City of Manteca
Wastewater Quality Control Facility

Biosolids and Biogas Utilization Plan

April 2016

HERWIT Engineering

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Control Facility

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APPENDIX

EXEXCUTIVE SUMMARY

The City of Manteca commissioned HERWIT Engineering to prepare a biosolids and Biogas utilization plan for the City of Manteca, Wastewater Quality Control Facility (WQCF). This report was prepared in conjunction with a **Solid Waste Master Plan**, to derive maximum benefit through joint use of WQCF facilities.

The Biosolids Plan is comprised of 11 Sections. Below is a summary of principal data presented in each of the 11 Sections.

Section 1 - Introduction

The purpose of this report is to assess conditions and capacity of the existing biosolids handling facilities, biosolids disposal methods, and biogas utilization, to determine modifications required to accommodate existing and projected biosolids produced from the current flow of 6.5 million gallons per day (mgd), and a future flow of 10 mgd. For the purposes of this report, we have rounded the NPDES permitted dry weather flow from 9.87 mgd to 10 mgd.

In addition to evaluating existing processes, this report also addresses impacts of receiving fats, oils, and grease (FOG), and food waste, in digesters, as well as alternatives for utilizing biogas to its maximum effectiveness.

Section 2 - Description of Existing Facilities and Operations

The City of Manteca owns and operates the WQCF located at 2450 W. Yosemite Ave. in Manteca, CA. Facility discharge is permitted at an average dry weather flow of 9.87 mgd, with a current daily flow rate of approximately 6.5 mgd. The facility has two parallel treatment processes. The first process is the original treatment process, referred to as the North Plant, and the second is the newer South Plant.

Biosolids handling facilities consist of the following:

1) Waste Activated Sludge (WAS) Pump Station
2) Waste activated sludge thickening with dissolved air floatation (DAF)
3) Anaerobic digestion of primary and thickened WAS
4) Anaerobic digester control building with associated equipment
5) Biosolids dewatering with centrifuges
6) Biosolids drying with open asphalt lined drying beds

Biogas utilization facilities consist of the following:

1) Gas flare used to burn waste biogas

2) Boilers to heat anaerobic digesters
3) 400 kilowatt (kW) electrical generator (currently abandoned)

Biosolids produced by the facility are currently dewatered to 19% solids and then transported north to Forward Landfill. Current cost of disposal is $27/wet ton.

Section 3 - Biosolids Design Loadings

To develop a solids loading criteria for existing and future conditions, a mass balance of the facility was prepared based on existing loading. Current average flow to the WQCF, when recycle flows are subtracted is approximately 6.5 mgd. Influent characteristics were taken from the Process Review and Process Model, which was developed with the North Aeration Improvements Project design. The mass balance was then calibrated against actual measured sludge disposal records. Based on this calibrated mass balance, biosolids loading for the future 10 mgd condition were estimated, assuming the same influent flow characteristics.

Section 4 - Regulations Governing Biosolids Disposal

Major regulations governing disposal of WQCF biosolids are the existing National Pollution Discharge Elimination System (NPDES) permit, the United States Environmental Protection Agency (US EPA) Standards for the Use or Disposal of Sewage Sludge (40 Code of Federal Regulations (CFR) Part 503), and the State Water Resources Control Board (SWRCB) Water Quality Order No. 200-10-DWQ (also known as the State General Order).

Based on biosolids loading to the anaerobic digesters at the WQCF, the City of Manteca meets Class B requirements only a portion of the year. This is a result of not meeting the minimum 15-day retention criteria when peak solids loadings occur, or when a digester is taken out of service for cleaning. Biosolids produced by the WQCF therefore do not consistently meet Class B, or Class A criteria, and are not eligible for land disposal without further processing. The City therefore correctly disposes of biosolids at Forward Landfill.

San Joaquin County currently bans the application of biosolids to land inside the County. In addition, Biosolids cannot be applied in the primary zone of the Delta. The City of Manteca is located within San Joaquin County and is adjacent to the primary zone of the delta. This means that land application of biosolids produced by the WQCF must be disposed of within City limits or outside the County and outside the primary zone of the delta. The most likely location is Merced or Kern County which still accepts biosolids for land application. Either location will incur costs to haul the sludge a further distance.

To mitigate the risks of regulatory changes, while maintaining the greatest flexibility in disposal options for biosolids, it is recommended that the City construct additional anaerobic digesters to provide the minimum 15 day retention time needed to produce Class

B biosolids. In addition, the City should plan for drying biosolids and making a Class A product in the future.

Once the City produces consistent Class B biosolids, the City should contract out land application of the biosolids to divert them from Forward Landfill. Site space should be reserved for Active Solar drying of biosolids to produce a Class A biosolid, with implementation of Class A processing. Production of dried Class A biosolids should mitigate impacts associated with future hauling costs outside the County, and anticipated regulatory changes.

Section 5 - Analysis of Compliance With Air Board Regulations

Primary air emissions equipment at the WQCF includes to following:

1. Standby generators.
2. Biogas fired boilers to heat digesters.
3. Biogas fired electrical cogeneration system (abandoned)
4. Biogas flare.

The governing air district for the City of Manteca is the San Joaquin Valley Air Pollution Control District (SJVAPCD). Regulations governing equipment at the WQCF include the following:

1. R4307 Boilers, Steam Generators, and Process Heaters - 2.0 MMBtu/hr to 5.0 MMBtu/hr.
2. R4311 Flares
3. R4702 Internal Combustion Engines

The existing biogas fired electrical generator is a 450 kW Waukesha Model F3512 GLD. This generator has a valid air permit, N-1049-8-1. When the generator was initially started, it did not meet permitted emissions limits, and has not been operated since. It remains out of compliance with emissions standards, including the current permit.

Existing Biogas boilers do meet current emissions standards of SJVAPCD. The boilers are currently in very poor condition, and well beyond their useful life and will have to be replaced with newer larger boilers meeting stricter air emissions regulations than the existing boilers must meet.

Currently, no sulfur or hydrogen sulfide (H_2S) treatment is utilized at the WQCF. Rule 4307 requires a reduction by 95% of incoming H_2S in digester gas prior to boilers by July1 2015. Sulfur treatment is also required for any biogas utilization options discussed in this report. Treatment for H_2S in biogas will therefore be incorporated into any biogas utilization options including the boilers going forward.

The biogas flare does not meet current emissions limits for SJVAPCD Rule 4311, and is permitted to operate under grandfather provisions. For capacity and air permit reasons, a new compliant flare meeting rule 4311 should immediately be installed.. In addition, for the City to be in compliance with Rule 4311 a flare minimization plan should be prepared and filed with the air board.

Section 6 - Evaluation of Existing Facilities For Existing and Future Flows and Loads

Based on biosolids design loadings for existing and future conditions, each process area was evaluated for its ability to properly treat biosolids. Facilities evaluated include the following:

1) WAS pump Station
2) WAS thickening with DAF
3) Anaerobic digestion of primary and thickened WAS
4) Anaerobic digester control building with associated equipment
5) Biosolids dewatering with centrifuges
6) Biosolids drying with open asphalt lined drying beds

Results of the analysis are as follows:

1) Minor improvements are needed at the WAS pump station and the DAF.

2) One additional 60-foot diameter digester must immediately be built to provide 15-day hydraulic retention time (HRT) for current maximum month loading, and average loading conditions when one digester is out of service for cleaning. Building this digester will carry the facility to 7.7 mgd. A second additional 60-foot diameter digester must be on line by 7.7 mgd. Four total digesters are required to meet biosolids loading for a 10 mgd design capacity. Building these digesters together will reduce overall construction costs.

3) To support new digesters, a second digester control building is required.

4) Existing domes for digester's No. 1 and 2 are no longer structurally sound, and are in need of immediate replacement.

5) The following changes are recommended for the existing digester control building, after the new digesters and digester control building is constructed.

1. Replace existing boilers with larger boilers meeting air board regulations.
2. Replace existing digester heat exchangers and miscellaneous hot water equipment.
3. Replace existing sludge recirculation and mixing pumps.
4. Replace existing roof membrane
5. Replace existing digester gas piping with stainless steel piping.

6) Existing centrifuges are operated 7 days a week, 8 hours per day. To maintain an 8-hour work day, with one centrifuge out of service during average 10 mgd conditions, a third centrifuge is needed. The third centrifuge will be needed at approximately 8.9 mgd plant flow. Alternatively, the hours of operation when one centrifuge is out of service can be extended in lieu of adding the third centrifuge. At 10 mgd, the hours of operation required with one centrifuge out of service would be 9 hours per day, at average annual conditions, and 12 hours per day during maximum month conditions. Based on discussions with plant staff, this is acceptable, and an additional centrifuge will be planned to coincide with 10 mgd plant flow.

Section 7 - Evaluation of Existing Biogas Utilization Equipment

Existing biogas utilization equipment includes the following:

1. Biogas fired boilers to heat the digesters.
2. Biogas fired electrical cogeneration system (abandoned).
3. Biogas flare.

The existing and abandoned 450 kW Waukesha Model F3512 GLD biogas fired electrical generator, is not cost effective to repair and place in service.

Existing biogas boilers are in need of immediate replacement, with larger boilers meeting air emissions requirements. In addition, compliance with air board rule R4307 will require H_2S treatment of biogas prior to combustion in the boilers.

It is recommended the gas flare be replaced with expansion of digester facilities, or if FOG or food waste is added to the digesters, or if dedicated food waste digesters are built. The new gas flare will have to meet current air board regulation R4311. Required treatment of biogas H_2S, noted in the boiler discussion, will also be required with the flare.

Section 8 - Biosolids Disposal Alternatives

After dewatering biosolids are disposed by loading into roll off bins and hauling to Forward Landfill. The disposal rate at Froward Landfill has been negotiated at $27/wet ton. Biosolids are disposed as fill material due to their not meeting consisting Class B standards required to be used as alternative daily cover. The normal disposal rate for fill material at Forward Landfill is $49/wet ton. CalRecycle does not list a closure date for Forward Landfill, however the September 2012, **Forward Landfill Expansion Draft EIR,** estimates landfill capacity through 2039.

Based on current and pending regulations, the ultimate goal of the State of California appears to be eliminating organic material disposal in landfills. Diverting WQCF biosolids from landfill disposal will increase the City's solid waste landfill diversion by 6%.

Considering the City's goals, the fact that all landfills have a closure date, and that the State of California is trying to limit organic material disposal in landfills, the City needs to develop a plan for alternate disposal of biosolids generated at the WQCF. To accomplish this, the City will need to process biosolids sufficiently to make at least a Class B biosolids product under EPA 40 CFR Part 503 regulations. This can be achieved with expansion of the digester facility.

Biosolids can be further processed to Class A, or to Exceptional Quality (EQ) criteria. This is most easily achieved by drying dewatered biosolids from the centrifuge to greater than 75% solids. The benefit of this is additional flexibility in reuse, and reduction in biosolid hauling costs. This level of processing allows for sales to the general public, and reuse of the product in City landscaping. Site space at the WQCF should be preserved to allow for future drying options.

Section 9 - Impact of FOG and Food Waste on Biosolids Facilities and Gas Production

The City commissioned a parallel Solid Waste Master Plan in conjunction with this biosolids plan. The solid waste master plan included a comprehensive waste characterization, and a food waste and FOG assessment. Information from this analysis was used in estimating impacts of bringing these materials to the WQCF for co-digestion with WQCF biosolids.

FOG can be easily accommodated in the existing planned expansion of digestion facilities. There is likely to be a decrease in solids fed to the dewatering process with addition of FOG, resulting in no impact on the dewatering process. Adding FOG to digesters increases the heating value of biogas by 26% to 31%, and provides for collection of a tip fee. It is therefore recommended that the City proceed with a City wide FOG program, and construct a FOG receiving station at the WQCF.

Food waste Phase 1 includes 1,500 wet tons per year of self hauled commercial food waste. Phase 2 includes approximately 1,900 tons of commercial source separated City collected food waste. Phase 3 includes source separated City collected residential food waste at approximately 9,100 wet tons per year. Food waste will be preprocessed in a separate facility adjacent to the digesters.

Food waste Phases 1 and 2 can be accommodated in the existing planned digester capacity expansion. Addition of food waste, with biosolids, will increase biogas production by 34%.

Food waste Phases 1 and 2 will impact dewatering. To maintain an 8-hour workday, with one centrifuge out of service during current average conditions, a third centrifuge is needed. Alternatively, the hours of operation when one centrifuge out of service can be extended in lieu of adding the third centrifuge. At 6.5 mgd maximum month conditions, the hours of operation with one centrifuge out of service would be 9 hours per day. At 10 mgd, the hours of operations required with one centrifuge out of service would be 10.5

hours per day at average annual conditions, and 13.5 hours per day during maximum month conditions. Based on discussions with staff, this is acceptable in the first phase of the food waste program. However, additional separate dewatering will be planned as part of the second phase of the food waste program.

Food waste Phases 1, 2, and 3 will require construction of 2 additional digesters over and above what is required for biosolids alone, for a total of 6. Food waste Phases 1, 2 and 3 will overwhelm the dewatering process, requiring one additional centrifuge. Phase 1, 2, and 3 increase biogas production by 99% versus biosolids alone.

In all cases, the cost of disposal of the biosolids will increase in proportion to food waste processed. Disposal cost for the WQCF biosolids is currently $27/wet ton, under a negotiated rate at Forward Landfill. If the food waste is kept separate from the biosolids, it could be disposed of at $19.75/wet ton at Harvest Power's compost operation.

Regulatory agencies are beginning to catch up to the concept of co-digestion of food waste and solid waste. As a result, there are now permitting hurdles that must be addressed with any interconnection between a food waste facility and the WQCF. The most recent NPDES permit for the WQCF requires notification, and development of standard operating procedures, prior to injecting food waste into WQCF digesters.

As noted in the solid Waste Master Plan, the benefits for food waste digestion are substantial, including compliance with Assembly Bill (AB) 1826, and increased biogas production. It is therefore recommended the food waste program proceed. Separate industrial digesters at the food waste processing facility will allow flexibility in treatment of food waste, and limit permit impacts at the WQCF. Separate dewatering should be planned as part of the food waste facility expansion.

Section 10 - Biogas Utilization Analysis

For the analysis, 5 alternatives were considered for utilizing the biogas. They include the following:

Option 1: Treat and process biogas to a compressed natural gas (CNG) quality, and utilize CNG in City vehicles and garbage trucks. This process is also referred to as BioCNG or RCNG for renewable CNG. Option 1 is specifically for the BioCNG50 process manufactured by Unison. This process produces 250 diesel gallon equivalents (DGE) of BioCNG a day.

Option 2: Option 2 is the same as Option 1 except with the BioCNG100 from Unison, which makes 500 DGE per day.

Option 3: This option utilizes two 250 kW Ingersoll Rand gas turbines to make electricity. Waste heat from the turbines is used to heat the digesters.

Option 4: This option is to rehabilitate the existing 400 kW electrical cogeneration system to make electricity. Waste heat from the engine is used to heat the digesters.

Option 5: This option is to purchase a new ultra high efficiency 600 kW engine from MWM (marketed through Caterpillar). Waste heat from the engine is used to heat the digesters.

In all cases, supplemental natural gas is used to make up for shortfalls in production of biogas. All options also include gas conditioning to appropriate levels for the equipment, and to meet air regulations. All options also include maintenance contracts where appropriate, to properly maintain equipment.

Key items from the analysis are as follows:

1. Lower volumes of biogas production generally result in longer simple payback of each option.
2. Both CNG options are greatly affected by the offset cost of diesel. Diesel prices have fallen substantially in the last few months. However, long-term diesel costs are not expected to remain at current levels. The cost of diesel used in this analysis is based on the Clean Cities Alternative Fuels Price Report, October 2014.
3. With CNG the City achieves the highest return when CNG offsets the City's retail purchase of diesel. Selling CNG to third parties at current market rates is significantly less valuable than offsetting City diesel purchases.
4. For the existing garbage truck fleet, the City purchase 134,105 gallons of diesel fuel in 2014. This equates to 367 gallons per day. For the BioCNG100 option of 500 DGE, it is assumed the City will continue to convert other City vehicles in addition to the garbage truck fleet.
5. Both BioCNG options are generally more attractive than electrical cogeneration., This is due to the offset value of diesel being significantly more valuable than the offset cost of electricity.

Based on this analysis, the recommended alternative is to construct the BioCNG 100 system near the WQCF.

Section 11 - Recommendations and Costs

Recommendations noted above are summarized in this section. Table ES-1 presents a summary of projects with costs and timing. Figure ES-1 presents a schedule of all of near term projects proposed for the new digester control building and digester project, including the CNG facilities. The remaining recommended projects and will be implemented separately either as part of O&M projects (WAS and DAFT improvements) or as capacity demands increase (Centrifuge and Biosolids Drying).

Table ES-1, Manteca WQCF Biosolids Recommended Project Summary

Project No	Description	Total Project Cost	Cost for 2015-2018	Costs for 2020-2024	Costs Beyond 2024
Projects Included With Digester Control Building Project					
1-13	Construct New Digester Control Building, Digesters, Gas Flare, and Support Equipment.	$19,950,000(2)	$19,950,000		
14-16	Construct FOG Facility	$1,304,000(3)	$1,304,000		
17-19	Construct Food Waste Receiving Facilities	$508,000(4)	$508,000		
20-22	Construct BioCNG Facility	$3,938,000(5)	$3,938,000		
Remaining O&M/Capacity Projects					
1	WAS Building Improvements	$80,000	$80,000		
2	DAFT Control Upgrade	$89,000	$89,000		
10	Add Centrifuge No. 3	$1,517,000		$1,517,000	
11	Construct Biosolids Drying System	$14,917,000			$14,917,000
	Total	$42,303,000	$25,869,000	$1,517,000	$14,917,000

Notes:

1) Total capital cost, including construction, contingencies, engineering, administration and environmental documentation, as applicable. First quarter 2015 cost level. ENR 20-Cities CCI = 9,970.

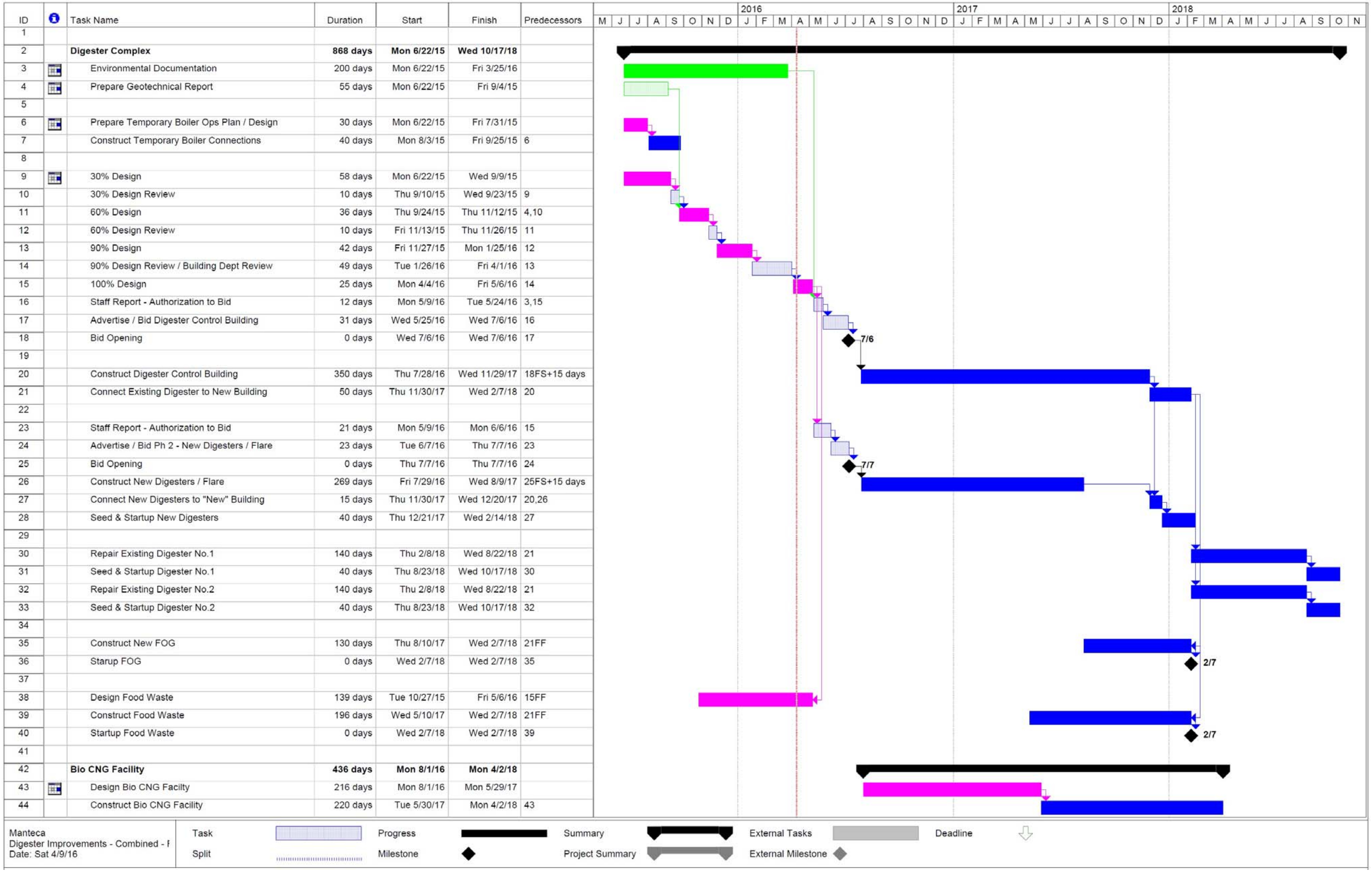
2) Based on $19,113,000 form Breakdown in Appendix plus $829,000 fees for design, survey, geotechnical services.

3) Based on breakdown in appendix. Design fees included as part of Digester Control Building Project.

4) Portion of facilities constructed at WQCF remaining costs for facilities at Lovelace Transfer Facility included in the Solid Waste Master plan.

5) Includes costs of some civil improvements to support the facility that will be constructed as part of the new Digester control Building Project. These costs are shown in the appendix.

Figure ES-1, Manteca WQCF Biosolids and Solid Waste Schedules



ID	ℹ	Task Name	Duration	Start	Finish	Predecessors
1						
2		**Digester Complex**	**868 days**	**Mon 6/22/15**	**Wed 10/17/18**	
3	▦	Environmental Documentation	200 days	Mon 6/22/15	Fri 3/25/16	
4	▦	Prepare Geotechnical Report	55 days	Mon 6/22/15	Fri 9/4/15	
5						
6	▦	Prepare Temporary Boiler Ops Plan / Design	30 days	Mon 6/22/15	Fri 7/31/15	
7		Construct Temporary Boiler Connections	40 days	Mon 8/3/15	Fri 9/25/15	6
8						
9	▦	30% Design	58 days	Mon 6/22/15	Wed 9/9/15	
10		30% Design Review	10 days	Thu 9/10/15	Wed 9/23/15	9
11		60% Design	36 days	Thu 9/24/15	Thu 11/12/15	4,10
12		60% Design Review	10 days	Fri 11/13/15	Thu 11/26/15	11
13		90% Design	42 days	Fri 11/27/15	Mon 1/25/16	12
14		90% Design Review / Building Dept Review	49 days	Tue 1/26/16	Fri 4/1/16	13
15		100% Design	25 days	Mon 4/4/16	Fri 5/6/16	14
16		Staff Report - Authorization to Bid	12 days	Mon 5/9/16	Tue 5/24/16	3,15
17		Advertise / Bid Digester Control Building	31 days	Wed 5/25/16	Wed 7/6/16	16
18		Bid Opening	0 days	Wed 7/6/16	Wed 7/6/16	17
19						
20		Construct Digester Control Building	350 days	Thu 7/28/16	Wed 11/29/17	18FS+15 days
21		Connect Existing Digester to New Building	50 days	Thu 11/30/17	Wed 2/7/18	20
22						
23		Staff Report - Authorization to Bid	21 days	Mon 5/9/16	Mon 6/6/16	15
24		Advertise / Bid Ph 2 - New Digesters / Flare	23 days	Tue 6/7/16	Thu 7/7/16	23
25		Bid Opening	0 days	Thu 7/7/16	Thu 7/7/16	24
26		Construct New Digesters / Flare	269 days	Fri 7/29/16	Wed 8/9/17	25FS+15 days
27		Connect New Digesters to "New" Building	15 days	Thu 11/30/17	Wed 12/20/17	20,26
28		Seed & Startup New Digesters	40 days	Thu 12/21/17	Wed 2/14/18	27
29						
30		Repair Existing Digester No.1	140 days	Thu 2/8/18	Wed 8/22/18	21
31		Seed & Startup Digester No.1	40 days	Thu 8/23/18	Wed 10/17/18	30
32		Repair Existing Digester No.2	140 days	Thu 2/8/18	Wed 8/22/18	21
33		Seed & Startup Digester No.2	40 days	Thu 8/23/18	Wed 10/17/18	32
34						
35		Construct New FOG	130 days	Thu 8/10/17	Wed 2/7/18	21FF
36		Starup FOG	0 days	Wed 2/7/18	Wed 2/7/18	35
37						
38		Design Food Waste	139 days	Tue 10/27/15	Fri 5/6/16	15FF
39		Construct Food Waste	196 days	Wed 5/10/17	Wed 2/7/18	21FF
40		Startup Food Waste	0 days	Wed 2/7/18	Wed 2/7/18	39
41						
42		**Bio CNG Facility**	**436 days**	**Mon 8/1/16**	**Mon 4/2/18**	
43	▦	Design Bio CNG Facilty	216 days	Mon 8/1/16	Mon 5/29/17	
44		Construct Bio CNG Facility	220 days	Tue 5/30/17	Mon 4/2/18	43

LIST OF ABBREVIATIONS

Abbreviation	Description
AB	Assembly Bill
BioCNG	Same as RCNG
BOD	Biological Oxygen Demand
BTU	British Thermal Unit
CENP	Centrifuge Pump
CENT	Centrifuge
cfd	Cubic Feet per Day
CFR	Cod of Federal Regulations
CNG	Compressed Natural Gas
CONV	Conveyor
CSTR	Continuously Stirred-Tank Reactor
DAF	Dissolved Air Floatation
DAFT	Dissolver Air Floatation Thickening
DGE	Diesel Gallon Equivalent
DSLP	Digestate Sludge Pump
EIR	Environmental Impact Report
EQ	Exceptional Quality
FOG	Fats, Oils, and Grease
Ft	Foot
Gal	Gallon
GPD	Gallons per Day
GPM	Gallons per Minute
GRND	Grinder
H_2S	Hydrogen Sulfide
HHV	Higher Heating Value
HR	Hour
HRT	Hydraulic Retention Time
kg	Kilogram
kW	Kilowatt
lb	Pound
mg	Milligram
mg/l	Milligram/Liter
MGD	Million Gallons per Day
MLE	Modified Ludzack Ettinger
MMBTU	Million British Thermal Units
NOI	Notice of Intent
NOx	Mono-Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System
NVSS	Non-Volatile Suspended Solids
PCB	Polychlorinated Biphenyl

LIST OF TABLES

ppbV	Part per Billion by Volume
ppmV	Parts per Million by Volume
RAS	Return Activated Sludge
RCNG	Renewable Compressed Natural Gas
RWQCB	Regional Water Quality Control Board
SCADA	Supervisory Control and Data Acquisition
sf	Square Foot
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
SWRCB	State Water Resources Control Board
TSS	Total Suspended Solids
TVSS	Total Volatile Suspended Solids
US-EPA	United States Environmental Protection Agency
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WASP	Waste Activated Sludge Pump
WQCF	Wastewater Quality Control Facility

LIST OF FIGURES

1.0 PURPOSE AND SCOPE

The purpose of this report is to assess the condition and capacity of the existing biosolids handling facilities, biosolids disposal methods, and biogas utilization, to determine what modifications must be made to accommodate the existing and a projected biosolids produced from the WQCF for the current flow of 6.5 million gallons per day (mgd) and a future flow of 10 mgd. For the purposes of this report, we have rounded the NPDES permitted dry weather flow from 9.87 mgd to 10 mgd.

In addition to an evaluation of the existing processes, this report also addresses the impact of receiving fats, oils, and grease (FOG), and food waste into the digesters as well as alternatives for utilizing the biogas to its maximum effectiveness. This report was prepared in conjunction with a Solid Waste Master Plan for the City of Manteca to determine the maximum benefit to the City of joint use of facilities at the WQCF.

The remainder of this report includes the following sections:

- Description of Existing Facilities and Operations
- Biosolids Design Loadings
- Regulations Governing Biosolids Disposal
- Recommendations for Future Biosolids Disposal
- Analysis of Compliance with Air Board Regulations
- Evaluation of Existing Facilities and Alternatives to Meet Existing and Future Flow and Load Requirements
- Evaluation of Existing Biogas Utilization Equipment
- Biosolids Disposal Alternatives
- Impacts of FOG and Food Waste on Biosolids Facilities and Gas Production
- Biogas Utilization Analysis
- Recommendations and Costs

2.0 DESCRIPTION OF EXISTING FACILITIES AND OPERATIONS

The City of Manteca owns and operates the Wastewater Quality Control Facility (WQCF) located at 2450 W. Yosemite Ave in Manteca, CA. The Facility is a regional facility in that it provides treatment and disposal service for commercial and residential customers within Manteca, a portion of the City of Lathrop, and Raymus Village, located in San Joaquin County. In all, the Facility serves a population of approximately 80,500. There is also the possibility that in the future the Facility will serve Oakwood Shores residential development, and portions of the City of Ripon.

Discharge from the Facility is permitted at an average dry weather flow of 9.87 mgd, with a current daily flow rate of approximately 6.5 mgd. The facility has a single influent pump station with two mechanical screens providing flow to two parallel treatment processes. One process is the original treatment process referred to as the North Plant, and the second process is the newer South Plant. Primary treatment is identical in both plants. Primary effluent undergoes aerobic biological treatment using ultra fine bubble activated sludge basins configured with aerobic and anoxic zones. The general process configuration involving aerobic zones downstream from anoxic zones with a mixed liquor recycle system for nitrate removal is referred to as a Modified Ludzack Ettinger (MLE) process. The aeration basins of the South Plant are larger than the aeration basins for the North Plant. Each plant has secondary sedimentation following the aeration process.

The biosolids handling facilities consist of the following:

1) Waste Activated Sludge (WAS) Pump Station
2) Waste activated sludge thickening with dissolved air floatation (DAF)
3) Anaerobic digestion of primary and thickened WAS
4) Anaerobic digester control building with associated equipment
5) Biosolids dewatering with centrifuges
6) Biosolids drying with open asphalt lined drying beds

The biogas utilization facilities consist of the following:

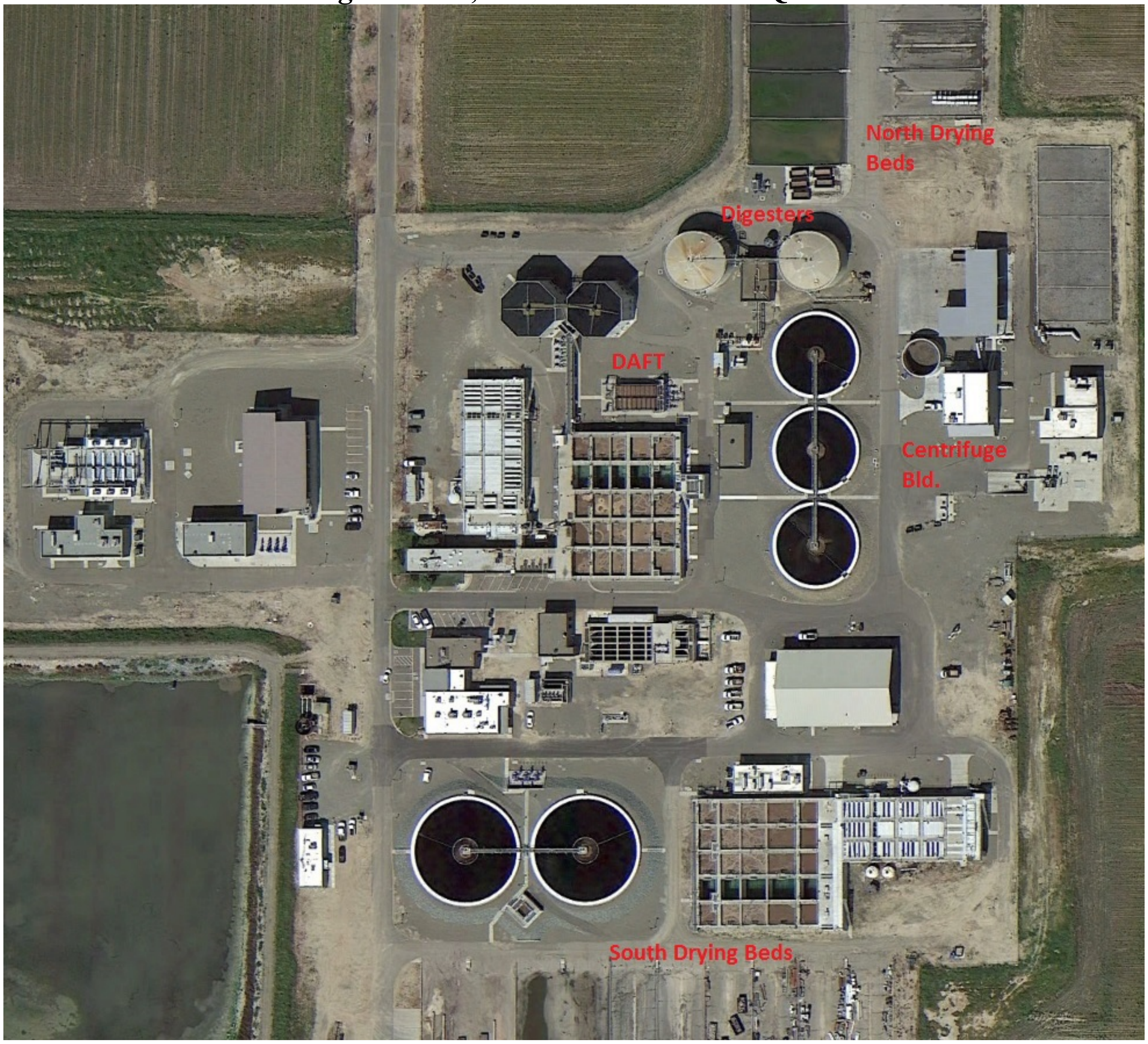
1) Gas flare to burn waste biogas
2) Boilers to heat the anaerobic digesters
3) 400 kilowatt (kW) electrical generator (currently abandoned)

Figure 2.0-1 shows an aerial photo of the Manteca WQCF. Key biosolids handling facilities are indicated in the photo.

Biosolids produced by the facility are currently dewatered to 19% solids and then hauled away to Forward Landfill north of Manteca. Current cost of disposal is $27/wet ton.

A detailed description of each process area follows.

Figure 2.0-1, Aerial View of the WQCF



2.1 Waste Activated Sludge (WAS) Pump Station

The WAS pump station is located in the Return Activated Sludge (RAS)/WAS Building between the north aeration basins and north secondary clarifiers. It is responsible for pumping WAS from the north and south secondary clarifiers to the sludge thickening facilities. The purpose of the WAS pump station is to direct "waste" WAS which is no longer needed in the secondary treatment process, to the sludge thickening facilities.

The RAS/WAS Building houses the two WAS pumps (WASP) (WASP-07-01 and WASP-07-02), which serve the north and south plants. A layout of the WAS pump station is provided in Figure 2.1-1. A summary of the specifications for the WAS pump station components is presented in Table 2.1-1.

Figure 2.1-1, WAS Pump Station

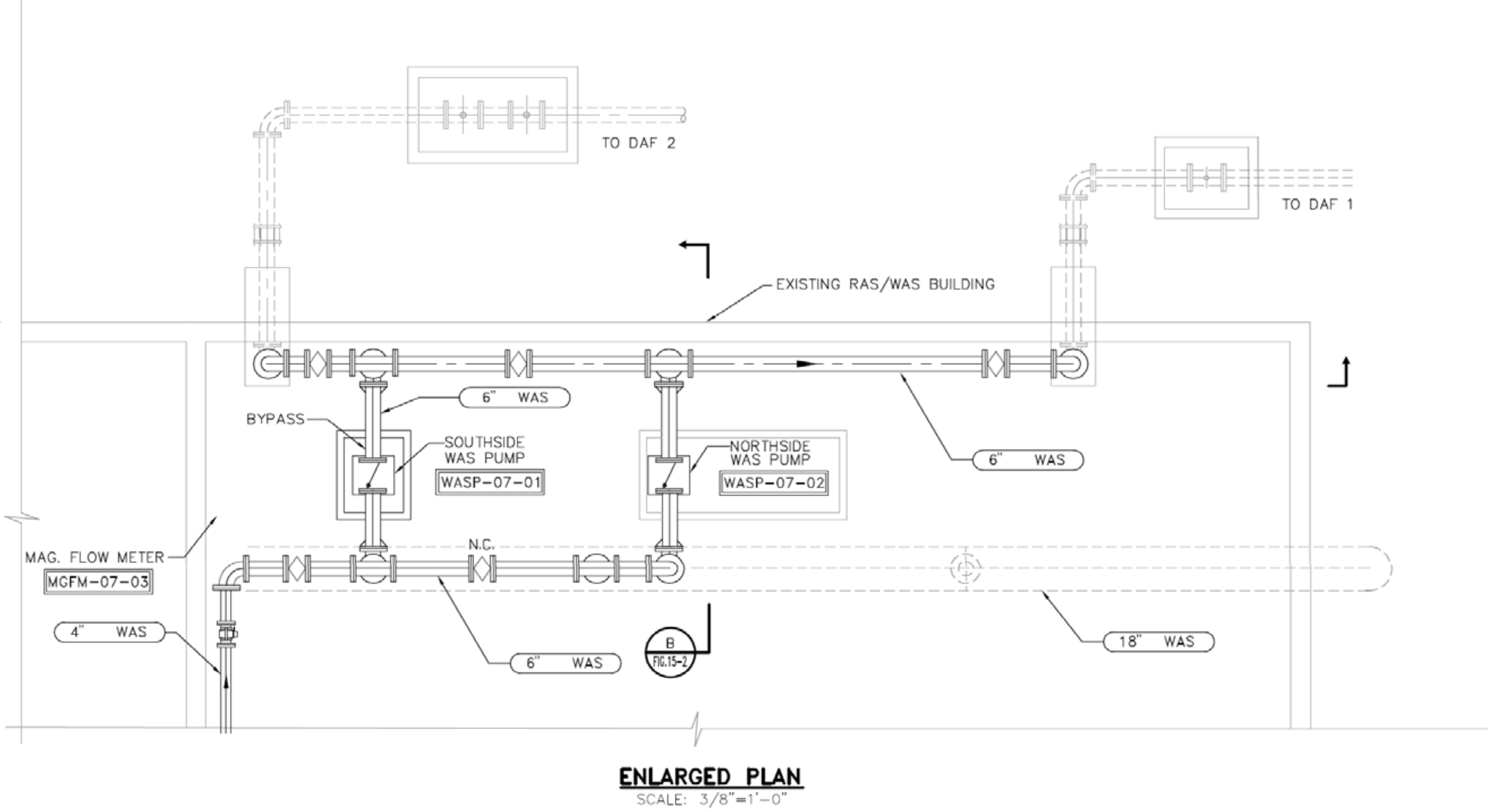


Table 2.1-1, WAS pump Station

Item	Value
Was Pumps	
Number	2
Equipment Numbers	WASP-07-01, WASP-07-02
Manufacturer	Aurora
Motor Size, hp	1.5
Capacity	159 gpm @ 21.4 ft

2.2 WAS Thickening with Dissolved Air Floatation

Sludge thickening facilities at the WQCF are comprised of two dissolved air floatation (DAF) thickeners. The sludge thickening facilities are responsible for thickening WAS to reduce the anaerobic digester heating requirements, minimize required digester capacity; and maximize solids retention time in the anaerobic digesters. The DAF units were designed to thicken WAS to an approximate concentration of 3 percent, without using polymer, and capture 85 to 95 percent of the input solids.

The sludge thickening facilities are composed of two DAF tanks (also referred to as DAF thickeners). Each DAF thickener is rectangular and constructed of reinforced concrete. Each DAF thickener includes the following components:

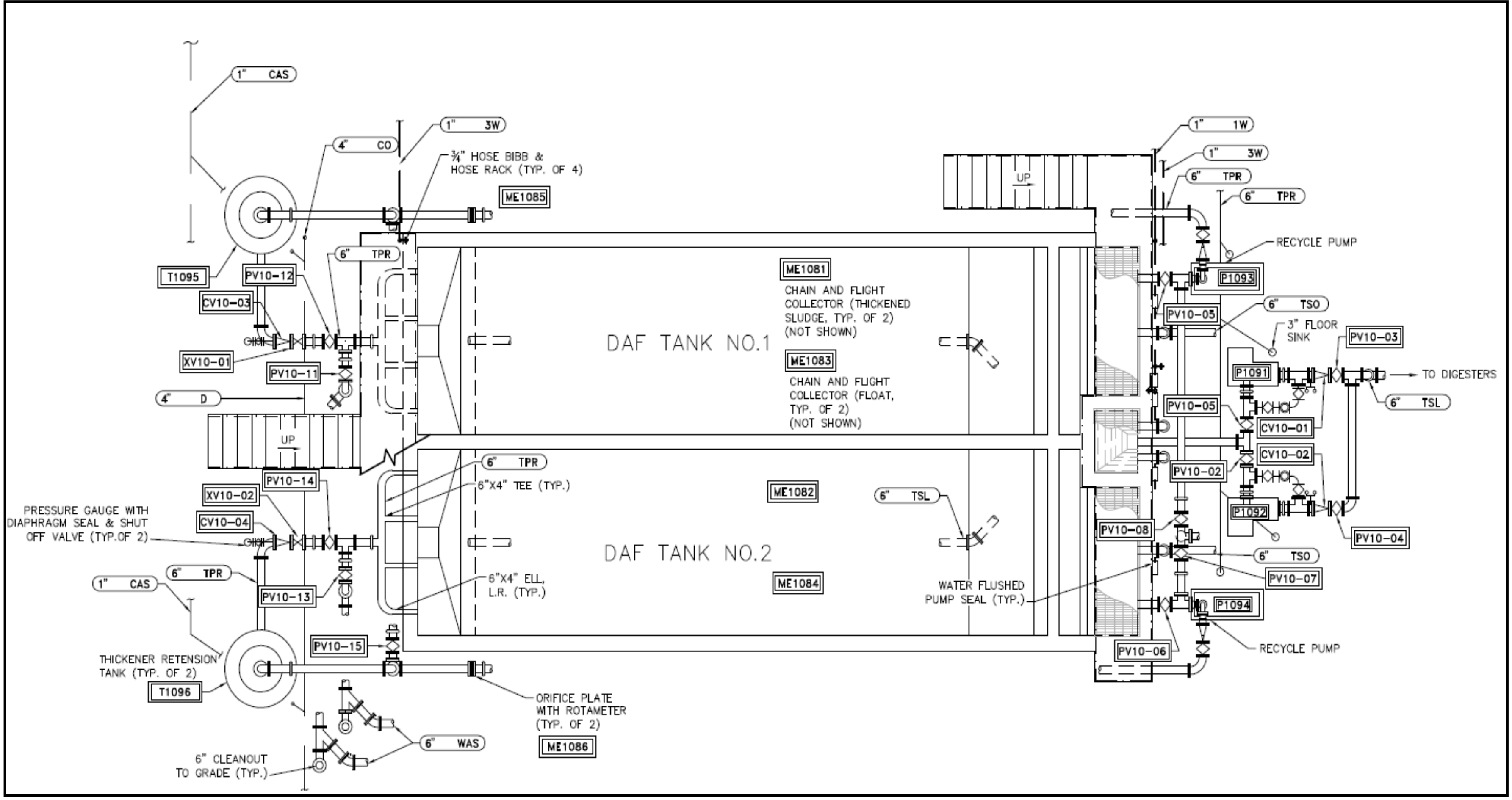
1. A float removal system (ME1083, ME1084).
2. A bottom sludge removal system (ME1081, ME1082).
3. A subnatant wet well with an overflow pipe to the plant drain and a suction pipe from the pressure recycle pump.
4. An effluent weir plate to control the penetration depth of the float skimmer blades in the wastewater.
5. A sludge box that receives float and bottom sludge from both tanks and functions as a wet well for the thickened sludge pumps.
6. An inlet distribution system consisting of a fabricated steel manifold with four, 4-inch diameter pipes that discharge the combined sludge feed and pressure recycle across the tank width directly against circular defector baffles to provide immediate and uniform distribution of the influent flow in the tank.

Specifications for the dissolved air floatation thickening (DAFT) units are shown in Table 2.2-1. The sludge thickening facility is shown in Figure 2.2-1.

Table 2.2-1, DAFT Equipment

Item	Value
DAF Tanks	
Number	2
Length x Width, ft x ft	38.25 x 12
Depth, ft	9
Pressure Retention Tanks	
Equipment Number	T1095, T1096
Height, ft	10.25
Diameter, ft	2
Pressure Recycle Pumps	
Equipment Number	P1093, P1094
Motor Size, Each, hp	40
Pump Capacity, Each, gpm	190-255
Thickened Sludge Pumps	
Equipment Number	P1091, P1092
Motor Size, Each, hp	10
Pump Capacity, Each	100 gpm @ 60 psig

Figure 2.2-1, DAFT Sludge Thickening Facilities



2.3 Anaerobic Digestion and Digester Control Building

The anaerobic digesters are responsible for stabilizing primary sludge and thickened WAS from the north and south plants. The purpose of the anaerobic digesters is to stabilize the organic solids in the primary sludge and thickened WAS prior to dewatering. Stabilizing the organic solids has the following benefits:

1. Reduces the amount of solids that must be dewatered and disposed
2. Reduces pathogens
3. Eliminates offensive odors
4. Improves the ability to dewater the sludge

The anaerobic digesters are designed to attain volatile solids destruction in the range of 55 to 70 percent on a weight basis (resulting in an approximate volatile fraction in the digested sludge solids of 50-60 percent). A digester gas production in the range of 12 to 17 cubic feet per pound of volatile solids destroyed is anticipated as part of the process.

The primary sludge and scum, and thickened WAS are pumped to the Sludge Control Building (see Figure 2.3-1). From the Sludge Control Building, the combined sludge is routed to one of the two anaerobic digesters by two pneumatically-operated valves through the heated sludge/sludge mixing discharge piping. To maintain a suitable environment for the microorganisms that decompose the sludge, the digesting sludge is maintained at 95°F by continuous sludge circulation through external heat exchangers. The digester gas produced as a result of the sludge decomposition is collected and piped to the two boilers and to the waste gas burner. The boilers provide the hot water needed for heating of the digesting sludge. The waste gas burner ignites the excess (unused) digester gas. The digesting sludge is displaced by the incoming sludge through a telescoping valve into an overflow box on the top side of each digester. From the digester overflow boxes, the sludge flows by gravity to the sludge drying beds, or routed to the sludge dewatering facility.

Specifications for the Digestion Facilities are shown in Table 2.3-1. A layout of the digester control building is shown in Figure 2.3-2.

Figure 2.3-1, Digester Control Building

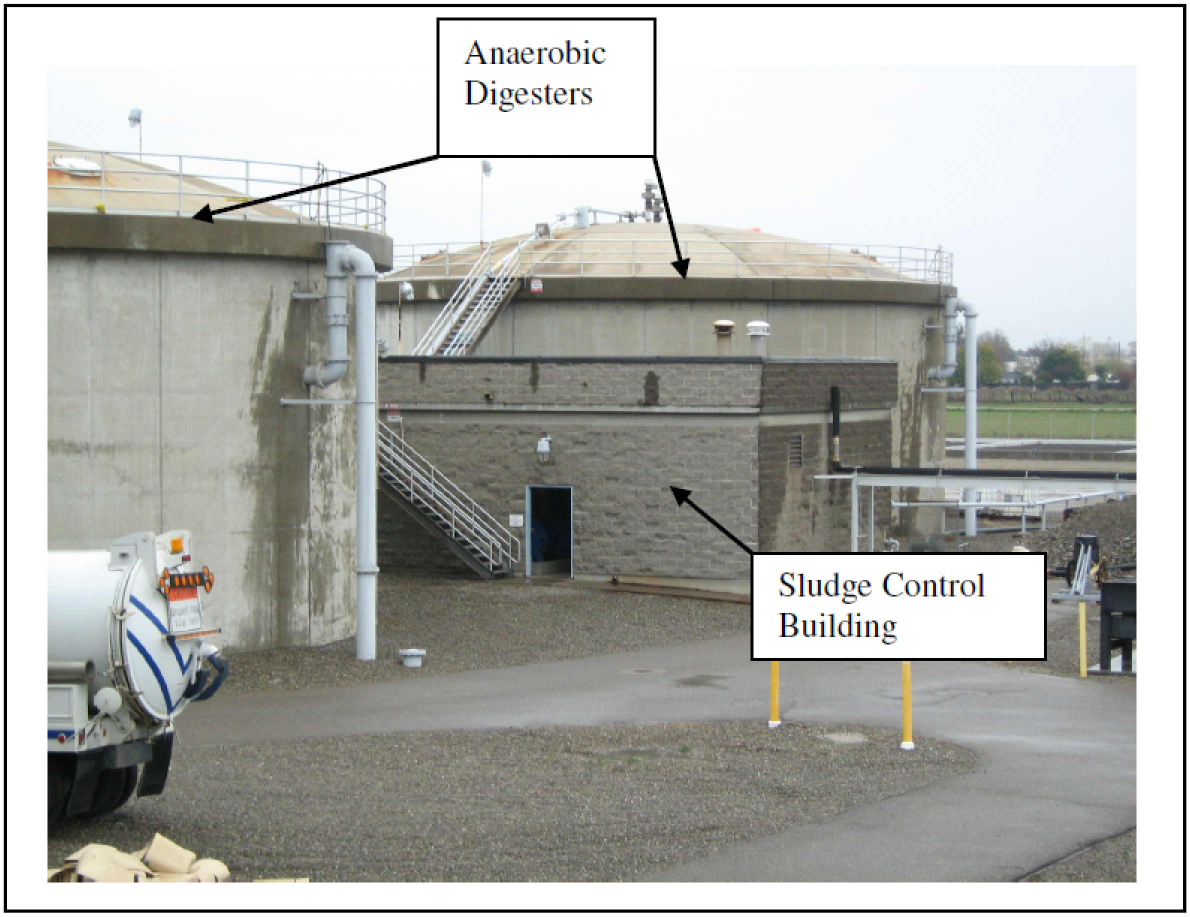
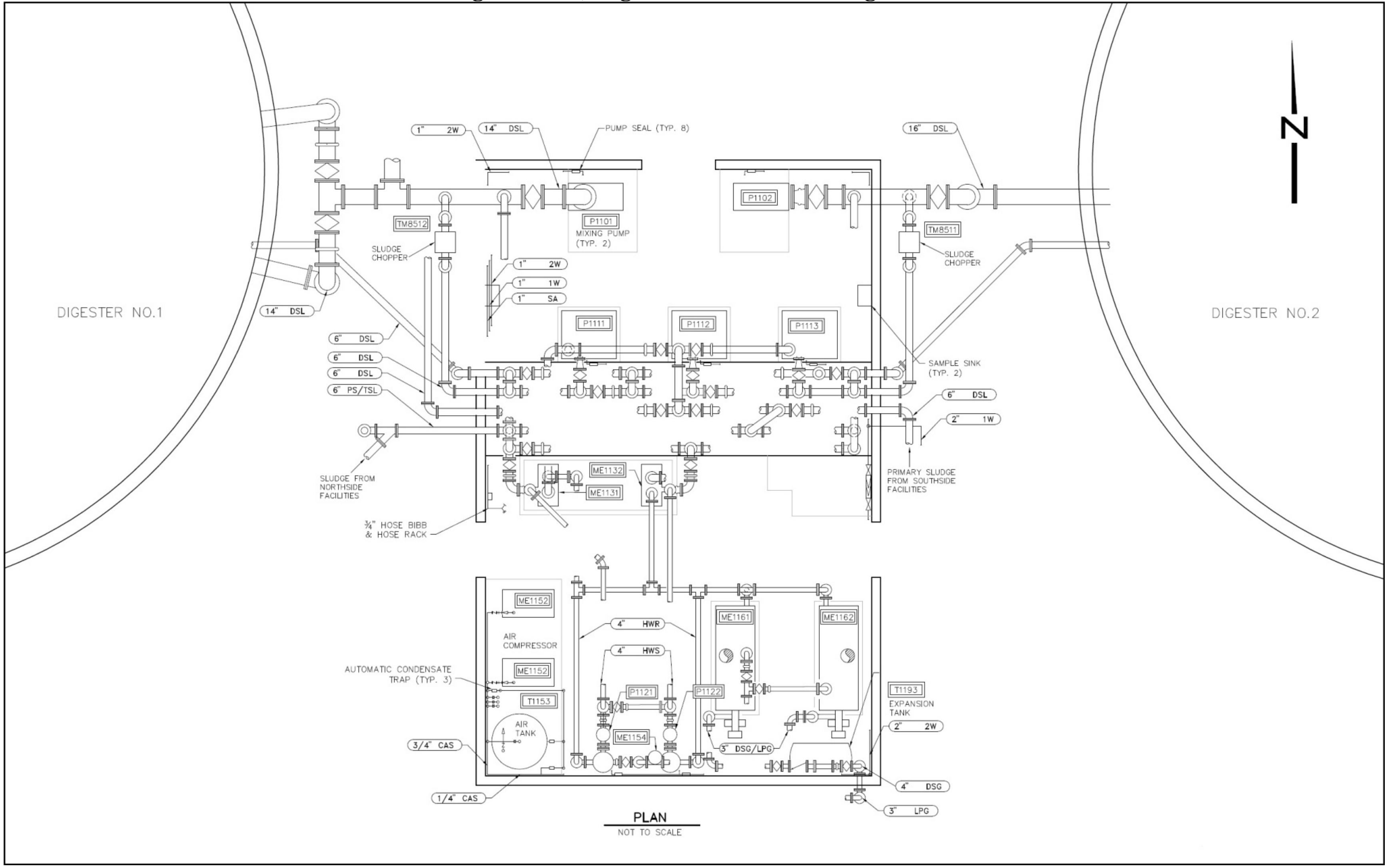


Table 2.3-1, Digester Facilities

Item	Value
Anaerobic Digesters	
Number	2
Inner Diameter, ft	60
Sidewall Height, ft	26
Max Water Depth, ft	25.33
Capacity, Each, gal	523,000
Gas Storage Capacity, ft^{3l}	29,000
Sludge Heating Pumps	
Equipment Number	P1111, P1112, P113
Motor Size, Each, hp	5
Pump Capacity, Each	150 gpm @ 20 ft
Sludge Heat Exchangers	
Equipment Number	ME1131, ME1132
Heat Capacity, Each, Btu/hr	750,000
Hot Water Boilers	
Equipment Number	ME1161, ME1162
Heat Capacity, Each, Btu/hr	2,000,000 input, 1,600,000 output
Hot Water Circulation Pumps	
Equipment Number	P1121, P1122
Motor Size, Each, hp	2
Pump Capacity, Each	150 gpm
Digester Mixing Pumps	
Equipment Number	P1101, P1102
Motor Size, Each, hp	20
Pump Capacity, Each	13,200 gpm @ 9 ft

Figure 2.3-2, Digester Control Building Plan



2.4 Biosolids Dewatering

The mechanical dewatering facility reduces the liquid content in the anaerobically digested sludge generated from the primary and secondary treatment facilities. The mechanical dewatering facility produces dewatered cake with an average solids concentration of 19 percent. Centrate is returned directly to the headworks for treatment.

The mechanical dewatering facility includes the following components. A digester effluent transfer structure with two digested sludge pumps, sludge holding tank, inline grinder, two centrifuge feed pumps, two polymer dilution units, two centrifuges, and a conveyor.

Process performance of the dewatering process is presented in Table 2.4-1

A summary of the specifications for the mechanical dewatering facility components is presented in Table 2.4-2.

A Layout of the dewatering building is presented in Figure 2.4-1.

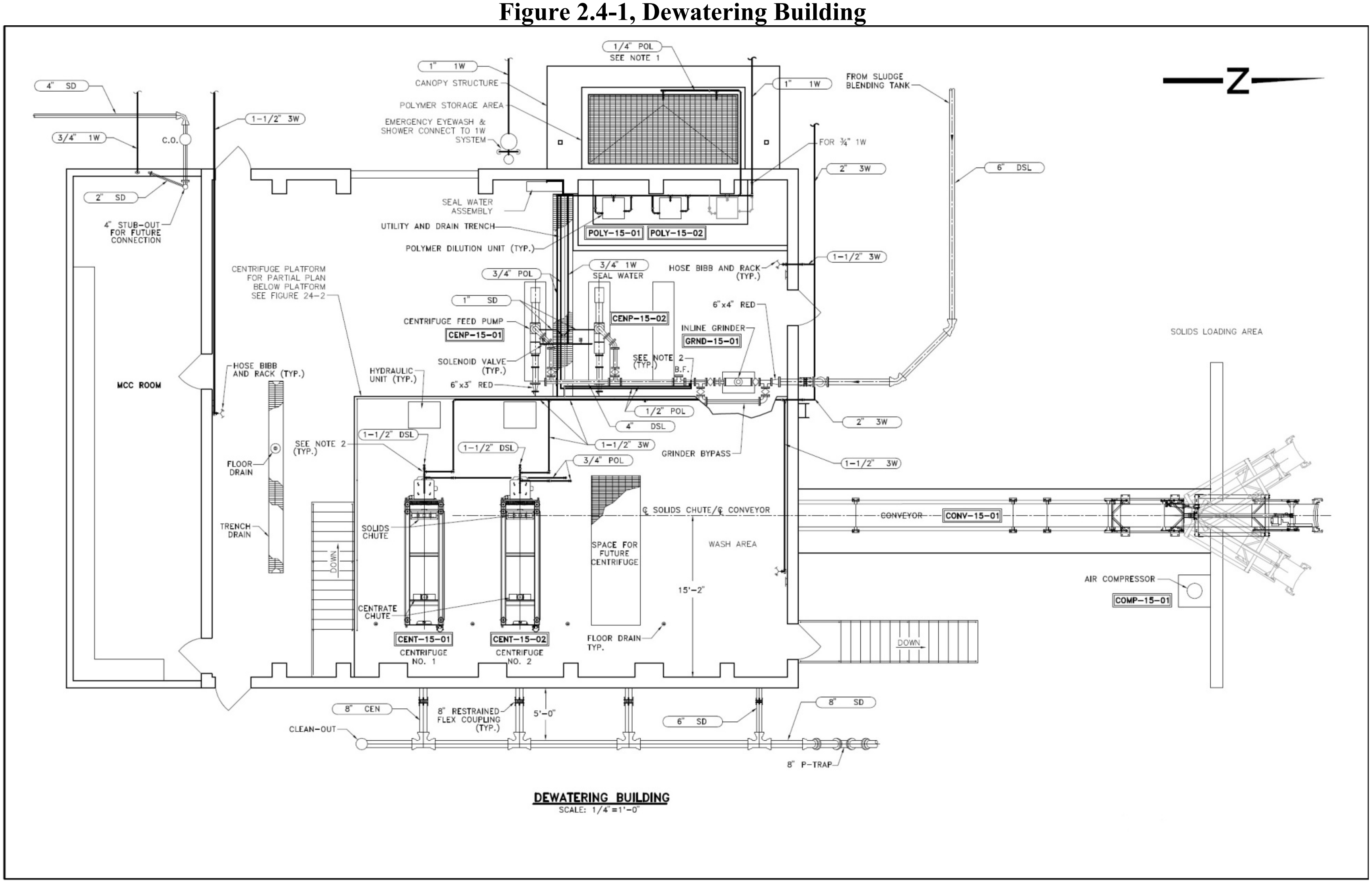
Table 2.4-1, Dewatering Process Performance

Category	Parameter	Value
Sludge Feed	Type of sludge	Anaerobically digested primary and thickened waste activated sludge
	Solids concentration, %	1.5-2.5
	Temperature Sludge,° F	60-98
	Volatile solids content, %	60-65
	pH	7.0- 7.5
	Maximum particle size, in	1
	Flow rate, gpm	185
	Solids Loading, dry lbs/hr	1,540
	Minimum solids capture, %	95
	Maximum polymer dosing, lb/dry ton solids	23
Dewatered Cake	Solids concentration achieved, %	19

Table 2.4-2, Dewatering Equipment

Item	Value
Sludge Blending Tank	
Number	1
Inner Diameter, ft	19
Sidewall Height, ft	14
Capacity, Each, gal	100,000
Digested Sludge Pumps	
Equipment Number	DSLP-09-01, DSLP-09-02
Motor Size, Each, hp	7.5
Pump Capacity, Each	165 gpm @ 42 ft
In-Line Grinder	
Equipment Number	GRND-15-01
Motor Size, Each, hp	3
Centrifuge Feed Pumps	
Equipment Number	CENP-15-01, CENP-15-02
Motor Size, Each, hp	7.5
Pump Capacity, Each	250 gpm @ 25 psi
Centrifuge	
Equipment Number	CENT-15-01, CENT-15-02
Motor Size, Each, hp	100
Bowl Width x Bowl Length, Each, in x in	18 x 72
Max flow rate, ea, gpm	185
Conveyor System	
Equipment Number	CONV-15-01
Belt Width, in	26
Belt Length, ft	90
Motor Size, Each, hp	3

Figure 2.4-1, Dewatering Building



2.5 Biosolids Drying Beds

The sludge drying beds were used to dry biosolids prior to the construction of the dewatering building. The south beds have been abandoned and are now used for equipment storage. The north drying beds are now used only as a place to periodically empty the digester contents for cleaning, and occasionally for storage of dewatered biosolids when disposal is not available.

The biosolids drying beds are shown on Figure 11.0-1.

Design criteria for the beds is summarized in Table 2.5.1

Table 2.5-1, Biosolids Drying Beds

Item	Value
North Beds	
Number	7
Width, ft	50
Length, ft	95
Area, Each, sf	4,750
Area, Total, sf	33,250
South Beds	
Number	10
Width, ft	50
Length, ft	95
Area, Each, sf	4,750
Area, Total, sf	47,500

2.6 Biogas Utilization Equipment

The biogas utilization equipment consists of a Varec candle style gas flare, Ajax cast iron boilers, and an abandoned 400 kW Waukesha electric generator. The flare operates continually, since there is more biogas produced than is needed for heating the digesters. The boilers have a heat input of 1.8 million British thermal units per hour (BTU/hr) and an output of 1.6 million BTU/hr. One boiler operates with one standby boiler.

The Waukesha generator did not operate properly when installed, was ultimately abandoned, and not operated.

3.0 BIOSOLIDS DESIGN LOADINGS

The current and project biosolids loadings are shown in Table 3.0-1.

Table 3.0-1, Manteca Biosolids Loading

Parameter	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Influent Characteristics				
Plant Influent flow, mgd	6.5	6.5	10	10
Influent BOD Concentration, mg/l	317	317	317	317
Influent TSS Concentration, mg/l	279	279	279	279
Primary Solids Wasted				
Dry solids, lb/day	9,829	12,737	15,120	19,593
% Solids (average)	3.21	3.21	3.21	3.21
Flow, gal/day	36,679	47,531	56,423	73,118
Secondary Solids Wasted				
Dry solids, lb/day	5,784	7,550	8,832	11,549
% Solids (average)	0.85	1.1	1.3	1.7
Flow, gal/day	80,208	81,216	80,208	81,216
TWAS to Digesters				
Dry solids, lb/day	5,727	7,474	8,745	11,432
% Solids (average)	3.1	3.1	3.1	3.1
Flow, gal/day	22,152	28,909	33,823	44,218
Digested Biosolids to Dewatering				
Dry solids, lb/day	9,026	11,729	13,845	18,003
% Solids (average)	1.8	1.8	1.8	1.8
Flow, gal/day	58,832	76,440	90,246	117,336
Biosolids Disposal				
Dry solids, lb/day	8,575	11,143	13,153	17,103
% Solids (average)	19	19	19	19
Cake Produced, wet tons/day	22.6	29.3	34.6	45.0

Table 3.0-1 includes the combined results for the North and South Plants. To develop the solids loading criteria for existing and future conditions, a mass balance of the facility was prepared based on existing loading conditions. Current average flow conditions to the WQCF when recycle flows are subtracted out is approximately 6.5 mgd. Influent characteristics were taken from the process review and process model developed under the design for the North Aeration Improvements Project. The mass balance was then calibrated against actual measured sludge disposal records. Based on this calibrated mass balance, biosolids loading for the future 10 mgd condition were estimated assuming the same influent flow characteristics.

4.0 REGULATIONS GOVERNING BIOSOLIDS DISPOSAL

The major regulations that govern the disposal of biosolids for the City of Manteca WQCF are the existing National Pollution Discharge Elimination System (NPDES) permit, the United States Environmental Protection Agency (US EPA) Standards for the Use or Disposal of Sewage Sludge (40 Code of Federal Regulations (CFR) Part 503), and the State Water Resources Control Board (SWRCB) Water Quality Order No. 200-10-DWQ (also known as the State General Order).

4.1 Regulations Governing Biosolids Disposal

40 CFR Part 503 became effective in 1993. These regulations are self-implementing and impose requirements on facilities that produce biosolids, and on land appliers of biosolids. The regulations include standards for pollutant limits, treatment requirements, operations standards, management practices, monitoring, record keeping, and reporting requirements. In order for biosolids to qualify for land application, all biosolids must satisfy limitations for specific metals, and requirements for pathogen reduction and vector attraction reduction.

40 CFR Part 503 regulations contain pollutant limits that can qualify biosolids for land application, or exclude them from land application. In addition to pollutant concentration limits, 40 CFR Part 503 also includes pathogen reduction and vector attraction reduction standards. Pathogen reduction is the process where viruses and bacteria in the biosolids are destroyed to reduce the risk of disease transmission to acceptably low levels. Vector attraction reduction is a process that makes the biosolids less attractive to insects and animals. The minimum pathogen reduction level needed for land application of biosolids is Class B. Class A is the highest pathogen reduction level, and if attained allows more options for disposal or reuse of the biosolids.

In order for an anaerobic digestion process to produce Class B biosolids the biosolids must meet EPA 503 metals limits, and must be digested for a minimum of 15 days. In order to be considered Class A, biosolids would need additional processing to reduce pathogens and vector attraction, such as drying the biosolids.

Biosolids are considered to be “Exceptional Quality” (EQ) when they meet the high quality pollutant limits, Class A pathogen reduction, and have been processed to meet the vector attraction reduction requirements in 40 CFR Part 503. There are far less restrictions on the use of EQ biosolids than on Class B biosolids that don’t meet these standards. In general, EQ biosolids are the least expensive biosolids to dispose of, and have the most options for disposal. Disposal options for Class A EQ biosolids include bagging and selling to the public, soil amendment, land application to food crops.

Based on biosolids loading to the anaerobic digesters at the WQCF, the City of Manteca meets Class B requirements only a portion of the year, and does not meet the minimum 15 day criteria when peak solids loadings occur, or when a digester is taken out of service for cleaning. As a result, biosolids produced by the WQCF do not meet Class B, Class A, or EQ criteria, and are not eligible for land disposed without further processing. The City therefore correctly disposes of biosolids at Forward landfill.

Metals testing of biosoilds for December 2014 are presented in Table 4.1-1. The WQCF does produce biosolids in conformance with EQ metals limits. This makes it possible to achieve Class B, Class A, or EQ biosolids for land application, provided a complete Class B or Class A process is utilized.

Table 4.1-1, Manteca WQCF Biosolids Testing 12/09/14

Description	Test Result mg/kg	EPA 503 Class B limit mg/kg	EPA 503 Exceptional Quality Limit mg/kg
Arsenic	15	75	41
Cadmium	ND	85	39
Copper	215	4300	1500
Lead	8.9	840	300
Mercury	1.4	57	17
Molybdenum	ND	75	
Nickel	11.8	420	420
Selenium	5.6	100	100
Zinc	623	7500	2800

4.2 State General Order

The SWRCB adopted the State General Order for the discharge of biosolids as a soil amendment to land in 2000. It gave guidelines for the application of both Class A and Class B solids to land. The environmental impact report (EIR) supporting the General Order was subsequently challenged by environmental groups who said the General Order was not protective enough of groundwater, and Class B land application should not be allowed at all. Revisions to the EIR were subsequently made by the SWRCB and a new final EIR has been adopted. Key provisions of the General Order that go beyond 40 CFR Part 503 are as follows:

1. The Order applies to all Class A biosolids applied at more than an agronomic rate of 10 dry tons per acre per year and all Class B biosolids.
2. The discharger and the applier must file a Notice of Intent (NOI) form with associated data, and pay a filing fee. A separate NOI and filing fee must be submitted for each landowner involved in a reuse project.

3. The 40 CFR Part 503 pollutant ceiling concentrations must be met. In addition, the General Order contains a molybdenum limit of 75 mg/kg with a cumulative loading limit of 16 pounds per acre.
4. In addition to metals and nutrients, biosolids must be monitored annually for pesticides and PCBs and semi-volatile organics.
5. Cumulative loading limits are required for all sites, even those that receive EQ biosolids. Background solids concentrations must be measured and used to calculate cumulative loading limits on solids.
6. Biosolids must be incorporated into the soils within 24 hours.
7. To protect from dust and blown particles, biosolids covered under the ordinance with a dry solids content greater than 50 percent cannot be land applied. This is a major issue when considering dried biosolids.
8. Class B biosolids within ½ mile of sites with high potential for public exposure (schools, parks, hospitals, etc.) must be injected.
9. Annual plant tissue testing for molybdenum, copper, and selenium is required.
10. Previously undisturbed lands or sites that lay fallow for a period of more than 1 year (excluding land that has been disked or tilled) must have a biological site assessment completed to identify special-status species.
11. Individual owners of the real property at which the land application occurs are ultimately responsible for ensuring compliance with the general order.

As indicated above, some of the State General Order requirements are quite onerous. The most inhibitive for Manteca is Item 7, which prohibits land application of biosolids greater than 50% solids. This is because the most economical way to achieve Class A biosolids is through drying to greater than 75% solids. This issue has been resolved at other municipalities by combining the dried solids from a drying process with wet solids from other agencies at compost operations by either Synagro or Liberty Composting prior to disposal. Both Synagro and Liberty Composting are in the business of hauling, treating, and land applying biosolids in the State of California.

The requirements of the General Order can be avoided entirely, by producing EQ biosolids and applying them at agronomic rates of less than 10 dry tons per acre per year. This has been verified with written correspondence from the Regional Water Quality Control Board (RWQCB) on past projects and is practiced at some agencies.

4.3 County Regulations Governing Biosolids

San Joaquin County currently bans the application of biosolids to land inside the County. In addition, Biosolids cannot be applied in the primary zone of the Delta. The City of Manteca is located within San Joaquin County and is adjacent to the primary zone of the delta. This means that land application of biosolids produced by the WQCF must be disposed of within City limits or outside the County and outside the primary zone of the delta. The most likely location is Merced or Kern County which still accepts biosolids for land application. Either location will incur costs to haul the sludge a further distance.

4.4 Recommendations for Future Biosolids Disposal

To mitigate the risks of regulatory changes, while maintaining the greatest flexibility in disposal options for biosolids, it is recommended that the City construct additional anaerobic digesters to provide the minimum 15 day retention time needed to produce Class B biosolids. In addition, the City should plan for drying biosolids and making a Class A product in the future.

Once the City produces consistent Class B biosolids, the City should contract out land application of the biosolids to divert them from Forward Landfill. Site space should be reserved for Active Solar drying of biosolids to produce a Class A biosolid, with implementation of Class A processing. Production of dried Class A biosolids should mitigate impacts associated with future hauling costs outside the County, and anticipated regulatory changes.

5.0 ANALYSIS OF COMPLIANCE WITH AIR BOARD REGULATIONS

The primary air emissions equipment at the WQCF includes to following.

1. Standby generators.
2. Biogas fired boilers to heat the digesters.
3. Biogas fired electrical cogeneration system (abandoned)
4. Biogas flare.

The governing air district for the City of Manteca is the San Joaquin Valley Air Pollution Control District (SJVAPCD). The regulations governing equipment at the WQCF include the following.

1. R4307 Boilers, Steam Generators, and Process Heaters - 2.0 MMBtu/hr to 5.0 MMBtu/hr.
2. R4308 Boilers, Steam Generators, and Process Heaters - 0.75 MMBtu/hr to 2.0 MMBtu/hr.
3. R4311 Flares
4. R4702 Internal Combustion Engines

The existing electrical cogeneration system and standby generators are covered under Rule 4702. The standby generators must also comply with Tier emissions standard in effect at time of purchase. Emissions compliance for the standby generators was not verified.

The biogas fired electrical generator is a 450 kW Waukesha Model F3512 GLD and has a valid air permit, N-1049-8-1. When it was started, it did not meet emissions limits in the permit, and it has not been operated since. It remains out of compliance with emissions standards and its current permit. The level of effort to bring the engine within compliance is unknown.

The biogas boilers heating the digesters consists of two AJAX Model WGGFD2000 cast iron boilers. The boilers are rated at a heat input of 1.8 million BTU/hr and an output of 1.6 million BTU/hr and are set up to fire on digesters gas or natural gas. The boilers appear to have been manufactured in 1986 based on their name tag, making them 26 years old. The existing boilers meet a 100 parts per million, volume (ppmv) NOx limit. The boilers do meet current emissions Rule 4308 standards for the SJVAPCD. New boilers have to meet lower standards than the existing boilers. The boilers are currently in very poor condition, low on capacity, and well beyond their useful life. Newer larger boilers should be installed.

In addition to lower NOx limits, new boilers must meet SO_2 limits noted in Section 5.3.1.3 of Rule 4307 as follows.

> *5.3.1.3 On and after July 1, 2015, operators shall install and properly operate an emission control system that reduces SO_2 emissions*

> *by at least 95% by weight; or limit exhaust SO_2 to less than or equal to 9 ppmv corrected to 3.0% O_2.*

There currently is no sulfur or H_2S treatment utilized at the WQCF. This provision then requires a reduction by 95% of incoming H_2S in the digester gas prior to the boilers. Sulfur treatment is also required for any of the biogas utilization options discussed later in this report. Treatment for H_2S in the biogas will therefore be required and must be incorporated into any biogas utilization options as well as for any new boilers.

The biogas flare is a Varec model 239A Flare with an electronic pilot ignition and a heat input rating of 5.12 MMBTU/hr. The existing air permit for the flare is N-1049-7-0. The biogas flare does not meet emissions limits in Rule 4311 and is permitted to operates under grandfather provisions. In addition, existing flares with a heat input rating of 5 MMBTU/hr or greater were required to have a flare minimization plan on file with the air board by July 1, 2010. This plan does not appear to have been created or filed. Based on gas measurements, the flare currently flares approximately 30,000 standard cubic feet per day of biogas which is equivalent to 0.8 MMBTU/hr. The flare appears original with the digester construction in 1985. A new flare in compliance with rule 4311 should be planned in the reasonably near future. A flare minimization plan should be immediately prepared and filed with the air board to be in compliance with Rule 4311.

The required treatment of H_2S in the biogas noted in the discussion on the boilers will also be utilized prior to the gas flare. This is required to comply with total daily limits of SO_2 emissions.

6.0 EVALUATION OF EXISTING FACILITIES FOR EXISTING AND FUTURE FLOWS AND LOADS

Based on the biosolids design loadings for existing and future conditions, each process area was evaluated for its ability to properly treat the design biosolids loadings. The facilities evaluated included the following.

1) WAS pump Station
2) WAS thickening with DAF
3) Anaerobic digestion of primary and thickened WAS
4) Anaerobic digester control building with associated equipment
5) Biosolids dewatering with centrifuges
6) Biosolids drying with open asphalt lined drying beds

6.1 Waste Activated Sludge Pump Station

Table 6.1-1 presents a summary of design flows for the WAS pumping as well as the WAS pump capacities. As can be seen, the WAS pumps are actually well oversized for current conditions and the 10 mgd design loadings.

There is however a need for a redundant WAS pump. Currently, the piping does not allow either WAS pump to back up the other pump if it fails. As a result, it is not possible to waste from one of the plants if there is a WAS pump failure. It is therefore recommended that a third WAS pump be added and piped in a manner to be redundant to either of the two existing RAS pumps.

Table 6.1-1, WAS Pumping Design Flows

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Process/Equipment Capacity					
WAS pumps, gpm	159				
Required WAS Flow					
WAS Flow North Side, gpm		22.4	22.7	22.4	22.7
WAS Flow South Side, gpm		33.3	33.6	33.3	33.6

6.2 Waste Activated Sludge Thickening with Dissolved Air Floatation

Table 6.2-1 presents a summary of design loadings for the DAFT units. The existing DAFTS are currently operated without polymer and produce approximately 3% solids. As can be seen, the DAFTs have sufficient capacity for current conditions and the 10 mgd average design loadings, with one DAFT unit out of service. Both DAFT units will be required to be in service during maximum month loadings of 10 mgd. This is considered an acceptable level of redundancy, and additional DAFT units are not needed until after 10 mgd.

The DAFTs are currently being mechanically reconditioned and so should be suitable for the facility through the 10 mgd conditions. Rehabilitation does not include controls, instruments, or connection of the DAFT process to the plant supervisory control and data acquisition (SCADA) system. Given the age of the DAFTs it is recommended that the controls and instruments be updated, and the system connected to the plant SCADA system.

Table 6.2-1, DAFT Design Loadings

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Process/Equipment Capacity W/O Polymer					
Each Daft unit dry lbs/hr/sf	0.4 to 1.0				
Area of Each DAFT, sf	456				
Each Daft unit dry lbs/hr	192 to 456				
Required DAFT Loading					
WAS North Plant, dry lbs/hr		89	116	136	178
WAS South Plant, dry lbs/hr		152	198	232	303
Total Loading, dry lbs.hr		241	315	368	481

6.3 Anaerobic Digestion

Table 6.3-1 presents a summary of design loadings for the anaerobic digesters. Currently there are two 60-foot diameter digesters built in 1985. Each digester has an active volume of 523,000 gallons. As can be seen, the existing anaerobic digesters are not capable of treating biosolids to a minimum Class B standard with a minimum 15 day hydraulic retention time (HRT) under current maximum month conditions or when a digester is taken out of service. This only gets worse as flows increase to 10 mgd.

Table 6.3-1, Anaerobic Digester Design Loadings

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Digester Capacity					
Digester No. 1 Volume, gal	523,000				
Digester No. 2 Volume, gal	523,000				
Digester Loading					
North Plant Primary Sludge, gpd		15,943	20,659	24,524	31,781
South Plant Primary sludge, gpd		20,737	26,872	31,899	41,337
DAFT WAS, gpd		22,152	28,909	33,823	44,218
Total Flow, gpd		58,832	76,440	90,246	117,336
North Plant Primary TSS, lbs/day		4,122	5,341	6,341	8,217
South Plant Primary TSS, lbs/day		5,707	7,396	8,779	11,377
DAFT WAS TSS, lbs/day		5,727	7,474	8,745	11,432
Total Solids TSS, lbs/day		15,556	20,211	23,864	31,026
North Plant Primary VSS, lbs/day		3,627	4,700	5,580	7,231
South Plant Primary VSS, lbs/day		5,022	6,508	7,726	10,012
DAFT WAS VSS, lbs/day		4,410	5,755	6,733	8,803
Total Solids VSS, lbs/day		13,059	16,964	20,039	26,045
Influent NVSS, lbs/day		2,497	3,247	3,826	4,981
VSS Destroyed, lbs/day		6,530	8,482	10,019	13,022
VSS Remaining, lbs/day		6,530	8,482	10,019	13,022
TSS Remaining, lbs/day		9,026	11,729	13,845	18,003
Final Digested Sludge Solids , %		1.8%	1.8%	1.8%	1.8%
HRT 1 Digester, days		8.9	6.8	5.8	4.5
HRT 1 & 2 Digesters, days		17.8	13.7	11.6	8.9
1 Digester out of service OK?		No	No	No	No

Based on the analysis of digester capacity, one additional 60-foot diameter digester must be built immediately to provide a 15 day HRT under current maximum month loading and under average loading conditions when one digester is out of service for cleaning. Building this digester will carry the facility to 7.7 mgd. A second additional 60-foot diameter digester must be on line by 7.7 mgd. Four total digesters are required to meet biosolids loading at the 10 mgd design capacity.

In order to build the new digesters, a second digester control building will be required to support the new digesters.

As part of this plan, a structural inspection of the domes of existing Digesters No. 1 and No. 2 was conducted. The domes have experienced significant cracking. An attempt to repair the cracking previously was not effective, and the cracking has gotten worse. Figure 6.3-1 shows a picture of the cracking on the existing digester covers.

Figure 6.3-1, Typical Digester Dome Cracking

The cracking on the domes is extensive and gas pressure from inside the digesters is pushing moisture through the cracks continuously. Biogas is also bubbling through these cracks, and bubbles can be seen in the moisture continuously. Cracks also run the entire circumference of the domes, crossing all radial reinforcing internal to the digester concrete. This indicates the rebar has been exposed long term to digester gas with high H_2S levels. There is therefore a significant potential that the rebar reinforcing has also been damaged. The domes were therefore determined to be no longer structurally sound and are in need of immediate replacement since additional crack repair will not be able to repair damage to the concrete reinforcing.

The following is therefore recommend for the anaerobic digesters.

1. Construct two new 60-foot digesters
2. Construct new digester control building
3. Remove and replace the existing digester domes

6.4 Existing Digester Control Building

The existing digester control building contains the hot water equipment needed to keep the anaerobic digesters hot. It also contains digester heated sludge pumps and digester mixing pumps. Biogas piping is located on the roof of the building. The existing plant air system is also located in the building.

The hot water system used to heat the digesters consists of two AJAX Model WGGFD2000 cast iron boilers, two Alpha-Laval spiral heat exchangers, and associated sludge and hot water circulation pumps, grinders, and other miscellaneous equipment. Operations staff has noted they are not able to hold the digesters at the set point temperature during winter operation

The boilers are rated at a heat input of 2 million BTU/hr and an output of 1.6 million BTU/hr, and are set up to fire on digesters gas or natural gas. This capacity is marginal during winter periods with one digester out of service. The boilers appear to have been manufactured in 1986 based on their name tag, making them 26 years old. The boilers show extensive corrosion and appear in very poor condition. In addition, the boilers do not meet current emissions standards as noted in Section 5. These boilers should be immediately replaced with boilers that are slightly larger and that can meet current air regulations. One major issue with replacing boilers is new boilers meeting air emissions standards, with all emissions control devices, are substantially longer than current boilers. As a result, they will likely not fit into the existing digester control building, requiring significant modifications to the room.

The existing heat exchangers, manufactured in 1986 are each rated for 750,000 BTU/hr. Their capacity is also marginal during worst case winter conditions. Operations have regular issues with rags plugging the entrance of the heat exchanger even with grinders in series prior to the heat exchangers. The heat exchangers are sized for a sludge flow of 150 gpm, and have only a 4 inch sludge inlet. The heat exchangers should be replaced when the boilers are replaced.

The existing 26-year-old sludge heating recirculation pumps, and digester mixing pumps, are all original. The digester mixing pumps are no longer manufactured in the present configuration. As a result, the solids pumping equipment inside the existing digester control building is also at the end of its useful life, and must be replaced.

The roof of the existing digester control building leaks in many places. Operations staff has placed a tent inside the building to keep rain water from falling on equipment. The roof is flat concrete with a top asphalt membrane. The concrete appears sound. Therefore replacement of the roofing on top of the concrete is all that is required, and should be done immediately.

Gas piping on top of the digesters and digester control building is ductile iron. Ductile iron is not suitable for digester gas, because the digester gas will attack the piping causing corrosion.. This piping sits on top of the control building roof, and will have to be removed to allow replacement of the roof membranes. It is therefore recommended the digester gas piping be replaced with stainless steel piping when the control building roofing is replaced.

The following is therefore recommend for the existing digester control building. This work will have to take place after the new digesters, and digester control building noted in Section 6.3 are constructed.

1. Replace the existing boilers with larger boilers meeting air board regulations.
2. Replace the existing digester heat exchangers and miscellaneous hot water equipment.
3. Replace the existing sludge recirculation and mixing pumps.
4. Replace the existing roof membrane
5. Replace the existing digester gas piping with stainless steel gas piping.

6.5 Biosolids Dewatering With Centrifuges

Once biosolids are digested, the biosolids overflow to a concrete box north of the existing digesters, and then are pumped to a holding/mixing tank in front of the centrifuge building. The holding tank and dewatering building are recently constructed, and are in very good condition. A picture of the holding tank, and dewatering building are shown in Figure 6.5-1.

Figure 6.5-1, Solids Holding Tank and Dewatering Building

Table 6.5-1 presents a summary of design loadings for the solids holding tank and centrifuges. The existing centrifuges are operated 7 days a week, 8 hours per day. As can be seen, centrifuges are solids limited at 1,540 lbs per hour. To maintain an 8-hour work day, with one centrifuge out of service during average 10 mgd conditions, a third centrifuge is needed. The third centrifuge will be needed at approximately 8.9 mgd plant flow. Alternatively, the hours of operation when one centrifuge is out of service can be extended in lieu of adding the third centrifuge. At 10 mgd, the hours of operation required with one centrifuge out of service would be 9 hours per day at average annual conditions, and 12 hours per day during maximum month conditions. Based on discussions with plant staff, this is acceptable, and an additional centrifuge will be planned to coincide with 10 mgd plant flow.

Table 6.5-1, Holding Tank and Centrifuge Dewatering Design Loadings

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Process/Equipment Capacity					
Holding Tank, gal	112,000				
Centrifuge No. 1, dry lbs/hr	1,540				
Centrifuge No. 2, dry lbs/hr	1,540				
Centrifuge No. 1 flow, gpm	185				
Centrifuge No. 2 flow, gpm	185				
Days per week of operation	7				
Hours of Operation per day	8				
Centrifuge Loading					
Centrifuge Feed Flow, gpd		58,832	76,440	90,246	117,336
Centrifuge Feed Flow, gpm		122.6	159.2	188.0	244.5
Centrifuge Feed Loading, lbs/hr		1,128	1,466	1,731	2,250
One Centrifuge OK?		OK	OK	No	No
Solids Holding Tank					
Holding Tank Flow, gpd		58,832	76,440	90,246	117,336
Holding Tank Volume 1 Tank, days		1.90	1.47	1.24	0.95
One Centrifuge OK?		OK	OK	OK	OK

6.6 Biosolids Drying with Open Asphalt Drying Beds

The sludge drying beds were used to dry biosolids prior to construction of the dewatering building. The south beds have been abandoned and are now used for equipment storage. The north drying beds are now used only as a place to periodically empty digester contents for cleaning, and occasionally for storage of dewatered biosolids when disposal options are not available. Once biosolids are dewatered, they are loaded into roll of bins, and picked up periodically for disposal at Forward Landfill.

The remaining North beds are only large enough to be used for their current purpose, and for emergency storage of biosolids. Expansion of the open asphalt drying beds is not recommended, because they would take up significant site space, and have significant odor issues.

7.0 EVALUATION OF EXISTING BIOGAS UTILIZATION EQUIPMENT

The existing biogas utilization equipment includes the following.

1. Biogas fired boilers to heat the digesters.
2. Biogas fired electrical cogeneration system (abandoned).
3. Biogas flare.

The biogas fired electrical generator is a 450 kW Waukesha Model F3512 GLD and has a valid air permit. When it was started, it did not meet emissions limits in the permit, and has not been operated since. It remains out of compliance with emissions standards and its current permit. The level of effort to bring the engine within compliance is unknown. An analysis of refurbishing the engine and providing a new gas conditioning system is included in Section 9.

As noted in Section 6.4, existing biogas boilers are in need of immediate replacement with larger boilers that meet air emissions requirements. In addition, compliance with air board rule R4307 will require addition of H_2S treatment of biogas prior to combustion in the boilers.

The biogas flare is a Varec model 239A Flare with an electronic pilot ignition, and a heat input rating of 5.12 MMBTU/hr. As noted earlier, the flare operates under grandfathered air board rules for flares.

Figure 7.0-1 shows daily WQCF biogas production for a portion of 2014. As can be seen, under current conditions the maximum gas produced was 200,000 cubic feet per day (cfd). This equates to a maximum heating value of 5.42 MMBTU/hr. This gas production is significantly in excess of what would be expected based on the actual volume of biosolids produced at the WQCF. Investigation noted the gas meters were last calibrated May 2013. Figure 7.0-2 shows daily gas production from May 2010 through September 2011. The average gas production during this period was 110,000 cfd, and the maximum was 176,000 cfd. These values are consistent with the volume of biosolids produced at the WQCF, and therefore used to calibrate the solids balance. The maximum gas production of 176,000 cfd equates to 4.55 MMBTU/hr.

For safety reasons, the flare must be capable of burning all gas produced at the facility. The gas flare is marginal for current conditions, and must be replaced with a larger gas flare as flows increase, or if gas production increases with digestion of FOG and/or food waste. These scenarios are discussed later in this report. It is recommended the gas flare be replaced with the expansion of the digester facilities, or if FOG or food waste is added to the digesters or if dedicated food waste digesters are built. The new gas flare will have to meet current air board regulation R4311.

Required treatment of H_2S in the biogas, noted in the discussion of the boilers, will also be utilized prior to the gas flare to complying with total daily limits on H_2S emissions.

Figure 7.0-1, Manteca Biogas Daily Production - 2014

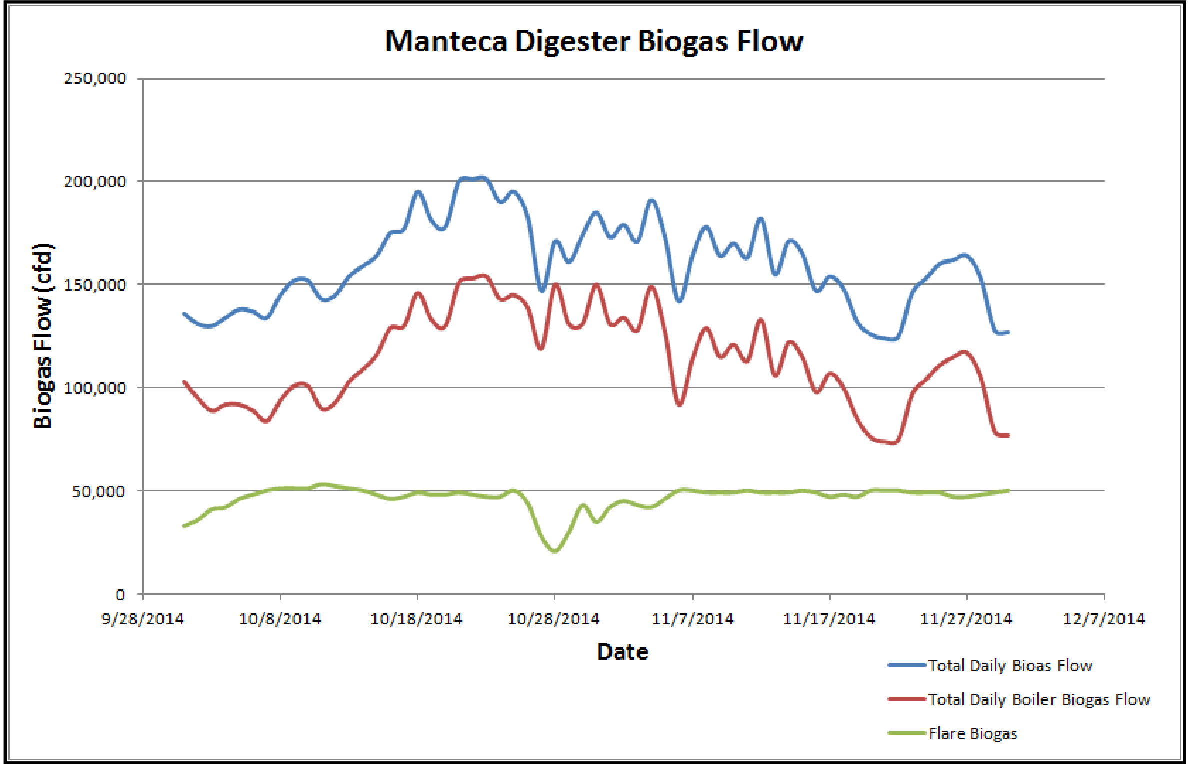
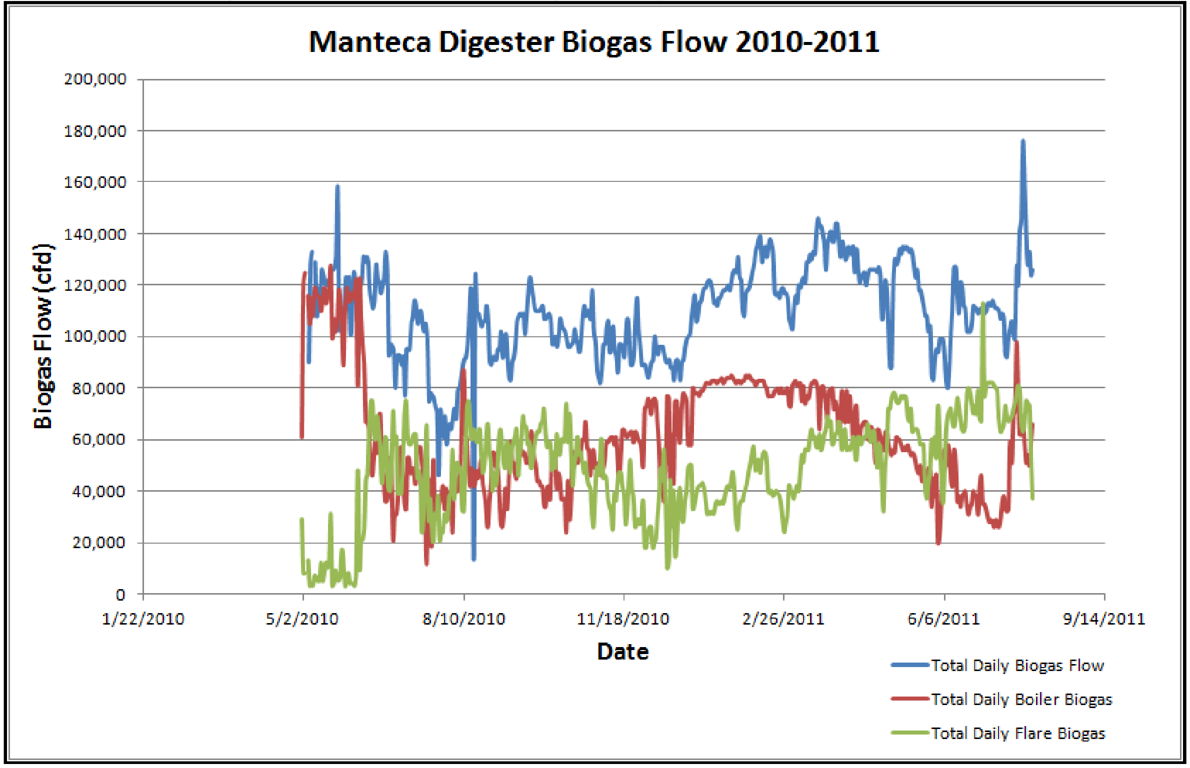


Figure 7.0-2, Manteca Biogas Daily Production 2010-2011



8.0 BIOSOLIDS DISPOSAL ALTERNATIVES

After dewatering, the City currently disposes of biosolids by loading them into roll off bins and then hauling the biosolids to the Forward Landfill. The disposal rate has been negotiated at $27/wet ton. Biosolids are disposed as fill because, they do not meet a consistent Class B standard required to be used as alternative daily cover. The normal disposal rate for fill material is $49/wet ton at Forward Landfill. CalRecycle does not list a closure date for Forward Landfill, however the September 2012, **Forward Landfill Expansion Draft EIR,** estimates landfill capacity through 2039.

As part of the City solid waste master plan the City has established State Assembly Bill (AB) 431 goal of 75% diversion of solid waste from landfill disposal by 2020.. In addition the State also passed AB 1826, directing diversion of commercial generated food waste from landfill disposal. The ultimate state goal appears to be eliminating organic material disposal in landfills.

Based on analysis in the solid waste master plan, diverting WQCF biosolids from landfill disposal will increase the City's overall landfill diversion by 6%. This is one of the largest single steps the City can take to meet AB 341 goal of 75% landfill diversion.

Given the City goals, the fact that all landfills have a closure date, and that the State of California is trying to limit organic materials disposal in landfills, the City needs to develop a plan for alternate disposal of biosolids generated at the WQCF. To accomplish this, the City will need to either process biosolids sufficiently to make a least a Class B biosolids product under EPA 40 CFR Part 503 regulations, or contract with a third party to do so.

Currently, Synagro is the only vendor in the state known to contract haul, process, and land apply biosolids that do not meet Class B criteria. Charges in excess of $59/wet ton are common and there is no competition to hold down costs. In addition, not fully treating the biosolids will significantly increase odors in the existing dewatering operation as undigested and partially digested sludge can create massive odors when handled and stored in the open, as is current practice at the WQCF. Therefore, it is not recommended that the City proceed with third party processing and disposal of their biosolids.

Creating a Class B biosolids product can be achieved by expansion of the digestion facility as noted in Sections 6.3 and 6.4. Once a consistent Class B product is achieved, the City can land apply biosolids outside the County, or contract this out to a third party. There are several third party vendors available for hauling and land applying of biosolids that meet Class B criteria. Producing Class B biosolids will allow for bidding of land application services. Class B will also ensure odors from the dewatering operation do not increase above current levels.

As noted in Section 4.0, biosolids can be further processed to Class A, or to Exceptional Quality (EQ) criteria. This is most easily achieved by drying dewatered biosolids from the centrifuge to greater than 75% solids. The benefit of this is additional flexibility in the reuse of biosolids, and reduction in hauling costs. This level of processing allows sales to the general public, and reuse of the product in City landscaping.

Preliminary site locations and costs for drying biosolids with active solar dryers were developed. In order to process biosolids produced at 10 mgd, 8 active solar dryers 240 feet by 42 feet would be required. Estimated cost of the drying facility is $15 million. Selling biosolids to the public or other Class A reuses takes time to develop, as uses for biosolids in the local community has to be developed. As a result, the normal progression is to begin small scale production of Class A biosolids, and develop uses around a portion of the total biosolids before scaling up to the full size facility. Ultimately, developing a Class A biosolid product will provide maximum flexibility to the City by diverting biosolids from landfill disposal, while holding down disposal costs.

Based on this analysis, the following is recommended.

1. Expand the digestion facilities as recommended in Sections 6.3 and 6.4 to create a Class B biosolids product.
2. Once consistent Class B biosolids are produced, divert the biosolids from landfill disposal through City directed land application, or through third party land application.
3. Plan for production of Class A biosolids by providing sufficient site space for future active solar drying.
4. Consider development of a Class A biosolids program on a portion of produced biosolids. This will allow for scaling of markets for the final product.

9.0 IMPACT OF FOG AND FOOD WASTE ON BIOSOLIDS FACILITIES AND GAS PRODUCTION

The City commissioned a parallel solid waste master plan in conjunction with this biosolids plan. The solid waste master plan included a comprehensive waste characterization, and food waste and fats, oil, and grease assessment. Information from this analysis is used below in calculating the impacts of bringing these materials to the WQCF for co-digestion with WQCF biosolids.

9.1 Fats, Oil, and Grease (FOG)

Table 9.1-1 present the FOG estimates for the WQCF. Grease has a high energy content, but a very low liquid volume relative to the WQCF biosolids. As a result, there is only a maximum 2.3% reduction in digester HRT with the addition of FOG to the digesters. The FOG can therefore be easily accommodated with the existing planned expansion of the digester facilities noted in Section 6.3.

Table 9.1-1, City of Manteca (FOG) Generation

Parameter	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
FOG				
FOG Generated as trap grease, tons/year	291	291	448	448
Program Participation, %	95%	95%	95%	95%
FOG Received as trap grease, tons/year	276	276	425	425
FOG Trap Grease Total Solids, %	67%	67%	67%	67%
FOG as Pure Grease Total Solids, tons/year	185	185	285	285
FOG Received as pure grease, lbs/day	1,015	1,015	1,561	1,561
Average Concentration of Grease from interceptor	9%	9%	9%	9%
FOG Received as Slurry Mixture, lbs/day	11,277	11,277	17,349	17,349
FOG Received as Slurry Mixture, gal/day	1,352	1,352	2,080	2,080
FOG Volatile Solids, %	100%	100%	100%	100%
FOG Volatile Solids, lbs/day	1,015	1,015	1,561	1,561
Decrease in Digester HRT, %	2.3%	1.8%	2.3%	1.8%

The impact of FOG on the dewatering system is actually very unique. Almost 100% of grease will be destroyed in the digesters, so there is no net increase in biosolids for dewatering. Also, there is significant evidence of an enhanced digestion effect on existing biosolids with the addition of FOG to a municipal digester. As a result, there is likely to be a decrease in solids fed to the dewatering process, with addition of FOG.

Table 9.1-2 presents the resultant impact of FOG addition on production of biogas at the WQCF. Adding FOG to digesters increases the heating value of biogas by 26% to 31%.

Table 9.1-2, City of Manteca Biogas Generation With FOG

Parameter	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Biosolids Only				
Total VSS, Loading, lbs/day	13,059	16,964	20,039	26,045
VSS Converted, lbs/day	6,530	8,482	10,019	13,022
Gas Production, cf/lb-VSS Converted	16.5	16.5	16.5	16.5
Gas Production, cf/day	107,741	139,949	165,319	214,871
Higher Heating Value, BTU/cf	620	620	620	620
Higher Heating Value, BTU/day	66,799,141	86,768,393	102,498,085	133,220,049
Higher Heating Value, BTU/hr	2,783,298	3,615,350	4,270,754	5,550,835
Biosolids Combined with FOG				
Total Gas Production, cf/day	133,551	167,986	204,997	258,005
Higher Heating Value, BTU/cf HHV	655	655	655	655
Higher Heating Value, BTU/day	87,540,188	110,073,318	134,372,310	169,073,779
Higher Heating Value, BTU/hr	3,647,508	4,586,388	5,598,846	7,044,741
Increase in Heating Value, %	31.0%	26.9%	31.1%	26.9%

Based on the analysis of the impacts of FOG to the digesters at the WQCF, the negative impacts are very small and the positive impact of additional gas production is very substantial. It is therefore recommended that the City proceed with a City wide FOG program and construct a FOG receiving station at the WQCF.

9.2 Food Waste

Two options were evaluated as part of the solids handling master plan for handling food waste within the City. Under both options, a new food waste receiving and processing facility is constructed adjacent to the WQCF. One option for this facility is to construct separate dedicated food waste digesters. Another option is to prepare food waste and then pump it into the WQCF biosolids digesters for co-digestion. This section evaluates the impact of co-digestion of the biosolids at the WQCF.

Table 9.2-1 present the food waste estimates for the City. Table 9.2-2 presents the impact of the food waste Phases 1 and 2 on the WQCF if this material is co-digested with the biosolids. Table 9.2-3 presents the impacts of food waste Phases 1, 2, and 3 on the WQCF if this material is co-digested with the biosolids.

Table 9.2-1, City of Manteca Food Waste Generation

Parameter	Phase 1 Commercial Organics/ Self Haul	Phase 2 Commercial Organics/ Food Waste	Phase 3 Residential Organics/ Food Waste
Food Waste			
Generated, tons/year	1,500	1,910	9,128
Program Participation, %	100%	75%	61%
Received, wet tons/year	1,500	1,432	5,568

It is planned as part of the new food waste preparation facility to prepare the waste for digestion at 8% solids to reduce the hydraulic impact on the digestion facilities. This compares to an average of 3% solids for the municipal biosolids. As a result, the impact is unequal for hydraulic retention time, as it is for TSS, and total volatile suspended solids (TVSS). The additional food waste solids processed have a higher impact on downstream dewatering facilities than it does on the digesters.

Food waste Phases 1 and 2 can be accommodated in the existing digester capacity expansion planned under Section 6.3, without constructing additional digesters.

Food waste Phases 1 and 2 impacts dewatering. The existing centrifuges are operated 7 days a week 8 hours per day. As can be seen, the centrifuges are solids limited at 1,540 lbs per hour at the current 6.5 mgd max month design loadings, with one centrifuge out of service. To maintain an 8-hour work-day, with one centrifuge out of service during average conditions, a third centrifuge is needed under current conditions.

Table 9.2-2, Impact of Food Waste Phases 1 and 2 on the WQCF

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Digester Loading					
Biosolids Flow, gal/day		58,832	76,440	90,246	117,336
Food Waste Flow, gal/day		7,225	7,225	7,225	7,225
Total Flow, gal/day		66,057	83,665	97,471	124,561
Biosolids TSS, lbs/day		15,556	20,211	23,864	31,026
Food Waste Flow, TSS lbs/day		4,821	4,821	4,821	4,821
Total Solids TSS, lbs/day		20,377	25,032	28,685	35,846
Biosolids VSS, lbs/day		13,059	16,964	20,039	26,045
Food Waste Flow VSS, lbs/day		3,856	3,856	3,856	3,856
Total Solids VSS, lbs/day		16,916	20,820	23,895	29,901
Food Waste Impact on Digester					
Decrease in HRT, %		12%	9%	8%	6%
Increase in TSS, %		31%	24%	20%	16%
Increase in VSS, %		30%	23%	19%	15%
Additional Digesters Required Beyond Required Under Section 6.3		0	0	0	0
Food Waste Impact on Dewatering					
Centrifuge Feed solids, dry lbs/hr	1540				
Biosolids Feed, dry lbs/hr		1,128	1,466	1,731	2,250
Food Waste Feed, dry lbs/hr		265	265	265	265
Total Feed, dry lbs/hr		1,393	1,731	1,996	2,516
One Centrifuge OK?		OK	No	No	No

Table 9.2-3, Impact of Food waste Phases 1, 2, and 3 on the WQCF

Parameter	Capacity	6.5 MGD Average	6.5 MGD Peak Month	10 MGD Average	10 MGD Peak Month
Digester Loading					
Biosolids Flow, gal/day		58,832	76,440	90,246	117,336
Food Waste Flow, gal/day		20,944	20,944	20,944	20,944
Total Flow, gal/day		79,775	97,384	111,190	138,280
Biosolids TSS, lbs/day		15,556	20,211	23,864	31,026
Food Waste Flow, TSS lbs/day		13,974	13,974	13,974	13,974
Total Solids TSS, lbs/day		29,530	34,185	37,838	44,999
Biosolids VSS, lbs/day		13,059	16,964	20,039	26,045
Food Waste Flow VSS, lbs/day		11,179	11,179	11,179	11,179
Total Solids VSS, lbs/day		24,238	28,142	31,218	37,224
Food Waste Impact on Digester					
Decrease in HRT, %		36%	27%	23%	18%
Increase in TSS, %		90%	69%	59%	45%
Increase in VSS, %		86%	66%	56%	43%
Additional Digesters Required Beyond Required Under Section 6.3		2	2	2	2
Food Waste Impact on Dewatering					
Centrifuge Feed solids, dry lbs/hr	1540				
Biosolids Feed, dry lbs/hr		1,128	1,466	1,731	2,250
Food Waste Feed, dry lbs/hr		769	769	769	769
Total Feed, dry lbs/hr		1,897	2,235	2,499	3,019
Additional Centrifuges Required		1	1	1	1

Alternatively, the hours of operation when one centrifuge is out of service can be extended in lieu of adding the third centrifuge. At 6.5 mgd maximum month conditions, the hours of operation with one centrifuge out of service would be 9 hours per day. At 10 mgd, the hours of operations required with one centrifuge out of service would be 10.5 hours per day at average annual conditions and 13.5 hours per day during maximum month conditions. Based on discussions with staff, this is acceptable in the early portions of the food waste program. However separate additional dewatering will be planned as part of the second phase of the food waste program.

Food waste Phases 1, 2, and 3 would require the construction of 2 additional digesters than is required under Section 6.3 for biosolids alone. Hydraulically, only 1 digester would be required. However, as the ratio of food waste at 8% solids becomes a larger and larger portion of the biosolids only loading, the digesters become limited by the amount of solids that can be processed in a continuously stirred-tank reactor (CSTR). Thus a second digester is required in loading Phase 1, 2, and 3.

Food waste Phases 1, 2 and 3 immediately overwhelms the dewatering process. One additional centrifuge is needed at current conditions.

In all cases, the cost of disposal of the biosolids will increase in proportion to food waste processed. Disposal cost for the WQCF biosolids is currently $27/wet ton, under a negotiated rate at the Forward Landfill. If the food waste is kept separate from the biosolids, it could be disposed of at $19.75/wet ton at Harvest Power's compost operation.

Table 9.2-4 presents the biogas generated from each phase of the Food Waste program based on the quantities and participation rates presented in Table 9.2-1. Food waste can generate substantial additional biogas.

Table 9.2-4, City of Manteca Biogas Generation From Food Waste

Parameter	Phase 1 Commercial Organics/ Self Haul	Phase 2 Commercial Organics/ Food Waste	Phase 3 Residential Organics/ Food Waste
Food Waste			
Total Gas Production, cf/day	17,951	17,143	66,634
Higher Heating Value, BTU/cf HHV	650	650	650
Higher Heating Value, BTU/day	11,667,936	11,142,888	43,312,032
Higher Heating Value, BTU/hr	486,164	464,287	1,804,668
Cumulative Increase in Heating Value vs Biosolids Only, %	17.5%	34.1%	99%

9.3 Permit Considerations for Food Waste Co-Digestion with WQCF Biosolids

Regulatory agencies are beginning to catch up to the co-digestion concept of food waste and solid waste. As a result, there are now some permitting hurdles that must be addressed as part of any interconnection between a food waste facility and the WQCF. The most recent NPDES permit for the WQCF requires the following in relation to receiving food waste.

> **VI.C.5.d. Anaerobically Digestible Material.** If the Discharger proposes to receive hauled-in anaerobically digestible material for injection into an anaerobic digester for co-digestion, the Discharger shall notify the Central Valley Water Board and develop and implement standard operating procedures (SOP's) for this activity prior to initiation of the hauling. The SOP's shall address material handling, including unloading, screening, or other processing prior to anaerobic digestion; transportation; spill prevention; and spill response. In addition, the SOP's shall address avoidance of the introduction of materials that could cause interference, pass-through, or upset of the treatment processes; avoidance of prohibited material, vector control, odor control, operation and maintenance, and the disposition of any solid waste segregated from introduction to the digester. The Discharger shall provide training to its staff on the SOP's and shall maintain records for a minimum of three years for each load received, describing the hauler, waste type, and quantity received. In addition, the Discharger shall maintain records for a minimum of three years for the disposition, location, and quantity of accumulated pre-digestion-segregated solid waste hauled off-site.

9.4 Summary of Recommendations for FOG and Food Waste Co-digestion

Based on the previous analysis, the following is recommended in relation to FOG and food waste co-digestion with the WQCF biosolids.

1. Construct a FOG receiving facility at the WQCF to accept FOG. This increases biogas production, enhances digestion of the WQCF biosolids, and provides other benefits as outlined in the solids waste master plan.
2. Assuming Digester No. 3 and 4 are added to treat the WQCF biosolids as recommended in Section 6.3, food waste Phases 1 and 2 can be co-digested in the digesters with the WQCF biosolids without significantly impacting the digester operation or sizing.
3. Food waste Phase 3 requires additional digesters be constructed at either the food waste facility or the WQCF. It is recommended they be constructed at the food waste facility since they can be specialized for the food waste digestion.
4. Dewatering is immediately impacted with food waste Phases 1 and 2. This impact can be accommodated in the short term by operating additional hours when one centrifuge is out of service. In the long term, a third centrifuge is required or

dewatering must be provided at the food waste facility. It is therefore recommend the food waste facility plan for dewatering as part of its second phase expansion.

5. Dewatering cannot accommodate food waste Phase 3 without a third centrifuge. It is therefore recommended that a food waste facility plan for dewatering as part of its second phase expansion. This expansion needs to be complete prior to implementation of Phase 3.
6. Biogas generated from food waste is significant. Regardless of where the digestion and dewatering of food waste takes place, it is recommended that the biogas from food waste be combined with biogas from the WQCF for processing and utilization.
7. The WQCF has NPDES permit steps that must be complied with in order to accept food waste biosolids. These steps must be integrated into the planning for the new food waste facility.

10.0 BIOGAS UTILIZATION ANALYSIS

As noted previously, the existing electrical cogeneration system at the WQCF does not function and has not been operated in many years. As a result, the WQCF currently flares excess gas not used to heat the digesters. Therefore an economic analysis was performed to determine the best way to utilize biogas currently produced, as well as biogas that will be produced with FOG and food waste digestion.

For the analysis, 5 alternatives were considered for utilizing the biogas. They include the following.

> **Option 1:** Treat and process the biogas to a compressed natural gas (CNG) quality and utilize in the City vehicles and garbage trucks. This process is also referred to as BioCNG or RCNG for renewable CNG. Option 1 is specifically for the BioCNG50 process manufactured by Unison which produces 250 diesel gallon equivalents (DGE) of BioCNG a day. This option also includes the a fill station for the vehicles and some additional costs to retrofit City vehicles to natural gas or upgrade new vehicles to natural gas at time of purchase. For this option, biogas is first used to heat the digesters, and the remaining biogas is utilized to make BioCNG.
>
> **Option 2:** Option 2 is the same as Option 1 except with the BioCNG100 from Unison which makes 500 DGE per day.
>
> **Option 3:** This option utilizes two 250 kW Ingersoll Rand gas turbines to make electricity. Waste heat from the turbines is used to heat the digesters.
>
> **Option 4:** This option is to rehabilitate the existing 400 kW electrical cogeneration system to make electricity. Waste heat from the engine is used to heat the digesters.
>
> **Option 5:** This option is to purchase a new ultra high efficiency 600 kW engine from MWM (marketed through Caterpillar). Waste heat from the engine is used to heat the digesters.

In all cases, supplemental natural gas is used to make up for shortfalls in production of biogas. All options also include gas conditioning to appropriate levels for the equipment, and to meet air regulations. All options also include maintenance contracts where appropriate, to properly maintain the equipment.

10.1 Biogas Quantity and Quality

As noted in Section 7.0, the current biogas production is approximately 110,000 cfd. Estimates of gas production at 10 mgd, with and without FOG is presented in Section 9.2. Estimates of gas production from food waste Phases 1, 2 and 3 are presented in Section 9.3.

To determine the level of biogas treatment required, a gas sample was taken and analyzed at Centek labs. The results of this analysis are presented in Table 10.1-1.

Table 10.1-1, Biogas Test Results for WQCF - Sample Date 12-18-2014

Parameter	Results	Units
BTU Normalized by ATM 3588		
BTU Gross or HHV	620	BTU/Cubic Foot
BTU Net or LHV	560	BTU/Cubic Foot
Normalized Fixed Gases		
Carbon dioxide	36.8	%
Carbon Monoxide	0	%
Methane	61.4	%
Nitrogen	1.57	%
Oxygen	0.28	%
Sulfur Series By TO-15		
1-Propanethiol	420	ppbV
Dimethyl sulfide	22	ppbV
Ethyl mercaptan	97	ppbV
Hydrogen Sulfide	4,700,000	ppbV
Isopropyl mercaptan	27	ppbV
Methyl mercaptan	190	ppbV
Siloxane Series		
Decamethylcyclopentasiloxane-D5	99	ppbV
Decamethyltetrasiloxane-L4	0	ppbV
Dodecamethylcyclohexasiloxane-D6	0	ppbV
Dodecamethylpentasiloxane-L5	0	ppbV
Hexamethylcyclotrisiloxane-D3	0	ppbV
Hexamethyldisiloxane-L2	0	ppbV
Octamethylcyclotetrasiloxane-D4	95	ppbV
Octamethyltrisiloxane-L3	7.5	ppbV
Trimethyl silanol	15	ppbV

A complete copy of the gas analysis is included in the appendix. Based on this gas analysis, there is very high H_2S at 4,700,000 parts per billion by volume, ppbv, (4,700 parts per million by volume ppmV) in the biogas. A typical WWTP would be in the range of 1,000 to 2,000 ppmV. This results in increased size, complexity, operational costs, and capital cost of the gas conditioning system in the analysis of each alternative.

Because Siloxanes were also present in the gas analysis, the gas conditioning system is required to remove this siloxane as well. Siloxanes, even in the parts per billion range will quickly impact operation of the CNG system, or cogeneration equipment.

To properly control biogas utilization equipment and maximum biogas recovery, a low pressure gas holder is needed. A ground mounted membrane style is the most cost effective and is recommended. The cost for the gas holder is treated separately from the five gas utilization options.

10.2 Analysis of Options

The analysis for each of the alternatives is extensive. Table 10.2-1 presents a summary of results for the 5 Options for the current condition of 6.5 mgd. Table 10.2-2 presents the same summary for biosolids at 6.5 mgd with addition of FOG. Table 10.2-3 presents the same summary for biosolids at 6.5 mgd, FOG, and Phase 1 and 2 of the food waste program. An economic analysis at 10 mgd was not conducted since it is too far in the future to be considered valid. A more detailed breakdown, and analysis of all options is included in the appendix.

Key items to note are as follows:

1. The less gas that is produced generally results in longer simple payback for each project.
2. Both the CNG options are greatly affected by the offset cost of diesel. Diesel prices have fallen substantially in the last year. The Clean Cities Alternative Fuels Price Report listed the average cost of West Coast Diesel at $2.46/gallon in January 2016. Excel downloads from the US Energy Information Administration list the average diesel price for California with a five year average of $3.74/gallon, a 2year average of $3.28/gallon, a 1 year average of $2.81/gallon, and an April 4, 2016 price of $2.43/gallon. The lowest price in the last 2 years was $2.29/gallon in February 2016. However, long-term diesel costs are not expected to remain at current levels. The cost of diesel used in this economic analysis is a long term average of $3.18/gallon based on the Clean Cities Alternative Fuels Price Report average for west coast on October 2014 and January 2016. This is also close to, but a more conservative economic analysis number than, the 2 year California average noted above.
3. Production of CNG for transportation is eligible for RIN (Renewable Identification Number) credits under the federal EPA Renewable Fuel Program. These RIN credits have a substantial value and greatly affect the economic payback for CNG process. For the analysis, a value of $1.65 for D-5 advanced Biofuels RIN credits

was used based historic value and testimonials on the current market value of the RINs. A RIN equates to 77,000 BTU lower heating value of energy.

4. For CNG, the City achieves the highest return when they offset their own retail purchase of diesel. Selling CNG to third parties at current market rates is significantly less valuable than offsetting City fuel purchases.
5. For the existing garbage truck fleet, the City purchase 134,105 gallons of diesel fuel in 2014. This equates to 367 gallons per day. For the BioCNG100 option at 500 DGE, it is assumed the City will continue to convert other City vehicles in addition to the garbage truck fleet.
6. Either of the BioCNG options are much more attractive than the electrical cogeneration options because the offset value of diesel and RIN credits are significantly better than the offset cost of electricity.

Based on this analysis, the recommended alternative is the BioCNG 100 system constructed near the WQCF. This project has a strong economic performance especially since FOG and food waste addition to the digesters is planned as part of the expansion. At an average diesel cost of $3.18/gallon, the BioCNG 100 project option has a simple payback of 5.13 years with FOG and food waste additions. If Diesel costs were to drop to the 2 year low of $2.29/gal, the simple payback for this alternative rises to 6.5 years. The recommended project is there for a strong performer even if diesel fuel costs stay at their current low levels.

Table 10.2-1, Biogas Utilization for Biosolids Only at 6.5 mgd

Parameter	**BioCNG 50**	**BioCNG 100**	**2 x 250 kW Gas Turbines**	**Existing 400 kW Engine**	**New 600 kW Engine**
Diesel Fuel Cost ($/gal)	$3.18	$3.18	$3.18	$3.18	$3.18
Natural Gas Cost per $/Therm (HHV)	$0.61	$0.61	$0.65	$0.65	$0.65
Minimum Average Plant Electric Load (kW)			750	750	750
Size of CNG System (DGE/Day)	250	367			
Net Cogen Power Output (kW)			438.8	358.9	548.9
Percentage of Total Energy from Biogas	62%	42%	43%	64%	56%
Average Plant Electric Cost per kW	$0.1220	$0.1220	$0.1220	$0.1220	$0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	133,955			
Additional NG Purchased (Therms/yr)	51,320	110,253	312,810	128,115	178,725
Total Annual Electric Reduction on PG&E Service (kW-hr)			3,652,055	2,987,014	4,568,170
Net Electrical Revenue ($/yr)			3,652,055	2,987,014	4,568,170
Reduction in Fuel Cost When Converted to NG ($/yr)	$290,175	$425,977			
RIN Credits $/yr	$184,096	$184.096			
Total Net Income/Offset Cost ($/yr)	$474,271	$610,073	$434,410	$355,304	$543,382
Operations Costs ($/yr)	$200,319	$240,148	$326,460	$293,789	$390.598
Net Offset Revenue per Year ($/yr)	$257,064	$337,674	$71,884	$25,448	$116,717
Total Project Costs After Rebates	$3,437,575	$3,937,575	$3,519,180	$2,232,120	$3,315,120
Simple Payback, years	13.37	11.66	48.96	87.71	28.40

Table 10.2-2, Biogas Utilization for Biosolids at 6.5 mgd with FOG

Parameter	BioCNG 50	BioCNG 100	2 x 250 kW Gas Turbines	Existing 400 kW Engine	New 600 kW Engine
Diesel Fuel Cost ($/gal)	$3.18	$3.18	$3.18	$3.18	$3.18
Natural Gas Cost per $/Therm (HHV)	$0.61	$0.61	$0.65	$0.65	$0.65
Minimum Average Plant Electric Load (kW)			750	750	750
Size of CNG System (DGE/Day)	250	367			
Net Cogen Power Output (kW)			445.0	361.7	552.1
Percentage of Total Energy from Biogas	100%	73%	53%	80%	70%
Average Plant Electric Cost per kW	$0.1220	$0.1220	$0.1220	$0.1220	$0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	133,955			
Additional NG Purchased (Therms/yr)	6,748	56,655	257,323	72,628	123,237
Total Annual Electric Reduction on PG&E Service (kW-hr)			3,702,879	3,009,911	4,594,288
Net Electrical Revenue ($/yr)			$440,456	$358,028	$546,489
Reduction in Fuel Cost When Converted to NG ($/yr)	$290,175	$425,997			
RIN Credits $/yr	$291,427	$291,427			
Total Net Income/Offset Cost ($/yr)	$581,602	$717,404	$440,456	$358,028	$546,489
Operations Costs ($/yr)	$200,319	$240,148	$326,460	$293,789	$390.598
Net Offset Revenue per Year ($/yr)	$381,283	$477,255	$113,996	$64,239	$155,891
Total Project Costs After Rebates	$3,437,575	$3,937,575	$3,519,180	$2,232,120	$3,315,120
Simple Payback, years	9.02	8.25	30.87	34.75	21.27

Table 10.2-3, Biogas Utilization for Biosolids at 6.5 mgd With FOG and Food Waste Phases 1 and 2

Parameter	**BioCNG 50**	**BioCNG 100**	**2 x 250 kW Gas Turbines**	**Existing 400 kW Engine**	**New 600 kW Engine**
Diesel Fuel Cost ($/gal)	$3.18	$3.18	$3.18	$3.18	$3.18
Natural Gas Cost per $/Therm (HHV)	$0.61	$0.61	$0.65	$0.65	$0.65
Minimum Average Plant Electric Load (kW)			750	750	750
Size of CNG System (DGE/Day)	250	500			
Net Cogen Power Output (kW)			450.4	364.0	554.8
Percentage of Total Energy from Biogas	100%	82%	67%	100%	89%
Average Plant Electric Cost per kW	$0.1220	$0.1220	$0.1220	$0.1220	$0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	182,500			
Additional NG Purchased (Therms/yr)	6,748	56,497	180,139		46,053
Total Annual Electric Reduction on PG&E Service (kW-hr)			3,747,829	3,029,208	4,617,388
Net Electrical Revenue ($/yr)			$445,803	$360,323	$549,236
Reduction in Fuel Cost When Converted to NG ($/yr)	$290,175	$580,350			
RIN Credits $/yr	$427,746	$427,746			
Total Net Income/Offset Cost ($/yr)	$717,921	$1,008,096	$445,803	$360,323	$549,236
Operations Costs ($/yr)	$202,475	$240,052	$276,290	$246,581	$340,428
Net Offset Revenue per Year ($/yr)	$515,446	$768,044	$169,513	$113,742	$208,808
Total Project Costs After Rebates	$3,437,575	$3,937,575	$3,519,180	$2,232,120	$3,315,120
Simple Payback, years	6.67	5.13	20.76	19.62	15.88

11.0 RECOMMENDATIONS AND COSTS

Based on the previous analysis, the following is summary of all recommendations to handle Biosolids and utilize the biogas at the WQCF.

1. **Recommendation:** Add a redundant WAS pump and piping in the RAS/WAS control Building.

   Reason: Cannot waste from either North or South plant if existing North/South WAS pump fails.

2. **Recommendation:** After completion of mechanical rehabilitation of the existing DAFT units, provide instrument replacement, new control panels, and connection to plant SCADA system for both DAFT units.

   Reason: DAFT instruments and controls are original equipment and missing or in need of replacement. There is no SCADA interface currently to monitor DAFT operation.

3. **Recommendation:** Upgrade the digestion facilities to consistently produce a EPA 40 CFR Part 503 Class B biosolids as a minimum level of treatment with a minimum of 15 days of hydraulic retention time in the digesters.

   Reason: Land filling is currently the only biosolids disposal alternative available to the City with an under treated biosolids product. Producing Class B biosolids is the first step in diversion of biosolids from the landfill, which is a goal of the solids waste master plan and the likely direction of future legislation. This also ensures adequate digestion time to properly produce biogas from the biosolids.

4. **Recommendation:** Construct Digesters No. 3 and No.4 and a new digester control building.

   Reason: Required to consistently produce Class B biosolids at 10 mgd plant flow. Also required to allow rehabilitation of the existing digesters and digester control building.

5. **Recommendation:** Rehabilitate Digesters No. 1 and No. 2, including replacement of the concrete domes and associated piping.

   Reason: The digester domes are cracked beyond simple repair and no longer safe. The gas piping is the wrong materials and must be removed to accommodate the dome replacement.

6. **Recommendation:** Demolish existing equipment in the existing digester control building once the new building is constructed.

   Reason: Equipment and piping has reached the end of its useful life. New digester control building and equipment will replace this equipment.

7. **Recommendation:** Replace the existing gas flare as flows increase, or if FOG or food waste is added to the digesters.

Reason: The flare is to small for future gas flows and does not meet new air board regulations.

8. **Recommendation:** Construct a gas holder to be incorporated with the new digesters.

   Reason: Needed to control gas utilization equipment and increase recovery and reuse of biogas.

9. **Recommendation:** Construct Centrifuge No. 3 if food waste is digested and digestate is sent to the WQCF dewatering process in lieu of a new dewatering process at the food waste facility.

   Reason: Existing centrifuges not big enough to handle food waste digestate with one centrifuge out of service. Existing facilities is okay to use in the short term if separate dewatering is planned for the second phase of the food waste facility.

10. **Recommendation:** Plan for future biosolids drying to produce Class A, or exceptional Quality biosolids. This included site space and the cost to build the project.

    Reason: Drying the biosolids reduces hauling and disposal costs, and allows for reuse to the general public, as well as a possibility to sell the product.

11. **Recommendation:** Construct a FOG receiving station at the WQCF, and proceed with a FOG collection program within the City.

    Reason: FOG produces a significant amount of Biogas, and helps digestion of existing biosolids. FOG also provides revenue from tip fees.

12. **Recommendation:** Construct a biogas renewable compressed natural gas (BioCNG) facility and fill station. Proceed with conversion of City trucks to CNG power.

    Reason: BioCNG has the shortest payback and the greatest benefit to the City of biogas utilization projects considered.

13. **Recommendation:** Construct a food waste receiving station at the WQCF.

    Reason: The Co-digesting food waste at the digesters will increase gas production and allow for diversion of food waste from the landfill.

Table 11.0-1 presents a summary of projects and costs for each of the proposed projects. The Costs are separated in projects to be included with the new digester control building and digesters project and the remaining biosolids projects. A detailed cost estimate for each project is included in the appendix.

Figure 11.0-1 presents a site plan of all biosolids and other WQCF planned facilities.

Figure 11.0-2 presents a schedule of all of near term projects proposed for the new digester control building and digester project, including the CNG facilities. The remaining recommended projects will be implemented separately either as part of O&M projects (WAS and DAFT improvements) or as capacity demands increase (Centrifuge and Biosolids Drying).

Table 11.0-1, Manteca WQCF Biosolids Recommended Project Summary

Project No	Description	Total Project Cost	Cost for 2015-2018	Costs for 2020-2024	Costs Beyond 2024
Projects Included With Digester Control Building Project					
1-13	Construct New Digester Control Building, Digesters, Gas Flare, and Support Equipment.	$19,950,000(2)	$19,950,000		
14-16	Construct FOG Facility	$1,304,000(3)	$1,304,000		
17-19	Construct Food Waste Receiving Facilities	$508,000(4)	$508,000		
20-22	Construct BioCNG Facility	$3,938,000(5)	$3,938,000		
Remaining O&M/Capacity Projects					
1	WAS Building Improvements	$80,000	$80,000		
2	DAFT Control Upgrade	$89,000	$89,000		
10	Add Centrifuge No. 3	$1,517,000		$1,517,000	
11	Construct Biosolids Drying System	$14,917,000			$14,917,000
	Total	$42,303,000	$25,869,000	$1,517,000	$14,917,000

Notes:
1) Total capital cost, including construction, contingencies, engineering, administration and environmental documentation, as applicable. First quarter 2015 cost level. ENR 20-Cities CCI = 9,970.
2) Based on $19,113,000 form Breakdown in Appendix plus $829,000 fees for design, survey, geotechnical services.
3) Based on breakdown in appendix. Design fees included as part of Digester Control Building Project.
4) Portion of facilities constructed at WQCF remaining costs for facilities at Lovelace Transfer Facility included in the Solid Waste Master plan.
5) Includes costs of some civil improvements to support the facility that will be constructed as part of the new Digester control Building Project. These costs are shown in the appendix.

Figure 11.0-1, Manteca WQCF Biosolids and Solid Waste Site Plan

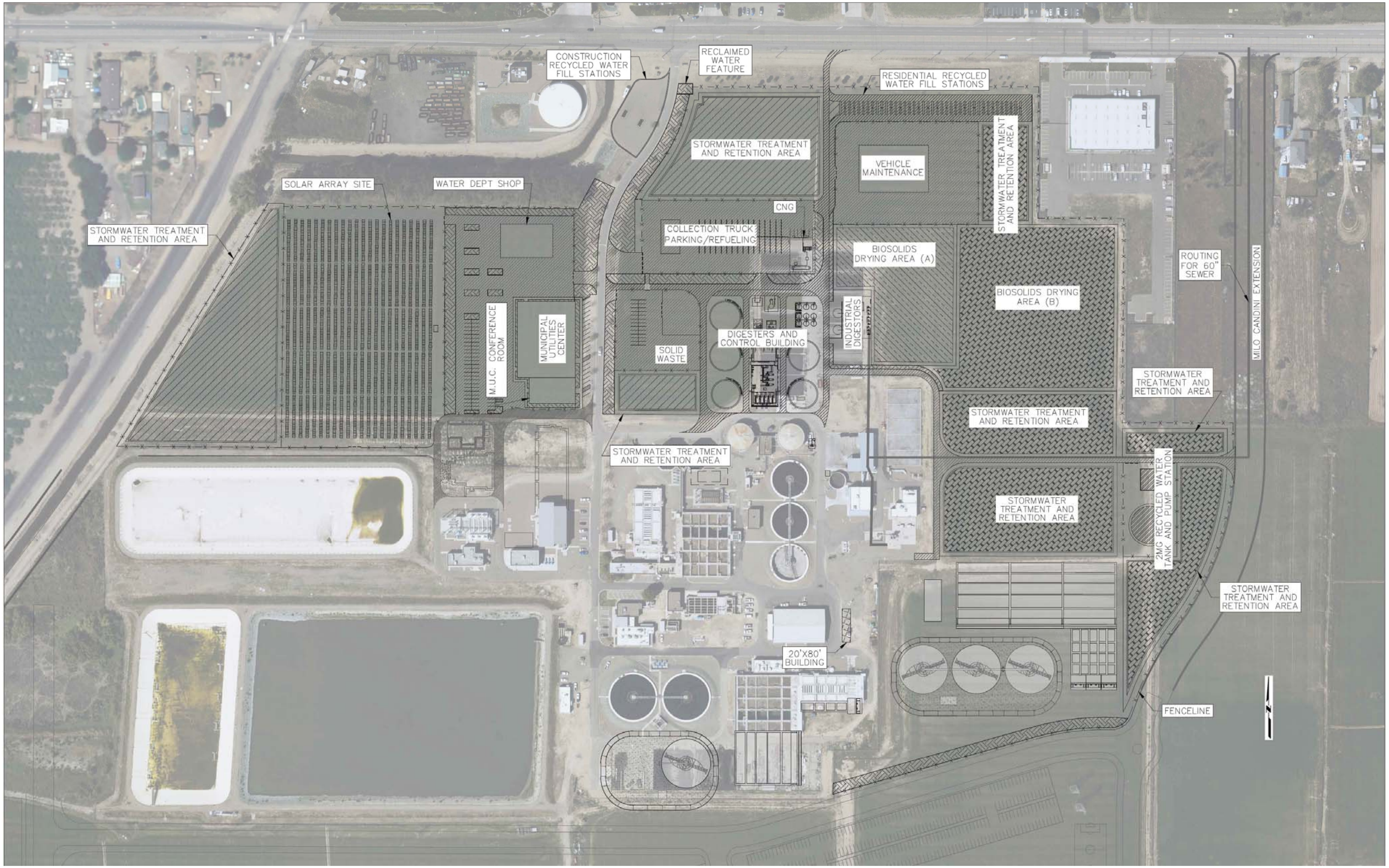
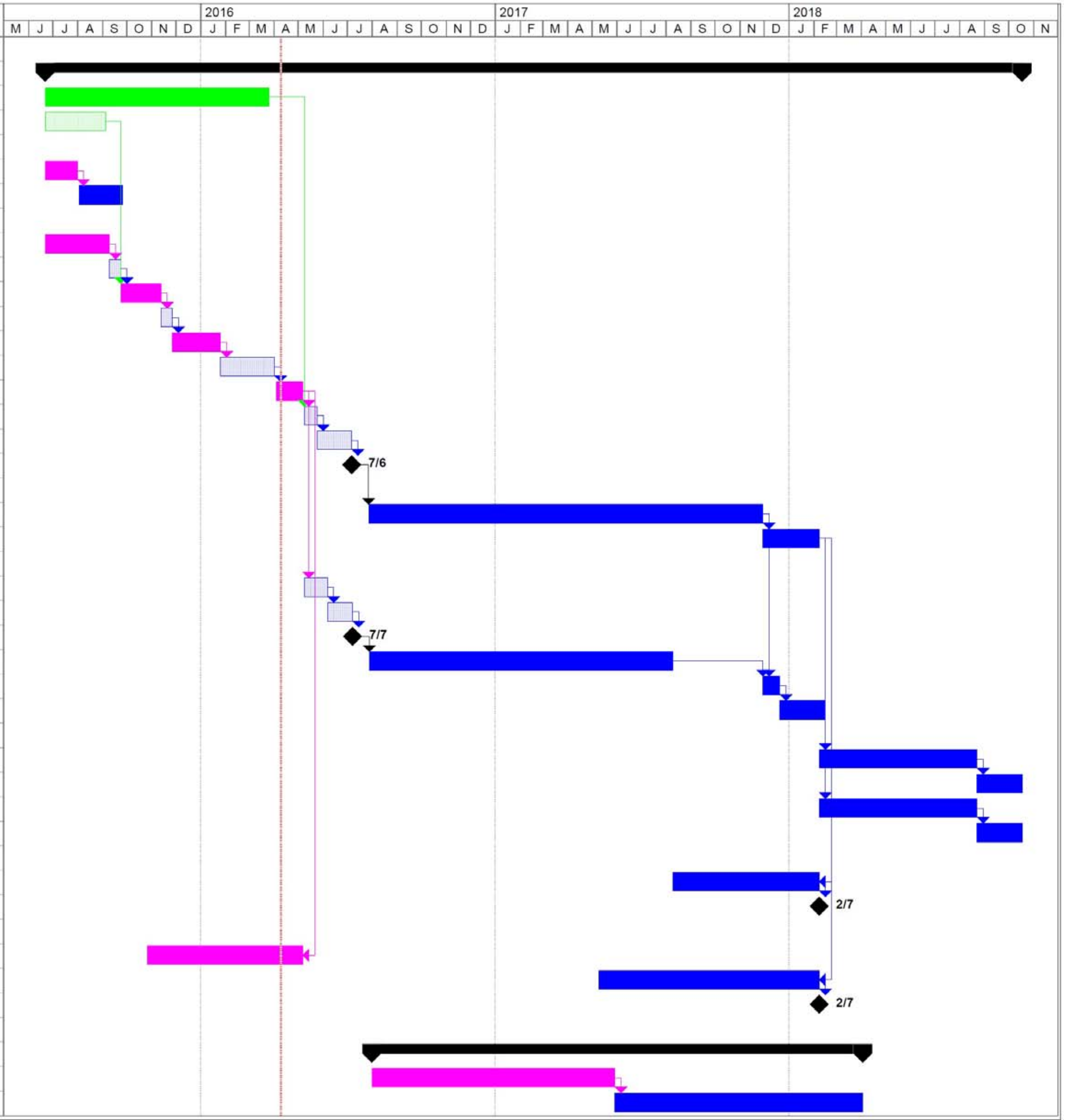


Figure 11.0-2, Manteca WQCF Biosolids Schedule

ID	ℹ	Task Name	Duration	Start	Finish	Predecessors
1						
2		**Digester Complex**	**868 days**	**Mon 6/22/15**	**Wed 10/17/18**	
3	▦	Environmental Documentation	200 days	Mon 6/22/15	Fri 3/25/16	
4	▦	Prepare Geotechnical Report	55 days	Mon 6/22/15	Fri 9/4/15	
5						
6	▦	Prepare Temporary Boiler Ops Plan / Design	30 days	Mon 6/22/15	Fri 7/31/15	
7		Construct Temporary Boiler Connections	40 days	Mon 8/3/15	Fri 9/25/15	6
8						
9	▦	30% Design	58 days	Mon 6/22/15	Wed 9/9/15	
10		30% Design Review	10 days	Thu 9/10/15	Wed 9/23/15	9
11		60% Design	36 days	Thu 9/24/15	Thu 11/12/15	4,10
12		60% Design Review	10 days	Fri 11/13/15	Thu 11/26/15	11
13		90% Design	42 days	Fri 11/27/15	Mon 1/25/16	12
14		90% Design Review / Building Dept Review	49 days	Tue 1/26/16	Fri 4/1/16	13
15		100% Design	25 days	Mon 4/4/16	Fri 5/6/16	14
16		Staff Report - Authorization to Bid	12 days	Mon 5/9/16	Tue 5/24/16	3,15
17		Advertise / Bid Digester Control Building	31 days	Wed 5/25/16	Wed 7/6/16	16
18		Bid Opening	0 days	Wed 7/6/16	Wed 7/6/16	17
19						
20		Construct Digester Control Building	350 days	Thu 7/28/16	Wed 11/29/17	18FS+15 days
21		Connect Existing Digester to New Building	50 days	Thu 11/30/17	Wed 2/7/18	20
22						
23		Staff Report - Authorization to Bid	21 days	Mon 5/9/16	Mon 6/6/16	15
24		Advertise / Bid Ph 2 - New Digesters / Flare	23 days	Tue 6/7/16	Thu 7/7/16	23
25		Bid Opening	0 days	Thu 7/7/16	Thu 7/7/16	24
26		Construct New Digesters / Flare	269 days	Fri 7/29/16	Wed 8/9/17	25FS+15 days
27		Connect New Digesters to "New" Building	15 days	Thu 11/30/17	Wed 12/20/17	20,26
28		Seed & Startup New Digesters	40 days	Thu 12/21/17	Wed 2/14/18	27
29						
30		Repair Existing Digester No.1	140 days	Thu 2/8/18	Wed 8/22/18	21
31		Seed & Startup Digester No.1	40 days	Thu 8/23/18	Wed 10/17/18	30
32		Repair Existing Digester No.2	140 days	Thu 2/8/18	Wed 8/22/18	21
33		Seed & Startup Digester No.2	40 days	Thu 8/23/18	Wed 10/17/18	32
34						
35		Construct New FOG	130 days	Thu 8/10/17	Wed 2/7/18	21FF
36		Starup FOG	0 days	Wed 2/7/18	Wed 2/7/18	35
37						
38		Design Food Waste	139 days	Tue 10/27/15	Fri 5/6/16	15FF
39		Construct Food Waste	196 days	Wed 5/10/17	Wed 2/7/18	21FF
40		Startup Food Waste	0 days	Wed 2/7/18	Wed 2/7/18	39
41						
42		**Bio CNG Facility**	**436 days**	**Mon 8/1/16**	**Mon 4/2/18**	
43	▦	Design Bio CNG Facilty	216 days	Mon 8/1/16	Mon 5/29/17	
44		Construct Bio CNG Facility	220 days	Tue 5/30/17	Mon 4/2/18	43



Manteca
Digester Improvements - Combined - f
Date: Sat 4/9/16

Task	▭	Progress	▬	Summary	▼▬▼	External Tasks	▬	Deadline	⇩
Split	┈┈┈	Milestone	◆	Project Summary	▼▬▼	External Milestone	◆		

APPENDIX

A) Detailed Gas Test Report

B) Detailed Gas Utilization Economic Analysis

C) Detailed Cost Breakdowns for Recommended Projects

Detailed Gas Test Report

CENTEK LABORATORIES, LLC
143 Midler Park Drive * Syracuse, NY 13206
Phone (315) 431-9730 * Emergency 24/7 (315) 416-2752
NYSDOH ELAP Certificate No. 11830

Analytical Report

Gregory Harris
HERWIT Engineering
6200 Center Street, Suite 310
Clayton, CA 94517

TEL: (925) 672-6599
FAX

Wednesday, December 24, 2014
Order No.: C1412064

RE: Manteca

Dear Gregory Harris:

Centek Laboratories, LLC received 2 sample(s) on 12/19/2014 for the analyses presented in the following report.

I certify that this data package is in compliance with the terms and conditions of the Contract, both technically and for completeness. Release of the data contained in this hardcopy data package and/or in the computer readable data submitted has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Centek Laboratories performs all analyses according to EPA, NIOSH or OSHA-approved analytical methods. Centek Laboratories is dedicated to providing quality analyses and exceptional customer service. All method blanks, laboratory spikes, and/or matrix spikes met quality assurance objective except as indicated in the case narrative. All samples were received and analyzed within the EPA recommended holding times. Test results are not Method Blank (MB) corrected for contamination.

We do our best to make our reporting format clear and understandable and hope you are thoroughly satisfied with our services. Please contact your client service representative at (315) 431-9730 or myself, if you would like any additional information regarding this report.

Thank you for using Centek Laboratories. This report can not be reproduced except in its entirety, without prior written authorization.

Sincerely,

William Dobbin
Lead Technical Director

Disclaimer: The test results and procedures utilized, and laboratory interpretations of the data obtained by Centek as contained in this report are believed by Centek to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of Centek for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages. ELAP does not offer certification for the following parameters by this method at present time, they are: 4-ethyltoluene, ethyl acetate, propylene, 4-PCH, sulfur derived and silcon series compounds.

Centek Laboratories, LLC Terms and Conditions

Sample Submission

All samples sent to Centek Laboratories should be accompanied by our Request for Analysis Form or Chain of Custody Form. A Chain of Custody will be provided with each order shipped for all sampling events, or if needed, one is available at our website www.CentekLabs.com. Samples received after 3:00pm are considered to be a part of the next day's business.

Sample Media

Samples can be collected in an canister or a Tedlar bag. Depending on your analytical needs, Centek Laboratories may receive a bulk, liquid, soil or other matrix sample for headspace analysis.

Blanks

Every sample is run with a surrogate or tracer compound at a pre-established concentration. The surrogate compound run with each sample is used as a standard to measure the performance of each run of the instrument. If required, a Minican can be provided containing nitrogen to be run as a trip blank with your samples.

Sampling Equipment

Centek Laboratories will be happy to provide the canisters to carry-out your sampling event at no charge. The necessary accessories, such as regulators, tubing or personal sampling belts, are also provided to meet your sampling needs. The customer is responsible for all shipping charges to the client's destination and return shipping to the laboratory. Client assumes all responsibility for lost, stolen and any damages of equipment.

Turn Around time (TAT)

Centek Laboratories will provide results to its clients in one business-week by 6:00pm EST after receipt of samples. For example, if samples are received on a Monday they are due on the following Monday by 6:00pm EST. Results are faxed or emailed to the requested location indicated on the Chain of Custody. Non-routine analysis may require more than the one business-week turnaround time. Please confirm non-routine sample turnaround times.

Reporting

Results are emailed or faxed at no additional charge. A hard copy of the result report is mailed within 24 hours of the faxing or emailing of your results. Cat "B" like packages are within 3-4 weeks from time of analysis. Standard Electronic Disk Deliverables (EDD) is also available at no additional charge.

Payment Terms

Payment for all purchases shall be due within 30 days from date of invoice. The client agrees to pay a finance charge of 1.5% per month on the overdue balance and cost of collection, including attorney fees, if collection proceedings are necessary. You must have a completed credit application on file to extend credit. Purchase orders or checks information must be submitted for us to release results

Rush Turnaround Samples

Expedited turn around times is available. Please confirm rush turnaround times with Client Services before submitting samples.

Applicable Surcharges for Rush Turnaround Samples:
Same day TAT = 200%
Next business day TAT by Noon = 150%
Next business day TAT by 6:00pm = 100%
Second business day TAT by 6:00pm = 75%
Third business day TAT by 6:00pm = 50%
Fourth business day TAT by 6:00pm = 35%
Fifth business day = Standard

Statement of Confidentiality

Centek Laboratories, LLC is aware of the importance of the confidentiality of results to many of our clients. Your name and data will be held in the strictest of confidence. We will not accept business that may constitute a conflict of interest. We commonly sign Confidential Nondisclosure Agreements with clients prior to beginning work. All research, results and reports will be kept strictly confidential. Secrecy Agreements and Disclosure Statements will be signed for the client if so specified. Results will be provided only to the addressee specified on the Chain of Custody Form submitted with the samples unless law requires release. Written permission is required from the addressee to release results to any other party.

Limitation on Liability

Centek Laboratories, LLC warrants the test results to be accurate to the methodology and sample type for each sample submitted to Centek Laboratories, LLC. In no event shall Centek Laboratories, LLC be liable for direct, indirect, special, punitive, incidental, exemplary or consequential damages, or any damages whatsoever, even if Centek Laboratories, LLC has been previously advised of the possibility of such damages whether in an action under contract, negligence, or any other theory, arising out of or in connection with the use, inability to use or performance of the information, services, products and materials available from the laboratory or this site. These limitations shall apply notwithstanding any failure of essential purpose of any limited remedy. Because some jurisdictions do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of liability for consequential or incidental damages, the above limitations may not apply to you. This is a comprehensive limitation of liability that applies to all damages of any kind, including (without limitation) compensatory, direct, indirect or consequential damages, loss of data, income or profit and or loss of or damage to property and claims of third parties.

CENTEK LABORATORIES, LLC

Date: *06-Jan-15*

CLIENT: HERWIT Engineering
Project: Manteca
Lab Order: C1412064

CASE NARRATIVE

Samples were analyzed using the methods outlined in the following references:

Compendium of Methods for the Determination of Toxic Organic Compounds, Compendium Method TO-15, January 1999 and Centek Laboratories, LLC SOP TS-80:

All method blanks, laboratory spikes, and/or matrix spikes met quality assurance objective except as indicated in the corrective action report(s). All samples were received and analyzed within the EPA recommended holding times. Test results are not Method Blank (MB) corrected for contamination.

NYSDEC ASP samples:
Canisters should be evacuated to a reading of less than or equal to 50 millitorr prior to shipment to sampling personnel. The vacuum in the canister will be field checked prior to sampling, and must read 28" of Hg (±2", vacuum, absolute) before a sample can be collected. After the sample has been collected, the pressure of the canister will be read and recorded again, and must be 5" of Hg (±1", vacuum, absolute) for the sample to be valid. Once received at the laboratory, the canister vacuum should be confirmed to be 5" of Hg,±1". Please record and report the pressure/vacuum of received canisters on the sample receipt paperwork. A pressure/vacuum reading should also be taken just prior to the withdrawal of sample from the canister, and recorded on the sample preparation log sheet. All regulators are calibrated to meet these requirements before they leave the laboratory. However, due to environmental conditions and use of the equipment Centek can not guarantee that this criteria can always be achieved. Analytical Comments for METHOD LFG SILOX, SAMPLE C1412064-001A:

Chain of Custody
BioGas

Centek Laboratories

143 Midler Park Dr., Syracuse, NY 13206
(315)431-9730
www.CentekLabs.com

Site Name: MANTECA
Project: DIGESTER
PO#:
Quote Q-5P14
Other:

Origin of Sample ***(circle on)***

LFG DG-AG [✓ DG-WWTP]
Blended Other________
Total # of Tedlars 2

Turnaround Time:	Check One	Rush TAT Surcharge %	Due Date:
5 Business Days	☒	0%	
4 Business Days	☐	25%	
3 Business Days	☐	50%	
2 Business Days	☐	75%	
Next Day by 5pm	☐	100%	
Next Day by Noon	☐	150%	
Same Day	☐	200%	

Company: HERWIT ENGINEERING
Report to: Gregory Harris
Address: 6200 Center Street Suite 310
City, State, Zip Clayton CA 94517
Email: GHarris@HERWIT.com
Phone: 925-672-6599

Company:
Invoice to: Check if same ☑
Address:
City, State, Zip
Email:
Phone:

Sample Identification	Date & Time Sampled	Major Gases	BTU	Normalize MG&BTU	VOC w/TIC's	Siloxane Series	Sulfur Series	Comments
DIGESTER NO.1	12/18/14	✓	✓		✓	✓	✓	
DIGESTER NO.2	12/18/14	✓	✓		✓	✓	✓	BACK UP SAMPLE
								CALL ME IF
								O2 FOUND IN
								SAMPLE
								925-672-6599

(**Check All That Apply** heads the columns Major Gases to Sulfur Series.)

Chain of Custody	Print Name	Signature	Date/Time
Sampled by:	Gregory Harris		12:33
Relinquished by:			
Received at Lab by:	NICK MANDARINO		12-19-14

Courier: CIRCLE ONE
FedEx [✓ UPS] Pickup/Dropoff

For LAB USE ONLY
Work Order # C1412064

***** By signing Centek Labs Chain of Custody, you are accepting Centek Labs Terms and Conditions listed on the reverse side.**

CENTEK LABORATORIES, LLC

Sample Receipt Checklist

Client Name HERWIT ENGINEERING

Date and Time Receive 12/19/2014

Work Order Numbe C1412064

Received by NM

Checklist completed by 12-19-14
Signature Date

Reviewed by WD 12/19/14
Initials Date

Matrix:

Carrier name: UPS

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Presen ☐
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Presen ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Presen ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐
Water - pH acceptable upon receipt?	Yes ☐	No ☑	

Adjusted? ________ Checked by ________

Any No and/or NA (not applicable) response must be detailed in the comments section be

Client contacted ________ Date contacted: ________ Person contacted ________

Contacted by: ________ Regarding: ________

Comments: ________

Corrective Action ________

Date: *06-Jan-15*

CENTEK LABORATORIES, LLC

CLIENT: HERWIT Engineering
Project: Manteca
Lab Order: C1412064

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
C1412064-001A	Digester No. 1	1245	12/18/2014	12/19/2014
C1412064-002A	Digester No. 2		12/18/2014	12/19/2014

Centek Laboratories, LLC *06-Jan-15*

Lab Order: C1412064
Client: HERWIT Engineering
Project: Manteca

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
C1412064-001A	Digester No. 1	12/18/2014	Air	BTU Normalized by ASTM 3588			12/19/2014
				Normalized Fixed Gas Series			12/19/2014
				Siloxane Series			12/20/2014
				Sulfurs Series by TO-15			12/20/2014
				Sulfurs Series by TO-15			12/23/2014
				VOC's Method TO15 + TIC			12/20/2014

Centek Laboratories, LLC

Date: *29-Dec-14*

CLIENT: HERWIT Engineering
Lab Order: C1412064
Project: Manteca
Lab ID: C1412064-001A

Client Sample ID: Digester No. 1
Tag Number: 1245
Collection Date: 12/18/2014
Matrix: AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
FIELD PARAMETERS		**FLD**				Analyst:
Tedlar Date Transfer	12/19/2014					12/19/2014
BTU NORMALIZED BY ASTM 3588		**STM 3588@14.73PSI**				Analyst: **WD**
BTU Gross or HHV	620	0		BTU/cubic ft	1	12/19/2014
BTU Net or LHV	560	0		BTU/cubic ft	1	12/19/2014
SILOXANE SERIES		**TO-15**				Analyst: **WD**
Decamethylcyclopentasiloxane-D5	99	20		ppbV	4	12/20/2014 2:37:00 AM
Decamethyltetrasiloxane-L4	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Dodecamethylcyclohexasiloxane-D6	ND	100		ppbV	4	12/20/2014 2:37:00 AM
Dodecamethylpentasiloxane-L5	ND	100		ppbV	4	12/20/2014 2:37:00 AM
Hexamethylcyclotrisiloxane-D3	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Hexamethyldisiloxane-L2	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Octamethylcyclotetrasiloxane-D4	95	20		ppbV	4	12/20/2014 2:37:00 AM
Octamethyltrisiloxane-L3	7.5	20	J	ppbV	4	12/20/2014 2:37:00 AM
Trimethyl silanol	15	20	J	ppbV	4	12/20/2014 2:37:00 AM
Surr: Bromofluorobenzene	77.2	70-130		%REC	4	12/20/2014 2:37:00 AM
NORMALIZED FIXED GAS SERIES		**EPA METHOD 3C**				Analyst: **WD**
Carbon dioxide	36.8	1.90		%	1	12/19/2014
Carbon Monoxide	ND	0.880		%	1	12/19/2014
Methane	61.4	0.580		%	1	12/19/2014
Nitrogen	1.57	8.30	J	%	1	12/19/2014
Oxygen	0.280	0.880	J	%	1	12/19/2014
SULFURS SERIES BY TO-15		**TO-15**				Analyst: **WD**
1-Propanethiol	420	40		ppbV	4	12/20/2014 2:37:00 AM
Carbon disulfide	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Carbonyl sulfide	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Dimethyl sulfide	22	40	J	ppbV	4	12/20/2014 2:37:00 AM
Ethyl mercaptan	97	40		ppbV	4	12/20/2014 2:37:00 AM
Hydrogen Sulfide	4700000	110000		ppbV	10560	12/23/2014 8:27:00 PM
Isopropyl mercaptan	27	40	J	ppbV	4	12/20/2014 2:37:00 AM
Methyl mercaptan	190	40		ppbV	4	12/20/2014 2:37:00 AM
Surr: Bromofluorobenzene	77.2	70-130		%REC	4	12/20/2014 2:37:00 AM
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
1,1,1-Trichloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,1,2,2-Tetrachloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,1,2-Trichloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,1-Dichloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,1-Dichloroethene	ND	20		ppbV	4	12/20/2014 2:37:00 AM

Qualifiers:				
	**	Reporting Limit	.	Results reported are not blank corrected
	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
1,2,4-Trichlorobenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,2,4-Trimethylbenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,2-Dibromoethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,2-Dichlorobenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,2-Dichloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,2-Dichloropropane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,3,5-Trimethylbenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,3-butadiene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,3-Dichlorobenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,4-Dichlorobenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
1,4-Dioxane	ND	40		ppbV	4	12/20/2014 2:37:00 AM
2,2,4-trimethylpentane	200	20		ppbV	4	12/20/2014 2:37:00 AM
4-ethyltoluene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Acetone	14	40	J	ppbV	4	12/20/2014 2:37:00 AM
Allyl chloride	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Benzene	7.5	20	J	ppbV	4	12/20/2014 2:37:00 AM
Benzyl chloride	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Bromodichloromethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Bromoform	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Bromomethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Carbon disulfide	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Carbon tetrachloride	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Chlorobenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Chloroethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Chloroform	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Chloromethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
cis-1,2-Dichloroethene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
cis-1,3-Dichloropropene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Cyclohexane	32	20		ppbV	4	12/20/2014 2:37:00 AM
Dibromochloromethane	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Ethyl acetate	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Ethylbenzene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Freon 11	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Freon 113	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Freon 114	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Freon 12	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Heptane	55	20		ppbV	4	12/20/2014 2:37:00 AM
Hexachloro-1,3-butadiene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Hexane	33	20		ppbV	4	12/20/2014 2:37:00 AM
Isopropyl alcohol	ND	20		ppbV	4	12/20/2014 2:37:00 AM

Qualifiers:				
	**	Reporting Limit	.	Results reported are not blank corrected
	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

Centek Laboratories, LLC

Date: *29-Dec-14*

CLIENT: HERWIT Engineering
Lab Order: C1412064
Project: Manteca
Lab ID: C1412064-001A

Client Sample ID: Digester No. 1
Tag Number: 1245
Collection Date: 12/18/2014
Matrix: AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
m&p-Xylene	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Methyl Butyl Ketone	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Methyl Ethyl Ketone	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Methyl Isobutyl Ketone	ND	40		ppbV	4	12/20/2014 2:37:00 AM
Methyl tert-butyl ether	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Methylene chloride	8.8	20	J	ppbV	4	12/20/2014 2:37:00 AM
o-Xylene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Propylene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Styrene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Tetrachloroethylene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Tetrahydrofuran	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Toluene	320	20		ppbV	4	12/20/2014 2:37:00 AM
trans-1,2-Dichloroethene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
trans-1,3-Dichloropropene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Trichloroethene	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Vinyl acetate	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Vinyl Bromide	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Vinyl chloride	ND	20		ppbV	4	12/20/2014 2:37:00 AM
Surr: Bromofluorobenzene	91.5	70-130		%REC	4	12/20/2014 2:37:00 AM
TIC: .beta.-Pinene	61	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Butene, 2-methyl-	200	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Ethyl-4-methylcyclohexane	36	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Methyl-4-(1-methylethyl)-cyclohexane	39	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Pentanethiol	59	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Pentene, 2,3-dimethyl-	53	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Pentene, 2,4,4-trimethyl-	18	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 1-Propanethiol	200	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 2-Propanethiol	20	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 2-Propanethiol, 2-methyl-	14	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 3-Octene, 4-ethyl-	47	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 4-Nonene, 2-methyl-	30	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: 4-Octene, 2,6-dimethyl-, [S-(Z)]-	33	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Butane, 2-methyl-	42	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclohexane, 1,1,3-trimethyl-	12	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclohexane, 1,2,3-trimethyl-(1.alpha.	27	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclohexane, 1,3,5-trimethyl-	78	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclohexane, 1,4-dimethyl-, cis-	22	0	JN	ppbV	4	12/20/2014 2:37:00 AM

Qualifiers:

**	Reporting Limit	.	Results reported are not blank corrected
B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits		

Centek Laboratories, LLC

Date: *29-Dec-14*

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
TIC: Cyclohexane, 2-propenyl-	36	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclohexene,1-hexyl-	13	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclopentane, (2-methylpropyl)-	28	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclopentasiloxane, decamethyl-	210	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclotetrasiloxane, octamethyl-	200	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Cyclotrisiloxane, hexamethyl-	11	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: D-Limonene	140	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane	88	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane, 2,2,7-trimethyl-	14	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane, 2-methyl-	73	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane, 3,8-dimethyl-	13	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane, 3-methyl-	71	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Decane, 4-methyl-	120	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Dodecane	24	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Dodecane, 6-methyl-	12	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,2,4,6,6-pentamethyl-	150	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,2-dimethyl-	16	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,3-dimethyl-	15	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,4-dimethyl-	22	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,5-dimethyl-	22	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 2,6-dimethyl-	15	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 3-ethyl-2-methyl-	100	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Heptane, 3-methyl-	27	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 2,2,5-trimethyl-	140	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 2,3,5-trimethyl-	20	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 2,4-dimethyl-	28	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 2,5-dimethyl-	40	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 2-methyl-	19	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Hexane, 3-methyl-	22	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Naphthalene, decahydro-2,6-dimethyl-	24	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Naphthalene, decahydro-2-methyl-	100	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Nonane, 3,7-dimethyl-	46	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Nonane, 3-methyl-	58	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Octane	84	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Octane, 3,5-dimethyl-	14	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Octane, 4-methyl-	41	0	JN	ppbV	4	12/20/2014 2:37:00 AM

Qualifiers:	**	Reporting Limit	.	Results reported are not blank corrected
	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

Centek Laboratories, LLC

Date: *29-Dec-14*

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
TIC: Pentane, 2,3,3-trimethyl-	170	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Pentane, 2,3,4-trimethyl-	120	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Pentane, 2,4-dimethyl-	15	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Undecane (18.25)	190	0	JN	ppbV	4	12/20/2014 2:37:00 AM
TIC: Undecane, 3-methyl-	21	0	JN	ppbV	4	12/20/2014 2:37:00 AM

Qualifiers:				
	**	Reporting Limit	.	Results reported are not blank corrected
	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

Centek Laboratories, LLC

Date: *24-Dec-14*

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
SILOXANE SERIES		**TO-15**				Analyst: **WD**
Decamethylcyclopentasiloxane-D5	1500	300		ug/m3	4	12/20/2014 2:37:00 AM
Decamethyltetrasiloxane-L4	ND	250		ug/m3	4	12/20/2014 2:37:00 AM
Dodecamethylcyclohexasiloxane-D6	ND	1800		ug/m3	4	12/20/2014 2:37:00 AM
Dodecamethylpentasiloxane-L5	ND	1600		ug/m3	4	12/20/2014 2:37:00 AM
Hexamethylcyclotrisiloxane-D3	ND	180		ug/m3	4	12/20/2014 2:37:00 AM
Hexamethyldisiloxane-L2	ND	130		ug/m3	4	12/20/2014 2:37:00 AM
Octamethylcyclotetrasiloxane-D4	1100	240		ug/m3	4	12/20/2014 2:37:00 AM
Octamethyltrisiloxane-L3	72	190	J	ug/m3	4	12/20/2014 2:37:00 AM
Trimethyl silanol	55	74	J	ug/m3	4	12/20/2014 2:37:00 AM
SULFURS SERIES BY TO-15		**TO-15**				Analyst: **WD**
1-Propanethiol	1300	120		ug/m3	4	12/20/2014 2:37:00 AM
Carbon disulfide	ND	120		ug/m3	4	12/20/2014 2:37:00 AM
Carbonyl sulfide	ND	98		ug/m3	4	12/20/2014 2:37:00 AM
Dimethyl sulfide	84	150	J	ug/m3	4	12/20/2014 2:37:00 AM
Ethyl mercaptan	250	100		ug/m3	4	12/20/2014 2:37:00 AM
Hydrogen Sulfide	6600000	150000		ug/m3	10560	12/23/2014 8:27:00 PM
Isopropyl mercaptan	83	120	J	ug/m3	4	12/20/2014 2:37:00 AM
Methyl mercaptan	380	79		ug/m3	4	12/20/2014 2:37:00 AM
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
1,1,1-Trichloroethane	ND	110		ug/m3	4	12/20/2014 2:37:00 AM
1,1,2,2-Tetrachloroethane	ND	140		ug/m3	4	12/20/2014 2:37:00 AM
1,1,2-Trichloroethane	ND	110		ug/m3	4	12/20/2014 2:37:00 AM
1,1-Dichloroethane	ND	81		ug/m3	4	12/20/2014 2:37:00 AM
1,1-Dichloroethene	ND	79		ug/m3	4	12/20/2014 2:37:00 AM
1,2,4-Trichlorobenzene	ND	150		ug/m3	4	12/20/2014 2:37:00 AM
1,2,4-Trimethylbenzene	ND	98		ug/m3	4	12/20/2014 2:37:00 AM
1,2-Dibromoethane	ND	150		ug/m3	4	12/20/2014 2:37:00 AM
1,2-Dichlorobenzene	ND	120		ug/m3	4	12/20/2014 2:37:00 AM
1,2-Dichloroethane	ND	81		ug/m3	4	12/20/2014 2:37:00 AM
1,2-Dichloropropane	ND	92		ug/m3	4	12/20/2014 2:37:00 AM
1,3,5-Trimethylbenzene	ND	98		ug/m3	4	12/20/2014 2:37:00 AM
1,3-butadiene	ND	44		ug/m3	4	12/20/2014 2:37:00 AM
1,3-Dichlorobenzene	ND	120		ug/m3	4	12/20/2014 2:37:00 AM
1,4-Dichlorobenzene	ND	120		ug/m3	4	12/20/2014 2:37:00 AM
1,4-Dioxane	ND	140		ug/m3	4	12/20/2014 2:37:00 AM
2,2,4-trimethylpentane	920	93		ug/m3	4	12/20/2014 2:37:00 AM
4-ethyltoluene	ND	98		ug/m3	4	12/20/2014 2:37:00 AM
Acetone	33	95	J	ug/m3	4	12/20/2014 2:37:00 AM
Allyl chloride	ND	63		ug/m3	4	12/20/2014 2:37:00 AM

Qualifiers:	**	Reporting Limit	.	Results reported are not blank corrected
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	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

Centek Laboratories, LLC

Date: *24-Dec-14*

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
Benzene	24	64	J	ug/m3	4	12/20/2014 2:37:00 AM
Benzyl chloride	ND	110		ug/m3	4	12/20/2014 2:37:00 AM
Bromodichloromethane	ND	130		ug/m3	4	12/20/2014 2:37:00 AM
Bromoform	ND	210		ug/m3	4	12/20/2014 2:37:00 AM
Bromomethane	ND	78		ug/m3	4	12/20/2014 2:37:00 AM
Carbon disulfide	ND	62		ug/m3	4	12/20/2014 2:37:00 AM
Carbon tetrachloride	ND	130		ug/m3	4	12/20/2014 2:37:00 AM
Chlorobenzene	ND	92		ug/m3	4	12/20/2014 2:37:00 AM
Chloroethane	ND	53		ug/m3	4	12/20/2014 2:37:00 AM
Chloroform	ND	98		ug/m3	4	12/20/2014 2:37:00 AM
Chloromethane	ND	41		ug/m3	4	12/20/2014 2:37:00 AM
cis-1,2-Dichloroethene	ND	79		ug/m3	4	12/20/2014 2:37:00 AM
cis-1,3-Dichloropropene	ND	91		ug/m3	4	12/20/2014 2:37:00 AM
Cyclohexane	110	69		ug/m3	4	12/20/2014 2:37:00 AM
Dibromochloromethane	ND	170		ug/m3	4	12/20/2014 2:37:00 AM
Ethyl acetate	ND	140		ug/m3	4	12/20/2014 2:37:00 AM
Ethylbenzene	ND	87		ug/m3	4	12/20/2014 2:37:00 AM
Freon 11	ND	110		ug/m3	4	12/20/2014 2:37:00 AM
Freon 113	ND	150		ug/m3	4	12/20/2014 2:37:00 AM
Freon 114	ND	140		ug/m3	4	12/20/2014 2:37:00 AM
Freon 12	ND	99		ug/m3	4	12/20/2014 2:37:00 AM
Heptane	220	82		ug/m3	4	12/20/2014 2:37:00 AM
Hexachloro-1,3-butadiene	ND	210		ug/m3	4	12/20/2014 2:37:00 AM
Hexane	120	70		ug/m3	4	12/20/2014 2:37:00 AM
Isopropyl alcohol	ND	49		ug/m3	4	12/20/2014 2:37:00 AM
m&p-Xylene	ND	170		ug/m3	4	12/20/2014 2:37:00 AM
Methyl Butyl Ketone	ND	160		ug/m3	4	12/20/2014 2:37:00 AM
Methyl Ethyl Ketone	ND	120		ug/m3	4	12/20/2014 2:37:00 AM
Methyl Isobutyl Ketone	ND	160		ug/m3	4	12/20/2014 2:37:00 AM
Methyl tert-butyl ether	ND	72		ug/m3	4	12/20/2014 2:37:00 AM
Methylene chloride	31	69	J	ug/m3	4	12/20/2014 2:37:00 AM
o-Xylene	ND	87		ug/m3	4	12/20/2014 2:37:00 AM
Propylene	ND	34		ug/m3	4	12/20/2014 2:37:00 AM
Styrene	ND	85		ug/m3	4	12/20/2014 2:37:00 AM
Tetrachloroethylene	ND	140		ug/m3	4	12/20/2014 2:37:00 AM
Tetrahydrofuran	ND	59		ug/m3	4	12/20/2014 2:37:00 AM
Toluene	1200	75		ug/m3	4	12/20/2014 2:37:00 AM
trans-1,2-Dichloroethene	ND	79		ug/m3	4	12/20/2014 2:37:00 AM
trans-1,3-Dichloropropene	ND	91		ug/m3	4	12/20/2014 2:37:00 AM
Trichloroethene	ND	110		ug/m3	4	12/20/2014 2:37:00 AM

Qualifiers:				
	**	Reporting Limit	.	Results reported are not blank corrected
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	H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
	JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT:	HERWIT Engineering	**Client Sample ID:**	Digester No. 1
Lab Order:	C1412064	**Tag Number:**	1245
Project:	Manteca	**Collection Date:**	12/18/2014
Lab ID:	C1412064-001A	**Matrix:**	AIR

Analyses	Result	**Limit	Qual	Units	DF	Date Analyzed
VOC'S METHOD TO15 + TIC		**TO-15**				Analyst: **WD**
Vinyl acetate	ND	70		ug/m3	4	12/20/2014 2:37:00 AM
Vinyl Bromide	ND	87		ug/m3	4	12/20/2014 2:37:00 AM
Vinyl chloride	ND	51		ug/m3	4	12/20/2014 2:37:00 AM

Qualifiers:				
**	Reporting Limit	.	Results reported are not blank corrected
B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected at or below quantitation limits
JN	Non-routine analyte. Quantitation estimated.	ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits		

Detailed Gas Utilization Economic Analysis

Manteca Gas Utilization Economic Analysis

	Existing Biosolids Only					
	BioCNG 50 No Heat Recover at Digesters	BioCNG 100 No Heat Recover at Digesters	BioCNG 100 With Heat Recover at Digesters	2 x 250 kW Ingersoll Rand Gas Turbine NG&DG	Existing 400 kW Waukesha Engine NG&DG	New 600 kW MWM Engine NG&DG
Income and Diesel Fuel Offsets						
Diesel Fuel Cost ($/gal) (1)	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18
Natural Gas Cost per $/Therm (HHV) (2,3)	$ 0.61	$ 0.61	$ 0.61	$ 0.65	$ 0.65	$ 0.65
Minimum Average Plant Electric Load (kW) (4)				750	750	750
Size of Prime Mover (kW)				500	400	592
Size of CNG System (DGE/Day) (14)	250	367	367			
Digester Gas Elec. Eff. (HHV 620 BTU/hr)				26.1%	31.6%	41.0%
Natural Gas Elec. Eff. (HHV 1,000 BTU/hr)				26.1%	31.6%	41.0%
Digester Gas Available (scfd)	48,485	48,485	68,270	107,741	107,741	107,741
Digester Gas Available (scfm)	33.7	33.7	47.4	74.8	74.8	74.8
Digester Gas Available HHV (Therms/hr) (5)	10.9	10.9	15.3	27.8	27.8	27.8
Digester Gas Prime Mover Power Output (kW)				212.7	257.5	334.2
Natural Gas Prime Mover Power Output (kW)				287.3	142.5	257.8
Natural Gas Heat Input HHV (Therms/hr)	3.5	10.2	5.8	37.6	15.4	21.5
Digester Gas Compressor Power (kW)				22.0	15.0	15.0
Digester Gas Conditioning Power (kW) (9)	54	54	54	19.0	19.0	19.0
Hot Water Pumps (kW)			4	2.0	2.0	2.0
Natural Gas Compressor Power (kW)	27	45	45	18.2	5.1	7.1
Total All Ancillary Losses (kW)	81.0	99.0	103.0	61.2	41.1	43.1
Net Cogen Power Output (kW)				438.8	358.9	548.9
Standby Capacity for PG&E				439	359	549
Percentage of Total Energy from Digester Gas	76%	52%	73%	43%	64%	56%
Average Plant Electric Cost per kW (6)	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220
Cost of Energy Sold to PG&E				$ 0.1220	$ 0.1220	$ 0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%	95%
Prime Mover Heat Recovery (% of Input Energy)				34.9%	60.0%	42.0%
Heat Available to Plant From Cogen (Therms/hr)	-	-	-	22.8	25.9	20.7
Heat Available to Plant From Cogen (BTUs/hr)	-	-	-	2,283,209	2,593,671	2,070,989
Peak Month Heating Demand at Plant (BTU/hr)	1,438,753	1,438,753	1,134,369	1,438,753	1,438,753	1,438,753
Average Heating Demand at Plant (BTU/hr)	1,224,591	1,224,591	1,019,640	1,224,591	1,224,591	1,224,591
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	133,955	133,955			
Additional NG Purchased (Therms/yr)	35,241	94,173	57,168	312,810	128,115	178,725
Total Annual Electric Reduction on PG&E Service (kW-hr)				3,652,055	2,987,014	4,568,170
Total Annual Electrical Export to PG&E (kW-hr)				-	-	-
Offset Energy Cost From PG&E				$ 445,690	$ 364,530	$ 557,492
Total Annual Electricity Sales to PG&E				$ -	$ -	$ -
Total Electricity Offsets and Sales				$ 445,690	$ 364,530	$ 557,492
Standby Charges to PG&E (7)				$ 11,280	$ 9,226	$ 14,110
Net Electrical Revenue ($/yr)	$ -	$ -	$ -	$ 434,410	$ 355,304	$ 543,382
Reduction in Fuel Cost When Converted to NG ($/yr)	$ 290,175	$ 425,977	$ 425,977	$ -	$ -	$ -
RIN Credits @ $1.65/RIN (RIN =77,000 BTU LHV)	$ 184,096	$ 184,096	$ 259,221			
Total Net Income/Offset Cost ($/yr)	$ 474,271	$ 610,073	$ 685,197	$ 434,410	$ 355,304	$ 543,382
Annual Costs						
Natural Gas Purchased (Therms/yr)	35,241	94,173	57,168	312,810	128,115	178,725
Natural Gas Fuel Cost ($/yr)	$ 21,497	$ 57,446	$ 34,872	$ 203,327	$ 83,275	$ 116,171
Electrical Costs ($/yr)	$ 83,707	$ 102,950	$ 107,012	$ -	$ -	$ -
Yearly Warranty and Service Contract Prime Mover ($/kW-hr)(13)				$ 0.011	$ 0.040	$ 0.040
Yearly Warranty and Service Contract Prime Mover ($/yr)				$ 45,771	$ 133,152	$ 197,065
Yearly Warranty and Service Contract Gas Conditioning				$ -	$ -	$ -
Gas Conditioning Sulfur Media Replacement (8,9)	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155
Gas Conditioning Siloxane Media Replacement	$ 4,848	$ 4,848	$ 6,827	$ 10,774	$ 10,774	$ 10,774
Gas Conditioning Miscellaneous Maintenance	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500
BioCNG Maintenance	$ 4,500	$ 4,500	$ 4,500	$ -	$ -	$ -
Subtotal Operations Costs	$ 217,207	$ 272,399	$ 255,866	$ 362,526	$ 329,856	$ 426,665
Net Offset Revenue per Year	$ 257,064	$ 337,674	$ 429,331	$ 71,884	$ 25,448	$ 116,717
Project Costs (10, 11)						
Total On Site Construction Cost	$ 3,437,575	$3,937,575	$2,962,000	$ 3,087,000	$ 1,958,000	$ 2,908,000
PG&E Natural Gas Upgrades	$ -	$ -	$ -	$ -	$ -	$ -
Digester Heat Recovery System	$ -	$ -	$ 265,000	$ -	$ -	$ -
Project Design and Construction Management			$ 414,680	$ 432,180	$ 274,120	$ 407,120
Total Project Costs	$ 3,437,575	$3,937,575	$3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
CNG Vehicle Upgrade Costs On New Truck Purchase	$ -	$ -	$ -	$ -	$ -	$ -
CNG Station Rebates						
SJVAPCD CNG Truck Rebates ($10K/vehicle x 5 trucks)	$ -	$ -	$ -			

Manteca Gas Utilization Economic Analysis

		Existing Biosolids Only					
		BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
PG&E Self Generation Rebate Non-Renewable Portion ($2.08/W)					Expires 2015	Expires 2015	Expires 2015
Total Project Costs After Rebate		$ 3,437,575	$3,937,575	$3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
Simple Payback Years		13.37	11.66	8.48	48.96	87.71	28.40
Available Financing							
Period (years)	15						
Interest Rate (%)	3.50%						
Yearly Payment		($298,468)	($341,880)	($316,189)	($305,553)	($193,804)	($287,836)
Yearly Savings Fuel & Electricity		$ 257,064	$ 337,674	$ 429,331	$ 71,884	$ 25,448	$ 116,717
Net Savings		($41,403)	($4,206)	$113,142	($233,669)	($168,356)	($171,118)

Notes:
1) Cost of diesel based on West Cost average of Clean Cities Alternative Fuels Price Report, October 2014 and April 2016.
2) Cost of natural gas for vehicle fueling based on PG&E Natural Gas Vehicle Schedule 1 Projected for 2015
3) Cost of natural gas for cogeneration based on U.S Energy Administration Industrial Rate for 2014 plus PG&E Electrical Generation Transportation Tariff for 2015
4) Historic average power demand ranges from 750 kW up to 950 kW
5) Digester Gas Heating Value for BioCNG reduce by 13% to account for losses in CNG process
6) Average year around electric charge base don PG&E E20P Rate Schedule January 2015
7) PG&E has a capacity standby charge for cogeneration systems.
8) Sulfur Treatment is still required for the Boiler Operation per SJVUPACD Rule 4307 by July 2015. Siloxane treatment is only required on the portion going to BioCNG
9) BioCNG 50 system still has full gas conditioning to treat sulfur for boiler so no reduction from BioCNG 100 system.
10) Low Pressure gas holder is part of Digester Project and not included in these costs.
11) WQCF flare to be used. Cost of flare system is not included in these costs.
12) Costs for receiving and processing food waste and FOG are separately covered as self supported programs through tip fees and processing fees and are not included in this analysis.
13) Costs obtained from CAT for new 600 kW MWM Engine assumed similar for existing 400 kW engine option.
14) Yearly existing diesel usage for solid waste trucks was 134,105 gallons in 2014 or 367 gallons per day. This is used for Existing and near term conditions. For future Food Waste conditions, it is assumed additional vehicles will be converted to CNG to the capacity of the system at 500 DGE per day.

Manteca Gas Utilization Economic Analysis

	Biosolids with FOG					
	BioCNG 50 No Heat Recover at Digesters	BioCNG 100 No Heat Recover at Digesters	BioCNG 100 With Heat Recover at Digesters	2 x 250 kW Ingersoll Rand Gas Turbine NG&DG	Existing 400 kW Waukesha Engine NG&DG	New 600 kW MWM Engine NG&DG
Income and Diesel Fuel Offsets						
Diesel Fuel Cost ($/gal) (1)	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18
Natural Gas Cost per $/Therm (HHV) (2,3)	$ 0.61	$ 0.61	$ 0.61	$ 0.65	$ 0.65	$ 0.65
Minimum Average Plant Electric Load (kW) (4)				750	750	750
Size of Prime Mover (kW)				500	400	592
Size of CNG System (DGE/Day) (14)	250	367	367			
Digester Gas Elec. Eff. (HHV 620 BTU/hr)				26.1%	31.6%	41.0%
Natural Gas Elec. Eff. (HHV 1,000 BTU/hr)				26.1%	31.6%	41.0%
Digester Gas Available (scfd)	76,752	76,752	95,889	133,551	133,551	133,551
Digester Gas Available (scfm)	53.3	53.3	66.6	92.7	92.7	92.7
Digester Gas Available HHV (Therms/hr) (5)	17.3	17.3	21.6	34.5	34.5	34.5
Digester Gas Prime Mover Power Output (kW)				263.7	319.2	414.2
Natural Gas Prime Mover Power Output (kW)				236.3	80.8	177.8
Natural Gas Heat Input HHV (Therms/hr)	0.0	3.9	0.0	30.9	8.7	14.8
Digester Gas Compressor Power (kW)				22.0	15.0	15.0
Digester Gas Conditioning Power (kW) (9)	54	54	54	19.0	19.0	19.0
Hot Water Pumps (kW)			4	2.0	2.0	2.0
Natural Gas Compressor Power (kW)	27	45	45	12.0	2.3	3.9
Total All Ancillary Losses (kW)	81.0	99.0	103.0	55.0	38.3	39.9
Net Cogen Power Output (kW)				445.0	361.7	552.1
Standby Capacity for PG&E				445	362	552
Percentage of Total Energy from Digester Gas	100%	82%	100%	53%	80%	70%
Average Plant Electric Cost per kW (6)	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220
Cost of Energy Sold to PG&E				$ 0.1220	$ 0.1220	$ 0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%	95%
Prime Mover Heat Recovery (% of Input Energy)				34.9%	60.0%	42.0%
Heat Available to Plant From Cogen (Therms/hr)	-	-	-	22.8	25.9	20.7
Heat Available to Plant From Cogen (BTUs/hr)	-	-	-	2,283,209	2,593,671	2,070,989
Peak Month Heating Demand at Plant (BTU/hr)	1,438,753	1,438,753	1,134,369	1,438,753	1,438,753	1,438,753
Average Heating Demand at Plant (BTU/hr)	1,224,591	1,224,591	1,019,640	1,224,591	1,224,591	1,224,591
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	133,955	133,955			
Additional NG Purchased (Therms/yr)	7,556	41,303	9,439	257,323	72,628	123,237
Total Annual Electric Reduction on PG&E Service (kW-hr)				3,702,879	3,009,911	4,594,288
Total Annual Electrical Export to PG&E (kW-hr)				-	-	-
Offset Energy Cost From PG&E				$ 451,893	$ 367,324	$ 560,679
Total Annual Electricity Sales to PG&E				$ -	$ -	$ -
Total Electricity Offsets and Sales				$ 451,893	$ 367,324	$ 560,679
Standby Charges to PG&E (7)				$ 11,437	$ 9,297	$ 14,190
Net Electrical Revenue ($/yr)	$ -	$ -	$ -	$ 440,456	$ 358,028	$ 546,489
Reduction in Fuel Cost When Converted to NG ($/yr)	$ 290,175	$ 425,977	$ 425,977	$ -	$ -	$ -
RIN Credits @ $1.65/RIN (RIN =77,000 BTU LHV)	$ 291,427	$ 291,427	$ 364,090			
Total Net Income/Offset Cost ($/yr)	$ 581,602	$ 717,404	$ 790,067	$ 440,456	$ 358,028	$ 546,489
Annual Costs						
Natural Gas Purchased (Therms/yr)	7,556	41,303	9,439	257,323	72,628	123,237
Natural Gas Fuel Cost ($/yr)	$ 4,609	$ 25,195	$ 5,758	$ 167,260	$ 47,208	$ 80,104
Electrical Costs ($/yr)	$ 83,707	$ 102,950	$ 107,012	$ -	$ -	$ -
Yearly Warranty and Service Contract Prime Mover ($/kW-hr)(13)				$ 0.011	$ 0.040	$ 0.040
Yearly Warranty and Service Contract Prime Mover ($/yr)				$ 45,771	$ 133,152	$ 197,065
Yearly Warranty and Service Contract Gas Conditioning				$ -	$ -	$ -
Gas Conditioning Sulfur Media Replacement (8,9)	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155
Gas Conditioning Siloxane Media Replacement	$ 4,848	$ 4,848	$ 6,827	$ 10,774	$ 10,774	$ 10,774
Gas Conditioning Miscellaneous Maintenance	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500
BioCNG Maintenance	$ 4,500	$ 4,500	$ 4,500	$ -	$ -	$ -
Subtotal Operations Costs	$ 200,319	$ 240,148	$ 226,752	$ 326,460	$ 293,789	$ 390,598
Net Offset Revenue per Year	$ 381,283	$ 477,255	$ 563,314	$ 113,996	$ 64,239	$ 155,891
Project Costs (10, 11)						
Total On Site Construction Cost	$ 3,437,575	$3,937,575	$ 2,962,000	$ 3,087,000	$ 1,958,000	$ 2,908,000
PG&E Natural Gas Upgrades	$ -	$ -	$ -	$ -	$ -	$ -
Digester Heat Recovery System	$ -	$ -	$ 265,000	$ -	$ -	$ -
Project Design and Construction Management			$ 414,680	$ 432,180	$ 274,120	$ 407,120
Total Project Costs	$ 3,437,575	$3,937,575	$ 3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
CNG Vehicle Upgrade Costs On New Truck Purchase	$ -	$ -	$ -	$ -	$ -	$ -
CNG Station Rebates						
SJVAPCD CNG Truck Rebates ($10K/vehicle x 5 trucks)	$ -	$ -	$ -			

Manteca Gas Utilization Economic Analysis

		Biosolids with FOG					
		BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
PG&E Self Generation Rebate Non-Renewable Portion ($2.08/W)					Expires 2015	Expires 2015	Expires 2015
Total Project Costs After Rebate		$ 3,437,575	$3,937,575	$ 3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
Simple Payback Years		9.02	8.25	6.46	30.87	34.75	21.27
Available Financing							
Period (years)	15						
Interest Rate (%)	3.50%						
Yearly Payment		($298,468)	($341,880)	($316,189)	($305,553)	($193,804)	($287,836)
Yearly Savings Fuel & Electricity		$ 381,283	$ 477,255	$ 563,314	$ 113,996	$ 64,239	$ 155,891
Net Savings		$82,815	$135,375	$247,125	($191,557)	($129,565)	($131,945)

Notes:

1) Cost of diesel based on West Cost average of Clean Cities Alternative Fuels Price Report, October 2014 and April 2016.
2) Cost of natural gas for vehicle fueling based on PG&E Natural Gas Vehicle Schedule 1 Projected for 2015
3) Cost of natural gas for cogeneration based on U.S Energy Administration Industrial Rate for 2014 plus PG&E Electrical Generation Transportation Tariff for 2015
4) Historic average power demand ranges from 750 kW up to 950 kW
5) Digester Gas Heating Value for BioCNG reduce by 13% to account for losses in CNG process
6) Average year around electric charge base don PG&E E20P Rate Schedule January 2015
7) PG&E has a capacity standby charge for cogeneration systems.
8) Sulfur Treatment is still required for the Boiler Operation per SJVUPACD Rule 4307 by July 2015. Siloxane treatment is only required on the portion going to BioCNG
9) BioCNG 50 system still has full gas conditioning to treat sulfur for boiler so no reduction from BioCNG 100 system.
10) Low Pressure gas holder is part of Digester Project and not included in these costs.
11) WQCF flare to be used. Cost of flare system is not included in these costs.
12) Costs for receiving and processing food waste and FOG are separately covered as self supported programs through tip fees and processing fees and are not included in this analysis.
13) Costs obtained from CAT for new 600 kW MWM Engine assumed similar for existing 400 kW engine option.
14) Yearly existing diesel usage for solid waste trucks was 134,105 gallons in 2014 or 367 gallons per day. This is used for Existing and near term conditions. For future Food Waste conditions, it is assumed additional vehicles will be converted to CNG to the capacity of the system at 500 DGE per day.

Manteca Gas Utilization Economic Analysis

	Biosolids with FOG With Food Phase 1					
	BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
Income and Diesel Fuel Offsets	Increase in Gas Production		17,951	cfd		
Diesel Fuel Cost ($/gal) (1)	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18
Natural Gas Cost per $/Therm (HHV) (2,3)	$ 0.61	$ 0.61	$ 0.61	$ 0.65	$ 0.65	$ 0.65
Minimum Average Plant Electric Load (kW) (4)				750	750	750
Size of Prime Mover (kW)				500	400	592
Size of CNG System (DGE/Day) (14)	250	500	500			
Digester Gas Elec. Eff. (HHV 620 BTU/hr)				26.1%	31.6%	41.0%
Natural Gas Elec. Eff. (HHV 1,000 BTU/hr)				26.1%	31.6%	41.0%
Digester Gas Available (scfd)	94,703	94,703	113,840	151,502	151,502	151,502
Digester Gas Available (scfm)	65.8	65.8	79.1	105.2	105.2	105.2
Digester Gas Available HHV (Therms/hr) (5)	21.3	21.3	25.6	39.1	39.1	39.1
Digester Gas Prime Mover Power Output (kW)				299.1	362.2	469.9
Natural Gas Prime Mover Power Output (kW)				200.9	37.8	122.1
Natural Gas Heat Input HHV (Therms/hr)	0.0	7.5	3.2	26.3	4.1	10.2
Digester Gas Compressor Power (kW)				22.0	15.0	15.0
Digester Gas Conditioning Power (kW) (9)	54	54	54	19.0	19.0	19.0
Hot Water Pumps (kW)			4	2.0	2.0	2.0
Natural Gas Compressor Power (kW)	27	45	45	9.0	1.0	2.4
Total All Ancillary Losses (kW)	81.0	99.0	103.0	52.0	37.0	38.4
Net Cogen Power Output (kW)				448.0	363.0	553.6
Standby Capacity for PG&E				448	363	554
Percentage of Total Energy from Digester Gas	100%	74%	89%	60%	91%	79%
Average Plant Electric Cost per kW (6)	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220
Cost of Energy Sold to PG&E				$ 0.1220	$ 0.1220	$ 0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%	95%
Prime Mover Heat Recovery (% of Input Energy)				34.9%	60.0%	42.0%
Heat Available to Plant From Cogen (Therms/hr)	-	-	-	22.8	25.9	20.7
Heat Available to Plant From Cogen (BTUs/hr)	-	-	-	2,283,209	2,593,671	2,070,989
Peak Month Heating Demand at Plant (BTU/hr)	1,438,753	1,438,753	1,134,369	1,438,753	1,438,753	1,438,753
Average Heating Demand at Plant (BTU/hr)	1,224,591	1,224,591	1,019,640	1,224,591	1,224,591	1,224,591
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	182,500	182,500			
Additional NG Purchased (Therms/yr)	9,323	74,720	38,927	218,731	34,036	84,645
Total Annual Electric Reduction on PG&E Service (kW-hr)				3,728,017	3,021,236	4,607,207
Total Annual Electrical Export to PG&E (kW-hr)				-	-	-
Offset Energy Cost From PG&E				$ 454,961	$ 368,706	$ 562,256
Total Annual Electricity Sales to PG&E				$ -	$ -	$ -
Total Electricity Offsets and Sales				$ 454,961	$ 368,706	$ 562,256
Standby Charges to PG&E (7)				$ 11,515	$ 9,332	$ 14,230
Net Electrical Revenue ($/yr)	$ -	$ -	$ -	$ 443,446	$ 359,375	$ 548,025
Reduction in Fuel Cost When Converted to NG ($/yr)	$ 290,175	$ 580,350	$ 580,350	$ -	$ -	$ -
RIN Credits @ $1.65/RIN (RIN =77,000 BTU LHV)	$ 359,586	$ 359,586	$ 432,249			
Total Net Income/Offset Cost ($/yr)	$ 649,761	$ 939,936	$1,012,599	$ 443,446	$ 359,375	$ 548,025
Annual Costs						
Natural Gas Purchased (Therms/yr)	9,323	74,720	38,927	218,731	34,036	84,645
Natural Gas Fuel Cost ($/yr)	$ 5,687	$ 45,579	$ 23,746	$ 142,175	$ 22,123	$ 55,019
Electrical Costs ($/yr)	$ 83,707	$ 102,950	$ 107,012	$ -	$ -	$ -
Yearly Warranty and Service Contract Prime Mover ($/kW-hr)(13)				$ 0.011	$ 0.040	$ 0.040
Yearly Warranty and Service Contract Prime Mover ($/yr)				$ 45,771	$ 133,152	$ 197,065
Yearly Warranty and Service Contract Gas Conditioning				$ -	$ -	$ -
Gas Conditioning Sulfur Media Replacement (8,9)	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155
Gas Conditioning Siloxane Media Replacement	$ 4,848	$ 4,848	$ 6,827	$ 10,774	$ 10,774	$ 10,774
Gas Conditioning Miscellaneous Maintenance	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500
BioCNG Maintenance	$ 4,500	$ 4,500	$ 4,500	$ -	$ -	$ -
Subtotal Operations Costs	$ 201,397	$ 260,533	$ 244,740	$ 301,375	$ 268,704	$ 365,513
Net Offset Revenue per Year	$ 448,364	$ 679,404	$ 767,860	$ 142,071	$ 90,671	$ 182,512
Project Costs (10, 11)						
Total On Site Construction Cost	$ 3,437,575	$ 3,937,575	$2,962,000	$ 3,087,000	$ 1,958,000	$ 2,908,000
PG&E Natural Gas Upgrades	$ -	$ -	$ -	$ -	$ -	$ -
Digester Heat Recovery System	$ -	$ -	$ 265,000	$ -	$ -	$ -
Project Design and Construction Management			$ 414,680	$ 432,180	$ 274,120	$ 407,120
Total Project Costs	$ 3,437,575	$ 3,937,575	$3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
CNG Vehicle Upgrade Costs On New Truck Purchase	$ -	$ -	$ -	$ -	$ -	$ -
CNG Station Rebates						
SJVAPCD CNG Truck Rebates ($10K/vehicle x 5 trucks)	$ -	$ -	$ -			

Manteca Gas Utilization Economic Analysis

		Biosolids with FOG With Food Phase 1					
		BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
PG&E Self Generation Rebate Non-Renewable Portion ($2.08/W)					Expires 2015	Expires 2015	Expires 2015
Total Project Costs After Rebate		$ 3,437,575	$ 3,937,575	$3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
Simple Payback Years		7.67	5.80	4.74	24.77	24.62	18.16
Available Financing							
Period (years)	15						
Interest Rate (%)	3.50%						
Yearly Payment		($298,468)	($341,880)	($316,189)	($305,553)	($193,804)	($287,836)
Yearly Savings Fuel & Electricity		$ 448,364	$ 679,404	$ 767,860	$ 142,071	$ 90,671	$ 182,512
Net Savings		$149,897	$337,524	$451,671	($163,482)	($103,133)	($105,323)

Notes:

1) Cost of diesel based on West Cost average of Clean Cities Alternative Fuels Price Report, October 2014 and April 2016.
2) Cost of natural gas for vehicle fueling based on PG&E Natural Gas Vehicle Schedule 1 Projected for 2015

3) Cost of natural gas for cogeneration based on U.S Energy Administration Industrial Rate for 2014 plus PG&E Electrical Generation Transportation Tariff for 2015
4) Historic average power demand ranges from 750 kW up to 950 kW
5) Digester Gas Heating Value for BioCNG reduce by 13% to account for losses in CNG process
6) Average year around electric charge base don PG&E E20P Rate Schedule January 2015
7) PG&E has a capacity standby charge for cogeneration systems.
8) Sulfur Treatment is still required for the Boiler Operation per SJVUPACD Rule 4307 by July 2015. Siloxane treatment is only required on the portion going to BioCNG
9) BioCNG 50 system still has full gas conditioning to treat sulfur for boiler so no reduction from BioCNG 100 system.
10) Low Pressure gas holder is part of Digester Project and not included in these costs.
11) WQCF flare to be used. Cost of flare system is not included in these costs.
12) Costs for receiving and processing food waste and FOG are separately covered as self supported programs through tip fees and processing fees and are not included in this analysis.
13) Costs obtained from CAT for new 600 kW MWM Engine assumed similar for existing 400 kW engine option.
14) Yearly existing diesel usage for solid waste trucks was 134,105 gallons in 2014 or 367 gallons per day. This is used for Existing and near term conditions. For future Food Waste conditions, it is assumed additional vehicles will be converted to CNG to the capacity of the system at 500 DGE per day.

Manteca Gas Utilization Economic Analysis

	Biosolids with FOG With Food Phase 2					
	BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
Income and Diesel Fuel Offsets	Increase in Gas Production		17,143	cfd		
Diesel Fuel Cost ($/gal) (1)	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18	$ 3.18
Natural Gas Cost per $/Therm (HHV) (2,3)	$ 0.61	$ 0.61	$ 0.61	$ 0.65	$ 0.65	$ 0.65
Minimum Average Plant Electric Load (kW) (4)				750	750	750
Size of Prime Mover (kW)				500	400	592
Size of CNG System (DGE/Day) (14)	250	500	500			
Digester Gas Elec. Eff. (HHV 620 BTU/hr)				26.1%	31.6%	41.0%
Natural Gas Elec. Eff. (HHV 1,000 BTU/hr)				26.1%	31.6%	41.0%
Digester Gas Available (scfd)	112,654	112,654	131,791	169,453	169,453	169,453
Digester Gas Available (scfm)	78.2	78.2	91.5	117.7	117.7	117.7
Digester Gas Available HHV (Therms/hr) (5)	25.3	25.3	29.6	43.8	43.8	43.8
Digester Gas Prime Mover Power Output (kW)				334.6	400.0	525.6
Natural Gas Prime Mover Power Output (kW)				165.4	0.0	66.4
Natural Gas Heat Input HHV (Therms/hr)	0.0	3.4	0.0	21.6	0.0	5.5
Digester Gas Compressor Power (kW)				22.0	15.0	15.0
Digester Gas Conditioning Power (kW) (9)	54	54	54	19.0	19.0	19.0
Hot Water Pumps (kW)			4	2.0	2.0	2.0
Natural Gas Compressor Power (kW)	27	45	45	6.6	0.0	1.2
Total All Ancillary Losses (kW)	81.0	99.0	103.0	49.6	36.0	37.2
Net Cogen Power Output (kW)				450.4	364.0	554.8
Standby Capacity for PG&E				450	364	555
Percentage of Total Energy from Digester Gas	100%	88%	100%	67%	100%	89%
Average Plant Electric Cost per kW (6)	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220	$ 0.1220
Cost of Energy Sold to PG&E				$ 0.1220	$ 0.1220	$ 0.1220
BIOCNG/Cogen Availability	95%	95%	95%	95%	95%	95%
Prime Mover Heat Recovery (% of Input Energy)				34.9%	60.0%	42.0%
Heat Available to Plant From Cogen (Therms/hr)	-	-	-	22.8	26.3	20.7
Heat Available to Plant From Cogen (BTUs/hr)	-	-	-	2,283,209	2,626,522	2,070,989
Peak Month Heating Demand at Plant (BTU/hr)	1,438,753	1,438,753	1,134,369	1,438,753	1,438,753	1,438,753
Average Heating Demand at Plant (BTU/hr)	1,224,591	1,224,591	1,019,640	1,224,591	1,224,591	1,224,591
Reduction in Diesel Fuel for Trucks (gal/yr)	91,250	182,500	182,500			
Additional NG Purchased (Therms/yr)	11,090	41,145	12,974	180,139	-	46,053
Total Annual Electric Reduction on PG&E Service (kW-hr)				3,747,829	3,029,208	4,617,388
Total Annual Electrical Export to PG&E (kW-hr)				-	-	-
Offset Energy Cost From PG&E				$ 457,379	$ 369,679	$ 563,498
Total Annual Electricity Sales to PG&E				$ -	$ -	$ -
Total Electricity Offsets and Sales				$ 457,379	$ 369,679	$ 563,498
Standby Charges to PG&E (7)				$ 11,576	$ 9,356	$ 14,262
Net Electrical Revenue ($/yr)	$ -	$ -	$ -	$ 445,803	$ 360,323	$ 549,236
Reduction in Fuel Cost When Converted to NG ($/yr)	$ 290,175	$ 580,350	$ 580,350	$ -	$ -	$ -
RIN Credits @ $1.65/RIN (RIN =77,000 BTU LHV)	$ 427,746	$ 427,746	$ 500,409			
Total Net Income/Offset Cost ($/yr)	$ 717,921	$ 1,008,096	$ 1,080,759	$ 445,803	$ 360,323	$ 549,236
Annual Costs						
Natural Gas Purchased (Therms/yr)	11,090	41,145	12,974	180,139	-	46,053
Natural Gas Fuel Cost ($/yr)	$ 6,765	$ 25,099	$ 7,914	$ 117,090	$ -	$ 29,935
Electrical Costs ($/yr)	$ 83,707	$ 102,950	$ 107,012	$ -	$ -	$ -
Yearly Warranty and Service Contract Prime Mover ($/kW-hr)(13)				$ 0.011	$ 0.040	$ 0.040
Yearly Warranty and Service Contract Prime Mover ($/yr)				$ 45,771	$ 133,152	$ 197,065
Yearly Warranty and Service Contract Gas Conditioning				$ -	$ -	$ -
Gas Conditioning Sulfur Media Replacement (8,9)	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155	$ 98,155
Gas Conditioning Siloxane Media Replacement	$ 4,848	$ 4,848	$ 6,827	$ 10,774	$ 10,774	$ 10,774
Gas Conditioning Miscellaneous Maintenance	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500	$ 4,500
BioCNG Maintenance	$ 4,500	$ 4,500	$ 4,500	$ -	$ -	$ -
Subtotal Operations Costs	$ 202,475	$ 240,052	$ 228,908	$ 276,290	$ 246,581	$ 340,428
Net Offset Revenue per Year	$ 515,446	$ 768,044	$ 851,851	$ 169,513	$ 113,742	$ 208,808
Project Costs (10, 11)						
Total On Site Construction Cost	$ 3,437,575	$ 3,937,575	$ 2,962,000	$ 3,087,000	$ 1,958,000	$ 2,908,000
PG&E Natural Gas Upgrades	$ -	$ -	$ -	$ -	$ -	$ -
Digester Heat Recovery System	$ -	$ -	$ 265,000	$ -	$ -	$ -
Project Design and Construction Management			$ 414,680	$ 432,180	$ 274,120	$ 407,120
Total Project Costs	$ 3,437,575	$ 3,937,575	$ 3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
CNG Vehicle Upgrade Costs On New Truck Purchase	$ -	$ -	$ -	$ -	$ -	$ -
CNG Station Rebates						
SJVAPCD CNG Truck Rebates ($10K/vehicle x 5 trucks)	$ -	$ -	$ -			

Manteca Gas Utilization Economic Analysis

		Biosolids with FOG With Food Phase 2					
		BioCNG 50 No Heat Recover at Digesters	**BioCNG 100 No Heat Recover at Digesters**	**BioCNG 100 With Heat Recover at Digesters**	**2 x 250 kW Ingersoll Rand Gas Turbine NG&DG**	**Existing 400 kW Waukesha Engine NG&DG**	**New 600 kW MWM Engine NG&DG**
PG&E Self Generation Rebate Non-Renewable Portion ($2.08/W)					Expires 2015	Expires 2015	Expires 2015
Total Project Costs After Rebate		$ 3,437,575	$ 3,937,575	$ 3,641,680	$ 3,519,180	$ 2,232,120	$ 3,315,120
Simple Payback Years		6.67	5.13	4.28	20.76	19.62	15.88
Available Financing							
Period (years)	15						
Interest Rate (%)	3.50%						
Yearly Payment		($298,468)	($341,880)	($316,189)	($305,553)	($193,804)	($287,836)
Yearly Savings Fuel & Electricity		$ 515,446	$ 768,044	$ 851,851	$ 169,513	$ 113,742	$ 208,808
Net Savings		$216,979	$426,164	$535,662	($136,040)	($80,062)	($79,027)

Notes:
1) Cost of diesel based on West Cost average of Clean Cities Alternative Fuels Price Report, October 2014 and April 2016.
2) Cost of natural gas for vehicle fueling based on PG&E Natural Gas Vehicle Schedule 1 Projected for 2015

3) Cost of natural gas for cogeneration based on U.S Energy Administration Industrial Rate for 2014 plus PG&E Electrical Generation Transportation Tariff for 2015
4) Historic average power demand ranges from 750 kW up to 950 kW
5) Digester Gas Heating Value for BioCNG reduce by 13% to account for losses in CNG process
6) Average year around electric charge base don PG&E E20P Rate Schedule January 2015
7) PG&E has a capacity standby charge for cogeneration systems.
8) Sulfur Treatment is still required for the Boiler Operation per SJVUPACD Rule 4307 by July 2015. Siloxane treatment is only required on the portion going to BioCNG
9) BioCNG 50 system still has full gas conditioning to treat sulfur for boiler so no reduction from BioCNG 100 system.
10) Low Pressure gas holder is part of Digester Project and not included in these costs.
11) WQCF flare to be used. Cost of flare system is not included in these costs.
12) Costs for receiving and processing food waste and FOG are separately covered as self supported programs through tip fees and processing fees and are not included in this analysis.
13) Costs obtained from CAT for new 600 kW MWM Engine assumed similar for existing 400 kW engine option.
14) Yearly existing diesel usage for solid waste trucks was 134,105 gallons in 2014 or 367 gallons per day. This is used for Existing and near term conditions. For future Food Waste conditions, it is assumed additional vehicles will be converted to CNG to the capacity of the system at 500 DGE per day.

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE :

MAJOR ELEMENT NUMBER: 17
MAJOR ELEMENT: BioCNG 100

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	SITE WORK						
		BIOCNG						
		EXCAVATION	0	CY	8.0		1	
		ABC (ROADWAYS)	0	CY	45.0		1	
		BACKFILL	0	CY	10.0		1	
		PLANTING	0	SF	4.0		1	
		SLOW FILL PARKING AND OFF-SITE IMPROVEMENTS						
		CNG FENCING	0	LF	30.0		1	
	3	CONCRETE						
		EQUIPMENT PADS	10	CY	1,100		1	11,000
	11	EQUIPMENT						
		BioCNG EQUIPMENT						
		BioCNG 100	1	EA	600,000		1	600,000
		Enclosure	1	EA	110,000		1	110,000
		SALES TAX	1	EA	58,575	8.25%	1	58,575
		INSTALL	1	EA	230,573		1	230,573
		FILL STATION EQUIPMENT						
		SLOW FILL COMP ANGI NG50	1	EA	85,000		1	85,000
		DRYER	1	EA	45,000		1	45,000
		SLOW FILL STATION	1	EA	5,100		1	5,100
		FAST FILL STATION	2	EA	39,000		1	78,000
		LOW PRESSURE STORAGE 120 P	1	EA	40,000		1	40,000
		HIGH PRESSURE STORAGE 4500	4	EA	85,000		1	340,000
		HARDWARE AND PIPING	1	EA	0		1	0
		SALES TAX	1	EA	48,931	8.25%	1	48,931
		INSTALL	1	EA	192,609		1	192,609
	15	MISCELLANEOUS MECHANICAL (NOT INCLUDED WITH CNG INSTALL)						
	15	VALVES	10	EA	500		1	5,000
	15	LOW PRESSURE DG GAS PIPING	200	LF	80		1	16,000
	15	HIGH PRESSURE NG FROM Yoser	0	LF	80			
	15	FAST FILL GAS PIPING	75	LF	80		1	6,000

	15	BACKUP GAS FLARE	1	EA	75,000		1	75,000
	16	MISCELLANEOUS ELECTRICAL (NOT INCLUDED WITH CNG INSTALL)						
	16	NEW ELECTRICAL SERVICE	665	LF	250		1	166,250
	16	ELECTRICAL INSTALL	1	EA	100,000		1	100,000
	17	MISCELLANEOUS INSTRUMENTATION (NOT INCLUDED WITH CNG INSTALL)						
	17	CONDUIT AND WIRE	0	LF	5			
	17	SCADA AND CUMMUNICATIONS	0	EA	10,000			
MAJOR ELEMENT NUMBEI	17	SUBTOT BioCNG 100						2,213,000
		ESTIMATING CONTINGENCY				@	15%	332,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)						2,545,000

Project Design and Construction Management	$	356,300
CNG Civil Improvements Included With Digester Project	$	1,036,275
Total Project Cost	$	3,937,575

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE :

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: 400 KW WAUKESHA NG AND DG

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	SITE WORK						
		EXCAVATION	1,000	CY	8		1	8,000
		ABC (ROADWAYS)	125	CY	45		1	5,625
		BACKFILL	100	CY	10		1	1,000
		PLANTING	2,000	SF	4		1	8,000
	3	CONCRETE						
		FOR COGEN, INCLUDED IN INSTALLED COST						
		GAS CONDITIONING PAD	6	CY	1,100		1	6,600
	11	EQUIPMENT						
		PRIME MOVER EQUIPMENT						
		PRIME MOVER REHAB	1	EA	250,000		1	250,000
		HARDWARE	1	EA	50,000		1	50,000
		SALES TAX	1	EA	24,750	8.25%	1	24,750
		INSTALL	1	EA	0		1	0
		GAS CONDITIONING EQUIPMENT						
		SKID	1	EA	700,000		1	700,000
		HARDWARE AND PIPING	1	EA	15,000		1	15,000
		SALES TAX	1	EA	58,988	8.25%	1	58,988
		INSTALL	1	EA	357,500		1	357,500
	15	MISCELLANEOUS MECHANICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	15	HW PIPING	400	LF	60		1	24,000
	15	VALVES	10	EA	500		1	5,000
	15	GAS PIPING	200	LF	80		1	16,000
	16	MISCELLANEOUS ELECTRICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	16	DUCT BANK	250	LF	150		1	37,500
	16	MCC MODS	1	EA	10,000		1	10,000
	16	GAS CINDITIONING SYSTEM	1	EA	113,149		1	113,149
	17	MISCELLANEOUS INSTRUMENTATION (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	17	CONDUIT AND WIRE	400	LF	5		1	2,000

		17		SCADA AND CUMMUNICATIONS	1	EA	10,000		1	10,000
MAJOR ELEMENT NUMBEF			1	SUBTOT	400 KW WAUKESHA NG AND DG					1,703,000
				ESTIMATING CONTINGENCY				@	15%	255,000
				SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)						1,958,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE :

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: 600 kW COGEN FACILITY NG AND DG

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	SITE WORK						
		EXCAVATION	1,000	CY	8		1	8,000
		ABC (ROADWAYS)	125	CY	45		1	5,625
		BACKFILL	100	CY	10		1	1,000
		PLANTING	2,000	SF	4		1	8,000
	3	CONCRETE						
		FOR COGEN, INCLUDED IN INSTALLED COST						
		GAS CONDITIONING PAD	6	CY	1,100		1	6,600
	11	EQUIPMENT						
		PRIME MOVER EQUIPMENT						
		PRIME MOVER	1	EA	597,000		1	597,000
		ENCLOSURE AND HARDWARE	1	EA	130,000		1	130,000
		SALES TAX	1	EA	59,978	8.25%	1	59,978
		INSTALL	1	EA	363,500		1	363,500
		GAS CONDITIONING EQUIPMENT						
		SKID	1	EA	700,000		1	700,000
		HARDWARE AND PIPING	1	EA	15,000		1	15,000
		SALES TAX	1	EA	58,988	8.25%	1	58,988
		INSTALL	1	EA	357,500		1	357,500
	15	MISCELLANEOUS MECHANICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	15	HW PIPING	400	LF	60		1	24,000
	15	VALVES	10	EA	500		1	5,000
	15	GAS PIPING	200	LF	80		1	16,000
	16	MISCELLANEOUS ELECTRICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	16	DUCT BANK	250	LF	150		1	37,500
	16	MCC MODS	1	EA	10,000		1	10,000
	16	GAS CINDITIONING SYSTEM	1	EA	113,149		1	113,149
	17	MISCELLANEOUS INSTRUMENTATION (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	17	CONDUIT AND WIRE	400	LF	5		1	2,000

		17		SCADA AND CUMMUNICATIONS	1	EA	10,000		1	10,000
MAJOR ELEMENT NUMBEF			1	SUBTOT 600 kW COGEN FACILITY NG AND DG						2,529,000
				ESTIMATING CONTINGENCY				@	15%	379,000
				SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)						2,908,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE :

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: 500 KW GAS TURBINE COGEN FACILITY NG AND DG

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	SITE WORK						
		EXCAVATION	1,000	CY	8		1	8,000
		ABC (ROADWAYS)	125	CY	45		1	5,625
		BACKFILL	100	CY	10		1	1,000
		PLANTING	2,000	SF	4		1	8,000
	3	CONCRETE						
		FOR COGEN, INCLUDED IN INSTALLED COST						
		GAS CONDITIONING PAD	6	CY	1,100		1	6,600
	11	EQUIPMENT						
		PRIME MOVER EQUIPMENT						
		PRIME MOVER (250 Kw EA)	2	EA	450,380		1	900,761
		HARDWARE	1	EA	91,200		1	91,200
		SALES TAX	1	EA	44,680	8.25%	1	44,680
		INSTALL	1	EA	268,800		1	268,800
		GAS CONDITIONING EQUIPMENT						
		SKID	1	EA	700,000		1	700,000
		HARDWARE AND PIPING	1	EA	15,000		1	15,000
		SALES TAX	1	EA	58,988	8.25%	1	58,988
		INSTALL	1	EA	357,500		1	357,500
	15	MISCELLANEOUS MECHANICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	15	HW PIPING	400	LF	60		1	24,000
	15	VALVES	10	EA	500		1	5,000
	15	GAS PIPING	200	LF	80		1	16,000
	16	MISCELLANEOUS ELECTRICAL (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	16	DUCT BANK	250	LF	150		1	37,500
	16	MCC MODS	1	EA	10,000		1	10,000
	16	GAS CINDITIONING SYSTEM	1	EA	113,149		1	113,149
	17	MISCELLANEOUS INSTRUMENTATION (NOT INCLUDED WITH PRIME MOVER INSTALL)						
	17	CONDUIT AND WIRE	400	LF	5		1	2,000

		17		SCADA AND CUMMUNICATIONS					1	EA	10,000		1	10,000
	MAJOR ELEMENT NUMBE				1		SUBTOT	500 KW GAS TURBINE COGEN FACILITY NG AND D						2,684,000
							ESTIMATING CONTINGENCY					@	15%	403,000
							SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)							3,087,000

Detailed Cost Breakdowns for Recommended Projects

Manteca Digester Improvements Opinion of Probable Cost

Project No.	Project Description		Construction Cost	Budgetting Contingency	Budget Estimate
				2.5%	
WQCF Digester Improvements Projects					
1	Civil Improvements		$ 1,535,000	$ 38,375	$ 1,573,375
2	Temporary Boiler		$ -	$ -	$ -
3	Build New Digester Control Building		$ 3,327,000	$ 83,175	$ 3,410,175
4	Biogas Sulfur Removal System		$ 1,162,000	$ 29,050	$ 1,191,050
5	Replace Gas Flare		$ 322,000	$ 8,050	$ 330,050
6	Chemical Facilities		$ 228,000	$ 5,700	$ 233,700
7	Misc Electrical and Instrumentation		$ 1,742,000	$ 43,550	$ 1,785,550
8	Build Digester No. 3		$ 1,965,000	$ 49,125	$ 2,014,125
9	Build Digester No. 4		$ 1,965,000	$ 49,125	$ 2,014,125
10	Demolition in Existing Control Building		$ 65,000	$ 1,625	$ 66,625
11	Rehab Digesters No. 1 and No. 2		$ 2,516,000	$ 62,900	$ 2,578,900
12	Items Added for 60% Design		$ 249,040	$ 6,226	$ 255,266
13	Items Added for 90% Design		$ 403,755	$ 10,094	$ 413,849
				$ 386,995	$ 15,866,790
	Subtotal 1 through 13		$ 15,479,795	$ 386,995	$ 15,866,790
	Construction Contingency/Change Orders	10%	$ 1,547,979.50	$ 38,699.49	$ 1,586,678.99
	CM SERVICES	7.85%	$ 1,214,714.12	$ 30,367.85	$ 1,245,082
	CONST. ENG. SUPPORT SERVICES	2.61%	$ 404,000.00	$ 10,100.00	$ 414,100
	Total 1 through 13		$ 18,646,489	$ 466,162	**$ 19,112,651**
FOG Receiving Facilities Improvements Project					
14	Construct FOG Receiving Facility		$ 1,020,000	$ 25,500	$ 1,045,500
15	Items Added for 60% Design		$ 8,615	$ 215	$ 8,831
16	Items Added for 90% Design		$ 27,459	$ 686	$ 28,146
				$ -	
	Subtotal 14 through 16		$ 1,056,074	$ 26,402	$ 1,082,476
	Construction Contingency/Change Orders	10%	$ 105,607.45	$ 2,640	$ 108,247.63
	CM SERVICES	7.85%	$ 82,871	$ 2,072	$ 84,943
	CONST. ENG. SERVICES	2.61%	$ 27,562	$ 689	$ 28,251
	Total 14 through 16		$ 1,272,115	$ 31,803	**$ 1,303,918**
Food Waste Receiving Facilities					
17	Construct Food Waste Receiving		$ 384,000	$ 9,600	$ 393,600
18	Items Added for 60% Design		$ -	$ -	$ -
19	Items Added for 90% Design		$ 27,459	$ 686	$ 28,146
	Subtotal 17 through 19		$ 411,459	$ 10,286	$ 421,746
	Construction Contingency/Change Orders	10%	$ 41,145.93	$ 1,028.65	$ 42,174.57
	CM SERVICES	7.85%	$ 32,288	$ 807	$ 33,095
	CONST. ENG. SUPPORT SERVICES	2.61%	$ 10,738	$ 268	$ 11,007
	Total 17 through 19		$ 495,631	$ 12,391	**$ 508,022**
Compressed Biogas Fueling Facilities, Civil Improvements Only (0.4 acre)					
20	Interim CNG Civil Improvements		$ 495,000	$ 12,375	$ 507,375
21	Items Added for 60% Design		$ 440,000	$ 11,000	$ 451,000
22	Items Added for 90% Design		$ 76,000	$ 1,900	$ 77,900
	Subtotal 20 through 22		$ 1,011,000	$ 25,275	$ 1,036,275
	Construction Contingency/Change Orders	10%	$ 101,100	$ 2,528	$ 103,628
	CM SERVICES	7.85%	$ 79,334	$ 1,983	$ 81,317
	CONST. ENG. SUPPORT SERVICES	2.61%	$ 26,386	$ 660	$ 27,045
	Total 20 through 22		$ 1,217,820	$ 30,445	**$ 1,248,265**
	Subtotal 1 through 22		$ 17,958,329	$ 448,958	$ 18,407,287
	Construction Contingency/Change Orders	10%	$ 1,795,833	$ 44,896	$ 1,840,729
	CM SERVICES	7.85%	$ 1,409,207	$ 35,230	$ 1,444,437
	CONST. ENG. SUPPORT SERVICES	2.61%	$ 468,686	$ 11,717	$ 480,403
	Total Project Cost		**$ 21,632,000**	**$ 540,800**	**$ 22,173,000**
	Basic Construction Cost		$ 17,958,000	$ 449,000	$ 18,407,000
	Support Services Cost		$ 1,877,900	$ 46,900	$ 1,924,800
	Total Construction Cost		$ 19,836,000	$ 495,900	$ 20,332,000
	Total Contingency		$ 1,795,800	$ 44,900.00	$ 1,840,700
	Total Project Cost		$ 21,632,000	$ 540,800	$ 22,173,000

a) Total construction cost, including construction and contingencies. First quarter 2015 cost level. ENR 20-Cities CCI = 9,970.

b) All costs must be adjusted by ENR to Mid Point of Construction

Manteca Biosolids Master Plan Recommended Improvements Not Part of Digester Project

Project No.	Project Description	Total Project Cost	
	WAS building Improvements	$	80,000
	DAFT Control Upgrade	$	89,000
	Add Centrifuge No. 3	$	1,517,000
	Construct Biosolids Drying System	$	14,917,000
	Total	$	16,603,000

a) Total capital cost, including construction, contingencies, engineering, administration and environmental documentation, as applicable. First quarter 2015 cost level. ENR 20-Cities CCI = 9,970.

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: CIVIL IMPROVEMENTS

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	SITE WORK						
		DEMOLITION						
		BED RETAINING WALLLS	108	CY	30.0		1	3,244
		BED and MISC ASPHALT	61,200	SF	0.5		1	30,600
		TRANSFER PUMP STATION	1	LS	25,000.0		1	25,000
		GAS FLARE AND PIPING	1	LS	10,000.0		1	10,000
		SOIL LIQUIFACTION MITIGAITON						
		STONE COLUMNS	7,895	LF	38.0		1	300,010
		MOBILIZATION	1	LS	100,000		1	100,000
		FILL DRYING BEDS						
		FILL AND COMPACT BEDS	3,526	CY	10.0		1	35,259
		ROADS						
		EXCAVATION	423	CY	8.0		1	3,384
		AB - Class I (roads)	338	CY	45.0		1	15,227
		PAVING	211	Ton	90.0		1	19,033
		12" WHITE THERMOPLASTIC WHITE STRIPING		SF	$ 4.00		1	
		12" YELLOW THERMOPLASTIC STRIPING		SF	$ 4.50		1	
		6" WHITE THERMOPLASTIC STRIPING		LF	$ 0.75		1	
		4" WHITE PAINT STRIPING	2,800	LF	$ 0.40		1	1,120
		THERMOPLASTIC WHITE MARKINGS		SF	$ 4.00		1	
		SIGNAGE		LS				
		OVERLAY ON ENTRANCE ROAD	0	SF	3.0		1	
		FENCING	540	LF	30.0		1	16,200
		GATES	8	EA	2,000.0		1	16,000
		DECRATIVE ROCK WITH WEED MATT	43,721	SF	2.0		1	87,443
	5	METALS						
		PIPE BRIDGES (to DIG 1 & 2)	80	LF	250.0		1	20,000

15 YARD PIPING

BOTTOM SLUDGE (Digesters 1 and 2 only, 3 & 4 included with digesters)					
8" DIP	120	LF	65	1	7,800
8" 90 DEG ELL	4	EA	600	1	2,400
8" TEE	2	EA	850	1	1,700
8" FILLER FLANGES	0	EA	150		
8" PV	2	EA	1,500	1.5	4,500
8" WALL PIPES	0	EA	600		
RETURN SLUDGE (Digesters 1 and 2 only, 3 & 4 included with digesters)					
8" DIP	120	LF	65	1	7,800
8" 90 DEG ELL	4	EA	600	1	2,400
8" TEE	2	EA	850	1	1,700
8" FILLER FLANGES	0	EA	150		
8" PV	2	EA	1,500	1.5	4,500
8" WALL PIPES	0	EA	600		
PS FEED					
6" DIP	275	LF	40	1	11,000
6" 45 and 90 DEG ELL	4	EA	400	1	1,600
6" PV	2	EA	1,050	1.5	3,150
6" WALL PIPES	0	EA	400		
6" ARVS	1	EA	1,000	1	1,000
6" CO	1	EA	800	1	800
TWAS FEED					
4" DIP	265	LF	35	1	9,275
4" 45 and 90 DEG ELL	4	EA	350	1	1,400
4" PV	2	EA	636	1.5	1,908
4" WALL PIPES	0	EA	350		
4" ARVS	1	EA	1,000	1	1,000
DSL OVERFLOW SLUDGE (Digesters 1 and 2 3 & 4 TO SOLIDS HOLDING TANK)					
8" DIP	300	LF	65	1	19,500
8" 45 AND 90 DEG ELL	4	EA	600	1	2,400
8" TEE	5	EA	850	1	4,250
8" CO	2	EA	1,200	1	2,400
DSL OVERFLOW SLUDGE (Digesters 1 and 2 3 & 4 TO DRYING BEDS)					
8" DIP	755	LF	65	1	49,075
8" 45 AND 90 DEG ELL	2	EA	600	1	1,200
8" TEE	11	EA	850	1	9,350
8" CO	2	EA	1,200	1	2,400
8" PV	6	EA	1,500	1.5	13,500
DSL SLUDGE (FROM DCB #2 TO TEE ON OVF PIPE TO SH TANK AND DRYING BEDS)					
8" DIP	90	LF	65	1	5,850
8" 45 AND 90 DEG ELL	4	EA	600	1	2,400
8" TEE	0	EA	850		
8" CO	0	EA	1,200		
8" PV	0	EA	1,500	1.5	

DIGESTER GAS FROM DIGESTERS TO SULFUR REMOVAL						
12" ST STL		264	LF	180	1	47,520
12" 90 DEG ELL		6	EA	1,700	1	10,200
12" TEE		2	EA	2,200	1	4,400
12" FC		0	EA	1,600		
12" PV		1	EA	2,570	1.5	3,855
DIGESTER GAS DIGESTERS 1 & 2 TO MAIN HEADER (ON BRIDGE)						
8" ST STL		70	LF	130	1	9,100
8" 90 DEG ELL		2	EA	1,200	1	2,400
8" TEE		1	EA	1,500	1	1,500
8" FC		1	EA	1,200	1	1,200
8" FLAME ARRESTOR		0	EA	1,500		
8" PV		3	EA	1,500	1.5	6,750
DIGESTER GAS FROM DIG. 3 TO HEADER NOT INCLUDED WITH NO. 3						
10" ST STL		42	LF	150	1	6,300
10" 90 DEG ELL		1	EA	1,450	1	1,450
10" TEE		1	EA	1,800	1	1,800
DIGESTER GAS FROM SULFUR BACK TO BOILERS						
6" ST STL		145	LF	110	1	15,950
6" 90 DEG ELL		4	EA	1,100	1	4,400
6" TEE		1	EA	1,400	1	1,400
6" PV		1	EA	1,050	1.5	1,575
DIGESTER GAS FROM SULFUR BACK TO BOILERS						
4"	ST STL	36	LF	90	1	3,240
4"	90 DEG ELL	12	EA	1,000	1	12,000
4"	TEE	6	EA	1,200	1	7,200
4"	FC	0	EA	1,000		
4"	PV	12	EA	636	1.5	11,448
DIGESTER GAS FROM SULFUR TO FLARE						
6" ST STL		5	LF	110	1	550
6" 90 DEG ELL		0	EA	1,100		
6" TEE		1	EA	1,400	1	1,400
6" PV		1	EA	1,050	1.5	1,575
PIPING HOT WATER SYSTEM ON BRIDG AND TRENCH TO DIG 1, 2, 3, 4						
4"	STL PIPE	260	LF	35	1	9,100
4"	TEE	8	EA	600	1	4,800
4"	ELL	16	EA	390	1	6,240
4"	RED	0	EA	350	1	
3W LINE						
4" PVC		620	LF	40	1	24,800
4" 45 and 90 DEG ELL		8	EA	400	1	3,200
4" PV		2	EA	636	1.5	1,908

CHEMICAL LINES						
2"	PVC CARRIER With 1" Tu	1,100	LF	25	2.5	68,750
	PULL BOXES	3	EA	2,000	1	6,000
1-W LINES FROM DCB No. 1 TO CHEM						
2"	PVC	50	LF	25	2.5	3,125
1-W LINE FROM BACK FLOW PREVENTER TO BUILDING						
4" PVC		220	LF	40	1	8,800
4" 45 and 90 DEG ELL		4	EA	400	1	1,600
4" BF PREVENTER		1	EA	2,500	1.5	3,750
NG LINE						
3" PE		365	LF	40	1	14,600
4" 45 and 90 DEG ELL		8	EA	400	1	3,200
4" PV		2	EA	636	1.5	1,908
STORM DRAIN						
18" C900		110	LF	80	1	8,800
12" C900		1,135	LF	60	1	68,100
CATCH BASINS		14	EA	5,000	1	70,000
MANHOLES		7	EA	10,000	1	70,000
MAJOR ELEMENT NUMBER :	1	SUBTOT CIVIL IMPROVEMENTS				1,395,000
		ESTIMATING CONTINGENCY		@	10%	140,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)				1,535,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT: CITY OF RICHMOND
JOB NUMBER: 2008 - 68 ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 3
MAJOR ELEMENT: **New Digester Heating and Support Building**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		BUILDING SLAB	0	CY	10			
		BUILDING TRENCH	600	CY	10		1	6,000
		SUMP	45	CY	10		1	450
		DRAINAGE TRENCH	6	CY	10		1	60
		OUTSIDE TRENCHES TO DIG	110	CY	10		1	1,100
		BACKFILL - NATIVE						
		BUILDING SLAB	500	CY	10		1	5,000
		BUILDING TRENCH	307	CY	10		1	3,070
		SUMP	32	CY	10		1	320
		DRAINAGE TRENCH	0	CY	10			
		OUTSIDE TRENCHES TO DIG	110	CY	10		1	1,100
		BACKFILL - AB						
		BUILDING SLAB	271	CY	60		1	16,260
		OUTSIDE TRENCHES TO DIG	13	CY	60		1	780
	3	CONCRETE						
		BUILDING SLAB	180	CY	635		1	114,300
		PIPE TRENCH SLAB	67	CY	635		1	42,545
		DRAIN TRENCH	6	CY	635		1	3,810
		BUILDING FOOTINGS	24	CY	635		1	15,240
		PIPE TRENCH WALLS	87	CY	1,050		1	91,350
		TRENCH STEP FOOTINGS	12	CY	1,050		1	12,600
		OUTSIDE PIPE TRENCH SLAB	15	CY	635		1	9,525
		OUTSIDE PIPE TRENCH WALLS	13	CY	1,050		1	13,650
	4	MASONRY						
		CMU 8" BELOW 18'	6,194	SF	38		1	235,372

	CMU 8" ABOVE 18'	2,289	SF	38		1	86,982
5	METAL						
	TRENCH GRATING	800	SF	88		1	70,400
	TRENCH TREAD PLATE	115	SF	65		1	7,475
	OUTSIDE TRENCH GRATING - H20	280	SF	120		1	33,600
	8' x 12' ROLL UP DOOR	3	EA	8,000		1	24,000
	12' x 12' ROLL UP DOOR	1	EA	10,000		1	10,000
	MAN DOORS	9	EA	2,050		1	18,450
	ROOF STEEL	40,000	LBS	2		1	60,000
	STEEL DECKING	6,650	SF	4		1	26,600
7	SPECIALTIES						
	MEMBRANE ROOFING	6,720	ST	20		1	134,400
11	EQUIPMENT						
	BUILDING						
	TRANSFER PUMPS	4	EA	19,000		1.7	129,200
	HOT WATER PUMPS	2	EA	9,000		1.7	30,600
	LOOP PUMPS AND 3-WAY VALVE	4	EA	4,500		1.7	30,600
	BOILERS	2	EA	150,000		1.7	510,000
	LOOP PUMPS AND 3-WAY VALVE	2	EA	4,500		1.7	15,300
	SLUDGE HEX	0	EA	40,000		1.7	
	EXPANSION TANK	1	LS	6,000		1.7	10,200
	AIR SEPARATOR	1	EA	5,000		1.7	8,500
	CHEMICAL FEEDER	1	EA	3,500		1.7	5,950
	AIR DRYER AND EQUIP	1	EA	4,500		1.7	7,650
	AIR HANDLING UNITS	6	EA	12,500		1.7	127,500
	HVAC - SPLIT UNIT W/ DUCTING	1	EA	15,000		1.7	25,500
13	SPECIAL CONSTRUCTION						
	BUILDING	0	SF	200	0	1.7	
15	MECHANICAL						
	MISC PIPE SUPPORTS	1	LS	50,000		1	50,000
	PIPING AND VALVES (SLUDGE)						
	DS PIPING						
	8" DI PIPE	330	LF	70		1	23,100
	8" PLUG VALVES	16	EA	1,500		1.5	36,000
	8" 3-WAY PLUG VALVES	0	EA	0		1	

	8"	FLEX COUPLINGS		8	EA	900	1	7,200
	8"	TEE		8	EA	1,050	1	8,400
	8"	ELL		16	EA	660	1	10,560
	8"	RED		8	EA	560	1	4,480
	8"	45 ELL		0	EA		1	
	PS / TWAS / FOG / FOOD PIPING							
	8"	DI PIPE		200	LF	70	1	14,000
	8"	PLUG VALVES		4	EA	1,500	1.5	9,000
	6"	PNEUMATIC PLUG VLVS		16	EA	4,000	1.5	96,000
	8"	FLEX COUPLINGS		0	EA	900	1	
	8" x 6"	TEE		32	EA	1,050	1	33,600
	8"	ELL		8	EA	660	1	5,280
	8" x 4"	RED		8	EA	560	1	4,480
	8"	45 ELL		0	EA		1	
	8"	BF		4	EA	300	1	1,200
	PIPING HOT WATER SYSTEM							
	6"	STL PIPE		532	LF	52	1	27,664
	6"	GATE VALVES		4	EA	800	1	3,200
	6"	FLEX COUPLINGS		4	EA	600	1	2,400
	6"	TEE		6	EA	775	1	4,650
	6"	ELL		46	EA	515	1	23,690
	6"	RED		4	EA	400	1	1,600
	PIPING HOT WATER SYSTEM							
	4"	STL PIPE		340	LF	35	1	11,900
	4"	GATE VALVES		8	EA	615	1	4,920
	4"	FLEX COUPLINGS		8	EA	530	1	4,240
	4"	TEE		12	EA	600	1	7,200
	4"	ELL		52	EA	390	1	20,280
	4"	RED		8	EA	350	1	2,800
	AIR PIPING							
	1"	STL PIPE		550	LF	20	1	11,000
	GAS PIPING							
	3"	ST. STL PIPE		200	LF	45	2.5	22,500
	3"	FITTINGS		1	LS	2,250	1	2,250
	DRAIN PIPING							
	2-4"	CPVC		300	LF	25	2.5	18,750
	2-4"	FITTINGS		1	LS	1,875	1	1,875
	PAINTING		5.0%	1	LS	121,000	1	121,000
16	ELECTRICAL		10.0%	1	LS	242,000	1	242,000
16	INSTRUMENTATION		10.0%	1	LS	242,000	1	242,000

MAJOR ELEMENT NUMBEF 3 SUBTOT New Digester Heating and Support Building 3,024,658

	ESTIMATING CONTINGENCY	@	10%	302,000
	SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)			3,327,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE 9,970

MAJOR ELEMENT NUMBER: 4
MAJOR ELEMENT: **BIOGAS SULFER REMOVAL**

ITEM NO.	DIV	DESCRIPTION	QUAN	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		BUILDING SLAB	110	CY	10		1	1,100
		BACKFILL - NATIVE						
		BUILDING SLAB	55	CY	10		1	550
		BACKFILL - AB						
		BUILDING SLAB	55	CY	60		1	3,300
	3	CONCRETE						
		BUILDING SLAB	110	CY	635		1	69,850
		EQUIPMENT PADS	5	EA	1,500		1	7,500
	11	EQUIPMENT						
		SULFUR REMOVAL	1	EA	280,000		1.5	420,000
		BLOWERS AND EQUIPMENT	4	EA	43,000		1.7	292,400
		HEAT EXCHANGER	1	EA	19,000		1.5	28,500
		PRESSURE RELIEVE VALVE	1	EA	3,000		1	3,000
	15	MECHANICAL						
		DIGESTER GAS FROM DIGESTERS TO SULFUR REMOVAL						
		12" ST STL	10	LF	180		1	1,800
		12" 90 DEG ELL	0	EA	1,700			
		12" TEE	1	EA	2,200		1	2,200
		12" FC	1	EA	1,600		1	1,600
		12" PV	1	EA	2,570		1.5	3,855
		DIGESTER GAS						
		6" ST STL	134	LF	110		1	14,740
		6" 90 DEG ELL	10	EA	1,100		1	11,000
		6" TEE	15	EA	1,400		1	21,000
		6" PV	5	EA	1,050		1.5	7,875
		DIGESTER GAS						
		4" ST STL	36	LF	90		1	3,240

		4"	90 DEG ELL		13	EA	1,000	1	13,000
		4"	TEE		6	EA	1,200	1	7,200
		4"	FC		8	EA	1,000	1	8,000
		4"	PV		8	EA	636	1.5	7,632
		4"	CV		8	EA	1,000	1.5	12,000
	DRAIN PIPING								
		2-4"	CPVC		180	LF	25	2.5	11,250
		2-4"	FITTINGS		1	LS	1,125	1	1,125
	3W PIPING								
		2"	PVC		90	LF	25	2.5	5,625
		2"	FITTINGS		1	LS	563	1	563
16	ELECTRICAL			5.0%	1	LS	48,000	1	48,000
16	INSTRUMENTATION			5.0%	1	LS	48,000	1	48,000
MAJOR ELEMENT NUMBEI	4		SUBTOT	BIOGAS SULFER REMOVAL					1,055,905
			ESTIMATING CONTINGENCY				@	10%	106,000
			SUBTOTAL (INCLUDING ESTIMATING CONTINGEN						1,162,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 5
MAJOR ELEMENT: **Gas Flare**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		BUILDING SLAB	16	CY	10		1	156
		BACKFILL - NATIVE						
		BUILDING SLAB	8	CY	10		1	78
		BACKFILL - AB						
		BUILDING SLAB	8	CY	60		1	467
	3	CONCRETE						
		BUILDING SLAB	16	CY	635		1	9,878
		EQUIPMENT PADS	1	EA	1,500		1	1,500
	11	EQUIPMENT						
		GAS FLARE	1	EA	125,000		1.7	212,500
	15	MECHANICAL						
		MISC PIPING, VALVES & FITTINGS	1	LS	15,000		1	15,000
		GAS PIPING						
		4" ST STL	24	LF	90		1	2,160
		4" PV	1	EA	636		1.5	954
		NG LINE						
		1" ST STL	30	LF	25		2.5	1,875
	16	ELECTRICAL 10.0%	1	LS	24,000		1	24,000
	16	INSTRUMENTATION 10.0%	1	LS	24,000		1	24,000

MAJOR ELEMENT NUMBEF 5	SUBTOT Gas Flare			292,567
	ESTIMATING CONTINGENCY	@	10%	29,000
	SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)			322,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 6
MAJOR ELEMENT: **Chem Facility**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		BUILDING SLAB	53	CY	10		1	533
		BACKFILL - NATIVE						
		BUILDING SLAB	27	CY	10		1	267
		BACKFILL - AB						
		BUILDING SLAB	27	CY	60		1	1,600
	3	CONCRETE						
		BUILDING SLAB	18	CY	635		1	11,289
		BUILDING WALLS	5	CY	1,050		1	5,367
		TANK PAD	4	CY	635		1	2,669
		CONCRETE STEPS	2	CY	636		1	1,272
		EQUIPMENT PAD	2	EA	1,500		1	3,000
	7	FIBERGLASS						
		FRP GRATING	140	SF	88		1	12,320
		FRP EQUIPMENT STAND	4	EA	1,500		1	6,000
	11	EQUIPMENT						
		DOUBLE WALL TANKS (1500 gal)	2	EA	15,000		1.5	45,000
		CHEMICAL PUMPS	4	EA	4,500		1.7	30,600
	13	METAL COVER						
		COVER	480	SF	50		1	24,000
	15	MECHANICAL						
		MISC PIPING, VALVES & FITTINGS	1	LS	15,000		1	15,000
		PAINTING 5.0%	1	LS	8,000		1	8,000
	16	ELECTRICAL 15.0%	1	LS	24,000		1	24,000
	16	INSTRUMENTATION 10.0%	1	LS	16,000		1	16,000
MAJOR ELEMENT NUMBEF	6	SUBTOT Chem Facility						206,917

ESTIMATING CONTINGENCY	@	10%	21,000
SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)			228,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE 9,970

MAJOR ELEMENT NUMBER: 7
MAJOR ELEMENT: Mscellaneous Electircal and Instrumentation

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	16	MISCELLANEOUS ELECTRICAL (NOT INCLUDED WITH OTHER ITEMS)						
	16	17 kV DUCT BANK	700	LF	250		1	175,000
	16	17 KV MANHOLES	2	EA	25,000		1	50,000
	16	TRANFORMERS	2	EA	46,000		1.5	138,000
	16	MCC AND TRANSFER SWITCH	1	EA	250,000		1.7	425,000
	16	ELECTRICAL COORDINATION ST	1	EA	50,000		1	50,000
	16	480 V MANHOLES	4	EA	15,000		1	60,000
	17	MISCELLANEOUS INSTRUMENTATION (NOT INCLUDED WITH OTHER ITEMS)						
	17	SCADA/PLC STATION	1	LS	250,000		1	250,000
	17	SCADA AND PLC PROGRAMMIN	1	EA	350,000		1	350,000
	17	FIBER OPTIC	380	FT	30		1	11,400
	17	EXISTING NETWORK MODIFICATI	1	EA	75,000		1	75,000

MAJOR ELEMENT NUME 7	SUBTOT Mscellaneous Electircal and Instrumentation	1,584,000
	ESTIMATING CONTINGENCY @ 10%	158,000
	SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY	1,742,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 8 & 9
MAJOR ELEMENT: **Digester No.3**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		EXCAVATION	1,522	CY	8		1	12,176
		BACKFILL	761	CY	8		1	6,088
		ABC	161	CY	60		1	9,644
		DRAIN ROCK	0	CY	60			
	3	CONCRETE						
		SLAB	288	CY	635		1	182,748
		WALLS	407	CY	1,050		1	427,606
		ROOF	0	CY	1,400			
		DISCHARGE BOX	5	CY	1,050		1	5,250
	5	METAL						
		ACCESS HATCHES	3	EA	3,000		1	9,000
		ALUMINUM STAIRS	50	RISERS	450		1	22,500
		ALUMINUM GRATING	502	SF	88		1	44,219
		HANDRAIL	376	FT	65		1	24,419
		DRIP TRAPS	1	EA	1,000		1	1,000
		SAMPLE PORTS	2	EA	1,500		1	3,000
		MANWAY	1	EA	2,500		1	2,500
		SIGHT GLASSES	0	EA	2,500			
		DOME VENTS	0	EA	1,500			
	7	INSULATION						
		INSULATE COVERS	3,318	sf	20		1	66,366
	10	SPECIALTIES						
		WARNING SIGNS	1	LS	1,000		1	1,000
	11	EQUIPMENT						
		FLOATING STEEL COVER	1	EA	259,000		2.1	543,900
		DRAFT TUBE MIXERS	2	EA	95,000		1.5	285,000
		ADDER FOR DRAFT TUBE HEXs	2	EA	7,500		1.15	17,250
	15	MECHANICAL						
		MISC PIPING, VALVES & FITTINGS	1	LS	5,000		1	5,000
		RES PIPING						

BOTTOM SLUDGE					
8" DIP	50	LF	65	1	3,250
8" 90 DEG ELL	3	EA	600	1	1,800
8" TEE	0	EA	850		
8" FILLER FLANGES	0	EA	150		
8" PV	0	EA	1,200		
8" WALL PIPES	0	EA	600		
RETURN SLUDGE					
8" DIP	30	LF	65	1	1,950
8" 90 DEG ELL	3	EA	600	1	1,800
8" TEE	0	EA	850		
8" FILLER FLANGES	0	EA	150		
8" PV	1	EA	1,200	1	1,200
8" WALL PIPES	0	EA	600		
OVERFLOW BOX HEADER					
8" DIP	45	LF	65	1	2,925
8" 2-3 FOOT SPOOLS	5	EA	450	1	2,250
8" X 6" TEE	3	EA	750	1	2,250
8" CROSS	2	EA	850	1	1,700
8" 90 DEG ELL	6	EA	600	1	3,600
8" WALL PIPES	8	EA	600	1	4,800
8" X 6" RED ELL	1	EA	600	1	600
8" PV	6	EA	1,200	1	7,200
OVERFLOW PIPE					
12" DIP	28	LF	100	1	2,800
12" 90 DEG ELL	2	EA	1,000	1	2,000
12" TEE	1	EA	1,500	1	1,500
DIGESTER GAS					
10" ST STL	99	LF	150	1	14,850
10" 90 DEG ELL	4	EA	1,450	1	5,800
10" TEE	1	EA	1,800	1	1,800
10" FC	1	EA	1,400	1	1,400
10" FLAME ARRESTOR	3	EA	1,500	1	4,500
10" PRESS / VACUUM VALVE	2	EA	1,500	1	3,000
10" PV	3	EA	2,020	1.5	9,090
PIPING HOT WATER SYSTEM FROM DIG TO BRIDG					
4" STL PIPE	80	LF	35	1	2,800
4" TEE	2	EA	600	1	1,200
4" ELL	6	EA	390	1	2,340
4" RED	4	EA	350	1	1,400
PIPING HOT WATER SYSTEM					
3" STL PIPE	180	LF	30	1	5,400
3" GATE VALVES	4	EA	615	1	2,460
3" FLEX COUPLINGS	4	EA	530	1	2,120
3" TEE	0	EA	600	1	
3" ELL	16	EA	390	1	6,240
3" RED	0	EA	350	1	
VALVES ON ACCESS HATCHES					

	6" PV		0	EA	1,050			
	3" PV		0	EA	400			
	PAINTING GENERAL	1.0%	1	LS	18,000		1	18,000
	PAINTING COVERS		1	LS	105,000		1	105,000
16	ELECTRICAL	2.5%	1	LS	44,000		1	44,000
16	INSTRUMENTATION	2.5%	1	LS	44,000		1	44,000
MAJOR ELEMENT NUMBEF8 & 9	SUBTOT Digester No.3							1,985,690
	ESTIMATING CONTINGENCY					@	10%	199,000
	SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)							2,185,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 10
MAJOR ELEMENT: **Demo Existing Digester Control Building**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	DEMOLITION AND DISPOSAL						
		EQUIPMENT	12	EA	2,500		1	30,000
		PIPING	500	FT	10		1	5,000
		EQUIPMENT PADS	12	EA	1,500		1	18,000
		REMOVE ROOF PIPING	350	FT	10		1	3,500

MAJOR ELEMENT NUMBEF 10	SUBTOT Demo Existing Digester Control Building			56,500
	ESTIMATING CONTINGENCY	@	15%	8,000
	SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)			65,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 11
MAJOR ELEMENT: **Rehabilitate Existing Digester No.1**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	DEMMOLITION						
		ROOF	94	CY	500		1	47,189
		WALLS PENS FOR DRAFT TUBES	2	CY	2,000		1	4,000
	3	CONCRETE						
		SLAB	0	CY	635			
		WALLS	16	CY	1,050		1	16,906
		ROOF	0	CY	1,400			
		DISCHARGE BOX	0	CY	2,050			
		WALL PENS DRAFT TUBES	4	EA	5,000		1	20,000
	5	METAL						
		ACCESS HATCHES	3	EA	3,000		1	9,000
		ADJUST EXIST STAIRS	1	EA	5,000		1	5,000
		ALUMINUM GRATING	0	SF	88			
		HANDRAIL	198	FT	65		1	12,865
		DRIP TRAPS	1	EA	1,000		1	1,000
		SAMPLE PORTS	2	EA	1,500		1	3,000
		MANWAY	0	EA	2,500			
		SIGHT GLASSES	0	EA	2,500			
		DOME VENTS	0	EA	1,500			
	7	INSULATION						
		INSULATE COVERS	2,827	sf	20		1	56,549
	10	SPECIALTIES						
		WARNING SIGNS	1	LS	1,000		1	1,000
	11	EQUIPMENT						
		FIXED STEEL COVER	1	EA	187,500		2.22	416,250
		DRAFT TUBE MIXERS	2	EA	95,000		1.5	285,000
		ADDER FOR DRAFT TUBE HEXs	2	EA	7,500		1.15	17,250
	15	MECHANICAL						
		MISC PIPING, VALVES & FITTINGS	1	LS	5,000		1	5,000
		RES PIPING						

	BOTTOM SLUDGE							
	8" DIP			50	LF	65	1	3,250
	8" 90 DEG ELL			3	EA	600	1	1,800
	8" TEE			0	EA	850		
	8" FILLER FLANGES			0	EA	150		
	8" PV			0	EA	1,200		
	8" WALL PIPES			0	EA	600		
	RETURN SLUDGE							
	8" DIP			30	LF	65	1	1,950
	8" 90 DEG ELL			3	EA	600	1	1,800
	8" TEE			0	EA	850		
	8" FILLER FLANGES			0	EA	150		
	8" PV			1	EA	1,200	1	1,200
	8" WALL PIPES			0	EA	600		
	OVERFLOW BOX OVERFLOW							
	10" DIP			28	LF	80	1	2,240
	10" 90 DEG ELL			2	EA	800	1	1,600
	DIGESTER GAS							
	6" ST STL			66	LF	110	1	7,260
	6" 90 DEG ELL			4	EA	1,100	1	4,400
	6" TEE			1	EA	1,400	1	1,400
	6" FC			1	EA	1,100	1	1,100
	6" FLAME ARRESTOR			3	EA	1,500	1	4,500
	6" PRESS / VACUUM VALVE			2	EA	1,500	1	3,000
	6" PV			3	EA	1,050	1.5	4,725
	PIPING HOT WATER SYSTEM FROM DIG TO BRIDG							
	4"	STL PIPE		56	LF	35	1	1,960
	4"	TEE		2	EA	600	1	1,200
	4"	ELL		6	EA	390	1	2,340
	4"	RED		4	EA	350	1	1,400
	PIPING HOT WATER SYSTEM							
	3"	STL PIPE		180	LF	30	1	5,400
	3"	GATE VALVES		4	EA	615	1	2,460
	3"	FLEX COUPLINGS		4	EA	530	1	2,120
	3"	TEE		0	EA	600	1	
	3"	ELL		16	EA	390	1	6,240
	3"	RED		0	EA	350	1	
	PAINTING GENERAL		1.0%	1	LS	10,000	1	10,000
	PAINTING COVERS			1	LS	75,000	1	75,000
16	ELECTRICAL		5.0%	1	LS	48,000	1	48,000
16	INSTRUMENTATION		5.0%	1	LS	48,000	1	48,000
MAJOR ELEMENT NUMBEF	11	SUBTOT Rehabilitate Existing Digester No.1						1,144,353
		ESTIMATING CONTINGENCY				@	10%	114,000

SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)	1,258,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 13
MAJOR ELEMENT: **New Items add as part of 60% Submittal**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	SUBTOTAL
	2	EXCAVATION						
		12 FOOT LARGER UNLOADING AREA (FOG Receiving Unloading)						
		EXCAVATION	88	CY	8.0		1	704
		AB-Class I (roads)	70	CY	45.0		1	3,168
		PAVING	44	Ton	90.0		1	3,960
		12" WHITE THERMOPLASTIC WHITE STRIPING		SF	$ 4.00			
		12" YELLOW THERMOPLASTIC STRIPING	792	SF	$ 4.50		1	3,564
		6" WHITE THERMOPLASTIC STRIPING		LF	$ 0.75			
		4" WHITE PAINT STRIPING		LF	$ 0.40			
		THERMOPLASTIC WHITE MARKINGS		SF	$ 4.00			
		SIGNAGE		LS				
	3	CONCRETE						
		CANTILEVERED WALKWAY DIG 1&2						
		ELEVATED SLAB	16	CY	2,000		1	32,000
	11	EQUIPMENT						
	13	BUILDING AND SEPCIALTY ITEMS						
		FIRE SPRINKLER/ALARM SYSTEM	7,000	SF	4		1	28,000
	15	MECHANICAL						
		FIRE WATER PIPING LOOP						
		10" C900 PIPE	540	LF	90		1	48,600
		10" GATE VALVES	1	EA	2,300		1	2,300
		10" FLEX COUPLINGS	1	EA	1,200		1	1,200
		10" TEE	3	EA	1,200		1	3,600
		8" C900 PIPE	480	LF	70		1	33,600
		8" GATE VALVES	2	EA	1,900		1	3,800
		8" FLEX COUPLINGS	2	EA	900		1	1,800
		8" TEE	1	EA	1,050		1	1,050
		8" ELL	2	EA	660		1	1,320
		8" FIRE HYDRANT	2	EA	2,500		1	5,000

	DSLR LOOP TO PICK UP FOG AND FW						
	8"	DI PIPE	460	LF	70	1	32,200
	8"	PLUG VALVES	2	EA	1,900	1	3,800
	8"	FLEX COUPLINGS	2	EA	900	1	1,800
	8"	TEE	1	EA	1,050	1	1,050
	8"	ELL	8	EA	660	1	5,280
16	ELECTRICAL						
16	INSTRUMENTATION						
	FIRE ALARM CONNECTION TO EXIST PANEL						
	1" CONDUIT AND WIRE		500	FT	40	1	20,000
MAJOR ELEMENT NUMBER :	13	SUBTOT New Items add as part of 60% Submittal					238,000
		ESTIMATING CONTINGENCY			@	0.1	24,000
	CONSTRUCTION TOTAL (INCLUDING ESTIMATING CONTINGENC						262,000

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 14
MAJOR ELEMENT: **New Items add as part of 90% Submittal**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		MATERIAL IMPORT						
		PAD (Digesters & Building)	7,600	CY	$ 15.00		1	114,000
		PAD (CNG)	2,900	CY	$ 15.00		1	43,500
		ROADWAYS (CNG & Food Waste)	3,600	CY	$ 15.00		1	54,000
		ROAD PAVING (CNG & Food Waste Service)						
		2" OVERLAY ON ENTRANCE ROAD	232	Ton	$ 90.00		1	20,889
		12" WHITE THERMOPLASTIC WHITE STRIPING		SF	$ 4.00			
		12" YELLOW THERMOPLASTIC STRIPING	-	SF	$ 4.50			
		6" WHITE THERMOPLASTIC STRIPING		LF	$ 0.75			
		4" WHITE PAINT STRIPING	1,880	LF	$ 0.40		1	752
		THERMOPLASTIC WHITE MARKINGS	100	SF	$ 4.00		2	800
		SIGNAGE		LS				
		LANDSCAPING AND IRRIGATION						
		LS (INTENSIVE)	750	SF	$ 5.00		1	3,750
		IRRIGATION (INTENSIVE)	750	SF	$ 2.00		1	1,500
		LS (TREE AND ROCK)	3,400	SF	$ 3.00		1	10,200
		IRRIGATION (TREE AND ROCK)	3,400	SF	$ 1.00		1	3,400
		ADDITIONAL FENCING	1,140	LF	$ 30.00		1	34,200
	3	CONCRETE						
		CRACK REPAIR & TEST DIG 1 & 2	2	EA	$ 25,000		1	50,000
	11	EQUIPMENT						
	13	BUILDING AND SEPCIALTY ITEMS						
		UPGRADE EXITING PLC (E and F)	2	EA	$ 50,000		1	100,000
		LAP TOP WOTH PLC SOFTWARE	1	EA	$ 10,000		1	10,000
		PROGRAMMING CMMS SYSTEM	1	EA	$ 25,000		1	25,000
	15	MECHANICAL						

	TEMPORARY BYPASSING						
	PS/PSC BYPASS	1	EA	$	5,000	1	5,000
	DIGE 1 & 2 OVERFLOW BYPASS	1	EA	$	10,000	1	10,000
16	ELECTRICAL						

MAJOR ELEMENT NUMBER :	14	SUBT New Items add as part of 90% Submittal		487,000
		ESTIMATING CONTINGENCY	@ 10%	49,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENC		536,000

Manteca Biosolids Master Plan Recommended Improvements Not Part of Digester Project

Project No.	Project Description	Total Project Cost	
	WAS building Improvements	$	80,000
	DAFT Control Upgrade	$	89,000
	Add Centrifuge No. 3	$	1,517,000
	Construct Biosolids Drying System	$	14,917,000
	Total	$	16,603,000

a) Total capital cost, including construction, contingencies, engineering, administration and environmental documentation, as applicable. First quarter 2015 cost level. ENR 20-Cities CCI = 9,970.

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: **WAS Pump Station**

ITEM NO.	DIV	DESCRIPTION		QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	DEMOLITION AND DISPOSAL							
		PIPING		40	FT	100		1	4,000
	3	CONCRETE							
		EQUIPMENT SUPPORTS		1	LS	3,000		1	3,000
	11	EQUIPMENT & PUMPS							
		WAS PUMPS		1	EA	15,000		1.7	25,500
	15	PIPING							
		DS PIPING							
		6" PIPE		40	LF	40		2.5	4,000
		6" PLUG VALVES		2	EA	762		2.5	3,810
		6" CHECK VALVES		1	EA	1,700		2.5	4,250
		6" FLEX COUPLINGS		2	EA	400		2.5	2,000
		6" ELL		2	EA	400		2.5	2,000
		6" RED		2	EA	400		2.5	2,000
		6" 45 ELL		0	EA	400		2.5	
		6" WYE		0	EA	500		2.5	
		PAINTING	5.0%	1	LS	3,000		1	3,000
		ELECTRICAL	10.0%	1	LS	5,000		1	5,000
		INSTRUMENTATION	10.0%	1	LS	5,000		1	5,000
MAJOR ELEMENT NUMBEF	1	SUBTOTWAS Pump Station							63,560
		ESTIMATING CONTINGENCY					@	10%	6,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)							70,000

Project Design and Construction Management	$ 9,800
Total Project Cost	79,800

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: **DAFT Controls**

ITEM NO.	DIV	DESCRIPTION		QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	16	INSTRUMENTATION							
		DAFT CONTROL PANELS		2	EA	25,000		1	50,000
		DAFT SV VALVES		6	EA	1,500		1	9,000
		PAINTING	0.0%	1	LS	0		1	0
		ELECTRICAL	10.0%	1	LS	6,000		1	6,000
		INSTRUMENTATION	10.0%	1	LS	6,000		1	6,000
MAJOR ELEMENT NUMBEF	1	SUBTOT DAFT Controls							71,000
		ESTIMATING CONTINGENCY					@	10%	7,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)							78,000

Project Design and Construction Management $ 10,920

Total Project Cost 88,920

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: **Centrifuge No. 3**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	11	EQUIPMENT						
		CENTRIFUGES	1	EA	500,000		1.7	850,000
		SLUDGE FEED PUMPS	1	EA	28,000		1.7	47,600
		POLYMER BLEND UNITS	1	EA	9,630		1.7	16,371
		POLYMER FEED PUMPS	1	EA	12,840		1.7	21,828
		POLYMER INJECTION RING PUMI	1	EA	7,490		1.7	12,733
	15	MECHANICAL						
		MISC PIPING, VALVES & FITTINGS	1	LS	30,000		1	30,000
		PIPING AND VALVES (WAS)						
		6" DI PIPING	100	LF	48		1	4,800
		6" 90 DEG EL	4	EA	325		1	1,300
		6" ECC PV	3	EA	946		1	2,838
		PIPING AND VALVES (VENT)						
		6" DI PIPE	15	LF	48		1	720
		6" 90 DEG EL	2	EA	325		1	650
		PIPING AND VALVES (CENTRATE ABOVE GROUND)						
		6" PVC PIPE	20	LF	24		1	480
		6" 90 DEG EL	7	EA	175		1	1,225
		6" RUBBER FLEX	3	EA	300		1	900
		PAINTING 2.0%	1	LS	20,000		1	20,000
	16	ELECTRICAL 10.0%	1	LS	99,000		1	99,000
	16	INSTRUMENTATION 10.0%	1	LS	99,000		1	99,000
MAJOR ELEMENT NUMBE	1	SUBTOT Centrifuge No. 3						1,209,445
		ESTIMATING CONTINGENCY				@	10%	121,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)						1,330,000

Project Design and Construction Management	$ 186,200
Total Project Cost	1,516,200

HERWIT ENGINEERING - ESTIMATE OF MOST PROBABLE CONSTRUCTION COST

PROJECT:
JOB NUMBER: ENR FOR ESTIMATE : 9,970

MAJOR ELEMENT NUMBER: 1
MAJOR ELEMENT: **ACTIVE SOLAR DRYERS - 18% SOLIDS (8 UNITS)**

ITEM NO.	DIV	DESCRIPTION	QUANT	UNIT	UNIT PRICE	SPEC ADJ	ADJ	TOTAL
	2	EXCAVATION						
		EXCAVATION	3,210	CY	5		1	16,050
		ABC	1,926	CY	60		1	115,560
		BACKFILL	500	CY	7		1	3,500
		PAVING	33,000	SF	8		1	264,000
	3	CONCRETE						
		END SLABS	379	CY	1,100	2	2	833,800
		INTERNAL SLABS	342	CY	1,100	6	6	2,257,200
		OUTSIDE WALLS	168	CY	1,500	1	1	252,000
		INTERNAL WALLS	36	CY	1,500	7	7	378,000
		BACK WALLS	0	CY	1,500	9		
	11	EQUIPMENT						
		SOLAR DRYER (264x42)	8	EA	662,500		1	5,300,000
		TAXES	8	EA	54,656		1	437,250
		FREIGHT	8	EA	0		1	0
		STRUCTURE INSTALLATION	8	EA	60,000		1	480,000
	15	MECHANICAL						
		WAS						
		6" DIP	0	LF	48			
		6" PLUG VALVES	0	EA	946			
		6" ELS	0	EA	325			
		6" 45 DEG	0	EA	300			
		6" TEES	0	EA	487			
		Drain						
		6" PVC	0	LF	25			
		6" WYE	0	EA	300			
		6" 45 DEG	0	EA	200			
		6" FLOUR DRAINS	0	EA	250			
		6" CLEANOUT	0	EA	700			

	2W							
	2"	PVC	0	LF	20			
	2"	VALVES	0	EA	100			
	2"	ELS	0	EA	25			
	2"	TEES	0	EA	30			
16	ELECTRICAL							
	SOLAR DRYER ELEC. INSTALLATION		8	EA	125,000		1	1,000,000
	FIELD ELEC. TO FEED DRYERS		1	LS	250,000		1	250,000
	MISCELLANEOUS							
		ELECTRICAL & CONTROL ROOM	3	EA	40,000		1	120,000
		SELF UNLOADING TRUCK	2	EA	150,000		1	300,000
		AGRICULTURAL TRACTOR	1	EA	100,000		1	100,000
MAJOR ELEMENT NUMBEF	1	SUBTOT ACTIVE SOLAR DRYERS - 18% SOLIDS (8 UNITS)						12,107,360
		ESTIMATING CONTINGENCY				@	10%	1,211,000
		SUBTOTAL (INCLUDING ESTIMATING CONTINGENCY)						13,318,000

Project Design and Construction Management	$ 1,598,160
Total Project Cost	14,916,160