Energy and Chemical Savings Options

Presentation Purpose

NapaSan Strategic Plan 2017

***3D**. Evaluate and recommend ways to reduce energy and chemistry consumption in treatment process and collection system.*

Chemistry and energy are the largest "consumables" in the operating budget, making up about 34% of the total Services and Supplies budget and 12% of the overall operating budget.

Timeframe:
This evaluation will be completed by NapaSan staff. Presentation of recommendations to the Board expected by March 31, 2018, in coordination with work identified in Objective 6D.

***6D**. Evaluate energy self-generation with the primary goal of decreasing overall energy costs, and recommend policy options for consideration.*

Explore the expansion of the Cogen system, expand solar, or other ideas, as long as there is both immediate and long-term cost savings.

Timeframe:
Initial framework of alternatives will be provided to the Board for consideration by March 31, 2018.

Energy and Chemical Savings Options

The District continues its focus on reducing operating costs through energy and chemical conservation.

Operations continues to implement process and chemical optimization.

Maintenance has;

- Delivered Reliable Equipment
- Improved Reliability of Generating Equipment (Cogen).
- Installed sub-metering

Engineering has implemented energy savings projects. Some projects include;

- Turbo Blower Installation
- FOG Receiving Station
- RW North /South Split (Jockey Pump)
- Aeration Diffuser Replacement
- Aeration Dissolved Oxygen Control System
- Solar

The District continues to evaluate Energy Conservation Measures (ECMs).

Energy and Chemical Savings Options

- Provide background
- Present Energy Conservation Measures (ECMs)
- Discuss Evaluated Measures

Energy and Chemical Savings Options

		Potential Saving of Evaluated Measures
Electrical 2017-2018	$ 854,700	$ 499,000
Chemical 2017-2018	$ 883,900	$ 230,000
Total	$ 1,738,600	$ 729,000

Budgets	Services and Supplies		Total	
Treatment Plant Operations	$ 2,149,650		$ 3,847,750	
Treatment Plant Maintenance	$ 881,500		$ 1,935,150	
Collection System	$ 411,700		$ 2,856,650	
Total	$ 3,442,900	50%	$ 8,639,550	20%

Chemicals

CHEMICALS

USES	
Ferric Chloride	Used to control odors H2S, improves primary sedimentation removals, promotes increased biogas production, reduces hydrogen sulfide content of biogas.
Sodium Hydroxide	Used for alkalinity adjustment in the aeration basins. Biology consume alkalinity in the uptake of BOD and the conversion of Ammonia.
Sodium Hypochlorite	Used to disinfect treated effluent. Used in the filter to reduce algae fouling.
Sodium Bisulfite	Used to remove chlorine from river discharge.
Coagulant	Typically a chloride based chemical or alum, that is used to break or weaken electrostatic bonds. We use it to separate algae from the water molecule.
Flocculant	Typically and emulsion polymer that causes particles in the water to clump together. We use it to clump the coagulated algae particles together in the DAF clarifier.
Dewatering Polymer	This is an emulsion polymer applied to the belt press sludge to remove water and clump sludge particles together.
Odor Chemicals	Used to neutralize foul air.
Carbon Dioxide	Used to lower pH if plant effluent pH is too high.

CHEMICALS

Chloride Based Chemicals*

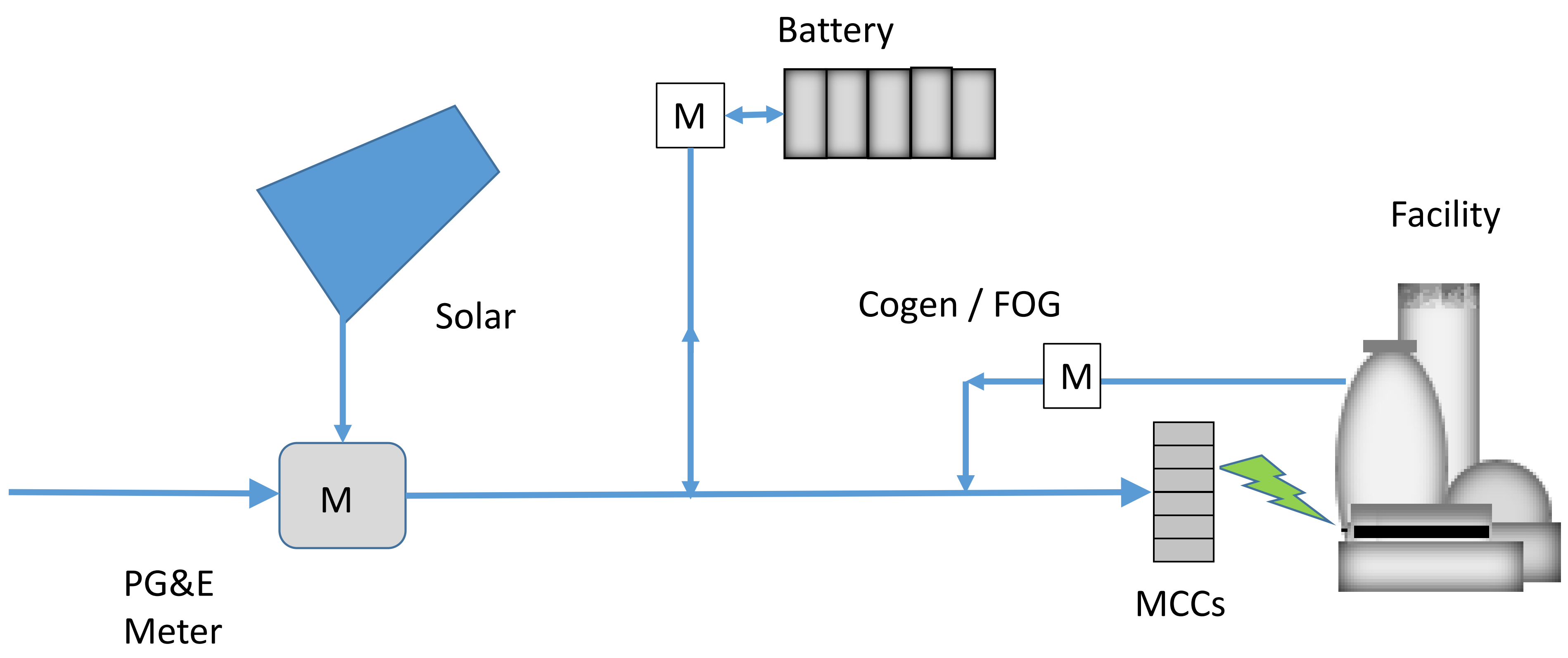
Pond Water Treatment Chemicals

Chemical Budget FY 2017-18		
Ferric Chloride	220 Dry Tons	$ 105,000
Sodium Hydroxide	96,00 lbs	$ 22,000
Sodium Hypochlorite	384,000 gallons	$ 172,000
Sodium Bisulfite	112,800 gallons	$ 103,000
Coagulant Filter	376,000 lbs	$ 107,000
Coagulant DAF	564,000 lbs	$ 160,000
Flocculant	94,000 lbs	$ 109,000
Dewatering Polymer	94,000 lbs	$ 73,500
Odor Chemicals		$ 10,000
Carbon Dioxide		$ 22,000
Total Cost		$ 883,900

NapaSan
Collection • Treatment • Recovery • Reuse

Power

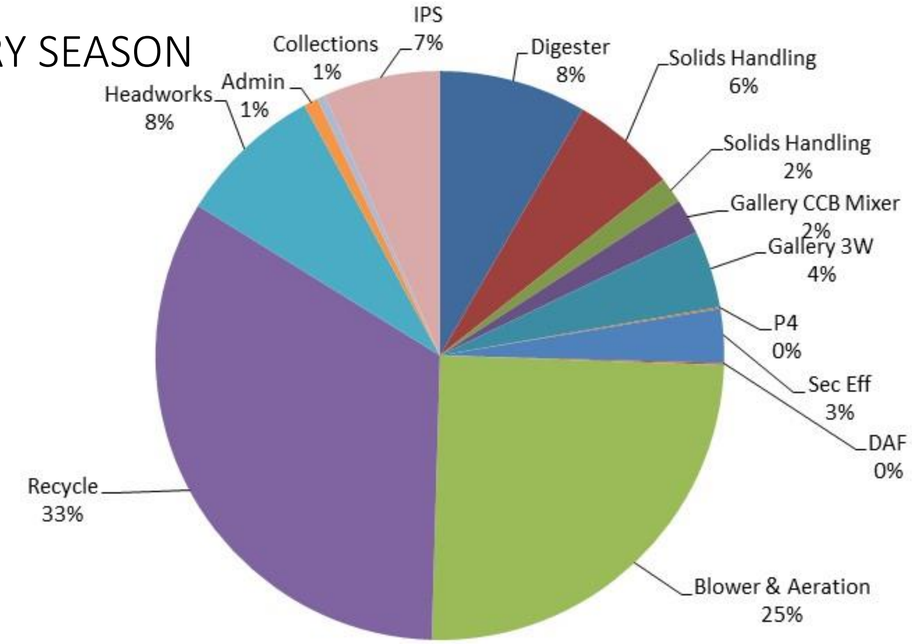
POWER DISTRIBUTION

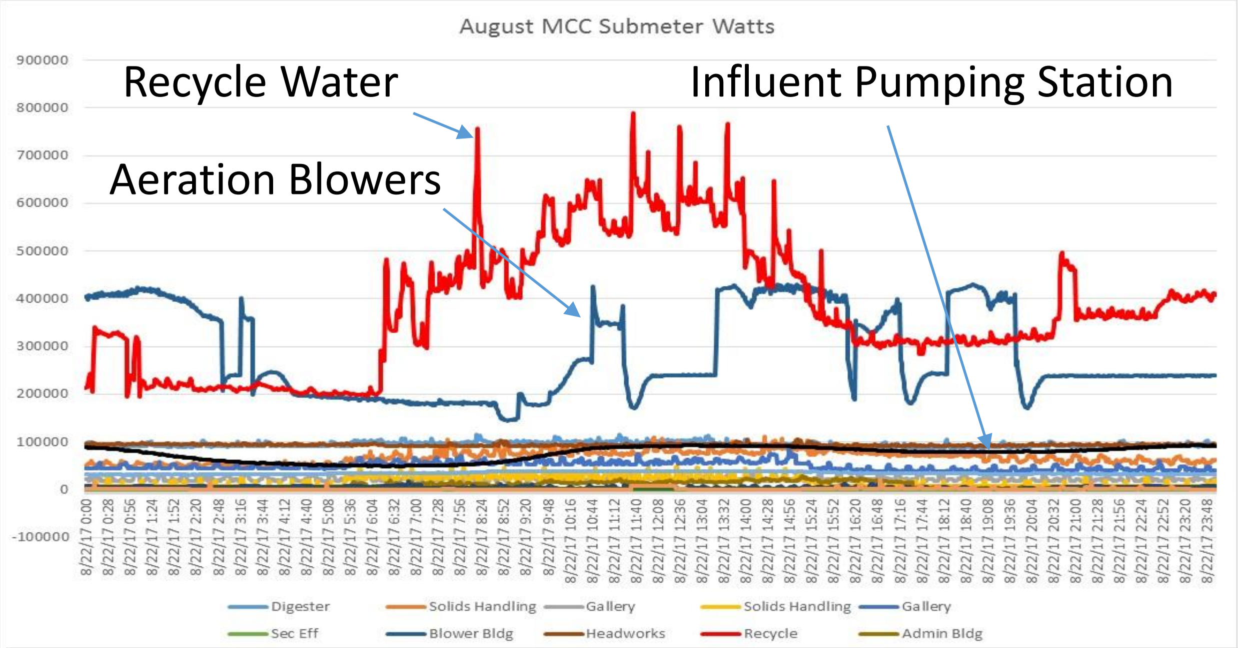


6,600 MWh		2,000 MWh	8,600 MWh	
6,200 MWh		2,700 MWh	8,900 MWh	
4,500 MWh	1,700 MWh	2,700 MWh	8,900 MWh	
5,500 MWh	1,700 MWh	2,700 MWh	9,900 MWh	3,700 ACFT RW

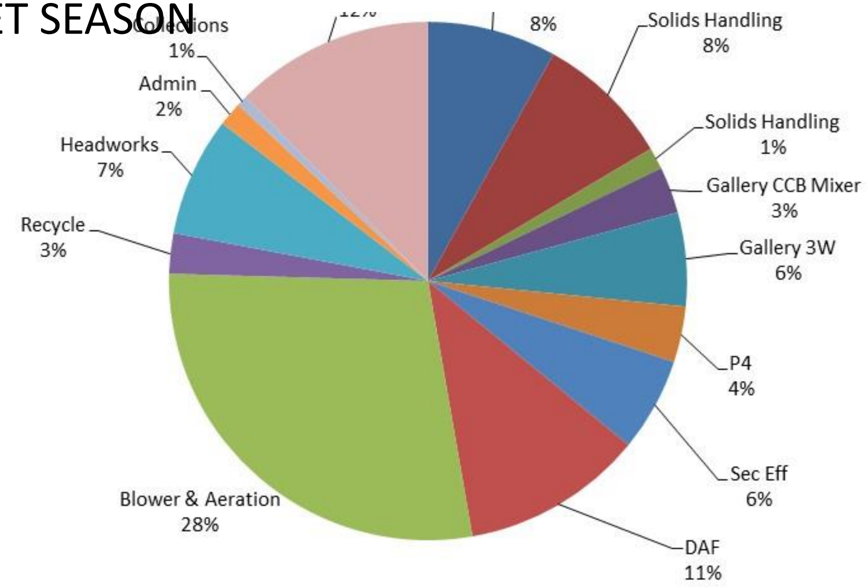
POWER USE

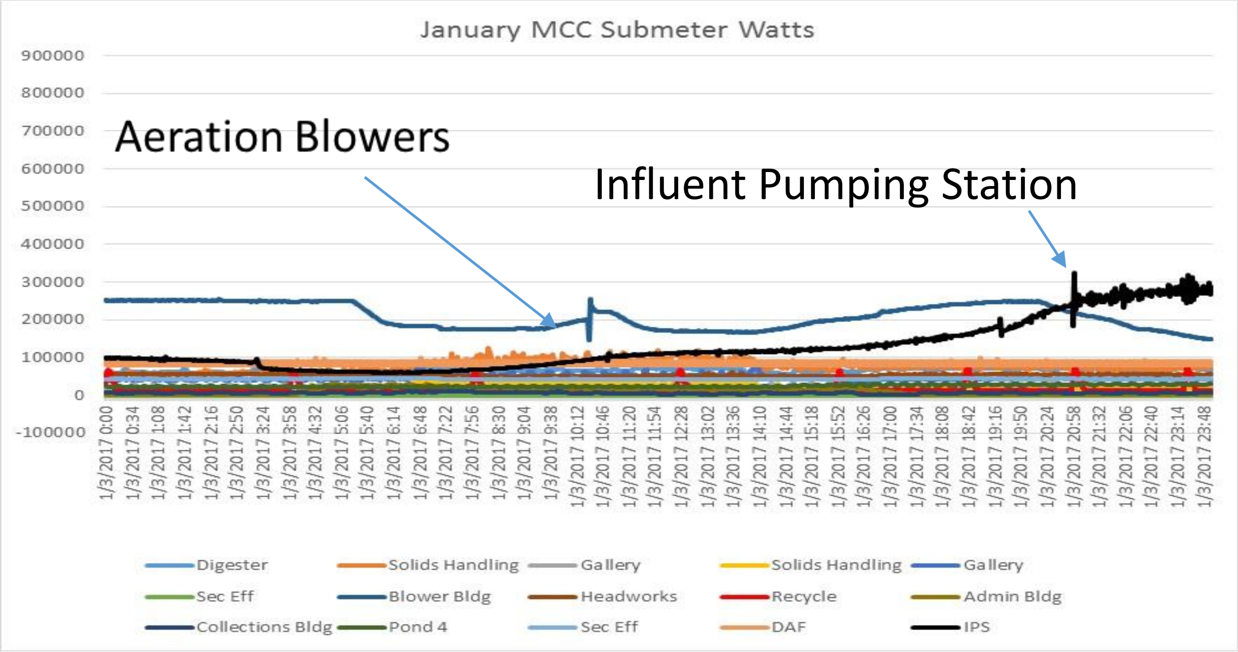
DRY SEASON





WET SEASON





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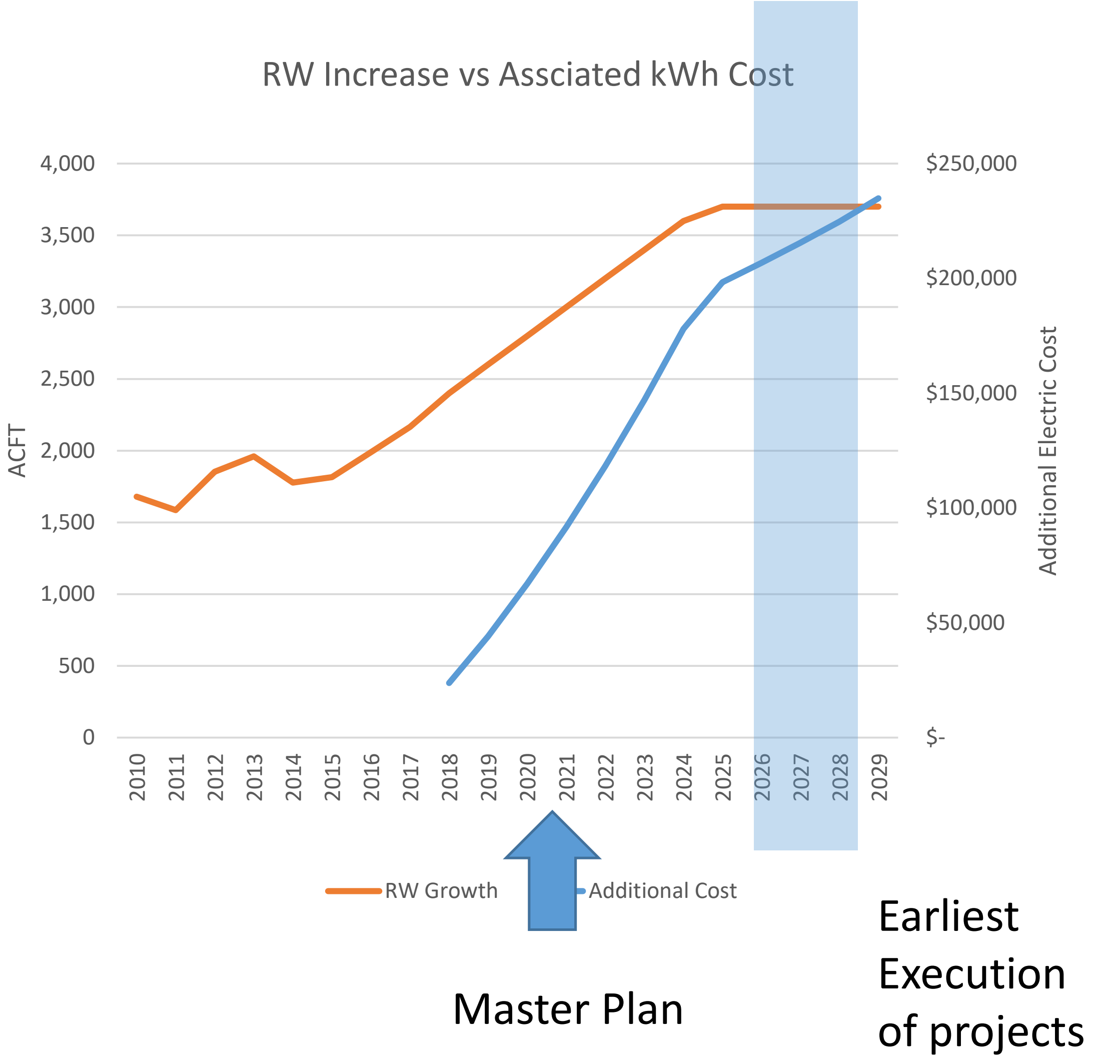
POWER USE - Projections

- Largest Load Recycled Water Distribution
- Anticipated steady growth until capacity is met 3,700 ACFT per year
- Currently ~ 2,200 ACFT per year
- Anticipate adding 200 ACFT per year
- Electrical use today is 709 kWh/ACFT
- Grid cost presented based on 4% blended escalation



Energy Conservation Measures

ECM

Energy and Chemical Projects

A total of 43 Energy Conservation Measures (ECM) were identified (Staff, PG&E, AECOM) screened by NSD and then placed in categories.

Categories

- Completed
- Evaluating
- Evaluate in Master Plan FY 20/21
- No

Energy and Chemical Projects

Energy Conservation Focus Areas

1) Chemical Conservation
2) Load Reduction
3) Cogen Optimization
4) Generation

Summary of Energy and Chemical Savings Measures

	ECM	ECM Name	kWh Saved ($0.14/kWh)	kW Saved	Therms Saved	Utility $ Savings	O&M/Other $ Sav	Total $ Savings	Investment	SPBP, yrs
Master Plan	19	Primary Effluent Filter	1,763,000	0		$ 246,820		$ 246,820	$4,000,000	16.2
Master Plan	20	Gravity belt thickener (GBT) for primary	Do not evaluate for PA							N/A
Master Plan	21	Maximize pond use for WW treatment	58,000	0	0	$ 8,000	$ (2,000)	$ 6,000	$ 39,000	6.5
Master Plan	22	Recycled water storage reservoir (2 Mgal)	0	1,000	0	$ 105,000	$ (3,000)	$ 102,000	$3,425,000	33.6
Master Plan	23	Electric demand based recycled water	0	0	0	$ 7,000	$ -	$ 7,000	$ 30,000	4.3
Master Plan	24	Additional co-digestion feedstock	Do not evaluate for PA							N/A
Master Plan	25	Additional co-digestion tanks	0	0	0	$ -	$ -	$ -	$ 308,000	N/A
Master Plan	26	Primary / secondary digester system	273,000	0	0	$ 667,000	$ (2,000)	$ 665,000	$4,616,000	6.9
Master Plan	27	Additional 500 kW CHP engine-generator	1,898,100	200	-109,600	$ 312,000	$ (93,000)	$ 220,000	$3,938,000	17.9
Master Plan	28	Lower pressure biogas compressor	5,000	0	0	$ 10,000	$ -	$ 10,000	$ 146,000	14.6
Master Plan	29	Biogas cleaning system upgrade (600 kW)	0	0	0	$ -	$ 10,000	$ 10,000	$ -	N/A
Master Plan	30	Biogas odorant	0	0	0	$ -	$ -	$ -	$ 53,000	N/A
Master Plan	31	Water source heat pumps (WSHPs)	45,000	0	0	$ 6,000	$ 1,000	$ 7,000	$ 385,000	54.4
Master Plan	32	Sand Filtration Air Compressor VSD	17,000			$ 2,363		$ 2,363	$ 20,000	8.5
Master Plan	33	Install High Efficiency Package Units	27,000			$ 4,733		$ 4,733	$ 30,000	6.3
Master Plan	34	Install Waste Heat Recovery System on Digester Gas Generator	167,000			$ 23,213		$ 23,213	$ 300,000	12.0
No	35	Plant irrigation canal system	0	1,000	0	$ 86,000	$ (1,000)	$ 85,000	$1,564,000	18.4
No	36	Irrigation pumping to off peak hours	0	464	0	$ 59,000	$ -	$ 59,000	$ 6,000	0.1
No	37	FOG pumping control using VFDs	1,000	0	0	$ 100	$ -	$ 100	$ 59,000	590.0
No	38	BioAir VFD	27,200	30	0	$ 3,781		$ 3,781	$ 14,000	3.0
No	39	Occupancy Controllers for Lighting Systems	17,100	6	0	$ 2,377		$ 2,377	$ 3,900	1.6
No	40	LED Interior Ceiling/Wall Mounted Fixtures	10,320	0		$ 1,434		$ 1,434	$ 8,000	2.8
No	41	Peak Period Lighting Load Shed in Main, Maintenance and Operations Buildings		0		$ 392		$ 392	$ 10,000	14.7
No	42	Peak Period Temperature Setback in Main, Maintenance and Operations Buildings				$ 553		$ 553	$ 15,000	16.3
No	43	Full Facility Shutdown				$ 10,580		$ 10,580	$ 250,000	4.3

NapaSan

Energy and Chemical Projects

Summary of Energy and Chemical Savings Measures

	ECM	ECM Name	kWh Saved ($0.14/kWh)	kW Saved	Therms Saved	Utility $ Savings	O&M/Other $ Sav	Total $ Savings	Investment	SPBP, yrs
Completed	1	FOG Receiving Station	1,500,000	0	85,000	$ 257,600		$ 257,600	$ 619,000	3.0
Completed	2	Recycled Water Jockey Pump	162,750	0	0	$ 22,622		$ 22,622	$ 150,000	6.6
Completed	3	Tesla Battery (Demand Charge Reduction)	0							
Completed	4	Solar Array 1MW	1,700,000			$ 193,800		PPA		
Completed	5	Enhanced Dissolved Oxygen Control	197,000			$ 27,383		$ 27,383	$ 252,000	8.5
Completed	6	Lighting upgrades	78,600	16		$ 11,000		$ 11,000	$ 76,700	11.0
Completed	7	VFD control existing odor system at headworks	101,700	12	0	$ 14,136		$ 14,136	$ 47,000	2.6
Completed	8	Fine Bubble Diffusers and Distribution Pipe Upsize	123,000			$ 17,097		$ 17,097	$ 180,000	9.8
Chemical	9	Evaluation Study of Alternate Treatment Chemicals					TBD		$ 135,000	TBD
	10	Peracetic Acid Pilot Study								
Load Reduction	11	Jockey blower	108,000	12	0	$ 14,000	$ 20,000	$ 34,000	$ 525,000	15.4
	12	Aeration basin internal recycle pumping	513,000	58	0	$ 66,000	$ (1,000)	$ 65,000	$ 211,000	2.5
Cogen Optimization	13	Dual fuel to maximize engine generator output	81,000	0	9,000	$ 37,000	$ (2,000)	$ 35,000	$ 114,000	3.3
	14	CEPT - Chemically Enhanced Primary Treatment (In-house pilot study)	747,000	85	0	$ 103,833		$ 103,833	$ 335,000	2.5
	15	Algae to Energy Study (Complete)					TBD		$ 60,000	TBD
Generation	16	Fuel Cell	4,098,585			$ 680,000	$ (260,000)	$ 420,000	$3,754,739	8.9
	17	New electric meter for recycled water pumps	0	0	0	$ 49,000	$ -	$ 49,000	$ 997,000	20.3

Energy and Chemical Projects

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Chemical

Alternative Treatment Chemical Study

This study evaluates all of our current chloride based chemicals and possible alternative chemicals to reduce chloride loading and possibly treatment costs.

Method

Study effective treatment chemicals in-place of ferric chloride, sodium hypochlorite, and coagulants for their performance and cost of treatment.

Benefits

The goal would be to reduce chloride loading through the treatment process while maintaining or reducing treatment costs.

Disadvantage

May require capital construction.

Estimated Cost: $135,000

Estimated savings: Unknown

Chemical

Peracetic Acid Pilot Study

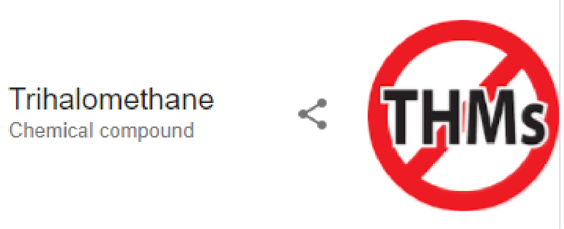
Peracetic Acid is widely used as a disinfect and in the food and medical industry. This pilot study would show the effectiveness of using peracetic acid in place of sodium hypochlorite.

Method

Engage the services of Stantec to engage the State Water Board and Health Department in approval of testing protocols. Once approved perform the full scale studies.

Benefits

Reduced chemical costs. Eliminate harmful byproducts of chlorination. Reduce chloride loading. Position the District for direct potable reuse.

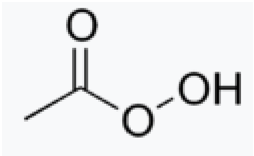


Disadvantage

Fairly intensive and costly virus deactivation testing needs to be performed.

Estimated Cost: $

Estimated savings: $



Load Reduction

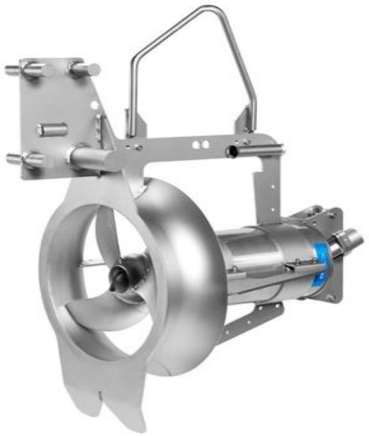
Aeration Basin Internal Recycle Pumping
In addition to reducing BOD the aeration basin biology reduce ammonia, NH_3 to Nitrite, NO_2 and then to Nitrate, NO_3 by the end of the process. This is called nitrification. Recirculating the nitrate laden water from the end of the aeration basin to the head of the aeration basin, in the absence of air (oxygen) causes the biology to take oxygen from the nitrate molecule. The nitrogen atom leaves the water and recombines as air. This is denitrification.

Method
Install a low head propeller pump between compartments 6 and 1 in the aeration basins.

Benefits
Reduced energy use by the aeration blowers . Denitrification occurs , resulting in a reduction in effluent total nitrogen and an increase in alkalinity. Small capital investment. Minimize alkalinity control chemical addition.

Disadvantage
Requires capital construction.

Estimated Cost: $ 211,000
Estimated savings: $ 65,000



Load Reduction

Jockey Blower
With the addition of new aeration diffusers, dissolved oxygen control, and potentially internal recirculation we are starting to reduce the oxygen requirement of the aeration basin below the minimum amount of air one blower can deliver.

Method
Replace the 20 year old constant speed blower with a 120-150 Hp, lower capacity turbo blower.

Benefits
Ability to turn down the blower in order to supply just enough air to the process. Optimize energy savings. Replaces aging equipment. Improves control of the blowers by having 3 of the same type.

Disadvantage
Requires capital construction.

Estimated Cost: $525,000
Estimated savings: $34,000 per year

Cogen Optimization

Additional FOG

The amount of FOG received by the plant varies from month to month and year to year. Lately there has been an increase in FOG received and there is potential for additional high energy waste; brewery, and dairy.

Method

Continue to add high strength waste to the digester to fill the cogeneration capacity..

Benefits

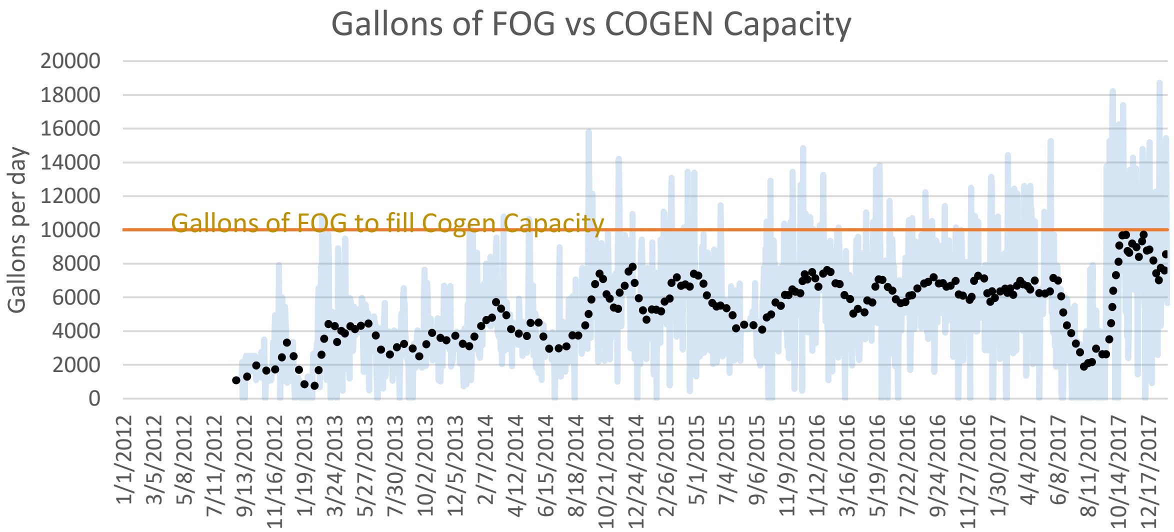
Approximately 10,000 gallons per day of high strength waste in addition to the plant's sludge feed , produces an adequate amount of fuel to run the cogeneration unit at full load.

Disadvantage

May require an additional FOG receiving tank.

Estimated Cost: $0

Estimated savings: $60,000



Cogen Optimization

CEPT (Chemically Enhanced Primary Treatment)
Identified throughout the industry as a proven treatment process to capture more solids and BOD through the primary sedimentation process.

Method
Dose ferric chloride and polymer prior to primary treatment.

Benefits
Reduces BOD loading to the aeration basins, increases aeration basin available capacity, reduces electricity used by the blowers, increases biogas production. Low capital cost. Ability to start or stop the increased treatment as needed to fill available cogeneration capacity.

Disadvantage
Purchase od additional chemical and delivery system.

Have: Ferric chloride dosing system.
Need: Polymer storage and delivery system.

Estimated Cost: $335,000 (May be able to use in-house system)
Estimated savings: $103,833

Cogen Optimization

Dual Fuel to Cogeneration Engine
By adding dual fuel capability to the existing cogeneration engine, the generator can be run at optimal performance (full capacity).

Method
Purchase and install a dual fuel burner and controls to burn a biogas and natural gas blend.

Benefits
Optimization of the cogeneration engine performance. Generate electricity at a lower cost than purchasing.

Disadvantage
Capital costs. Inability to recoup additional thermal energy.

Estimated Cost: $114,000
Estimated savings: $35,000

Cogen Optimization

Algae to Energy Study
Evaluate pretreating algae sludge as a feed stock for the anaerobic digester.

Method
Evaluate on-site waste thermal energy potential, mechanical, and chemical processes to lyse the algae cell as preparation for anaerobic digestion.

Benefits
Increases the organic solids fed to the digester in a form that can be readily broken down.
Increase in biogas production to fill the remaining available capacity in the digester.

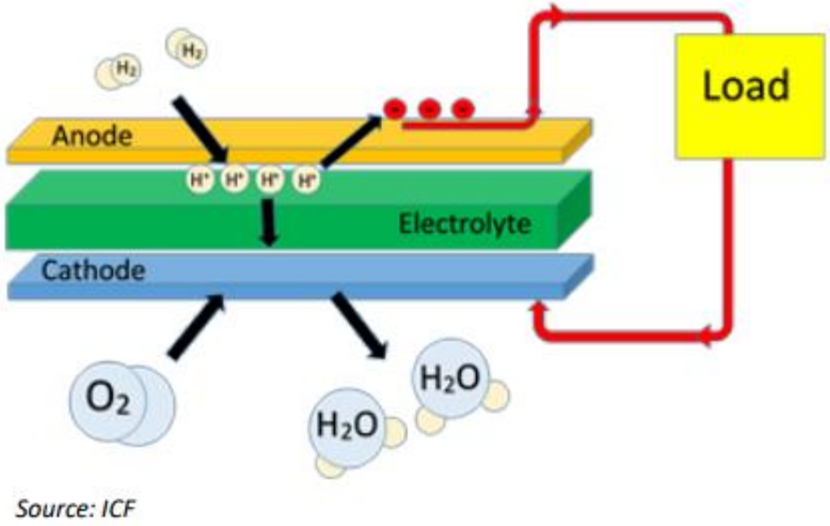
Disadvantage
There may not be enough thermal energy available to add benefit. Chemical and mechanical processes may add cost.

Study Cost: $60,000
Estimated savings: Unavailable at this time

Generation

Fuel Cell

A stationary device that converts natural gas to electricity.



Benefits

Generates electricity using natural gas at half the cost of purchasing electricity.

Disadvantage:

Capital cost. Maintenance package.

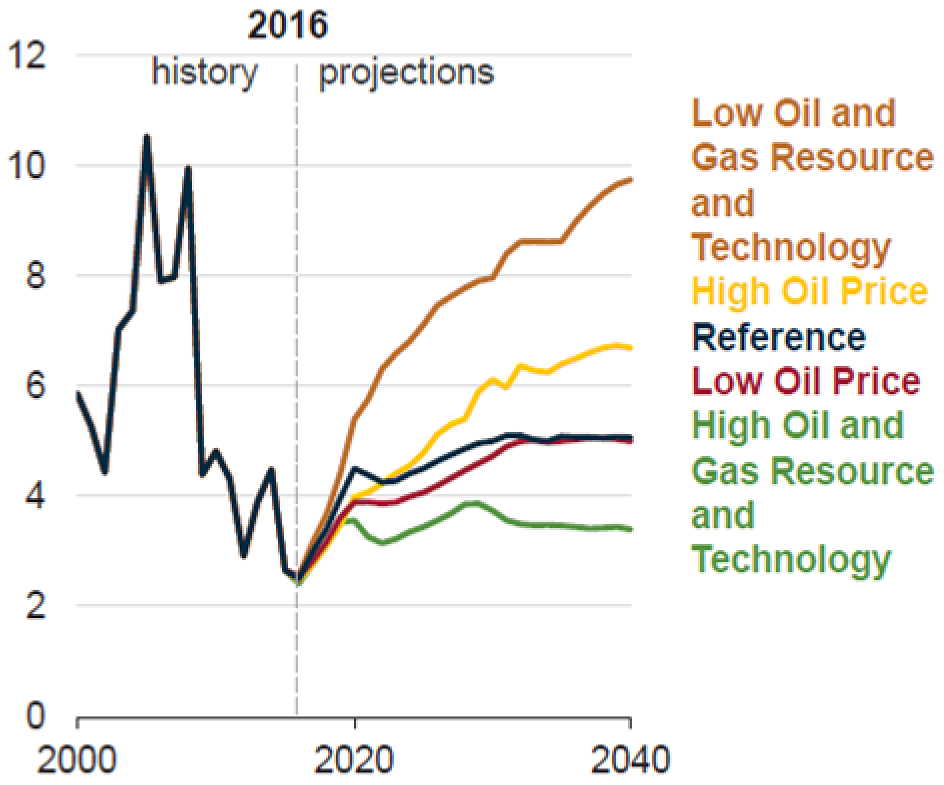
Estimated Cost: $3,754,739

Estimated savings: $420,000 per year

Generation

Henry Hub price increases from $2.50/million Btu Current to ~ $4.50 avg for next 24 years.

Henry Hub natural gas price
2016 dollars per million Btu



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ECM Impact

Total Cost	PG&E		Fuel Cell		Solar		Cogen	Facility	Actions
$	$	MWh	$	MWh	$	MWh	MWh	MWh	
868,000	868,000	6,200				0	1,900	8,100	
868,000	868,000	6,200				0	2,700	8,900	FOG Addition, RW Split
769,160	540,000	4,500			229,160	1,700	2,700	8,900	Solar
574,640	345,480	2,879			229,160	1,700	3,700	8,279	Cogen Optimized, Smaller Blower, Recirculation
328,130	(192,300)	(1,282)	291,270	4,161	229,160	1,700	3,700	8,279	Fuel Cell
478,130	(42,300)	(282)	291,270	4,161	229,160	1,700	3,700	9,279	RW at Capacity

Energy and Chemical Projects

Continue to Evaluate

	ECM	ECM Name	kWh Saved ($0.14/kWh)	kW Saved	Saved ($0.56/the	Utility $ Savings	O&M/Other $ Sav	Total $ Savings	Investment	SPBP, yrs
Chemical	9	Evaluation Study of Alternate Treatment Chemicals					TBD		$ 135,000	TBD
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Load Reduction	11	Jockey blower	108,000	12	0	$ 14,000	$ 20,000	$ 34,000	$ 525,000	15.4
	12	Aeration basin internal recycle pumping	513,000	58	0	$ 66,000	$ (1,000)	$ 65,000	$ 211,000	2.5
Cogen Optimization		Continue to Monitor FOG Import								
	14	CEPT - Chemically Enhanced Primary Treatment (In-house pilot study)	747,000	85	0	$ 103,833		$ 103,833	$ 335,000	2.5
	15	Algae to Energy Study (Complete)					TBD		$ 60,000	TBD
Generation	16	Fuel Cell	4,098,585			$ 680,000	$ (260,000)	$ 420,000	$3,754,739	8.9

Questions