillary components, minimizes the number of manufacturers of fittings, valves, and electrical equipment thereby providing a maintenance benefit once construction is complete Price is locked in early, which eliminates the effects of inflation and currency exchange rates.	Additional effort required from design and/or CM team (preparation of pre-negotiated documents and evaluation of submittals). Interface between pre-negotiated contract and construction contract must be carefully defined to ensure proper coordination of ancillary equipment Some increase in risk to owner from integration of contracts. Delivery dates must be carefully defined to prevent contractor change orders for schedule delays. Liquidated damages must be estimated and defined and payable to both the owner and to the contractor. Some contractors may perceive pre-negotiated equipment and materials as a "plug-in", leaving information gaps in installation details. Contractors lose some of their favorite "hammers" in their subcontracts
Owner negotiates sole source contract with vendor outside of the larger construction contract	Owner negotiates price and options with the manufacturer prior to bidding the construction contract and procures the equipment outside of the general contractor's contract.	Obtain long-lead time equipment and materials - fabrication and manufacturing can begin earlier, reducing the schedule If scheduled appropriately, can allows designer to review submittals directly with manufacturer, thereby confirming that equipment will meet the design intent and facilitating changes in the design resulting from submittal review Can expedite construction and maintain quality control because coordination of ancillary equipment can be completed earlier Owner direct selection avoids bid shopping and substitutions With owner selection of minor ancillary components, minimizes the number of manufacturers of fittings,	Additional effort required from design and CM team (preparation of sole source contract documents and evaluation/negotiation of submittals). Interface between sole source equipment contract and construction contract must be carefully defined to ensure proper coordination of the ancillary equipment, testing and commissioning responsibilities, etc. Some increase in risk to owner from integration of contracts. Delivery dates must be carefully defined to prevent contractor change orders for schedule delays. Liquidated damages must be estimated and defined and payable to both the owner and to the contractor. Some contractors may perceive pre-purchased equipment and materials as a "plug-in." For example, the responsibility for internal cabinet terminations, internal modifications, and troubleshooting

Table 8-1. Procurement Alternatives

Procurement Alternatives	Process Description	Opportunities	Challenges
		valves¸ and electrical equipment thereby providing a maintenance benefit once construction is complete Price is locked in early, eliminating the effects of inflation and currency exchange rates Eliminates contractor markup Owner can assign contract to general contractor.	must be clearly specified. May require "earnest money" to ensure full submittal participation. Contractors lose some of their favorite "hammers" in their subcontracts. Owner is less equipped than a contractor to enforce terms and conditions with manufacturer. Contractors may see this as extra risk for them without the benefit of a markup on equipment price.
Owner pre-purchases equipment by competitive bidding outside of the larger construction contract	Owner competitively bids the equipment prior to bidding the construction contract and procures the equipment outside of the general contractor's contract.	Obtain long-lead time equipment and materials - fabrication and manufacturing can begin earlier, reducing the schedule If scheduled appropriately, can allows designer to review submittals directly with manufacturer, thereby confirming that equipment will meet the design intent and facilitating changes in the design resulting from submittal review. Can expedite construction and maintain quality control because coordination of ancillary equipment can be completed earlier. Promotes bidding among qualified peers, which avoids bid shopping and substitutions Price is locked in early, eliminating the effects of inflation and currency exchange rates. Eliminates contractor markup. Owner can assign contract to general contractor.	Additional effort required from design and/or CM team (preparation of pre-purchase documents and evaluation of submittals). Interface between sole source equipment contract and construction contract must be carefully defined to ensure proper coordination of the ancillary equipment, testing and commissioning responsibilities, etc. Some increase in risk to owner from integration of contracts. Delivery dates must be carefully defined to prevent contractor change orders for schedule delays. Liquidated damages must be estimated and defined and payable to both the owner and to the contractor. Some contractors may perceive pre-purchased equipment and materials as a "plug-in." For example, the responsibility for internal cabinet terminations, internal modifications, and troubleshooting must be clearly specified. May require "earnest money" to ensure full submittal participation. Contractors lose some of their favorite "hammers" in their subcontracts. Owner is less equipped than a contractor to enforce terms and conditions with manufacturer. Contractors may see this as extra risk for them without the benefit of a markup on equipment price.

8.3 Recommended Delivery Strategy

Two contract packaging alternatives are presented in this implementation plan that span the range of reasonable contract packaging. Upon consideration, the City may elect to deliver the project by one or the other or some hybrid of the two. With the single major construction contract alternative, we recommend that the project consist of one major construction package (cover, mixer, DAFT, heating, manifold, and tunnel upgrades)and one minor contract for the anti-scaling chemical feed system only if they are proven effective. We recommend that these contracts be delivered by the design-bid-build method. In addition, wee recommend two pre-purchase contracts, one negotiated sole source contract for pilot tested mixers and one competitively bid pre-purchase contract for other mixers. If the City elects the multiple contract alternative, we recommend that the project consist a maximum of five construction packages delivered by the design-bid-build method and two pre-purchase contracts, one negotiated sole source mixer contract and one competitively bid pre-purchase mixer contract. The specific contracts for the multiple contract approach would include the following:

- Construction Contract No. 1 – Digester Gas Manifold and Tunnel Improvements – This contract includes a new above ground gas manifold, removal of other hazardous piping from the tunnels, sealing the tunnels from other classified areas, and relocating some ventilation intakes. It includes minor improvements to individual digester gas piping to improve safety and condensate removal (all digesters but 5, 6, 7, and 8 being modified in Contract No. 2)
- Construction Contract No. 2 – Digester Cover and Mixing Upgrades – This contract includes installing new submerged fixed covers and new mixers on Digesters 5, 6, 7, and 8.
- Pre-Purchase Contract No. 1 – Digester Mixing Equipment 1 – This contract includes pre-purchase of sole-source digester mixing equipment the City wishes to pilot test. This could include focused flow mixers and/or linear motion mixers
- Pre-Purchase Contract No. 2 – Digester Mixing Equipment 2 – This contract includes pre-purchase of other digester mixing equipment, notably mechanical draft tube mixers.
- Construction Contract No. 3 – DAFT Final Upgrades – DAFT final upgrades will allow for co-thickening of primary and secondary sludge.
- Construction Contract No. 4 – Digester Heating Upgrades – This contract makes piping, equipment and control modifications to the individual digester heat supply system.
- Construction Contract No. 5 – Struvite Control Chemical Feed – This contract would be implemented only if pilot testing confirmed the performance of proprietary chemicals for struvite control.

The City is currently exploring another contract with a private FOG (fats, oils, and grease) handling company to build and operate a pilot FOG receiving station that will be used to test FOG feed to the digestion system. The private company will likely be responsible for delivering the FOG and operating the receiving and FOG feed system. The recommended project work will be configured and scheduled to accommodate this pilot FOG receiving plan.

The City could elect to deliver Construction Contract No. 1 by the GCCM method (if allowable under current City policy).

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ATTACHMENT A. SUMMARY OF MAJOR ELEMENTS FOR CONSTRUCTION

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Table A-1. Summary of Major Elements for Construction Contact No. 1 for Multi-Contract Alternative	
Parameter	**Value**
Lateral Peak Gas Flow, scfm	2,050
Manifold Peak Gas Flow, scfm	3,250
Gas Manifold Piping to Cogeneration Facilities and Gas Storage	
Pipe Rack Supports	
Number	49
Height, ft	20
Width, in	30
Process Piping	
Type	316 ss
Number	1
Length, ft	1,400
Diameter, inch	30
Number of Elbows	35
Number of Valves	28
Number of Flanges	56
Number of 45's	7
Number of Tees	42
Gas Manifold Branch Lines	
Pipe Rack Supports	
Number	21
Height, ft	20
Width, in	30
Process Piping	
Type	316 ss
Number	2
Length, ft	600
Diameter, inch	24
Number of Elbows	15
Number of Valves	12
Number of Flanges	24
Number of 45's	3
Number of Tees	18
Tunnel Modifications	
Partition Wall Area, sf	1,350
Gas Detection System	2

Table A-1. Summary of Major Elements for Construction Contact No. 1 for Multi-Contract Alternative	
Parameter	**Value**
Fans	
Number	17
Power, hp	1/2
PRV/Flame Arrestor Assemblies	
Flame Aresstors	
Number	32
PRV Assemblies	
Number	32
Process Piping	
Type	316 ss
Length, ft	32
Diameter, inch	8
Number of Flanges/Fittings	64
Number of Valves	16
Condensate Tanks	
Number	16
Digester Gas Laterals	
Process Piping	
Type	316 ss
Length, ft	400
Diameter, inch	16
Number of Valves	4
Flowmeters	
Type	Insertion style with ball valve
Number	4
Pressure Transmitters	
Number	4

Table A-2. Summary of Major Elements for Construction Contact No. 2 for Multi-Contract Alternative	
Parameter	**Value**
Submerged Fixed Covers	
Type	concrete submerged fixed
Number	4
Structural Concrete, cy	3,271
Gunite, sf	20,732
Membrane Lining	
Type	HDPE
Area, sf	44,000
Railing	
Type	aluminum
Length, ft	1,380
Foundation	
Micropiles	
Type	cast in place concrete
Number	58
Diameter, in	8
Length, ft	60
Piers	
Type	uncased concrete
Number	96
Diameter, in	24
Length, ft	50
Gas Mixing System	
Compressors	4
Power, hp	30 each
Number of draft tube and lance assemblies	8
Process Piping	
Type	316 ss
Length	120 ft of 4 in 660 ft of 8 in
Number of Fittings	216 of 4 in 60 of 8 in
RDT Mixers	
Number	4
Type	draft tube
Power, hp	20 each

Table A-2. Summary of Major Elements for Construction Contact No. 2 for Multi-Contract Alternative	
Parameter	**Value**
Linear Motion Mixers	
Number	1
Power, hp	15
Digester Feed Pumps	
Type	Progressive Cavity
Number	6

Table A-3. Summary of Major Elements for Construction Contact No. 3 for Multi-Contract Alternative	
Parameter	**Value**
Piping Modifications	
Primary Sludge Piping	
Type	DIP cement lined
Diameter, in	10
Length, ft	120
WAS	
Type	DIP cement lined
Diameter, in	16
Length, ft	120
Feed Sludge	
Type	DIP cement lined
Diameter, in	16
Length, ft	120
Blend Tank	
Structural Concrete, cy	71
Mixing Pumps	
Number	2
Power, hp	25
DAFT Feed Pumps	
Type	centrifugal
Number	2
Power, hp	10
DAFT Float Pumps	
Type	progressive cavity
Number	2
Power, hp	10
Polymer Blending Units	
Number	6
Process Piping	
Type	schedule 80 PVC
Diameter, in	2.5
Length, ft	360
Number of Valves	24
Polymer Storage Tank	

Table A-3. Summary of Major Elements for Construction Contact No. 3 for Multi-Contract Alternative	
Parameter	**Value**
Type	cross-linked HDPE
Number	4
Volume, gal	5800
Pressure Retention Tank	
Type	Steel
Number	6
Volume, gal	2000
Compressors	
Number	6
Capacity, gal	1500
Odor Control Covers	
Type	aluminum
Area, sf	11500
Odor Control Fans and Ductwork	
Type	centrifugal
Number	2
Ductwork	
Type	FRP
Diameter, in	16 and 18
Length, ft	45
Number of Fittings	16
Process Piping	
Type	HDPE and PVC
Diameter, in	8, 10, 16 & 24
Length, ft	429
Number of Fittings	96
Odor Control Biofilter	
Biofilter	
Media Type	
Volume, cf	3672
Process Piping	
Type	PVC
Diameter, in	1.5 & 8
Length, ft	480
Number of Fittings	30

Table A-3. Summary of Major Elements for Construction Contact No. 3 for Multi-Contract Alternative	
Parameter	**Value**
Electrical, Instrumentation and Controls	lump sum
Dedicated Digester Feed Piping	
Process Piping	
Length. ft	500 (8 inch) 500 (4 inch)
Number of Fittings	11 (8 inch) 42 (4 inch)

Table A-4. Summary of Major Elements for Construction Contact No. 4 for Multi-Contract Alternative	
Parameter	**Value**
Process Piping	
Type	316 ss
Diameter, in	4
Length, ft	100
Number of Flanges	128
Number of Valves	32
Number of Flowmeters	32

Table A-5. Summary of Major Elements for Construction Contact No. 5 for Multi-Contract Alternative	
Parameter	**Value**
Structural	
Structural Concrete, cy	33
Mechanical	
Metering Pumps	
Type	peristaltic
Power, hp	0.75
Number	6
Process Piping	allowance
Polymer Tank	allowance
Electrical and Instrumentation	allowance

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ATTACHMENT B. CONSTRUCTION COST ESTIMATES

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Introduction

Brown and Caldwell (BC) is pleased to present this estimate of probable construction cost (estimate) prepared for the San Jose WWTP digester covers, mixing, and dissolved air flotation upgrades and modifications.

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

This project includes upgrades to the WPCP anaerobic digesters, digester tunnels and appurtenances, and dissolved air flotation thickening (DAFT) systems to improve digester capacity, safety, and performance. Although a number of contract packaging alternatives are workable for this project, to achieve multiple objectives in the shortest amount of time, we recommend that the project consist of five construction packages and two pre-purchase contracts, which include the following:

- Construction Contract No. 1 – Digester Gas Manifold and Tunnel Improvements – This contract is separated from Contract No. 2 to allow more rapid construction completion and to more quickly resolve digester tunnel classification issues. It includes a new above ground gas manifold, removal of other hazardous piping from the tunnels, sealing the tunnels from other classified areas, and relocating some ventilation intakes. It also includes minor improvements to individual digester gas piping to improve safety and condensate removal (all digesters but 5, 6, 7, and 8 being modified in Contract No. 1.)
- Pre-Purchase Contract No. 1 – Digester Mixing Equipment 1 - This includes pre-purchase of sole-source digester mixing equipment the City wishes to pilot test. This could include focused flow mixers or linear motion mixers
- Pre-Purchase Contract No. 2 – Digester Mixing Equipment 2 - This includes pre-purchase of mechanical draft tube mixers.
- Construction Contract No. 2 – Digester Cover and Mixing Upgrades – This includes installing new submerged fixed covers and new mixers on Digesters 5, 6, 7, and 8.
- Construction Contract No. 3 – DAFT Final Upgrades – DAFT final upgrades will incorporate findings from the testing to implement full co-thickening.

- Construction Contract No. 4 – Digester Heating Upgrades – This includes piping and equipment and control modifications to the individual digester heat supply system.
- Construction Contract No. 5 – Struvite Control Chemical Feed – This contract would be implemented only if pilot testing confirmed the performance of proprietary chemicals for struvite control.

Class of Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 4 estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Typically, engineering is from 1 percent to 15 percent complete. Class 4 estimates are used to prepare planning level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate.

Expected accuracy for Class 4 estimates typically range from -30 percent to +50 percent, depending on the complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes, and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs, including a shift differential if applicable, and anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of a Windows-based commercial estimating software engine using BC's material and labor database, historical project data, the latest vendor and material cost information, and other costs specific to the project locale.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel), and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and workers compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data, 2010/2011.

The contractor's cost for builder's risk, general liability, and vehicle insurance has been included in this estimate as part of the construction contingency markup. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost, and are added to the net totals after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

- Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
- Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions, or any other unplanned costs.
- Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
- Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
  - Electrical
  - Painting
  - Plumbing

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The assumptions below were used in the development of this estimate.

- Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
- Contractor has complete access for lay-down areas and mobile equipment.
- Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
- Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
- Major equipment costs are based on both vendor supplied price quotes obtained by the project design team and/or estimators, and on historical pricing of like equipment.
- Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material, is included in the purchase price of major equipment items where stated in that quotation.
- Bulk material quantities are based on manual quantity take-offs.
- There are no civil improvements such as new fencing, major pavement, and major site drainage upgrades.
- There are no dump fees for soil hauled off-site.
- Digester covers are 24" thick.
- Unless otherwise stated in the plans, slabs on grade include 12" of bedding. Slabs are #5 rebar @ 12" both sides/each way and are generally 12" thick under process equipment & 8" thick otherwise. This results in an average of 145 # of rebar per CY of concrete.
- Concrete walls are 8" thick unless otherwise indicated and with #7 rebar is placed at 12 both sides/each way. This results in an average of about #370 of rebar per CY.
- Where not specified, equipment pads are 1-ft thick
- Where allowances are used to cost piping, the cost in some places is accounted for by assuming double the longest length of the building and adding up to 50% to the bare pipe cost to account for fittings, supports,

etc. (for utility water for example). Alternately, piping can be estimated at up to 30% of the cost of the associated equipment (for example - a process pump) or more (up to 100% for chemical equipment).

- Welds occur at approximate 15-ft intervals on straight runs of stainless steel pipe. Two welds are added for each elbow and three for tees.
- Where no information exists, fittings are typically but not always assumed to be required on average for each 10-lf of pipe.
- Unless otherwise stated, pipe supports occur at a spacing of 10-lf.
- Equipment is supplied with a topcoat applied at the factory, and a final coat applied in the field.
- Pumps require equipment dismantling joints, where applicable, and are supplied without base plates, which are provided separately by the contractor.
- The digesters will have gas mixing.
- Gas piping is installed 5' above ground along most of its length, and 15'-7" across roads.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

- Hazardous materials remediation and/or disposal.
- O&M costs for the project with the exception of the vendor supplied O&M manuals.
- Utility agency costs for incoming power modifications.
- Permits beyond those normally needed for the type of project and project conditions.
- Metalwork including handrail, grating, etc.
- Civil work

Allowances

The following allowances were assumed in the development of one or more of these estimates.

- Process and utility piping.
- Electrical and Instrumentation
- Demolition
- Yard Piping
- Temporary Polymer Blend System
- Dewatering
- Misc and Structural Steel
- Struvite Control Polymer System

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors. Estimate markups are shown in Table B-1.

Table B-1. Estimate Markups	
Item	**Rate range, percent**
Labor Markup	10
Material/Process Equipment Mark-up	8
Subcontractor Mark-up	8
Construction Equipment Markup	8
Sales tax	9.25
Material Shipping & Handling (on div 11 items only)	2
Escalation	14.3
Contractor General Conditions	10
Contractor Start-up, training, O&M on Div 11 items	2
Construction Contingency	30
Building Risk, Liability and Auto Insurance	2
Bonds	1.5
Engineering, Legal and Administrative	35

Labor Markup. The labor rates used in the estimate were derived chiefly from the published State Prevailing Wage Rates at the time of estimate development. These rates include costs beyond raw labor for such items as Payroll Tax and Insurance (PT&I), FICA, and Workers Compensation Insurance. In addition to these markups, the General Contractor (GC) typically adds a percentage to each raw labor dollar to cover overhead and profit, payroll and accounting costs, additional insurance, retirement, 401k contributions, and sick leave/vacation cost.

Materials and Process Equipment Markup. This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup. This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all of the equipment needed for the job, but in order to recoup their initial purchasing cost they will charge the project an internal rate for

equipment use that is similar to the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned

Subcontractor Markup. This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts

Material Shipping and Handling. This can range from 2 percent to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paper work, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets, and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors. In addition to contingency, it is customary for projects that will be built over several years to include escalation to midpoint of anticipated construction to account for the potential escalation of labor, material, and equipment costs beyond values at the time the estimate is prepared. For this project, the anticipated rate of escalation is 4 percent per annum.

In developing the appropriate percentage rate to apply to this project, Brown and Caldwell reviewed information published by the following organizations and chief economists from nationally recognized companies.

- Engineering News Record – The Construction Cost Index (CCI) for April 2011 shows an annual increase of 4 percent with the labor component 3.4 percent and materials 6.9 percent.
- Goldman-Sach, Jim Hatzius, Chief Economist published his anticipated escalation rate of 4 percent to Mid 2012 as outlined in the construction economics section of their web site, May 2, 2011.
- Associated General Contractors of America, Ken Simonson, Chief Economist, in his latest published report dated April 5, 2011, sees an increase of 3 to 8 percent in overall material pricing by the end of 2011. He projects the PPI increase at 5 percent, slightly less than last year's 6.9 percent
- Gerson Lehrman Group Research – Analysis indicates that raw materials will escalate at 8 to 10 percent in 2012 and 2013, with alloy materials rising in price by 12 to 14 percent for the same period. Major manufactured equipment will increase on average 6 to 8 percent, coupled with longer lead times resulting from shop capacity shortages and a higher demand for finished products. Technical and skilled labor costs will also increase 5 to 7 percent for 2012 and 2013, with selected shortages in some skill sets. Pricing levels for late 2013 could have similar effects as those observed after the last major recession in the late 1970's and early 1980's when pricing increased significantly to rates approaching double digits
- US Department of Labor – The Producer Price Index (PPI) from March 2010 to March 2011 increased on at an average of 6.9 percent.
- Reed Construction Data – Jim Haughey, Chief Economist predicts 3 to 4 percent average increase across the board for 2011/2012 with an anticipated 5 percent increase in materials by the end of 2011. The reference is an economic update on the current Reed Construction Data web site, May 2, 2011.
- Federal Reserve Bank of Philadelphia is forecasting a 3 to 4 percent increase by the end of 2011 as outlined in the construction economics section of their web site, May 2, 2011

Based on the information from industry leading sources, Brown and Caldwell anticipates this project will experience a rate of escalation of 4 percent per annum. In reviewing the forecast above, this reflects an average labor increase of approximately 2.5 percent and a material increase of approximately 5 percent.

The estimated construction time for this project is 32 months, exclusive of delays due to unusual weather or site conditions. Construction is anticipated to start in March, 2013 and complete in August, 2015. The escalation for this estimate is calculated from the date the estimate is finalized to the anticipated midpoint of construction at approximately 41 months from the date of this estimate, January 1, 2011. Pre-purchased equipment is addressed separately from construction, and is assumed to have a purchase date of 12 months before the midpoint of construction.

Contractor General Conditions. This markup covers temporary cost not directly associated with any item being installed. It includes contractor's trailer and laydown area, project manager's and superintendant's salary, job schedule and cost accounting, etc.

Contractor Startup, Training, and O&M Manuals. This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup, and O&M Manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and trouble shoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings, and coordination with the plant personnel in other areas of the plant operation.

Construction Contingency. The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage, and area factors, construction contingency can range from five percent to 50 percent.

Builders Risk, Liability, and Vehicle Insurance. This percentage comprises all three items. There are many factors that make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry, we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity, and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and on the contractor's insurability at the time the project is bid.

Performance and Payment Bonds. Based on historical and industry data, this can range from 0.75 percent to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity, and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Engineering, Legal, and Administrative. This markup is intended to cover costs to the owner but outside the construction contract.

Range of Accuracy. The amount of contingency in the estimate should not be confused with the accuracy of the estimate. The Expected Accuracy Range defines the window within which the bids are expected to fall based on the project complexity, information available during the estimate process, outside influences (wage rates, material, bidding climate), and includes a level of contingency appropriate to the project definition at the time the estimate was prepared. It is important to understand that AACEI notes on its ranges of accuracy that,

> "The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value [of the ranges] represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50 percent level of confidence) for given scope."

While a 50-percent level of confidence in the contingency may seem broad, typically this results in a 90-percent confidence that the actual cost will fall within the bounds of the low and high ranges.

The caution here is that these estimates are not what are often referred to as "bid quality," i.e., estimates prepared by contractors who are receiving competitive bids from subcontractors, equipment vendors, and materials suppliers. In general, we receive reasonable budget values from those willing to provide quotations.

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

Digester Upgrade Project
Construction Contract 1
Various Project Components - with BC Markups

Project Number:	136242-005
BC Project Manager:	STEVE KRUGEL/TIM BANYAI
BC Office:	WALNUT CREEK
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	04
Estimate Revision Date:	2011-05-01
Lead Estimator:	DES ORSINELLI
Estimate QA/QC Reviewer:	TIM BANYAI
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Description	Total w/ Markups Allocated
--- Base Estimate ---	18,466,013
1100 - GENERAL DEMOLITION	
02 - Site Construction	1,014,863
1100 - GENERAL DEMOLITION Total	1,014,863
1101A - 24" REPLACEMENT OF DIGESTER GAS MANIFOLD PIPING	
02 - Site Construction	76,657
05 - Metals	356,854
09 - Finishes	1,812
15 - Mechanical	3,042,273
1101A - 24" REPLACEMENT OF DIGESTER GAS MANIFOLD PIPING Total	3,477,596
1101B - 30" REPLACE OF DIGESTER GAS MANIFOLD PIPING	
02 - Site Construction	199,526
05 - Metals	832,660
09 - Finishes	4,228
15 - Mechanical	9,402,907
1101B - 30" REPLACE OF DIGESTER GAS MANIFOLD PIPING Total	10,439,322
1102 - TUNNEL MODIFICATIONS	
02 - Site Construction	181,580
03 - Concrete	15,426
07 - Thermal & Moisture Protection	4,027
08 - Doors & Windows	8,010
09 - Finishes	58,364
11 - Equipment	8,392
13 - Special Construction	1,828
15 - Mechanical	113,439
16 - Electrical	249,308
1102 - TUNNEL MODIFICATIONS Total	640,375
1103 - PRV/FLAME ARRESTORS	
11 - Equipment	1,010,769
15 - Mechanical	318,603
1103 - PRV/FLAME ARRESTORS Total	1,329,372
1104 - CONDENSATE TANKS	
03 - Concrete	51,590
05 - Metals	10,648
15 - Mechanical	964,906
1104 - CONDENSATE TANKS Total	1,027,143

Description		Total w/ Markups Allocated
1105 - LATERALS		
15 - Mechanical		265,456
16 - Electrical		154,141
17 - Instrumentation		117,745
	1105 - LATERALS Total	537,342
	Grand Total	18,466,013

DETAILED ESTIMATE REPORT

Digester Upgrade Project
Construction Contract 1
Various Project Components - with BC Markups

Project Number:	136242-005
BC Project Manager:	STEVE KRUGEL/TIM BANYAI
BC Office:	WALNUT CREEK
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	04
Estimate Revision Date:	2011-05-01
Lead Estimator:	DES ORSINELLI
Estimate QA/QC Reviewer:	TIM BANYAI
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**7,074,839**
	1100 - GENERAL DEMOLITION									**400,000**
	02200 - Site Preparation									
	02220450 - Selective Demolition - Process Equipment									
0180bc	General Demolition Crew	1.0	lsum	270,914.36	17,830.82	111,254.81			400,000.00	400,000
	Site Preparation Total									**400,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1101A - 24" REPLACEMENT OF DIGESTER GAS MANIFOLD PIPING									**1,324,526**
	02200 - Site Preparation									
	02210200 - Core Drilling									
1700	Concrete core drilling, core, reinforced concrete slab, 24" diameter, up to 6" thick slab, includes bit, layout and set up	12.0	EA	111.88	52.87	13.25			178.00	2,136
1750	Concrete core drilling, core, reinforced concrete slab, 24" diameter, up to 6" thick slab, includes bit, layout and set up, each added inch thick in same hole, add	72.0	EA	6.99	9.45	0.83			17.28	1,244
	Site Preparation Total									**3,380**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
5420	Backfill, structural, common earth, 300 H.P. dozer, 300' haul	4,070.4	L.C.Y.	0.59		1.14			1.72	7,020
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2,930.7	E.C.Y.	2.17		0.17			2.34	6,870
	02315424 - Excavating, Bulk Bank Measure									
1550	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 80 C.Y./hour, wheel mounted, excluding truck loading	2,930.7	B.C.Y.	1.23		0.55			1.78	5,223
	Earthwork Total									**19,113**
	02950 - Site Restoration & Rehabilitation									
	02955400 - Pipe Repair									
0300	Pipe repair, clamp, stainless steel, lightweight, for steel pipe, 3" long, 24" diameter pipe, excludes excavation or backfill	24.0	EA	105.87	206.30				312.16	7,492
	Site Restoration & Rehabilitation Total									**7,492**
	05050 - Basic Metal Materials & Methods									
	05090900 - Welding Structural									
1500	Welding structural steel in field, single pass, 0.3 Lb/LF, 1/4" thick, continuous fillet, type 6011	975.0	LF	12.61	0.61	2.90			16.11	15,711

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Basic Metal Materials & Methods Total									**15,711**
	05100 - Structural Metal Framing									
	05120440 - Lightweight Framing									
0476	Angle framing, structural steel, 3"x3"x3/8", field fabricated, incl cutting & welding	600.0	LF	31.64	5.57	2.54			39.75	23,851
	Structural Metal Framing Total									**23,851**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0100bc	Pipe rack, 20 ft high x 30" wide, complete incl concrete base pedestal	21.0	each	902.56	3,500.00	200.00			4,602.56	96,654
	Metal Fabrications Total									**96,654**
	05900 - Metal Restoration & Cleaning									
	05910500 - Metal Cleaning									
6240	Metal cleaning, steel surface treatment, 3.0 lb sand per S.F., commercial blast, tight mill scale, little/no rust (SSPC-SP6)	600.0	SF	2.06	0.60	0.22			2.88	1,728
	Metal Restoration & Cleaning Total									**1,728**
	09900 - Paints & Coatings									
	09910650 - Coatings & Paints									
8020bc	**[2x] Coatings & paints, Steel, 6 mils Hi Build Epoxy**	**1,200.0**	**sqft**	**0.41**	**0.18**				**0.60**	**715**
	Paints & Coatings Total									**715**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0430	piping, cut-in, 24", existing line	12.0	each	1,425.64					1,425.64	17,108
	15080600 - Piping Insulation									
7662	Insulation, pipe covering, fiberglass with all service jacket, 3" wall, 24" iron pipe size	1,200.0	LF	45.45	26.08				71.54	85,842
	Basic Materials & Methods Total									**102,950**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15100 - Building Services Piping									
	15107920 - Pipe, Stainless Steel									
9420	Pipe, stainless steel, schedules 5 and 10, welding labor, per joint, 24" pipe size, making the weld, includes the weld machine	150.0	EA	915.11		45.92			961.03	144,155
	15110800 - Valves, Stainless Steel									
0350	Valves, stainless stl, butterfly, motor operated 24" size,	16.0	each	2,372.47	20,310.32				22,682.79	362,925
	15120730 - Sleeves And Escutcheons									
0270	Sleeve, link seal, for 24" carrier pipe	12.0	EA	354.95	565.11				920.06	11,041
	Building Services Piping Total									**518,120**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0240	Pipe, SS, A778, weld, Sched. 10S, type 316L, 24" dia.	600.0	lnft	130.07	237.55	5.53			373.15	223,890
	15200217 - Fittings, 316 Stainless Steel									
1290	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, 90<elb, smooth flow,24"	15.0	each	3,757.07	3,907.00	159.65			7,823.72	117,356
1740	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, 45<elb, smooth flow,24"	3.0	each	3,593.38	2,735.84	152.69			6,481.91	19,446
1740	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, blind flange, 24"	4.0	each	353.94	1,313.20	152.69			1,819.84	7,279
2340	Fittings, SS, A774, butt weld jt, type 316L,Sched. 10S, Tee, 24"	18.0	each	5,466.60	3,378.69	232.29			9,077.58	163,397
	Process Piping Total									**531,368**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0180	Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold	3.0	EA	1,148.49					1,148.49	3,445
	Testing/Adjusting/Balancing Total									**3,445**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1101B - 30" REPLACE OF DIGESTER GAS MANIFOLD PIPING									**3,960,536**
	02200 - Site Preparation									
	02210200 - Core Drilling									
1700	Concrete core drilling, core, reinforced concrete slab, 30" diameter, up to 6" thick slab, includes bit, layout and set up	28.0	EA	131.88	72.87	18.25			223.00	6,244
1750	Concrete core drilling, core, reinforced concrete slab, 30" diameter, up to 6" thick slab, includes bit, layout and set up, each added inch thick in same hole, add	168.0	EA	9.99	11.45	1.83			23.27	3,910
	Site Preparation Total									**10,154**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
5420	Backfill, structural, common earth, 300 H.P. dozer, 300' haul	9,497.5	L.C.Y.	0.59		1.14			1.72	16,379
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	6,838.2	E.C.Y.	2.17		0.17			2.34	16,030
	02315424 - Excavating, Bulk Bank Measure									
1550	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 80 C.Y./hour, wheel mounted, excluding truck loading	6,838.2	B.C.Y.	1.23		0.55			1.78	12,187
	Earthwork Total									**44,596**
	02950 - Site Restoration & Rehabilitation									
	02955400 - Pipe Repair									
0300	Pipe repair, clamp, stainless steel, lightweight, for steel pipe, 3" long, 30" diameter pipe, excludes excavation or backfill	56.0	EA	105.87	306.30				412.16	23,081
	Site Restoration & Rehabilitation Total									**23,081**
	05050 - Basic Metal Materials & Methods									
	05090900 - Welding Structural									
1500	Welding structural steel in field, single pass, 0.3 Lb/LF, 1/4" thick, continuous fillet, type 6011	2,275.0	LF	12.61	0.61	2.90			16.11	36,660

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Basic Metal Materials & Methods Total									**36,660**
	05100 - Structural Metal Framing									
	05120440 - Lightweight Framing									
0476	Angle framing, structural steel, 3"x3"x3/8", field fabricated, incl cutting & welding	1,400.0	LF	31.64	5.57	2.54			39.75	55,651
	Structural Metal Framing Total									**55,651**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0100bc	Pipe rack, 20 ft high x 30" wide, complete incl concrete base pedestal	49.0	each	902.56	3,500.00	200.00			4,602.56	225,525
	Metal Fabrications Total									**225,525**
	05900 - Metal Restoration & Cleaning									
	05910500 - Metal Cleaning									
6240	Metal cleaning, steel surface treatment, 3.0 lb sand per S.F., commercial blast, tight mill scale, little/no rust (SSPC-SP6)	1,400.0	SF	2.06	0.60	0.22			2.88	4,032
	Metal Restoration & Cleaning Total									**4,032**
	09900 - Paints & Coatings									
	09910650 - Coatings & Paints									
8020bc	**[2x] Coatings & paints, Steel, 6 mils Hi Build Epoxy**	**2,800.0**	**sqft**	**0.41**	**0.18**				**0.60**	**1,668**
	Paints & Coatings Total									**1,668**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0430	piping, cut-in, 30", existing line	28.0	each	1,671.44					1,671.44	46,800
	15080600 - Piping Insulation									
7666	Insulation, pipe covering, fiberglass with all service jacket, 3" wall, 30" iron pipe size	2,800.0	LF	53.53	32.84				86.38	241,858
	Basic Materials & Methods Total									**288,659**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15100 - Building Services Piping									
	15107920 - Pipe, Stainless Steel									
9420	Pipe, stainless steel, schedules 5 and 10, welding labor, per joint, 30" pipe size, making the weld, includes the weld machine	350.0	EA	1,015.11		55.92			1,071.03	374,861
	15110800 - Valves, Stainless Steel									
0350	Valves, stainless stl, butterfly, motor operated 30" size,	31.0	each	2,372.47	25,310.32				27,682.79	858,167
	15120730 - Sleeves And Escutcheons									
0280	Sleeve, link seal, for 30" carrier pipe	28.0	EA	441.67	874.23				1,315.90	36,845
	Building Services Piping Total									**1,269,872**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0250	Pipe, SS, A778, weld, Sched. 10S, type 316L, 30" dia.	1,400.0	lnft	156.62	341.63	6.66			504.90	706,865
	15200217 - Fittings, 316 Stainless Steel									
1300	Fittings, SS, A774, butt weld jt, type 316L,5/16" wall, 90<elb, smooth flow,30"	35.0	each	4,780.84	7,066.00	203.15			12,050.00	421,750
1750	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, 45<elb, smooth flow,30"	7.0	each	4,599.45	4,945.93	195.44			9,740.83	68,186
1750	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, blind flange, 30"	2.0	each	442.43	2,374.05	195.44			3,011.92	6,024
2350	Fittings, SS, A774, butt weld jt, type 316L, 5/16" wall, Tee, 30"	42.0	each	8,088.41	10,372.00	343.70			18,804.12	789,773
	Process Piping Total									**1,992,598**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0180	Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold	7.0	EA	1,148.49					1,148.49	8,039
	Testing/Adjusting/Balancing Total									**8,039**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1102 - TUNNEL MODIFICATIONS									**257,927**
	02200 - Site Preparation									
	02220330 - Selective Demolition, Dump Charges									
9999	Dump Charge, typical urban city, fees only, bldg constr mat'ls	100.0	ton					33.00	33.00	3,300
	02220390 - Selective Demolition, Steel Pipe With Insulation									
0400	Selective demolition, steel pipe, 18"-24", excludes excavation	2,700.0	LF	12.30		6.43			18.73	50,568
1200	Selective demolition, steel pipe with insulation, fittings, 18"-24", excludes excavation	81.0	EA	98.20		51.35			149.55	12,113
	Site Preparation Total									**65,982**
	02300 - Earthwork									
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	700.0	cuyd	0.81		1.10			1.91	1,338
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	700.0	L.C.Y.	2.68		3.65			6.33	4,432
	Earthwork Total									**5,771**
	03050 - Basic Concrete Materials & Methods									
	03055110 - Selective Concrete Demolition									
0150	Selective concrete demolition, remove whole pieces, incl loading, sawcut, demo, haul	11.0	EA	408.91		145.94			554.85	6,103
	Basic Concrete Materials & Methods Total									**6,103**
	07500 - Membrane Roofing									
	07570350 - Foamed Coated Roofing									
0500	Sprayed polyurethane foam roofing, closed cell spray polyureathane foam, 3 lbs per CF density, 3" thick, R20.1	675.0	SF	0.11	2.10	0.05			2.26	1,525
	Membrane Roofing Total									**1,525**
	08200 - Wood And Plastic Doors									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	08210960 - Wood Frames									
0400	Framing - barrier	360.0	LF	3.04	5.55				8.59	3,093
	Wood And Plastic Doors Total									**3,093**
	09200 - Plaster & Gypsum Board									
	09260100 - Partition Wall									
2000	Partition Wall, interior, fire resistant, 2 layers, 1 1/2 hour, taped both sides,installed on & incl. 2" x 4" wood studs, 16" O.C., 8' to 12' high, 1/2" gypsum drywall	1,350.0	SF	5.44	1.69				7.13	9,622
2000	Labor to form and cut to fit barrier	192.0	hour	71.46					71.46	13,720
	Plaster & Gypsum Board Total									**23,343**
	11000 - Equipment									
	11001800 - Leak detection systems									
0130	Gas Detection Unit	1.0	each		3,055.03				3,055.03	3,055
	Equipment Total									**3,055**
	13700 - Security Access And Surveillance									
	13720065 - Detection Systems									
3500	**[2x] Detection Systems, alarm bell, excl. wires & conduit**	**2.0**	**EA**	**258.75**	**98.80**				**357.55**	**715**
	Security Access And Surveillance Total									**715**
	15200 - Process Piping									
	15200200 - Flanges, Steel									
0180	Unbolt Coupling, 24"	80.0	each	117.98					117.98	9,439
	Process Piping Total									**9,439**
	15700 - Heating/Ventilating/Air Conditioning Equipment									
	15700200 - Fans									
1290	**[3x] Fan,1/2HP, supply, incl penetration, excluding concrete work**	**10.0**	**each**	**365.95**	**717.60**				**1,083.55**	**10,836**
1290	Fan,1/2HP, exhaust, incl. penetratio excluding concrete work	7.0	each	365.95	717.60				1,083.55	7,585

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Heating/Ventilating/Air Conditioning Equipment Total									18,420
	15800 - Air Distribution									
	15810100 - Metal Ductwork									
5520	[2x] Metal Ductwork, spiral preformed, steel, galvanized, straight lengths, max. 10" S.P.W.G., 24" , 24 Ga. includes supports and testing	240.0	LF	46.34	20.31				66.65	15,997
	Air Distribution Total									15,997
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	[5x] Electrical and Instrumentation Subcontract	5.0	lsum				18,180.00		18,180.00	90,900
	Electrical and Instrumentation Total									90,900
	16050 - Basic Electrical Materials & Methods									
	16055300 - Electrical Demolition									
2440	[3x] Lamp Fixture - remove and relocate	30.0	EA	452.82					452.82	13,584
	Basic Electrical Materials & Methods Total									13,584

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1103 - PRV/FLAME ARRESTORS									**496,729**
	11000 - Equipment									
	11000100 - Process Equipment									
0530	Arrestor, flame, digester	32.0	each	307.28	4,308.96				4,616.24	147,720
1470	PRV, digester pressure/vacuum assembly	32.0	each	1,143.36	5,815.67			75.00	7,034.03	225,089
	Equipment Total									**372,809**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0170	Pipe, SS, A778, weld, Sched. 10S, type 316L, 8" dia.	32.0	lnft	46.01	42.39	1.96			90.36	2,892
	15200217 - Fittings, 316 Stainless Steel									
1670	Fittings/Flanges, SS, A774, butt weld jt, type 316L,sched. 10S	64.0	each	1,016.69	109.50	43.20			1,169.40	74,841
	15200280 - Valves, Plug									
0295	Valves, 3-way, lubricated plug valve, flanged, 200 psi, 8" pipe	16.0	each	963.51	1,923.17				2,886.69	46,187
	Process Piping Total									**123,920**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1104 - CONDENSATE TANKS									**425,257**
	03300 - Cast-In-Place Concrete									
	03310240 - Concrete In Place									
B503	Concrete in place, equipment pads	16.0	cuyd	905.95	366.51	1.19			1,273.65	20,378
	Cast-In-Place Concrete Total									**20,378**
	05050 - Basic Metal Materials & Methods									
	05090300 - Chemical Anchors									
1540	Chemical anchoring, for fastener 1-1/4" diam x 10" embedment, incl epoxy cartridge, excl layout, drilling & fastener	64.0	EA	19.00	45.00				64.00	4,096
	Basic Metal Materials & Methods Total									**4,096**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0008	Piping, water supply	16.0	lsum					5,000.00	5,000.00	80,000
0008	Piping, drip discharge	16.0	lsum					5,000.00	5,000.00	80,000
0009	Piping, Gas connection	16.0	lsum					5,000.00	5,000.00	80,000
	Basic Materials & Methods Total									**240,000**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0240	Tank, Condensate 24" dia x 48" tall.	16.0	each	4,247.28	5,200.00	601.60			10,048.88	160,782
	Process Piping Total									**160,782**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1105 - LATERALS									**209,865**
	15100 - Building Services Piping									
	15107690 - Pipe, Grooved-Joint Steel Fittings & Valves									
8320	Pipe, fittings and valves, valve, butterfly, stainless steel trim, grooved joint, 10" pipe size, add 1 coupling (material only) per joint for installed price, includes lever operator, excludes joint coupling material	4.0	EA	219.83	5,700.00				5,919.83	23,679
	Building Services Piping Total									**23,679**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0210	Pipe, SS, A778, weld, Sched. 10S, type 316L, 16" dia.	400.0	lnft	88.48	98.95	3.76			191.19	76,476
	Process Piping Total									**76,476**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum				65,000.00		65,000.00	65,000
	Electrical and Instrumentation Total									**65,000**
	17020 - PRESSURE INSTRUMENTS									
	17020000 - Pressure Instruments									
0030	Pressure Transmitters	4.0	each	398.08	1,263.25				1,661.33	6,645
	PRESSURE INSTRUMENTS Total									**6,645**
	17030 - PROCESS TAPS & PRIMARY EL									
	17030000 - Process Taps And Primary Elements									
0083J	16" Insertion style flowmeter w/brass ball valve & SSnipple	4.0	ea	589.92	8,926.00				9,515.92	38,064
	PROCESS TAPS & PRIMARY EL Total									**38,064**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**7,074,839**

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**39.14 %**	**2,769,434**	**33,643.9**
Material	**51.30 %**	**3,629,596**	
Subcontractor	**2.20 %**	**155,900**	
Equipment	**3.88 %**	**274,209**	**15,326.4**
Other	**3.47 %**	**245,700**	
User			
Net Costs		**7,074,839**	
Labor Mark-up	10.00 %	276,943	
Material/Process Equipment Mark-up	8.00 %	290,368	
Subcontractor Mark-up	5.00 %	7,795	
Construction Equipment Mark-up	8.00 %	21,937	
Sales tax	9.25 %	361,102	
Material Shipping & Handling	2.00 %	65,383	
Escalation	14.30 %	1,158,066	
Subtotal		**9,256,432**	
Contractor General Conditions	10.00 %	809,837	
Subtotal		**10,066,269**	
Start-up, training, O & M on Div11	2.00 %	96,915	
Subtotal		**10,163,184**	
Construction Contingency	30.00 %	3,048,955	

Category	Percent	Amount	Hours
Subtotal		**13,212,140**	
Bldg Risk, Liability Auto Ins.	2.00 %	264,243	
Subtotal		**13,476,382**	
Bonds	1.50 %	202,146	
Subtotal		**13,678,528**	
Engineering, Legal & Admin	35.00 %	4,787,485	
Total --- Base Estimate ---		**18,466,013**	
Estimate Grand Total		**18,466,013**	

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

Digester Upgrade Project
Construction Contract 2
Digester Mixers and Covers with BC Markups

Project Number:	136242-004-200
BC Project Manager:	Steve Krugel/Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-27
Estimate Revision Number:	02
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	NA

PROCESS LOCATION/ALTERNATES INDEX

Digester Upgrade Project
Construction Contract 2

Description		Total w/ Markups Allocated
--- Base Estimate ---		33,199,445
1100 - DEMOLITION		
02 - Site Construction		1,831,370
	1100 - DEMOLITION Total	1,831,370
1200 - COVER - CONCRETE FIXED		
01 - Brown & Caldwell		3,253,185
02 - Site Construction		1,724,456
03 - Concrete		12,235,957
05 - Metals		1,571,569
07 - Thermal & Moisture Protection		1,377,365
14 - Conveying Systems		41,212
15 - Mechanical		1,488,104
	1200 - COVER - CONCRETE FIXED Total	21,691,848
1300 - MIXERS		
05 - Metals		469,515
09 - Finishes		424,625
11 - Equipment		538,645
15 - Mechanical		2,246,752
	1300 - MIXERS Total	3,679,537
1500 - ELECTRICAL AND INSTRUMENTATION		
16 - Electrical		5,996,689
	1500 - ELECTRICAL AND INSTRUMENTATION Total	5,996,689
	Grand Total	33,199,445

DETAILED ESTIMATE REPORT

Digester Upgrade Project
Construction Contract 2
Digester Mixers and Covers with BC Markups

Project Number:	136242-004-200
BC Project Manager:	Steve Krugel/Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-27
Estimate Revision Number:	02
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	NA

PROCESS LOCATION/ALTERNATES INDEX

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**13,079,831**
	1100 - DEMOLITION									**740,000**
	02000 - Site Civil Work									
	02000000 - General Civil Work									
0990	Allowance - Demolition of Cover, Piping and Misc	1.0	LSUM	493,333.33			246,666.67		740,000.00	740,000
	Site Civil Work Total									**740,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1200 - COVER - CONCRETE FIXED									**8,430,977**
	01230 - Final Clean Up									
	01230 - Final Clean Up									
0030	Drain, cleanup and prepare interior tank, interior of digester, drain final 20% of tank capacity, clean.	4.0	lsum	85,470.88	19,206.76	22,822.36			127,500.00	510,000
	Final Clean Up Total									**510,000**
	01500 - Temporary Facilities & Controls									
	01540750 - Scaffolding									
2550	Scaffolding, steel tubular, rented	4.0	lsum			99,176.00			99,176.00	396,704
6610	Scaffolding, steel tubular, heavy duty shoring for elevated slab forms, floor area, rent/month of materials only, to 14'-8" high	25.6	Csf		43.00				43.00	1,101
	01540950 - Daily Crane Crews									
0600	Crane crew, daily use for small jobs, 100-ton truck-mounted hydraulic crane, portal to portal	20.0	days	1,197.26		2,729.64			3,926.90	78,538
	Temporary Facilities & Controls Total									**476,343**
	01590 - Miscellaneous Equipment Rental without operators									
	01590600 - Lifting and hoisting equipment rental without operators									
2100D	Rent crane truck mount, cable 8x4 drive 90 ton, 15' radius - Rent per month	4.0	mnth			16,100.00			16,100.00	64,400
	Miscellaneous Equipment Rental without operators Total									**64,400**
	01800 - Facility Operation									
	01832230 - Concrete Facilities Maintenance									
1030	Patching concrete, walls, incl. chipping, cleaning & epoxy grout	2,400.0	SF	9.29	8.15				17.44	41,854
	Facility Operation Total									**41,854**
	02200 - Site Preparation									
	02210200 - Core Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
1300	Concrete core drilling, core, reinforced concrete slab, 12" diameter, up to 6" thick slab, includes bit, layout and set up	232.0	EA	91.07	27.00	10.82			128.88	29,901
1350	Concrete core drilling, core, reinforced concrete slab, 12" diameter, up to 6" thick slab, includes bit, layout and set up, each added inch thick in same hole, add	1,392.0	EA	4.87	4.35	0.58			9.81	13,653
	02220240 - Minor Site Demolition									
3390	Process Equipment and Piping - Remove, Store and Reinstall	4.0	Job	35,152.00		7,184.32			42,336.32	169,345
	02240900 - Wellpoints									
0200	Dewatering Allowance	4.0	lsum	12,000.00					12,000.00	48,000
	Site Preparation Total									**260,899**
	02450 - Foundation & Load Bearing Elements									
	02455100 - Cast-In-Place Concrete Piles									
0110	Uncased drilled concrete piers, thin wall shell pile, straight sided, 16 ga., 8" diameter, 5.8 lb./L.F., priced using 200 piles, 60' long, unless specified otherwise, excludes pile caps, mobilization, or reinforcing	3,480.0	vlft	6.84	9.25	1.36			17.45	60,740
1200	Uncased drilled concrete piers, friction pile, fluted tapered steel, 4000 psi concrete, 7 ga., 50' long, 24" diameter, priced using 200 piles, 60' long, unless specified otherwise, excludes pile caps, mobilization, or reinforcing	4,800.0	vlft	13.20	55.20	2.64			71.03	340,947
	Foundation & Load Bearing Elements Total									**401,687**
	03050 - Basic Concrete Materials & Methods									
	03060850 - Waterproofing And Dampproofing									
9000	Membrane lining, HDPE	44,000.0	sqft				26.40		26.40	1,161,600
	Basic Concrete Materials & Methods Total									**1,161,600**
	03100 - Concrete Forms & Accessories									
	03110420 - Forms In Place, Elevated Slabs									
1500	C.I.P. concrete forms, elevated slab, flat plate, plywood, 15' to 20' high ceilings, includes shoring, erecting, bracing, stripping and cleaning	2,560.0	SF	6.77	1.67				8.44	21,600

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2350	C.I.P. concrete forms, elevated slab, flat slab with drop panels, 20' to 35' high ceilings, 4 use, includes shoring, erecting, bracing, stripping and cleaning	38,013.3	SF	13.48	5.95				19.43	738,477
	03110445 - Forms In Place, Slab On Grade									
3050	**[2x] C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning**	**9,204.6**	**sfca**	**6.07**	**0.74**				**6.81**	**62,664**
	03150860 - Waterstop									
0600	Waterstop, hydrophylic, 3/8" thick x 9" wide	1,382.3	LF	8.01	4.50				12.51	17,297
0600	Waterstop, PVC, ribbed, with center bulb, 3/8" thick x 9" wide	2,576.0	LF	4.58	4.50				9.08	23,388
	Concrete Forms & Accessories Total									**863,427**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	**[2x] Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories**	**725,915.8**	**lb**	**0.95**	**0.56**				**1.51**	**1,095,961**
2000	**[2x] Reinforcing steel, unload and sort, add to base**	**426.5**	**ton**	**71.04**		**8.54**			**79.57**	**33,937**
2210	**[2x] Reinforcing steel, crane cost for handling, average, add**	**426.5**	**ton**	**76.83**		**9.30**			**86.13**	**36,733**
2450	**[2x] Reinforcing steel, in place, dowels, deformed, A615, grade 60, longer and heavier, add**	**127,047.7**	**lb**	**2.53**	**0.61**				**3.14**	**399,324**
2520	Reinforcing steel, in place, dowels, smooth, 12" long, 5/8" diameter, A615, grade 60	1,320.0	EA	9.14	1.15				10.29	13,577
	03230600 - Prestressing Steel									
1600	Prestressing steel, ungrouted strand, 200' span, 100 kip, post-tensioned in field	36,816.0	lb	1.56	0.62	0.99			3.17	116,766
	Concrete Reinforcement Total									**1,696,297**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	**[2x] Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments**	**3,052.8**	**CY**		**106.00**				**106.00**	**323,600**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03310240 - Concrete In Place									
1020	Structural concrete, in place, column, square, avg reinforcing, 36" x 36", includes forms(4 uses), reinforcing steel, and finishing	168.0	CY	601.11	505.00	35.67			1,141.78	191,818
	03310700 - Placing Concrete									
1500	Structural concrete, placing, elevated slab, pumped, 6" to 10" thick, includes vibrating, excludes material	237.0	CY	23.07		5.34			28.41	6,735
1650	Structural concrete, placing, elevated slab, with crane and bucket, over 10" thick, includes vibrating, excludes material	2,815.8	CY	57.46		9.94			67.40	189,788
	03350300 - Finishing Floors									
0150	**[2x] Concrete finishing, floors, manual screed, bull float, manual float, broom finish**	**40,573.3**	**SF**	**1.26**					**1.26**	**51,059**
	03370300 - Gunite (Dry-Mix)									
0550	Gunite, dry mix, typical in place, 4" thick, include 2 X 2 mesh reinforcing, maximum	20,732.0	SF	12.63	1.94	2.28			16.85	349,251
	Cast-In-Place Concrete Total									**1,112,251**
	05010 - Misc Metals									
	05010 - Misc Metals									
0980	Connect outrigger supports	212.0	each	45.76	101.47	2.77			150.00	31,800
	Misc Metals Total									**31,800**
	05500 - Metal Fabrications									
	05514500 - Ladder									
1390	Ladder, shop fabricated, alternating tread stair, aluminum, 68 deg	32.0	vlft	23.40	206.00				229.40	7,341
	05520700 - Railing, Pipe									
0160	Railing, pipe, aluminum, dark anodized finish, 3 rails, 3'-6" high, posts @ 5' O.C., 1-1/4" dia, toe plate, shop fabricated	1,380.0	LF	19.25	79.75	1.17			100.16	138,226
	05580950 - Miscellaneous Fabrication									
0010bc	Allowance - Misc and Structural Metals - supports, platforms, baseplates, grating	1.0	lsum	76,192.75	103,807.25				180,000.00	180,000
	Fabricated gas dome, 316 SS, 12' diameter, 10'H, w/lid, flg conn.	4.0	ea	8,361.40	50,000.00	1,246.56			59,607.96	238,432

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Metal Fabrications Total									**563,998**
	07200 - Thermal Protection									
	07240100 - Exterior Insulation Finish System									
0433	Crack and concrete surface repair	4.0	lsum	71,863.22	61,136.78				133,000.00	532,000
	Thermal Protection Total									**532,000**
	11000 - Equipment									
	11010 - Process Equipment									
001	Overflow u-tube assembly, complete	4.0	each	8,513.24	28,500.00				37,013.24	148,053
	Equipment Total									**148,053**
	14020 - Material handling									
	14020 - Material handling									
990	Crane, davit type, incl base	4.0	each	702.01	3,072.99				3,775.00	15,100
	Material handling Total									**15,100**
	15001 - Sludge Piping									
	15001002 - Ductile Iron Pipe									
3140	Allowance - Piping, fittings & accessories - sludge withdrawal	4.0	lsum	16,921.27	34,364.32	3,714.41			55,000.00	220,000
3140	Allowance - Piping, fittings & accessories - gas	4.0	lsum	12,306.38	24,992.24	2,701.39			40,000.00	160,000
	Sludge Piping Total									**380,000**
	15190 - CARBON STEEL PIPE, WELDED									
	15190 - Pipe, steel									
B0500	Manway, 30"	8.0	each	2,020.51	7,045.21	434.28			9,500.00	76,000
	CARBON STEEL PIPE, WELDED Total									**76,000**
	15200 - Process Piping									
	15200212 - Pipe, 316 Stainless Steel									
0130	Standpipe, 316 ss, 36" dia x 30 long. Includes mounting hardware, connections, supports	4.0	EA	2,409.75	16,000.00				18,409.75	73,639

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Process Piping Total									**73,639**
	15350 - Sleeves and escutcheons									
	15350 - Sleeves and escutcheons									
0110	Pipe sleeve/port. 8"	16.0	each	412.93	411.60				824.53	13,192
0130	Pipe sleeve/port. 12"	8.0	each	512.60	541.80				1,054.40	8,435
	Sleeves and escutcheons Total									**21,628**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1300 - MIXERS									**1,408,855**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0010bc	Allowance - Misc and Structural Metals - supports, platforms, baseplates, grating	1.0	lsum	76,192.75	103,807.25				180,000.00	180,000
	Metal Fabrications Total									**180,000**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0095bc	Coatings, B & C, Kynar. RDT - 3 tubes + 2 impellers	865.0	sqft	34.40	7.31				41.71	36,079
0095bc	Coatings & paints, B & C, Kynar. 8 tubes	3,140.0	sqft	34.40	7.31				41.71	130,969
	Paints & Coatings Total									**167,049**
	11000 - Equipment									
	11010 - Process Equipment									
1461DS	Mixer, digester draft tube, 15hp (install only)	4.0	each	5,899.20		528.88			6,428.08	25,712
1461DS	Mixer - 12.5 hp LM16 Linear Motion Mixer (Instl Only)	1.0	each	43,261.00		1,057.76			44,318.76	44,319
	11001000 - Pumps miscellaneous									
0131DS	Progressive cavity pump, CI, 200-gpm	4.0	each	2,472.71	20,097.01				22,569.72	90,279
0131DS	Progressive cavity pump, CI, 200-gpm (SPARES ONLY)	2.0	each	442.43	20,097.01				20,539.43	41,079
	Equipment Total									**201,389**
	15100 - Building Services Piping									
	15107690 - Pipe, Grooved-Joint Steel Fittings & Valves									
8280	Pipe, fittings and valves, valve, butterfly, stainless steel trim, grooved joint, 4" pipe size, add 1 coupling (material only) per joint for installed price, includes 2 position handle, excludes joint coupling material	48.0	EA	37.31	320.00				357.31	17,151
	Building Services Piping Total									**17,151**
	15200 - Process Piping									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15200065 - Pipe, Black Steel Welded									
0370	Gas Mixing Draft/Eductor Tube, 60" Steel w/ Tenemic Coating	1.0	ea	6,709.37	7,700.06	3,028.87			17,438.30	17,438
	15200212 - Pipe, 316 Stainless Steel									
0150	Pipe, SS, A778, weld, Sched. 10S, type 316L, 4" dia.	120.0	lnft	28.32	16.64	1.20			46.16	5,539
0170	Pipe, SS, A778, weld, Sched. 10S, type 316L, 8" dia.	660.0	lnft	46.01	42.39	1.96			90.36	59,638
	15200217 - Fittings, 316 Stainless Steel									
1200	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S,fitting, smooth flow,4"	40.0	each	660.10	28.13	28.05			716.28	28,651
1220	Fittings, SS, A774, butt weld jt, type 316L,sched. 10S, 90<elb, smooth flow,8"	36.0	each	1,032.62	138.00	43.88			1,214.50	43,722
2270	Fittings, SS, A774, butt weld jt, type 316L,Sched. 10S, Tee, 8"	8.0	each	1,544.95	247.50	65.65			1,858.10	14,865
5100	Gas Mixing Lance	48.0	each	6,306.00	1,428.00	200.00			7,934.00	380,832
5270	Fittings, SS, butt weld jt, type 316L, Stub Ends, 4" w flange	128.0	each	549.33	79.04	23.34			651.71	83,419
5290	Fittings, SS, butt weld jt, type 316L, Stub Ends,w flange 8"	16.0	each	720.48	127.64	30.62			878.74	14,060
	Process Piping Total									**648,164**
	15400 - Plumbing Fixtures & Equipment									
	15440800 - Pumps, Sewage Ejector									
3160	Compressor, Gas, 30-hp. Digester Gas.	4.0	EA	7,341.07	40,000.00	1,434.48			48,775.55	195,102
	Plumbing Fixtures & Equipment Total									**195,102**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1500 - ELECTRICAL AND INSTRUMENTATION									**2,500,000**
	16050 - Basic Electrical Materials & Methods									
	16055300 - Electrical Demolition									
0100	Electrical and Instrumentation	1.0	lsum				2,500,000.00		2,500,000.00	2,500,000
	Basic Electrical Materials & Methods Total									**2,500,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									13,079,831

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**37.94 %**	**4,962,659**	**72,045.2**
Material	**25.69 %**	**3,359,785**	
Subcontractor	**29.88 %**	**3,908,267**	
Equipment	**6.49 %**	**849,120**	**45,950.2**
Other			
User			
Net Costs		**13,079,831**	
Labor Mark-up	10.00 %	496,266	
Material/Process Equipment Mark-up	8.00 %	268,783	
Subcontractor Mark-up	5.00 %	195,413	
Construction Equipment Mark-up	8.00 %	67,930	
Sales tax	9.25 %	389,324	
Material Shipping/Handling Div11	2.00 %	16,068	
Escalation	14.30 %	2,075,447	
Subtotal		**16,589,062**	
Contractor General Conditions	10.00 %	1,658,906	
Subtotal		**18,247,968**	
Start-up, training, O & M on Div11	2.00 %	24,091	
Subtotal		**18,272,059**	
Construction Contingency	30.00 %	5,481,618	

Category	Percent	Amount	Hours
Subtotal		**23,753,676**	
Bldg Risk, Liability Auto Ins.	2.00 %	475,074	
Subtotal		**24,228,750**	
Bonds	1.50 %	363,431	
Subtotal		**24,592,181**	
Engineering, Legal, and Admin	35.00 %	8,607,263	
Total --- Base Estimate ---		**33,199,445**	
Estimate Grand Total		**33,199,445**	

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

Digester Upgrade Project
Construction Contract 3
DAFT Permanent Upgrades - with BC markups

Project Number:	136242-007
BC Project Manager:	Steve Krugel, Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-27
Estimate Revision Number:	02
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli / DSnowden
Estimate QA/QC Reviewer:	Tim Banyai
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Description		Total w/ Markups Allocated
--- Base Estimate ---		7,326,726
1105 - Misc Yard Piping & Demo		
02 - Site Construction		220,084
	1105 - Misc Yard Piping & Demo Total	220,084
1110 - Piping Modifications		
09 - Finishes		2,997
15 - Mechanical		114,620
	1110 - Piping Modifications Total	117,617
1115 - Blend Tank		
02 - Site Construction		19,051
03 - Concrete		65,114
05 - Metals		281,793
11 - Equipment		284,882
15 - Mechanical		37,918
16 - Electrical		45,553
	1115 - Blend Tank Total	734,312
1120 - DAFT Feed Pumps		
02 - Site Construction		19,051
03 - Concrete		65,114
05 - Metals		17,579
11 - Equipment		146,205
15 - Mechanical		34,267
16 - Electrical		26,058
	1120 - DAFT Feed Pumps Total	308,273
1125 - Float Pumps		
02 - Site Construction		55,230
05 - Metals		30,426
08 - Doors & Windows		7,082
11 - Equipment		215,851
15 - Mechanical		36,551
	1125 - Float Pumps Total	345,140
1126 - Dedicated Digester Feed Piping		
15 - Mechanical		370,046
	1126 - Dedicated Digester Feed Piping Total	370,046
1130 - Polymer Blending Units		
03 - Concrete		12,094

Description		Total w/ Markups Allocated
05 - Metals		47,679
09 - Finishes		2,141
11 - Equipment		512,204
15 - Mechanical		68,981
	1130 - Polymer Blending Units Total	643,098
1135 - Polymer Storage Tank		
03 - Concrete		28,223
05 - Metals		18,606
11 - Equipment		110,340
15 - Mechanical		11,422
	1135 - Polymer Storage Tank Total	168,590
1140 - Pressure Retention Tank		
11 - Equipment		319,335
13 - Special Construction		17,946
	1140 - Pressure Retention Tank Total	337,281
1145 - Odor Control Covers		
05 - Metals		1,552,837
	1145 - Odor Control Covers Total	1,552,837
1150 - Odor Control Fans & Ductwork		
01 - Brown & Caldwell		208,633
	1150 - Odor Control Fans & Ductwork Total	208,633
1155 - Odor Control Biofilter		
01 - Brown & Caldwell		401,874
	1155 - Odor Control Biofilter Total	401,874
5000 - Electrical, Instrumentation & Controls		
16 - Electrical		1,918,941
	5000 - Electrical, Instrumentation & Controls Total	1,918,941
	Grand Total	7,326,726

DETAILED ESTIMATE REPORT

Digester Upgrade Project
Construction Contract 3
DAFT Permanent Upgrades - with BC markups

Project Number:	136242-007
BC Project Manager:	Steve Krugel, Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-27
Estimate Revision Number:	02
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli / DSnowden
Estimate QA/QC Reviewer:	Tim Banyai
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

DETAILED ESTIMATE REPORT

Digester Upgrade Project
Construction Contract 3
DAFT Permanent Upgrades - with BC markups

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**2,841,137**
	1105 - Misc Yard Piping & Demo									**85,000**
	02000 - Site Civil Work									
	02000000 - General Civil Work									
0990	Allowance - Misc Yard Piping	1.0	LSUM	24,000.00	44,000.00		2,000.00		70,000.00	70,000
0990	Allowance - Misc Demo	1.0	LSUM	10,000.00			5,000.00		15,000.00	15,000
	Site Civil Work Total									**85,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1110 - Piping Modifications									**44,338**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	700.0	sqft	0.92	0.74				1.66	1,159
	Paints & Coatings Total									**1,159**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	120.0	LF	25.86	26.50	5.67			58.04	6,965
2080	Ductile iron, 10" diameter - Fittings, Valves & Supports (PS)	120.0	LF	11.64	11.93	2.55			26.12	3,134
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (WAS)	120.0	LF	40.59	45.50	8.97			95.06	11,407
2140	Ductile iron, 16" diameter - Fittings, Valves & Supports (WAS)	120.0	LF	18.26	20.48	4.04			42.78	5,133
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (Feed Sludge)	120.0	LF	40.59	45.50	8.97			95.06	11,407
2140	Ductile iron, 16" diameter - Fittings, Valves & Supports (Feed Sludge)	120.0	LF	18.26	20.48	4.04			42.78	5,133
	Pipe, Water Supply Total									**43,179**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1115 - Blend Tank									**277,155**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07		1.59			2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89		0.38			2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83		0.56			3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78		0.75			4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81		1.10			1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68		3.65			6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06		1.86			6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02	2.12			59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	**[2x] Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories**	**9,025.4**	**lb**	**0.54**	**0.48**				**1.02**	**9,250**
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39		8.54			49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77		9.30			54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	**[2x] Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments**	**70.7**	**CY**		**106.00**				**106.00**	**7,491**
	03310700 - Placing Concrete									
4650	**[2x] Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material**	**70.7**	**CY**	**20.01**		**4.62**			**24.62**	**1,740**
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41	0.56			7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	214.0	EA	12.70	0.10				12.80	2,739
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	214.0	EA	4.58	5.81				10.39	2,223
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50	7.24			166.00	2,656
	Basic Metal Materials & Methods Total									**8,720**
	05500 - Metal Fabrications									
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	1,700.0	SF	2.74	50.00	0.16			52.90	89,928
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	210.0	LF	8.34	2.88				11.22	2,357
	05580950 - Miscellaneous Fabrication									
0020bc	Pump mounting base plate, complete w/ anchor bolts, 8 sf	2.0	each	857.52	1,671.17				2,528.69	5,057
	Metal Fabrications Total									**97,343**
	11000 - Equipment									
	11000100 - Process Equipment									
0290	DAFT demo, (incl. piping; Excluding compressor, air sat tanks and covrs elsewhere)	1.0	each	36,000.00		18,000.00			54,000.00	54,000
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, sludge mix pump, 25hp	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**107,046**
	15001 - Pipe, Water Supply									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	170.0	LF	25.86	26.50	5.67			58.04	9,866
2080	Ductile iron, 10" diameter - Fittings, Valves & Supports (PS)	170.0	LF	11.64	11.93	2.55			26.12	4,440
	Pipe, Water Supply Total									**14,306**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1160	Variable frequency drives, custom-engineered, 460 volt, 25 HP motor size	2.0	EA	3,387.91	5,325.00				8,712.91	17,426
	Electrical Power Total									**17,426**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1120 - DAFT Feed Pumps									**117,076**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07		1.59			2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89		0.38			2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83		0.56			3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78		0.75			4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81		1.10			1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68		3.65			6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06		1.86			6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02	2.12			59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	**[2x] Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories**	**9,025.4**	**lb**	**0.54**	**0.48**				**1.02**	**9,250**
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39		8.54			49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77		9.30			54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	**[2x] Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments**	**70.7**	**CY**		**106.00**				**106.00**	**7,491**
	03310700 - Placing Concrete									
4650	**[2x] Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material**	**70.7**	**CY**	**20.01**		**4.62**			**24.62**	**1,740**
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41	0.56			7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50	7.24			166.00	2,656
	Basic Metal Materials & Methods Total									**3,758**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	2.0	each	714.60	795.79				1,510.40	3,021
	Metal Fabrications Total									**3,021**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, dilute sludge pump, complete w/ motor	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**53,046**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					########	15,000.00	15,000
	Basic Materials & Methods Total									**15,000**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1130	Variable frequency drives, custom-engineered, 460 volt, 10 HP motor size	2.0	EA	1,693.96	3,275.00				4,968.96	9,938
	Electrical Power Total									**9,938**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1125 - Float Pumps									**129,925**
	02050 - Basic Site Materials & Methods									
	02080400 - Utility Boxes									
0540	Utility structures, utility vaults precast concrete, 10' x 10', 10' deep, excludes excavation and backfill	1.0	EA	4,893.62	10,207.21	1,096.18			16,197.00	16,197
	Basic Site Materials & Methods Total									**16,197**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	183.0	L.C.Y.	1.07		1.59			2.66	488
	02315310 - Compaction, General									
7000	**[3x] Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate**	**169.0**	**E.C.Y.**	**2.17**		**0.17**			**2.34**	**396**
	02315424 - Excavating, Bulk Bank Measure									
4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	204.0	B.C.Y.	6.61		7.41			14.02	2,860
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	72.0	cuyd	0.81		1.10			1.91	138
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	72.0	L.C.Y.	2.68		3.65			6.33	456
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	2.0	L.C.Y.	9.37	43.50	2.12			54.99	110
	Earthwork Total									**4,447**
	02600 - Drainage & Containment									
	02630400 - Storm Drainage Manholes, Frames & Covers									
1300	Storm Drainage Manholes, Frames, and Covers, precast concrete, 4' diameter manhole, 8" thick top	1.0	EA	175.33	209.00	39.47			423.80	424

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Drainage & Containment Total									**424**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	30.0	EA	11.90	0.08				11.98	359
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	8.0	EA	60.26	98.50	7.24			166.00	1,328
	Basic Metal Materials & Methods Total									**1,687**
	05500 - Metal Fabrications									
	05514500 - Ladder									
0400	Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, excl cage	10.0	vlft	28.20	64.50	1.71			94.40	944
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	6.0	each	714.60	795.79				1,510.40	9,062
	Metal Fabrications Total									**10,006**
	08300 - Specialty Doors									
	08310350 - Floor, Industrial									
1550	Doors, specialty, access, floor, industrial, aluminum, 300 psf L.L., double leaf, 5' x 5', 235 lb	1.0	Opng	260.16	2,400.00				2,660.16	2,660
	Specialty Doors Total									**2,660**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0131DS	Progressive cavity pump, CI, 50 GPM, 100 PSI, 10 HP, 2 stage	6.0	each	1,433.46	11,650.44				13,083.90	78,503
	Equipment Total									**78,503**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0009	Piping, process, allowance	1.0	lsum					########	16,000.00	16,000
	Basic Materials & Methods Total									**16,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1126 - Dedicated Digester Feed Piping									**141,426**
	15100 - Building Services Piping									
	15110600 - Valves, Semi-Steel									
7030	Valves, semi-steel, lubricated plug valve, flanged, 200 lb., 4"	12.0	EA	471.92	385.00				856.92	10,283
7050	Valves, semi-steel, lubricated plug valve, flanged, 200 lb., 8"	1.0	EA	877.30	1,225.00				2,102.30	2,102
	Building Services Piping Total									**12,385**
	15200 - Process Piping									
	15200190 - Pipe, Steel									
1510	Pipe,stl, sched 80,wldd,on yoke & roller hngrs,10' o.c.,blk, 4" dia	500.0	lnft	42.90	12.93	1.82			57.65	28,826
1540	Pipe,stl, sched 80, wldd,, on yoke & roller hngrs, 10' o.c.,blk, 8" di	500.0	lnft	88.09	66.61	2.41			157.11	78,554
	15200195 - Fittings, Steel									
0065	Pipe, steel ftngs, CI, standard weight, black, 90< elb, straight, 4"	18.0	each	235.96	78.00				313.96	5,651
0085	Pipe, steel ftngs, CI, standard weight, black, 90< elb, straight, 8"	6.0	each	367.05	525.00				892.05	5,352
0310	Pipe, steel fittings, CI, standard weight, black, tee, straight, 8"	4.0	each	734.11	805.00				1,539.11	6,156
	15200200 - Flanges, Steel									
0060	Stl ftg, gskt & bolt set, 150#, 4" pipe	12.0	each	98.32	8.70				107.02	1,284
0680	Stl ftg, weld-on flg, fst, slip-on, 150 lb flg, wld fr&back, 4" pipe	12.0	each	235.96	22.00	10.03			267.99	3,216
	Process Piping Total									**129,040**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1130 - Polymer Blending Units									**236,873**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	120.0	sfca	17.59	1.98				19.57	2,349
	Concrete Forms & Accessories Total									**2,349**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	399.4	lb	0.54	0.48				1.02	409
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	108.0	EA	2.63	1.78				4.41	476
	Concrete Reinforcement Total									**885**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	3.6	CY		106.00				106.00	377
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	3.6	CY	20.01		4.62			24.62	88
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	120.0	SF	2.64					2.64	317
0750	Concrete finishing, walls, sandblast, heavy penetration	96.0	SF	5.50	1.41	0.56			7.48	718
	Cast-In-Place Concrete Total									**1,499**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	108.0	EA	11.90	0.08				11.98	1,293
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	48.0	EA	60.26	98.50	7.24			166.00	7,968
	Basic Metal Materials & Methods Total									**9,261**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	6.0	each	714.60	795.79				1,510.40	9,062
	Metal Fabrications Total									**9,062**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	500.0	sqft	0.92	0.74				1.66	828
	Paints & Coatings Total									**828**
	11000 - Equipment									
	11000100 - Process Equipment									
0300IK	Polymer Blending Unit	6.0	each	1,532.30	15,000.00	279.11			16,811.41	100,868
0300IK	Allowance - Temporary Polymer Blend System	1.0	each	4,557.31	44,612.56	830.13			50,000.00	50,000
1660	Polymer static mixer, inline type, 2" dia	6.0	each	786.56	1,497.16				2,283.72	13,702
	11000900 - Pumps, general utility									
0160	Pump, cntfgl, horiz mtd, end suct,vert splt,5HP,1.5"D. Dilution Pump	6.0	each	832.80	2,850.00				3,682.80	22,097
	Equipment Total									**186,668**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
2520	Pipe, plastic, PVC, 2-1/2" diameter, schedule 80	360.0	LF	27.23	4.60				31.83	11,457

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2520	Fittings, appurtenances,2-1/2" diameter, schedule 80, includes couplings 10' OC, and hangers 3 per 10'	360.0	LF	12.25	2.07				14.32	5,156
	15110500 - Valves, Plastic									
2680	Valves, plastic, PVC	24.0	EA	59.49	345.00				404.49	9,708
	Building Services Piping Total									**26,321**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1135 - Polymer Storage Tank									**63,409**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	160.0	sfca	17.59	1.98				19.57	3,132
	Concrete Forms & Accessories Total									**3,132**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1,664.0	lb	0.54	0.48				1.02	1,705
2000	Reinforcing steel, unload and sort, add to base	1.0	ton	41.39		8.54			49.93	51
2210	Reinforcing steel, crane cost for handling, average, add	1.0	ton	44.77		9.30			54.07	55
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	156.0	EA	2.63	1.78				4.41	688
	Concrete Reinforcement Total									**2,498**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	14.8	CY		106.00				106.00	1,570
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	14.8	CY	20.01		4.62			24.62	365
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	160.0	SF	2.64					2.64	423
0750	Concrete finishing, walls, sandblast, heavy penetration	400.0	SF	5.50	1.41	0.56			7.48	2,990
	Cast-In-Place Concrete Total									**5,348**
	05050 - Basic Metal Materials & Methods									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	156.0	EA	11.90	0.08				11.98	1,868
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	32.0	EA	60.26	98.50	7.24			166.00	5,312
	Basic Metal Materials & Methods Total									**7,180**
	11000 - Equipment									
	11000600 - Chemical Tanks									
0200	Tanks,xl-hdpe,5,800 gal,nutrient tank	4.0	each	1,415.00	8,647.64				10,062.64	40,251
	Equipment Total									**40,251**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					5,000.00	5,000.00	5,000
	Basic Materials & Methods Total									**5,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1140 - Pressure Retention Tank									**129,085**
	11000 - Equipment									
	11001700 - Compressors & Accessories									
0320	Compressors, air, receiver, 1500 gal. capacity	6.0	each	11,386.66	8,393.96			562.39	20,343.00	122,058
	Equipment Total									**122,058**
	13005 - Selective Demolition									
	13005201 - Selective Demolition, Storage Tanks									
0520	Steel tank, single wall, above ground, 550 thru 2,000 gallon, selective demolition, not including foundation, pumps or piping	6.0	EA	881.41		289.74			1,171.16	7,027
	Selective Demolition Total									**7,027**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1145 - Odor Control Covers									**583,485**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	1,284.0	EA	12.70	0.10				12.80	16,435
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	1,284.0	EA	4.58	5.81				10.39	13,340
	Basic Metal Materials & Methods Total									**29,775**
	05500 - Metal Fabrications									
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	10,200.0	SF	2.74	50.00	0.16			52.90	539,567
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	1,260.0	LF	8.34	2.88				11.22	14,143
	Metal Fabrications Total									**553,710**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1150 - Odor Control Fans & Ductwork									**78,800**
	11 - EQUIPMENT									
	11010 - Process Equipment									
0140	Odor control , centrifugal fan	2.0	each	1,624.68	18,010.00				19,634.68	39,269
	EQUIPMENT Total									**39,269**
	15 - MECHANICAL									
	15045 - Pipe, Fiberglass									
0100	Pipe, fitting, fbgl., 24" x 16" Tee	1.0	each	733.60	1,148.00				1,881.60	1,882
0180	Pipe, fitting, fbgl., 24" x 16" Reducer	1.0	each	532.00	100.96				632.97	633
B0016	Duct, FRP, 16" dia.	16.3	lnft	67.20	36.83				104.03	1,698
B0024	Duct, FRP, 24" dia.	28.9	lnft	84.00	74.93				158.93	4,593
B1016	Fitting, FRP, 90 Elbow, 16" dia.	1.0	ea	425.60	261.62				687.22	687
B4024	**[2x] Fitting, FRP, Weld, 24" dia.**	**12.0**	**ea**	**178.23**	**74.93**				**253.16**	**3,038**
B4036	Fitting, FRP, Weld, 36" dia.	1.0	ea	249.22	105.41				354.63	355
	15060 - Pipe,hdpe butt fusn jnts									
0030	Piping, HDPE butt fusion jts, SDR 21, 40' L, 8" dia	312.1	lnft	6.11	6.21	3.27			15.59	4,865
0070	Piping, HDPE butt fusion jts, SDR 21, 40 L, 16" dia	28.6	lnft	10.86	21.36	5.82			38.03	1,086
0240	Piping, HDPE butt fusion jts, SDR 21, fittings, 16" x 8" Cross	12.0	each	79.34	460.00	22.08			561.42	6,737
	15095 - Pipe,drng&sewg,plyv chlrd									
0020	Piping,drainage & sewage, PVC, no exc/bkfill,10' L,SDR 35,B&S,4" dia	87.7	lnft	2.44	1.68				4.12	361
0100	Piping, fittings, bends or elbows, 8" diameter	2.0	each	127.95	7.05				135.00	270
	15245 - Pipe,hgh dns ply hdpe									
0730	Pipe, plastic, HDPE, flange adapter w/ring, DR 26, 1/2 bolts, 8" dia	73.0	each		118.72				118.72	8,667
0760	Pipe, plastic, HDPE, flange adapter w/ring, DR 26, 1/2 bolts, 16" dia	5.0	each		551.20				551.20	2,756

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0795	Pipe, plastic, HDPE, flange adapter w/ring, DR 17, 1/2 bolts, 24" dia	1.0	each		1,245.50				1,245.50	1,246
	15270 - Solenoid valves									
0030	Solenoid valve, 1 1/2" . 120 vac, fail open	2.0	each	84.00	185.50				269.50	539
	15665 - Duct accessories									
2920	Round damper, butterfly, vol control w/lever lock rgltr, 24" dia	1.0	each	44.96	74.04				119.00	119
	MECHANICAL Total									**39,531**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1155 - Odor Control Biofilter									**154,565**
	01 - GENERAL REQUIREMENTS									
	01220 - Wellpoint equipment rent									
0010	Rent 8" diam wellpoint discharge pipe	102.0	lf_dy				0.45		0.45	46
0040	Rent wellpoint header pipe, 6" diameter, 400 GPM	51.0	lf_dy				0.48		0.48	24
0100	Rent wellpoint 25' long w/fittings & riser pipe 1-1/2" or 2" suction	2.0	ea_dy				3.50		3.50	7
0120	Rent wellpoint pump, diesel, 30 HP, 6" suction	1.0	days				199.00		199.00	203
	GENERAL REQUIREMENTS Total									**280**
	02 - SITE CONSTRUCTION									
	02260 - Wellpoints									
0020	Wellpoints, inst&rmv of sgl stage sys, L, 2.0 hours per L.F. header	17.0	lnft	93.36					93.36	1,587
	02330 - Backfill, structural									
0050	Backfill, structural, 200 H.P., 50' haul, common earth	690.5	cuyd	0.31		0.62			0.93	643
	02340 - Bedding									
0020	Crushed stone 2' to 2.5' - Biofilter	113.2	cuyd	9.60	26.21	2.67			38.48	4,357
	02360 - Compaction									
0090	Compaction, riding, sheepsfoot or wobbly whl rlr, 6" lifts, 3 passes - backfill	497.4	cuyd	0.39		0.66			1.05	523
0090	Compaction, riding, sheepsfoot or wobbly whl rlr, 6" lifts, 3 passes - subgrade	46.9	cuyd	0.39		0.66			1.05	49
0350	Compaction, water, truck, 3000 gal, 3 mile haul	497.4	cuyd	0.48	0.22	0.72			1.42	705
	02420 - Excavating, structural									
0050	Excavating, structural, mach excav, com earth, hyd backhoe, 2 CY bkt	905.8	cuyd	4.90		7.96			12.86	11,645
	02430 - Fill									
0050	Fill, pea gravel fill, compacted, 6" deep - Biofilter	1,224.0	sqft	0.28	0.28	0.03			0.58	715
	02460 - Hauling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0050	Hauling, LCY, no loading, 20 c.y dump truck, 20 MI RT, 0.4 lds/hr.	831.6	cuyd	5.36		11.58			16.94	14,089
0900	Loading Trucks, F.E. Loader, 3 C.Y.	831.6	cuyd	0.70		1.47			2.17	1,802
	02470 - Soil stabilization									
0020	Soil stabilization, geotextile fabric, woven, H.D., 600 lb. tensile st	482.8	sqyd	0.31	1.85				2.16	1,043
	02590 - Membrane lining systems									
0010	Membrane lining, HDPE, 60 mil thick	2,142.0	sqft	1.18	1.02				2.20	4,721
	SITE CONSTRUCTION Total									**41,880**
	03 - CONCRETE									
	03090 - Forms place, slab grade									
0030	**[3x] Forms in place, SOG, edge forms, over 12", wood**	**798.6**	**sfca**	**4.56**	**2.62**				**7.19**	**5,741**
	03110 - Forms in place, walls									
0080	**[3x] Forms in place, walls, job built plyform, 8-16' high**	**1,964.3**	**sfca**	**7.11**	**2.28**				**9.39**	**18,448**
	03120 - Waterstop									
0020	**[3x] Waterstop, PVC, ribbed 3/16" thick, 6" wide**	**129.5**	**lnft**	**2.81**	**1.58**				**4.39**	**569**
0030	**[3x] Waterstop, PVC, ribbed, w/center bulb, 3/16" thick, 9" wide**	**555.5**	**lnft**	**3.02**	**12.97**				**15.99**	**8,882**
	03130 - Reinforcing in place									
0080	**[6x] Reinforcing in place, A615 Gr 60, walls, #3 to #7**	**5.2**	**ton**	**640.64**	**920.00**				**1,560.64**	**8,185**
0130	**[6x] Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels**	**1,307.4**	**lb**	**1.32**	**2.49**				**3.81**	**4,988**
	03150 - Concrete, ready mix									
0030	**[6x] Concrete, ready mix, regular weight, 4000 psi**	**87.2**	**cuyd**		**106.00**				**106.00**	**9,240**
	03170 - Placing concrete									
0120	**[3x] Placing conc, incl vib, slab on grade, slab over 6" thick, pumped**	**50.8**	**cuyd**	**17.17**		**6.60**			**23.77**	**1,207**
0130	**[3x] Placing conc, incl vib, walls, 8" thick, pumped**	**36.4**	**cuyd**	**31.76**		**12.22**			**43.98**	**1,600**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03180 - Finishing floors									
0030	**[3x] Finishing floors, monolithic, screed, float & broom finish**	**1,230.0**	**sqft**	**0.65**					**0.65**	**796**
	03190 - Finishing walls									
0010	**[3x] Finishing walls, break ties & patch voids**	**1,241.2**	**sqft**	**0.75**	**0.03**				**0.79**	**976**
0020	**[3x] Finishing walls, carborundum rub, wet rub**	**1,180.1**	**sqft**	**2.33**	**0.03**				**2.36**	**2,787**
	CONCRETE Total									**63,419**
	11 - EQUIPMENT									
	11010 - Process Equipment									
0030	Bio-filter media componant, complete	3,672.0	cuft	5.86	2.54	1.40			9.81	36,029
0990	Soaker Hose	20.0	ea		10.00				10.00	200
	EQUIPMENT Total									**36,229**
	15 - MECHANICAL									
	15045 - Pipe, Fiberglass									
B1036	Fitting, FRP, 90 Elbow, 36" dia.	1.0	ea	896.00	1,121.41				2,017.41	2,017
	15050 - Pipe,watr dstr,plyth,c901									
0030	Piping, piping, 160 p.s.i., 1-1/2" diameter	97.2	lnft	2.04	0.97				3.00	292
0190	Piping, fittings, tee, 1-1/2" diameter	10.0	each	27.77	5.24				33.01	330
	15055 - Pipe,watr dstr,plyv chlrd									
0090	PVC pipe, class 160, sdr 26, 8" diameter	188.7	lnft	3.52	13.45				16.97	3,203
0090	PVC pipe, class 160, sdr 26, 8" diameter	17.0	lnft	4.63	14.38				19.01	323
0710	Piping, fittings, bends or elbows, 8" diameter	1.0	each	11.46	124.96				136.41	136
0760	Piping, fittings, wye or tee, 8" diameter	16.0	each	13.09	198.74				211.83	3,389
	15095 - Pipe,drng&sewg,plyv chlrd									
0120	Piping, drainage & sewage, PVC, tees, 8" diam.	1.0	each	112.03	38.97				151.00	151
	15115 - Pipe,subdraing,plastic									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0030	Piping, subdrainage, perforated PVC, 8" dia	176.8	lnft	8.18	2.43	1.16			11.77	2,081
	15395 - Cleanouts									
0060	Cleanouts, flr type, rnd top, xtra hvy dty, 8" pipe size	1.0	each	201.58	438.15				639.73	640
	15665 - Duct accessories									
2940	Round damper, butterfly, vol control w/lever lock rgltr, 36" dia	1.0	each	56.20	137.31				193.51	194
	MECHANICAL Total									**12,756**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	5000 - Electrical, Instrumentation & Controls									**800,000**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum				800,000.00		800,000.00	800,000
	Electrical and Instrumentation Total									**800,000**

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**19.63 %**	**557,800**	**8,053.4**
Material	**48.21 %**	**1,369,722**	
Subcontractor	**28.41 %**	**807,280**	
Equipment	**2.36 %**	**66,960**	**1,908.9**
Other	**1.39 %**	**39,374**	
User			
Net Costs		**2,841,137**	
Labor Mark-up	10.00 %	55,780	
Material/Process Equipment Mark-up	8.00 %	109,578	
Subcontractor Mark-up	5.00 %	40,364	
Construction Equipment Mark-up	8.00 %	5,357	
Sales tax	9.25 %	132,893	
Material Shipping/Handling on Div11	2.00 %	10,081	
Escalation	14.30 %	456,912	
Subtotal		**3,652,102**	
Contractor General Conditions	10.00 %	365,210	
Subtotal		**4,017,313**	
Start-up, training, O & M on Div11	2.00 %	15,115	
Subtotal		**4,032,428**	
Construction Contingency	30.00 %	1,209,728	

Category	Percent	Amount	Hours
Subtotal		**5,242,157**	
Bldg Risk, Liability Auto Ins.	2.00 %	104,843	
Subtotal		**5,347,000**	
Bonds	1.50 %	80,205	
Subtotal		**5,427,205**	
Engineering, Legal, and Admin	35.00 %	1,899,522	
Total --- Base Estimate ---		**7,326,726**	
Estimate Grand Total		**7,326,726**	

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

DIGESTER UPGRADE PROJECT
CONSTRUCTION CONTRACT 4
HEATING IMPROVEMENTS with BC MARKUPS

Project Number:	135522-440-441
BC Project Manager:	TIM BANYAI
BC Office:	WALNUT CREEK
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-29
Estimate Revision Number:	01
Estimate Revision Date:	2011-05-01
Lead Estimator:	DES ORSINELLI
Estimate QA/QC Reviewer:	TIM BANYAI, RION MERLO
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Description		Total w/ Markups Allocated
--- Base Estimate ---		996,529
1104 - VALVE/FM		
02 - Site Construction		46,873
15 - Mechanical		644,574
17 - Instrumentation		305,081
	1104 - VALVE/FM Total	996,529
	Grand Total	996,529

DETAILED ESTIMATE REPORT

DIGESTER UPGRADE PROJECT
CONSTRUCTION CONTRACT 4
HEATING IMPROVEMENTS with BC MARKUPS

Project Number:	135522-440-441
BC Project Manager:	TIM BANYAI
BC Office:	WALNUT CREEK
Estimate Issue Number:	01
Estimate Original Issue Date:	2011-04-29
Estimate Revision Number:	01
Estimate Revision Date:	2011-05-01
Lead Estimator:	DES ORSINELLI
Estimate QA/QC Reviewer:	TIM BANYAI, RION MERLO
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**339,986**
	1104 - VALVE/FM									**339,986**
	02200 - Site Preparation									
	02220450 - Selective Demolition - Process Equipment									
0180bc	Allowance - Demolition	5.0	days	2,279.04	148.59	927.12			3,354.75	16,774
	Site Preparation Total									**16,774**
	15200 - Process Piping									
	15200200 - Flanges, Steel									
0060	Stl ftg, gskt & bolt set, 150#, 4" pipe	64.0	each	98.32	8.70				107.02	6,849
0680	Stl ftg, weld-on flg, fst, slip-on, 150 lb flg, wld fr&back, 4" pipe	64.0	each	235.96	22.00	10.03			267.99	17,151
	15200212 - Pipe, 316 Stainless Steel									
0150	Pipe, SS, A778, weld, Sched. 10S, type 316L, 4" dia.	100.0	lnft	28.32	16.64	1.20			46.16	4,616
	15200280 - Valves, Plug									
1110do	Valves, semi-steel,eccentric plug, motor operated, 175 psi, Dezurik PEC style, 4" diameter	32.0	each	585.28	5,330.00				5,915.28	189,289
	Process Piping Total									**217,905**
	17030 - PROCESS TAPS & PRIMARY EL									
	17030000 - Process Taps And Primary Elements									
0010	4" Magnetic flowmeters, 150# AWWA flanges	32.0	each	196.64	3,094.20				3,290.84	105,307
	PROCESS TAPS & PRIMARY EL Total									**105,307**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**339,986**

Category	Percent	Amount	Hours
Base Estimate Totals			
Labor	**17.84 %**	**60,642**	**702.3**
Material	**80.58 %**	**273,946**	
Subcontractor			
Equipment	**1.59 %**	**5,398**	**141.0**
Other			
User			
Net Costs		**339,986**	
Labor Mark-up	10.00 %	6,064	
Material/Process Equipment Mark-up	8.00 %	21,916	
Subcontractor Mark-up	5.00 %		
Construction Equipment Mark-up	8.00 %	432	
Sales tax	9.25 %	25,839	
Demolition Costs	10.00 %	33,999	
Material Shipping & Handling	2.00 %	3,484	
Escalation	14.30 %	61,736	
Subtotal		**493,455**	
Contractor General Conditions	10.00 %	49,346	
Subtotal		**542,801**	
Start-up, training, O & M on Div11	2.00 %	5,661	
Subtotal		**548,462**	

Category	Percent	Amount	Hours
Construction Contingency	30.00 %	164,539	
Subtotal		**713,001**	
Bldg Risk, Liability Auto Ins.	2.00 %	14,260	
Subtotal		**727,261**	
Bonds	1.50 %	10,909	
Subtotal		**738,170**	
Engineering, Legal & Admin	35.00 %	258,359	
Total Base Estimate		**996,529**	
Estimate Grand Total		**996,529**	

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SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

Digester Upgrade Project
Construction Contract 5
Struvite Control with BC Markups

Project Number:	136242-004-460
BC Project Manager:	Rion Merlo/Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	01
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	Tim Banyai
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Digester Upgrade Project
Construction Contract 5

Description		Total w/ Markups Allocated
--- Base Estimate ---		317,456
1103 - Structural		
02 - Site Construction		5,412
03 - Concrete		82,398
05 - Metals		13,429
	1103 - Structural Total	101,239
1105 - Mechanical		
11 - Equipment		129,442
15 - Mechanical		44,893
	1105 - Mechanical Total	174,334
1106 - Electrical & Instrumentation		
16 - Electrical		41,882
	1106 - Electrical & Instrumentation Total	41,882
	Grand Total	317,456

DETAILED ESTIMATE REPORT

Digester Upgrade Project
Construction Contract 5
Struvite Control with BC Markups

Project Number:	136242-004-460
BC Project Manager:	Rion Merlo/Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	01
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	Tim Banyai
Estimate QA/QC Date:	2010-12-21

PROCESS LOCATION/AREA INDEX

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**116,473**
	1103 - Structural									**37,710**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	8.7	L.C.Y.	1.05		1.59			2.64	23
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	7.9	E.C.Y.	1.84		0.38			2.22	17
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	9.3	E.C.Y.	2.76		0.56			3.32	31
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	18.5	E.C.Y.	3.69		0.75			4.43	82
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	41.2	cuyd	0.81		1.10			1.91	79
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	41.2	L.C.Y.	2.61		3.65			6.27	258
	02315610 - Excavating, Trench									
0060	**[2x] Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering**	**45.4**	**B.C.Y.**	**4.93**		**1.86**			**6.79**	**308**
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	21.5	L.C.Y.	9.14	43.50	2.12			54.76	1,179
	Earthwork Total									**1,978**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	180.0	sfca	26.18	1.98				28.16	5,068

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	180.0	sfca	7.37	0.74				8.11	1,460
	03110455 - Forms In Place, Walls									
2550	C.I.P. concrete forms, wall, job built, plywood, 8 to 16' high, 4 use, includes erecting, bracing, stripping and cleaning	540.0	sfca	12.63	0.78				13.41	7,244
	03150860 - Waterstop									
0600	Waterstop, PVC, ribbed, with center bulb, 3/8" thick x 9" wide	90.0	LF	6.81	4.50				11.31	1,018
	Concrete Forms & Accessories Total									**14,790**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	**[4x] Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories**	**3,533.7**	**lb**	**0.68**	**0.78**				**1.46**	**5,146**
0702	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1,459.3	lb	0.48	0.81				1.29	1,879
2000	**[3x] Reinforcing steel, unload and sort, add to base**	**2.7**	**ton**	**51.37**		**8.54**			**59.91**	**160**
2210	**[3x] Reinforcing steel, crane cost for handling, average, add**	**2.7**	**ton**	**55.56**		**9.30**			**64.86**	**173**
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	54.0	EA	3.26	1.78				5.04	272
2450	Reinforcing steel, in place, dowels, deformed, A615, grade 60, longer and heavier, add	221.3	lb	1.95	0.85				2.80	620
	Concrete Reinforcement Total									**8,249**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	**[4x] Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments**	**32.5**	**CY**		**106.00**				**106.00**	**3,447**
	03310700 - Placing Concrete									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
4650	**[3x] Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material**	**25.9**	**CY**	**24.05**		**4.62**			**28.66**	**741**
5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	6.7	CY	37.04		7.13			44.18	295
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	530.0	SF	0.89					0.89	471
	03350350 - Finishing Walls									
0150	**[2x] Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids**	**780.0**	**SF**	**3.18**					**3.18**	**2,478**
0750	Concrete finishing, walls, sandblast, heavy penetration	36.0	SF	6.61	1.41	0.56			8.59	309
	Cast-In-Place Concrete Total									**7,741**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	54.0	EA	15.77	0.08				15.85	856
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	24.0	EA	64.90	98.50	7.24			170.64	4,095
	Basic Metal Materials & Methods Total									**4,951**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1105 - Mechanical									**62,097**
	11000 - Equipment									
	11000800 - Chemical Metering Pumps									
0230	Polymer pmp,mtr.,peristaltic type,3/4hp,dc drive w/cont.,bpv,prv,cal. col.	6.0	each	1,403.98	6,000.00			225.00	7,628.98	45,774
	Equipment Total									**45,774**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
	Polymer tank/pump piping and valve allowance	1.0	lsum	2,500.00	2,500.00				5,000.00	5,000
	Building Services Piping Total									**5,000**
	15200 - Process Piping									
	15200230 - Pipe, Plastic, Double Wall									
	Polymer distribution piping and valve allowance	1.0	lsum	5,000.00	5,000.00				10,000.00	10,000
	Process Piping Total									**10,000**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0160	Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold, 1" to 4" pipe, 250 - 500 L.F.	1.0	EA	1,322.79					1,322.79	1,323
	Testing/Adjusting/Balancing Total									**1,323**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1106 - Electrical & Instrumentation									**16,667**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
	Electrical & Instrumentation subcontract allowance	1.0	lsum				16,667.00		16,667.00	16,667
	Electrical and Instrumentation Total									**16,667**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									116,473

Category	Percent	Amount	Hours
Base Estimate Totals			
Labor	**35.93 %**	**41,845**	**374.2**
Material	**47.94 %**	**55,841**	
Subcontractor	**14.31 %**	**16,667**	
Equipment	**0.66 %**	**770**	**25.2**
Other	**1.16 %**	**1,350**	
User			
Net Costs		**116,473**	
Labor Mark-up	10.00 %	4,184	
Material/Process Equipment Mark-up	8.00 %	4,467	
Subcontractor Mark-up	5.00 %	833	
Construction Equipment Mark-up	8.00 %	62	
Sales tax	9.25 %	5,237	
Material Shipping & Handling	2.00 %	870	
Escalation to Midpoint	5.00 %	5,756	
Escalation	14.30 %	19,717	
Subtotal		**157,600**	
Contractor General Conditions	10.00 %	15,760	
Subtotal		**173,360**	
Start-up, training, O & M on Div11	2.00 %	1,359	
Subtotal		**174,719**	

Category	Percent	Amount	Hours
Construction Contingency	30.00 %	52,416	
Subtotal		**227,135**	
Bldg Risk, Liability Auto Ins.	2.00 %	4,543	
Subtotal		**231,677**	
Bonds	1.50 %	3,475	
Subtotal		**235,153**	
Engineering, Legal & Admin	35.00 %	82,303	
Total Base Estimate		**317,456**	
Estimate Grand Total		**317,456**	

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DETAILED ESTIMATE REPORT

Digester Upgrade Project
Digester Mixer Prepurchase - Linear Motion Mixer
Pre-Purchase Contract 1B

Project Number:	136242-005
BC Project Manager:	Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	06
Estimate Revision Date:	2011-05-23
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	NA

PROCESS LOCATION/ALTERNATES INDEX

Mixers - Linear Motion Vortex Ring

City of San Jose

Digester Upgrade Project
Digester Mixer Prepurchase - Linear Motion Mixer

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**250,635**
	-									**250,635**
	11000 - Equipment									
	11010 - Process Equipment									
1461DS	Mixer - 12.5 hp LM16 Linear Motion Mixer	1.0	each		250,635.00				250,635.00	250,635
	Equipment Total									**250,635**

Digester Upgrade Project
Digester Mixer Prepurchase - Linear Motion Mixer

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**250,635**

Digester Upgrade Project
Digester Mixer Prepurchase - Linear Motion Mixer

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor			
Material	**100.00 %**	**250,635**	
Subcontractor			
Equipment			
Other			
User			
Net Costs		**250,635**	
Tax	9.25 %	23,184	
Shipping	2.00 %	5,013	
Handling & Storage	2.00 %	5,013	
Escalation	10.70 %	30,371	
Subtotal		**314,215**	
O&M, training	2.00 %	6,284	
Subtotal		**320,500**	
Estimating Contingency	10.00 %	32,050	
Subtotal		**352,550**	
Engineering, Legal, and Admin	35.00 %	123,392	
Total --- Base Estimate ---		**475,942**	

Digester Upgrade Project
Digester Mixer Prepurchase - Linear Motion Mixer

Category	Percent	Amount	Hours
Estimate Grand Total		**475,942**	

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DETAILED ESTIMATE REPORT

Digester Upgrade Project
Prepurchase contract 2
Draft Tube Mixer Prepurchase

Project Number:	136242-005
BC Project Manager:	Tim Banyai
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	2010-12-21
Estimate Revision Number:	03
Estimate Revision Date:	2011-05-01
Lead Estimator:	Des Orsinelli
Estimate QA/QC Reviewer:	NA

PROCESS LOCATION/ALTERNATES INDEX

Mixers - Draft Tube

City of San Jose

Digester Upgrade Project
Prepurchase contract 2

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Equip $/Unit	Subs $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									**435,500**
	-									**435,500**
	11000 - Equipment									
	11010 - Process Equipment									
1461DS	Mixer, digester draft tube, 15hp	4.0	each		108,875.00				108,875.00	435,500
	Equipment Total									**435,500**

Digester Upgrade Project
Prepurchase contract 2

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor			
Material	**100.00 %**	**435,500**	
Subcontractor			
Equipment			
Other			
User			
Net Costs		**435,500**	
Tax	9.25 %	40,284	
Shipping	2.00 %	8,710	
Handling & Storage	2.00 %	8,710	
Escalation	10.70 %	52,773	
Subtotal		**545,977**	
O&M, training	2.00 %	10,920	
Subtotal		**556,896**	
Estimating Contingency	10.00 %	55,690	
Subtotal		**612,586**	
Engineering, Legal, and Admin	35.00 %	214,405	
Total --- Base Estimate ---		**826,991**	

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