I. Executive Summary

Purpose

The planned construction of the new Lancaster County Adult Detention Facility will require a considerable level of reliable thermal services. The critical nature of the facility supports the construction of a central plant to provide this service. District Energy Corporation has commissioned a feasibility study to determine the optimal mechanical system to be installed in a central plant constructed concurrently with the jail facility. The purpose of the study is to evaluate potential mechanical systems and offer a comparison and recommendation in terms of economic and technical feasibility.

Method

The study began with two phases, the Preliminary Analysis and the Final Analysis, and ultimately was expanded to include a Revised Analysis. The Preliminary and Final Analyses included heating and cooling loads calculated by the engineer during early stages of architectural design. These loads were calculated using several assumptions of the building’s architectural and mechanical design and as such were intentionally conservative. The Revised Analysis was requested after the building engineers had finalized the building and mechanical system design. The building engineer provided actual building load data for use in the Revised Analysis, greatly increasing the accuracy of the equipment sizing and energy consumption values.

Preliminary Analysis

The analysis began with a logistical analysis of the following ten mechanical system options:

Option #1 – Conventional System
Option #2 – Geothermal Heat Pump System
Option #3 – Thermal Storage
Option #4 – Condensing Boiler
Option #5 – Engine-Driven Chiller
Option #6 – Electric Boiler
Option #7 – Option #5 + Option #6
Option #8 – Heat Reclaim Chiller
Option #9 – Fuel Cell
Option #10 – Microturbine

Three options (#7, #9, and #10) were eliminated on the basis of technical or economic feasibility. The remaining seven options were subjected to economic analysis based on Life Cycle Cost.

The Life Cycle Cost analysis was calculated using a building model energy simulation, which due to the preliminary nature of architectural plans, was built with several assumptions and conservative factors. The Preliminary Economic Analysis annualized and summed the capital cost, energy cost, and operation and maintenance cost of each option to arrive at a Total Annual Cost for each. Option #1 was considered the Base Case, and all other options were compared to Option #1 to calculate the incremental costs and savings.

The results of the Preliminary Economic Analysis are shown below:

Preliminary Analysis Results					
Option	**Capital Cost**	**Annual Energy Cost**	**Annual O&M Cost**	**Total Annual Cost**	**Simple Payback (years)**
Option #1	$19,962,942	$395,354	$549,735	$2,361,509	--
Option #2	$22,423,442	$280,374	$439,788	$2,311,161	10.94
Option #3	$20,525,942	$358,783	$549,735	$2,364,884	15.39
Option #4	$19,982,542	$364,335	$549,735	$2,331,881	0.63
Option #4a	$19,982,542	$380,358	$549,735	$2,347,904	1.31
Option #5	$20,766,942	$335,311	$566,227	$2,375,004	18.46
Option #6	$19,858,942	$503,824	$538,740	$2,451,605	N/A
Option #6a	$20,044,609	$366,709	$538,740	$2,327,664	2.06
Option #8	$20,256,942	$415,955	$566,227	$2,419,462	N/A

Preliminary Recommendation

From the results of the Preliminary Analysis, Option #2 and Option #6a were selected for further evaluation in the Final Analysis. Option #2 was selected to be evaluated with one significant modification. The backup equipment included in the option was removed per DEC's request. Option #1 was also reevaluated to provide the same means of comparison among the options.

Final Analysis

As the design of the detention facility progressed, details of the building and its internal mechanical systems offered the opportunity to replace conservation assumptions used in the Preliminary Analysis with more concrete information. New equipment sizing and energy consumption values were calculated from new building loads resulting from the modified building model simulation. The revised capital costs, energy costs, and operation and maintenance costs were annualized and totaled, and equipment replacement costs were added as incurred. The Final Analysis calculated a 50 Year Life Cycle Cost as well as the Net Present Value of the Life Cycle Cost to serve as the comparison among the options. The results of the Final Economic Analysis are shown in the following table:

Final Analysis Results					
Option	**Capital Cost**	**Annual Energy Cost**	**Annual O&M Cost**	**Total Annual Cost**	**50 Year Lifecycle Cost**
Option #1	$18,833,261	$260,921	$594,165	$2,207,602	$155,484,969
Option #2	$20,819,961	$215,931	$472,659	$2,170,693	$147,519,793
Option #6a	$18,796,511	$241,121	$587,140	$2,179,170	$152,622,978

Non-Economic Considerations

In addition to the analysis of the cost of each option, non-economic considerations were included in the Final Analysis. This part of the analysis allows for the fact that an option which may have the lowest calculated cost may have other factors that preclude its selection and recommendation.

Final Recommendation

In consideration of the economic analysis and the non-economic factors, Option #6a was recommended. This option was found to achieve economic advantage, although to a lesser degree than Option #2, but offer the additional benefits of reliability, flexibility, relative ease of operation and maintenance, and the opportunity to construct a more cohesive plant in the long term.

Revised Analysis

Due to the building design schedule, the building’s architectural and mechanical systems had not been finalized when the Preliminary and Final Analyses were performed. Therefore, the building loads, and consequently the Life Cycle Costs, were based on conservative assumptions about the building, its occupancy, and its mechanical systems. The design has since progressed to the point where more accurate heating and cooling loads could be calculated based on the actual characteristics of the building and its systems. The building design engineer prepared a building model and performed an energy simulation to obtain monthly peak loads and energy consumption of each component of the mechanical system. These calculations form the basis of the Revised Analysis.

Option #1

In Option #1, the peak heating load of 4740 MBh, or 5200 lb/hr of steam at 50 psig, will be served by two (2) 100 BHP gas-fired firetube steam boilers, each with a capacity of 3450 lb/hr. An additional 100 BHP unit will be installed to provide firm capacity. The required auxiliary steam generation equipment is described in the Cost Estimate shown in Appendix A.

The peak cooling load of 677 tons will be served by two (2) 500 ton electric centrifugal chillers. (Although 400 ton units would be sufficient, a 500 ton unit with identical efficiency can be purchased at lower cost. Since the jail has planned expansions and the DEC plant has the potential to serve additional loads that may be constructed in the area, the larger capacity was selected.) The required auxiliary cooling and heat rejection equipment is listed in the Cost Estimate included in Appendix A.

Emergency electrical generation is proposed at the plant to serve emergency conditions at the plant and the jail facility. This same equipment will have the capability to export electricity back to the LES grid, however, this was not included in the economic analysis. The emergency electrical load requires the installation of four (4) 1875 kW generators.

The total capital cost of the equipment selected for the Option #1 Revised Analysis is detailed in Appendix A.

Option #2

Option #2 calls for the installation of ground source heat pumps to serve both the heating and cooling loads. The equipment selected consists of individual units combined with common piping and electrical connections in 5-unit modules. Each individual unit has two scroll compressors. The heat pumps are piped to underground vertical piping loops to provide heat exchange with the ground. The loop field was designed to handle the larger of the loads and includes compensation for long term ground temperature migration.

The 4740 MBh heating load will be served with two modules, each with a capacity of 3399 MBh. One additional module will be installed for redundancy. Heating load pumps and heating source pumps will be installed for each module.

The 677 ton cooling load will be served with three modules, each with a capacity of 244 tons. The additional module provided for heating redundancy will be piped to provide either heating or cooling backup. Cooling load pumps and cooling source pumps will be installed for each module.

The geothermal loop field will consist of two circuits for redundancy. Each circuit will require a vault to house valving and piping manifolds. Each vertical loop will be 300 feet deep, consisting of 3" pipe headers with 1" U-bends on 20 foot centers in a step-down, step-up reverse return configuration.

Option #2 includes the same provisions for emergency power as described for Option #1.

The incremental capital cost of the components of Option #2 compared to Option #1 are listed in Appendix A. Option #2 also includes a cost incurred by the jail to augment the mechanical systems within the building to heat with the 120°F water supplied by the heat pumps rather than the higher temperatures around which the jail had originally been designed.

Option #6a

Option #6a aims to provide the benefit of fuel flexibility in light of constantly changing utility rates by adding an electric boiler to the plant. The peak heating load will be served by the same two (2) 100 BHP gas-fired firetube boilers as in Option #1, but will also include the installation of a 255 kW electric boiler to take advantage of the demand ratchet imposed under the LES rate structure. This electric boiler is sized to use only the difference between the electric demand that is charged, the "billing demand", and the demand actually used by plant equipment during non-peak months. Due to the lower loads in this analysis, the available demand was significantly less, decreasing the size of the electric boiler and ultimately diminishing the benefit of this option.

This option also includes the same provisions for emergency power as Option #1.

The incremental capital cost for the electric boiler and required additional electrical support are detailed in Appendix A.

As in the Preliminary and Final Analyses, the capital recovery costs, energy costs, operating and maintenance costs, and equipment replacement costs for each option were combined and escalated for each year and finally summed to obtain a Life Cycle Cost. The Life Cycle Cost was decreased to a 25 year period for the Revised Analysis as directed by DEC. The results of the economic analysis are detailed in Appendix B and summarized below:

Revised Analysis Results					
Option	**Capital Cost**	**Annual Energy Cost**	**Annual O&M Cost**	**Total Annual Cost**	**25 Year Lifecycle Cost**
Option #1	$17,101,062	$177,346	$344,853	$1,735,561	$58,826,456
Option #2	$18,909,015	$125,424	$298,853	$1,765,918	$55,076,239
Option #6a	$17,196,312	$170,549	$344,853	$1,735,523	$58,740,129

Revised Recommendation

Disregarding any provision for domestic hot water service, Option #2, the Geothermal Heat Pump System, achieves the lowest Life Cycle Cost. Non-economic factors that previously favored the other options are mostly diminished due to the decreased peak load. The size of the electric boiler is now such that fuel flexibility is no longer a notable advantage of Option #6a. The smaller load also means the well field will not occupy the entire available space on the site, leaving area for loopfield expansion to serve future facility expansions. It must be noted however, that this system does not include backup equipment as recommended in previous analyses to ensure reliability.

Domestic Hot Water Service

The jail facility has a significant and relatively constant domestic hot water load. This load can be served by the plant or by separate equipment installed at the jail site and maintained by jail staff. The Revised Analysis incorporates a secondary version of each option that includes the additional equipment and energy consumption required if the plant were to serve the domestic hot water load of the facility.

Option #1
To provide for the jail's domestic hot water load under Option #1, the gas-fired boilers were upsized to serve the heating load and the domestic hot water load. The combined peak load is 14,740 MBh, or 16,167 lb/hr of steam at 50 psig. Two (2) 400 BHP gas-fired firetube boilers would be required to handle this peak load. Appendix C shows the incremental cost of the components required to modify Option #1 to include domestic hot water service.

Option #2
The geothermal heat pumps used in Option #2 provide only 120°F heating water to the jail. Therefore, this water can be used to preheat the domestic hot water at the jail where it will then be heated to service temperature by water heating equipment within the jail. When the heat pumps are used for the peak space heating load, the jail must supply virtually all the heat required for domestic hot water. The costs of the jail's hot water heating equipment, as well as the energy costs incurred by the jail, are included in the economic analysis. The incremental costs in comparison to the modified Option #1 are listed in Appendix C.

Option #6a
For a true comparison to the other options, the demand limitation was removed from the electric boiler in Option #6a. The electric boiler was operated full time at full load to handle the heating load and domestic hot water load to its full capability. The remainder of the load was served by the gas-fired boilers. The installed equipment is identical to that in the modified Option #1 with the addition of the electric boiler and the required electrical support. Appendix C details the estimated capital costs.

Option #8
The Options in the Revised Analysis have been expanded to include Option #8, a heat recovery chiller, to serve the building heating, cooling, and domestic hot water loads. This option has its benefit in the use of the chiller's heat rejection, which peaks in the summer. During the summer, the only significant heat load is domestic hot water. This option includes the installation of nine (9) 94 ton units, eight used for service and one reserved for backup. The condenser side of the unit has a leaving water temperature of 140°F. Due to the possibility that heat rejection to the building could be unavailable due

to unforeseen circumstances, the cooling tower remains in this option, but has been downsized. Like Option #2, there are times when hot water produced by the heat recovery chillers is at a minimum. During these times, the plant must provide space heating with boiler equipment, and the jail must heat the domestic hot water with equipment installed within the jail. The required equipment and the associated energy costs have been included in the economic analysis. The estimate for incremental equipment costs is shown in Appendix C.

Again, the capital recovery costs, energy costs, operating and maintenance costs, and equipment replacement costs for each option were combined and escalated for each year and finally summed to obtain a Life Cycle Cost. The Life Cycle Cost was performed for a 25 year period for the Revised Analysis. The results of the economic analysis are detailed in Appendix D and summarized below:

Revised Analysis Results for DHW Service					
Option	**Capital Cost**	**Annual Energy Cost**	**Annual O&M Cost**	**Total Annual Cost**	**25 Year Lifecycle Cost**
Option #1	$17,502,761	$476,015	$344,853	$2,062,732	$72,409,190
Option #2	$19,235,316	$388,908	$298,853	$2,052,554	$65,836,303
Option #6a	$17,196,312	$406,602	$344,853	$1,971,575	$69,167,767
Option #8	$17,781,608	$341,453	$344,853	$1,947,954	$67,826,880

Revised Recommendation
Including the service of domestic hot water to the jail facility, Option #2 is again the most economically advantageous over the 25 year Life Cycle projection. Option #8 provides an excellent alternative at a very comparable cost while preserving the benefit of fuel flexibility.

APPENDIX A
Revised Preliminary Cost Estimates

REVISED FINAL COST ESTIMATE - OPTION #1 BASE CASE				
SYSTEM	**EQUIPMENT**	**QUANTITY**	**TOTAL COST/UNIT**	**TOTAL COST**
BUILDING				
	THERMAL PLANT BUILDING	15,000 SF	135.00	2,025,000
	INTERIOR LIGHTING	1.00 LS	71,250.00	71,250
	DOCK DRAIN	1.00 LS	3,500.00	3,500
	EQUIPMENT FOUNDATIONS	1.00 LS	45,000.00	45,000
	PLATFORM & LADDERS	1.00 LS	60,000.00	60,000
	PLUMBING	1.00 LS	104,800.00	104,800
	FIRE PROTECTION	1.00 LS	188,000.00	188,000
	LANDSCAPING, GRADING, & PAVEMENT	1.00 LS	443,000.00	443,000
BUILDING TOTAL				**2,940,550**
BOILER				
	BOILER (100 BHP GAS-FIRED)	3.00 EA	171,750.00	515,250
	BOILER STACK	3.00 EA	14,950.00	44,850
	DEAERATOR W/ FEEDWATER PUMPS	1.00 EA	56,121.00	56,121
	CONDENSATE SURGE TANK W/ TRANSFER PUMPS	1.00 EA	34,477.50	34,478
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	237,200.00	237,200
	BOILER BLOWDOWN TANK, PIPING	1.00 EA	18,000.00	18,000
	CONTROL & INSTRUMENTS	1.00 LS	150,000.00	150,000
BOILER TOTAL				**1,055,899**
CHILLER				
	CHILLER (500 TON ELECTRIC CENTRIFUGAL)	3.00 EA	289,000.00	867,000
	COOLING TOWER 1500 GPM 95/85/78	3.00 EA	106,480.00	319,440
	CHILLED WATER PUMP 1200 GPM	3.00 EA	18,250.00	54,750
	CONDENSER WATER PUMP 1500 GPM	3.00 EA	18,250.00	54,750
	CHILLED & CONDENSER WATER PIPING	1.00 LS	555,000.00	555,000
	WATER TREATMENT	1.00 LS	40,000.00	40,000
	VARIABLE FREQUENCY DRIVE	6.00 EA	19,000.00	114,000
	CONTROL & INSTRUMENTS	1.00 LS	300,000.00	300,000
CHILLER TOTAL				**2,304,940**

REVISED FINAL COST ESTIMATE - OPTION #1 BASE CASE				
SYSTEM	**EQUIPMENT**	**QUANTITY**	**TOTAL COST/UNIT**	**TOTAL COST**
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 10000 GAL	2.00 EA	36,000.00	72,000
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	68,000.00	68,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	35,000.00	35,000
FUEL HANDLING TOTAL				**175,000**
DIRECT BURIED PIPING				
	STEAM PIPING	1075.00 LF	711.50	764,863
	CHW PIPING	1075.00 LF	315.00	338,625
	DW/FIRE LINE TO CUP	220.00 LF	85.00	18,700
	BLDG SANITARY SEWER TO CUP	220.00 LF	40.00	8,800
	TRUCK DOCK STORM DRAIN FROM CUP	300.00 LF	40.00	12,000
	BLDG STORM DRAIN FROM CUP	300.00 LF	120.00	36,000
	NATURAL GAS SERVICE TO CUP	250.00 LF	65.00	16,250
DIRECT BURIED PIPING TOTAL				**1,195,238**
ELECTRICAL-PLANT ONLY				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	1,168,718.00	1,168,718
	SWITCHGEAR AND FEEDERS	1.00 LS	1,915,931.05	1,915,931
	GENERATOR 1825 KW, PRIME POWER, 12470 V	4.00 EA	872,925.00	3,491,700
	CONCRETE TRANSFORMER PADS	2.00 EA	1,455.00	2,910
ELECTRICAL TOTAL				**6,579,259**
OTHER				
	ENGINEERING FEE	1.00 LS	1,425,088.50	1,425,089
	PROJECT MANAGEMENT FEE	1.00 LS	1,425,088.50	1,425,089
OTHER TOTAL				**2,850,177**
TOTAL				**17,101,062**

Cost Estimates of Options
Selected for Revised Economic Analysis

Option #2 - Ground Source Heat Pump			
Capital Costs	**Quantity**	**Cost/Unit**	**Total Cost**
Boiler (100 BHP Gas-Fired)	-3	$171,750	-$515,250
Boiler Stack	-3	$14,950	-$44,850
Deaerator w/ Feedwater Pumps	-1	$56,121	-$56,121
Condensate Surge Tank w/ Transfer Pumps	-1	$34,478	-$34,478
Boiler Blowdown Tank, Piping	-1	$18,000	-$18,000
No. 2 Fuel Oil Tank	-2	$36,000	-$72,000
Fuel Oil Tank Foundation, Monitoring, Excavation	-1	$68,000	-$68,000
No. 2 Fuel Oil Pumps and Double Wall Piping	-1	$35,000	-$35,000
Chiller (500 Ton Electric Centrifugal)	-3	$289,000	-$867,000
Cooling Tower (1500 gpm)	-3	$106,480	-$319,440
Condenser Water Pumps (1500 gpm)	-3	$18,250	-$54,750
CW Pump VFDs	-3	$19,000	-$57,000
Ground Source Loop Field	1	$1,980,000	$1,980,000
Loop Field Vaults	2	$55,000	$110,000
Loop Field Pumps	6	$13,538	$81,228
Hot Water Pumps	3	$13,538	$40,614
VFDs	3	$6,000	$18,000
Water-to-Water Heat Pumps (250 Ton Package)	6	$195,000	$1,170,000
Increased Cost for 120 deg HW (Jail)	1	$550,000	$550,000
Total Incremental Cost			$1,807,954

Option #6a - Electric Steam Boiler, Gas-Fired Steam Boiler, and Centrifugal Chillers			
Capital Costs	**Quantity**	**Type**	**Total Cost**
Boiler (255 kW Electric)	1	$41,250	$41,250
Additional 12470 V Circuit Breaker	1	$37,000	$37,000
12470 V Feeder	1	$17,000	$17,000
Total Incremental Costs			$95,250

APPENDIX B
Revised Economic Analysis

Option #1 - Gas-Fired Steam Boilers and Electric Centrifugal Chillers

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	30,915	25,084	19,142	31,361	74,231	161,448	202,089	165,455	115,700	80,493	18,382	30,909
LES (kW)*	49.270	46.432	77.194	155.352	270.749	391.235	458.581	392.381	344.195	280.337	94.271	49.270
Energy Charge	692.49	561.89	428.78	702.48	1,662.78	5,198.62	6,507.27	5,327.65	3,725.54	1,803.04	411.75	692.36
Demand Charge	3,576.93	3,576.93	3,576.93	3,576.93	3,576.93	4,694.82	5,502.97	4,708.57	4,130.34	3,576.93	3,576.93	3,576.93
Customer Charge	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72
Total Monthly Electrical Charge	4,302.14	4,171.54	4,038.43	4,312.13	5,272.42	9,926.16	12,042.95	10,068.94	7,888.60	5,412.69	4,021.39	4,302.01
Natural Gas Consumption (therm)	29,834	15,555	10,063	5,545	2,396	339	98	340	1,446	2,837	9,439	25,185
Natural Gas Peak (therm/hr)	59.25	36.625	24.875	16.625	10.125	3.375	1.25	3.5	8.625	11.25	25.125	52.75
Natural Gas Charge	28,676.64	15,599.25	10,891.84	6,440.79	2,360.67	356.25	108.09	301.05	1,128.52	2,417.78	9,019.00	24,286.69

Projected Annual Energy Costs	
Electrical Energy	28,107.27
Electrical Demand	47,652.12
Natural Gas	101,586.58
Total Annual Energy Costs	177,345.97

Total Capital Cost	$17,101,062

Total Annualized Costs

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Cost	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362
Projected Annual Energy Cost	177,346	182,666	188,146	193,791	199,604	205,593	211,760	218,113	224,657	231,396	238,338	245,488	252,853
Projected Annual O&M Cost	344,853	355,199	365,855	376,830	388,135	399,779	411,773	424,126	436,849	449,955	463,454	477,357	491,678
Projected Annual Replacement Cost													
Total Projected Annual Costs	1,735,561	1,751,227	1,767,363	1,783,983	1,801,102	1,818,734	1,836,895	1,855,601	1,874,868	1,894,714	1,915,154	1,936,208	1,957,893

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Capital Recovery	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362	1,213,362
Projected Annual Energy Cost	260,439	268,252	276,299	284,588	293,126	301,920	310,977	320,307	329,916	339,813	350,008	360,508	371,323
Projected Annual O&M Cost	506,428	521,621	537,270	553,388	569,989	587,089	604,702	622,843	641,528	660,774	680,597	701,015	722,046
Projected Annual Replacement Cost			935,518					1,378,490					4,832,667
Total Projected Annual Costs	1,980,229	2,003,235	2,962,449	2,051,338	2,076,478	2,102,371	2,129,041	3,535,002	2,184,806	2,213,950	2,243,967	2,274,885	7,139,398

Total 25 Year LifeCycle Cost	$58,826,456
Net Present Value of LCC	$29,998,530

*LES Rate = General Service - Demand

Option #2 - Water-to-Water Ground Source Heat Pump

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	195,038	114,698	75,120	69,792	103,972	207,877	265,739	212,905	152,066	116,928	72,776	167,906
LES (kW)*	382.84	264.40	219.13	300.60	387.27	515.41	604.35	517.44	479.72	420.91	249.63	345.68
Energy Charge	3,881.25	2,282.49	1,494.90	1,388.86	2,069.05	5,654.24	7,228.10	5,791.01	4,136.20	2,326.87	1,448.24	3,341.34
Demand Charge	6,088.83	6,088.83	6,088.83	6,088.83	6,088.83	7,988.92	9,367.44	8,020.35	7,435.70	6,524.06	6,088.83	6,088.83
Customer Charge	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9
Total Monthly Electrical Charge	10,171.98	8,573.22	7,785.63	7,679.59	8,359.78	13,845.07	16,797.44	14,013.26	11,773.80	9,052.83	7,738.97	9,632.07

Projected Annual Energy Costs

Electrical Energy	43,465.35
Electrical Demand	81,958.30
Natural Gas	0
Total Annual Energy Costs	125,423.65

Total Capital Cost	$18,909,015

Total Annualized Costs

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641
Projected Annual Energy Cost	125,424	129,186	133,062	137,054	141,165	145,400	149,762	154,255	158,883	163,649	168,559	173,616	178,824
Projected Annual O&M Cost	298,853	307,819	317,053	326,565	336,362	346,453	356,846	367,551	378,578	389,935	401,633	413,682	426,093
Projected Annual Replacement Cost													
Total Projected Annual Costs	1,765,918	1,778,646	1,791,756	1,805,260	1,819,168	1,833,494	1,848,250	1,863,448	1,879,102	1,895,226	1,911,833	1,928,939	1,946,558

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Capital Recovery	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641	1,341,641
Projected Annual Energy Cost	184,189	189,715	195,406	201,268	207,306	213,525	219,931	226,529	233,325	240,325	247,534	254,960	262,609
Projected Annual O&M Cost	438,876	452,042	465,603	479,571	493,958	508,777	524,041	539,762	555,955	572,633	589,812	607,507	625,732
Projected Annual Replacement Cost			3,367,864					468,551					
Total Projected Annual Costs	1,964,706	1,983,398	5,370,514	2,022,481	2,042,906	2,063,944	2,085,613	2,576,483	2,130,921	2,154,599	2,178,988	2,204,108	2,229,982

Total 25 Year LifeCycle Cost	$55,076,239
Net Present Value of LCC	$29,344,570

*LES Rate - Large Light and Power

Option #6a - Demand Limit Electric Steam Boiler, Gas-Fired Steam Boiler, and Electric Centrifugal Chillers

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	156,196	131,959	108,499	78,962	81,862	161,448	202,089	165,455	115,700	84,966	94,947	149,700
LES (kW)*	298.077	298.077	298.077	298.077	298.077	391.235	458.581	392.381	344.195	298.077	298.077	298.077
Energy Charge	3,498.80	2,955.88	2,430.37	1,768.75	1,833.71	5,198.62	6,507.27	5,327.65	3,725.54	1,903.25	2,126.81	3,353.28
Demand Charge	3,576.93	3,576.93	3,576.93	3,576.93	3,576.93	4,694.82	5,502.97	4,708.57	4,130.34	3,576.93	3,576.93	3,576.93
Customer Charge	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72
Total Monthly Electrical Charge	7,108.45	6,565.53	6,040.02	5,378.40	5,443.36	9,926.16	12,042.95	10,068.94	7,888.60	5,512.89	5,736.46	6,962.93
Natural Gas Consumption (therm)	25,560	11,908	7,014	3,921	2,135	339	98	340	1,446	2,684	6,826	21,132
Natural Gas Peak (therm/hr)	50.76	28.04	17.34	11.76	9.02	3.38	1.25	3.50	8.63	10.64	18.17	44.26
Natural Gas Charge	24,570.75	11,946.97	7,597.96	4,560.04	2,106.30	356.25	108.09	301.05	1,128.52	2,288.77	6,528.36	20,381.36

Projected Annual Energy Costs	
Electrical Energy	41,022.57
Electrical Demand	47,652.12
Natural Gas	81,874.41
Total Annual Energy Costs	170,549.09

Total Capital Cost	$17,196,312

Total Annualized Costs

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Capital Recovery	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121
Projected Annual Energy Cost	170,549	175,666	180,936	186,364	191,955	197,713	203,645	209,754	216,046	222,528	229,204	236,080	243,162
Projected Annual O&M Cost	344,853	355,199	365,855	376,830	388,135	399,779	411,773	424,126	436,849	449,955	463,454	477,357	491,678
Projected Annual Replacement Cost													
Total Projected Annual Costs	1,735,523	1,750,985	1,766,911	1,783,314	1,800,210	1,817,613	1,835,538	1,854,000	1,873,017	1,892,603	1,912,778	1,933,558	1,954,961

	2022	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Capital Recovery	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121
Projected Annual Energy Cost	250,457	257,971	265,710	273,681	281,892	290,348	299,059	308,031	317,272	326,790	336,593	346,691	357,092
Projected Annual O&M Cost	506,428	521,621	537,270	553,388	569,989	587,089	604,702	622,843	641,528	660,774	680,597	701,015	722,046
Projected Annual Replacement Cost			935,518					1,378,490					4,832,667
Total Projected Annual Costs	1,977,006	1,999,713	2,958,618	2,047,190	2,072,002	2,097,558	2,123,881	3,529,484	2,178,920	2,207,684	2,237,311	2,267,827	7,131,925

Total 25 Year LifeCycle Cost	$58,740,129
Net Present Value of LCC	$29,961,959

*LES Rate = General Service - Demand

APPENDIX C
Revised Preliminary Cost Estimates
Including Domestic Hot Water Service

REVISED FINAL COST ESTIMATE - OPTION #1 WITH DHW				
SYSTEM	**EQUIPMENT**	**QUANTITY**	**TOTAL COST/UNIT**	**TOTAL COST**
BUILDING				
	THERMAL PLANT BUILDING	15,000 SF	135.00	2,025,000
	INTERIOR LIGHTING	1.00 LS	71,250.00	71,250
	DOCK DRAIN	1.00 LS	3,500.00	3,500
	EQUIPMENT FOUNDATIONS	1.00 LS	45,000.00	45,000
	PLATFORM & LADDERS	1.00 LS	60,000.00	60,000
	PLUMBING	1.00 LS	104,800.00	104,800
	FIRE PROTECTION	1.00 LS	188,000.00	188,000
	LANDSCAPING, GRADING, & PAVEMENT	1.00 LS	443,000.00	443,000
BUILDING TOTAL				**2,940,550**
BOILER				
	BOILER (400 BHP GAS-FIRED)	3.00 EA	287,500.00	862,500
	BOILER STACK	3.00 EA	18,000.00	54,000
	DEAERATOR W/ FEEDWATER PUMPS	1.00 EA	84,181.50	84,182
	CONDENSATE SURGE TANK W/ TRANSFER PUMPS	1.00 EA	51,716.25	51,716
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	237,200.00	237,200
	BOILER BLOWDOWN TANK, PIPING	1.00 EA	18,000.00	18,000
	CONTROL & INSTRUMENTS	1.00 LS	150,000.00	150,000
BOILER TOTAL				**1,457,598**
CHILLER				
	CHILLER (500 TON ELECTRIC CENTRIFUGAL)	3.00 EA	289,000.00	867,000
	COOLING TOWER 1500 GPM 95/85/78	3.00 EA	106,480.00	319,440
	CHILLED WATER PUMP 1200 GPM	3.00 EA	18,250.00	54,750
	CONDENSER WATER PUMP 1500 GPM	3.00 EA	18,250.00	54,750
	CHILLED & CONDENSER WATER PIPING	1.00 LS	555,000.00	555,000
	WATER TREATMENT	1.00 LS	40,000.00	40,000
	VARIABLE FREQUENCY DRIVE	6.00 EA	19,000.00	114,000
	CONTROL & INSTRUMENTS	1.00 LS	300,000.00	300,000
CHILLER TOTAL				**2,304,940**

REVISED FINAL COST ESTIMATE - OPTION #1 WITH DHW

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 10000 GAL	2.00 EA	36,000.00	72,000
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	68,000.00	68,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	35,000.00	35,000
FUEL HANDLING TOTAL				**175,000**
DIRECT BURIED PIPING				
	STEAM PIPING	1075.00 LF	711.50	764,863
	CHW PIPING	1075.00 LF	315.00	338,625
	DW/FIRE LINE TO CUP	220.00 LF	85.00	18,700
	BLDG SANITARY SEWER TO CUP	220.00 LF	40.00	8,800
	TRUCK DOCK STORM DRAIN FROM CUP	300.00 LF	40.00	12,000
	BLDG STORM DRAIN FROM CUP	300.00 LF	120.00	36,000
	NATURAL GAS SERVICE TO CUP	250.00 LF	65.00	16,250
DIRECT BURIED PIPING TOTAL				**1,195,238**
ELECTRICAL-PLANT ONLY				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	1,168,718.00	1,168,718
	SWITCHGEAR AND FEEDERS	1.00 LS	1,915,931.05	1,915,931
	GENERATOR 1825 KW, PRIME POWER, 12470 V	4.00 EA	872,925.00	3,491,700
	CONCRETE TRANSFORMER PADS	2.00 EA	1,455.00	2,910
ELECTRICAL TOTAL				**6,579,259**
OTHER				
	ENGINEERING FEE	1.00 LS	1,465,258.43	1,425,089
	PROJECT MANAGEMENT FEE	1.00 LS	1,465,258.43	1,425,089
OTHER TOTAL				**2,850,177**
TOTAL				**17,502,761**

Cost Estimates of Options
Selected for Revised Economic Analysis
(Including DHW Service)

Option #2 - Ground Source Heat Pump Serving DHW			
Capital Costs	**Quantity**	**Cost/Unit**	**Total Cost**
Boiler (400 BHP Gas-Fired)	-3	$287,500	-$862,500
Boiler Stack	-3	$18,000	-$54,000
Deaerator w/ Feedwater Pumps	-1	$84,182	-$84,182
Condensate Surge Tank w/ Transfer Pumps	-1	$51,717	-$51,717
Boiler Blowdown Tank, Piping	-1	$18,000	-$18,000
No. 2 Fuel Oil Tank	-2	$36,000	-$72,000
Fuel Oil Tank Foundation, Monitoring, Excavation	-1	$68,000	-$68,000
No. 2 Fuel Oil Pumps and Double Wall Piping	-1	$35,000	-$35,000
Chiller (500 Ton Electric Centrifugal)	-3	$289,000	-$867,000
Cooling Tower (1500 gpm)	-3	$106,480	-$319,440
Condenser Water Pumps (1500 gpm)	-3	$18,250	-$54,750
CW Pump VFDs	-3	$19,000	-$57,000
Ground Source Loop Field	1	$1,980,000	$1,980,000
Loop Field Vaults	2	$55,000	$110,000
Loop Field Pumps	6	$13,538	$81,228
Hot Water Pumps	3	$13,538	$40,614
VFDs	3	$6,000	$18,000
Water-to-Water Heat Pumps (250 Ton Package)	6	$195,000	$1,170,000
Increased Cost for 120 deg HW (Jail)	1	$550,000	$550,000
Jail Hot Water Heaters	1	$728,000	$728,000
Total Incremental Cost			$2,134,253

Option #6a - Electric Steam Boiler, Gas-Fired Steam Boiler, and Centrifugal Chillers Serving DHW			
Capital Costs	**Quantity**	**Type**	**Total Cost**
Boiler (255 kW Electric)	1	$41,250	$41,250
Additional 12470 V Circuit Breaker	1	$37,000	$37,000
12470 V Feeder	1	$17,000	$17,000
Total Incremental Costs			$95,250

Cost Estimates of Options
Selected for Revised Economic Analysis
(Including DHW Service)

Option #8 - Heat Recovery Chillers and Gas-Fired Boiler Serving DHW			
Capital Costs	**Quantity**	**Type**	**Total Cost**
Boiler (400 BHP Gas-Fired)	-3	$287,500	-$862,500
Boiler Stack	-3	$18,000	-$54,000
Deaerator w/FW Pumps	-1	$84,182	-$84,182
Condensate Surge Tank w/Pumps	-1	$51,716	-$51,716
Boiler (100 BHP Gas-Fired)	3	$171,750	$515,250
Boiler Stack	3	$14,950	$44,850
Deaerator w/ FW Pumps	1	$56,121	$56,121
Condensate Surge Tank w/Pumps	1	$34,478	$34,478
Chiller (500 Ton Electric Centrifugal)	-3	$289,000	-$867,000
CW Pumps	-3	$18,250	-$54,750
CW Pump VFDs	-3	$19,000	-$57,000
Cooling Tower	-1	$106,480	-$106,480
Chiller (94 Ton Electric Centrifugal w/Heat Recovery)	9	$126,000	$1,134,000
Hot Water Pumps	3	$18,250	$54,750
Hot Water Pump VFDs	3	$19,000	$57,000
Chiller Evaporator Pumps	9	$10,763	$96,863
Chiller Condenser Pumps	9	$10,763	$96,863
Jail Hot Water Heaters	1	$728,000	$728,000
Total			$680,546

APPENDIX D
Revised Economic Analysis
Including Domestic Hot Water Service

Option #1 - Gas-Fired Steam Boiler and Electric Centrifugal Chillers Serving DHW

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	39,100	27,837	21,222	32,520	74,969	161,831	202,592	165,754	115,979	81,460	20,162	38,326
LES (kW)*	69.781	55.941	86.704	164.862	275.336	400.745	468.090	401.890	353.704	289.846	103.780	69.781
Energy Charge	875.84	623.55	475.38	728.44	1,679.31	5,210.97	6,523.45	5,337.27	3,734.54	1,824.70	451.62	858.50
Demand Charge	3,651.10	3,651.10	3,651.10	3,651.10	3,651.10	4,808.94	5,617.08	4,822.68	4,244.45	3,651.10	3,651.10	3,651.10
Customer Charge	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72	32.72
Total Monthly Electrical Charge	4,559.66	4,307.37	4,159.20	4,412.27	5,363.13	10,052.63	12,173.25	10,192.67	8,011.71	5,508.52	4,135.44	4,542.32
Natural Gas Consumption (therm)	56,339	39,495	36,568	31,195	28,901	25,989	26,603	26,845	27,096	29,342	35,089	51,690
Natural Gas Peak (therm/hr)	184.25	161.625	149.875	141.625	135.125	128.375	126.25	128.5	133.625	136.25	150.125	177.75
Natural Gas Charge	54,135.49	39,576.84	39,527.05	36,142.98	28,254.73	25,806.70	24,017.46	22,222.81	20,794.63	24,819.80	33,473.45	49,825.06

Projected Annual Energy Costs

Electrical Energy	28,716.20
Electrical Demand	48,701.95
Natural Gas	398,596.99
Total Annual Energy Costs	476,015.14

Total Capital Cost	$17,502,761

Total Annualized Costs

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Cost	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864
Projected Annual Energy Cost	476,015	490,296	505,004	520,155	535,759	551,832	568,387	585,439	603,002	621,092	639,725	658,916	678,684
Projected Annual O&M Cost	344,853	355,199	365,855	376,830	388,135	399,779	411,773	424,126	436,849	449,955	463,454	477,357	491,678
Projected Annual Replacement Cost													
Total Projected Annual Costs	2,062,732	2,087,358	2,112,723	2,138,849	2,165,758	2,193,475	2,222,023	2,251,428	2,281,715	2,312,911	2,345,042	2,378,137	2,412,226

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Capital Recovery	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864	1,241,864
Projected Annual Energy Cost	699,044	720,016	741,616	763,865	786,780	810,384	834,695	859,736	885,528	912,094	939,457	967,641	996,670
Projected Annual O&M Cost	506,428	521,621	537,270	553,388	569,989	587,089	604,702	622,843	641,528	660,774	680,597	701,015	722,046
Projected Annual Replacement Cost			935,518					1,498,683					6,039,564
Total Projected Annual Costs	2,447,336	2,483,501	3,456,267	2,559,116	2,598,634	2,639,337	2,681,261	4,223,126	2,768,920	2,814,732	2,861,918	2,910,520	9,000,144

Total 25 Year LifeCycle Cost	$72,409,190
Net Present Value of LCC	$36,666,813

*LES Rate = General Service - Demand

Option #2 - Water-to-Water Ground Source Heat Pump Serving DHW

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	241,579	178,060	171,253	174,442	220,203	328,680	393,157	337,584	266,428	231,764	165,619	222,876
LES (kW)*	631.29	632.58	678.53	811.82	935.65	1,103.88	1,204.96	1,105.17	1,036.68	962.86	707.60	631.29
Energy Charge	4,807.42	3,543.39	3,407.93	3,471.40	4,382.04	8,940.09	10,693.88	9,182.29	7,246.85	4,612.11	3,295.82	4,435.24
Demand Charge	12,139.99	12,139.99	12,139.99	12,583.18	14,502.64	17,110.09	18,676.91	17,130.09	16,068.57	14,924.32	12,139.99	12,139.99
Customer Charge	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9	201.9
Total Monthly Electrical Charge	17,149.31	15,885.28	15,749.83	16,256.48	19,086.58	26,252.08	29,572.69	26,514.28	23,517.32	19,738.33	15,637.71	16,777.14
Natural Gas Consumption (therm)	21048.6807	14678.5716	13759.8057	11623.041	10632.2157	8904.141	8750.3607	9227.4507	9981.441	10870.7607	13367.241	19670.4207
Natural Gas Peak (therm/hr)	99.2675	76.6425	64.8925	56.6425	50.1425	43.3925	41.2675	43.5175	48.6425	51.2675	65.1425	92.7675
Natural Gas Charge	20,237.96	14,721.70	14,885.76	13,479.33	10,407.28	8,855.01	7,913.58	7,651.89	7,672.92	9,208.02	12,764.26	18,973.11

Projected Annual Energy Costs	
Electrical Energy	70,441.25
Electrical Demand	171,695.79
Natural Gas	146,770.82
Total Annual Energy Costs	388,907.85

Total Capital Cost	$19,235,316

Total Annualized Costs

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793
Projected Annual Energy Cost	388,908	400,575	412,592	424,970	437,719	450,851	464,376	478,308	492,657	507,437	522,660	538,339	554,490
Projected Annual O&M Cost	298,853	307,819	317,053	326,565	336,362	346,453	356,846	367,551	378,578	389,935	401,633	413,682	426,093
Projected Annual Replacement Cost													
Total Projected Annual Costs	2,052,554	2,073,187	2,094,438	2,116,328	2,138,874	2,162,096	2,186,015	2,210,652	2,236,028	2,262,165	2,289,086	2,316,815	2,345,375

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Capital Recovery	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793	1,364,793
Projected Annual Energy Cost	571,124	588,258	605,906	624,083	642,805	662,090	681,952	702,411	723,483	745,188	767,543	790,570	814,287
Projected Annual O&M Cost	438,876	452,042	465,603	479,571	493,958	508,777	524,041	539,762	555,955	572,633	589,812	607,507	625,732
Projected Annual Replacement Cost			3,367,864					468,551					
Total Projected Annual Costs	2,374,793	2,405,093	5,804,166	2,468,447	2,501,557	2,535,660	2,570,786	3,075,517	2,644,231	2,682,614	2,722,148	2,762,869	2,804,811

Total 25 Year LifeCycle Cost	$65,836,303
Net Present Value of LCC	$34,861,153

*LES Rate - Large Light and Power

Option #6a - Demand Limit Electric Steam Boiler, Gas-Fired Steam Boiler, and Electric Centrifugal Chillers Serving DHW

Operating Costs

	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)*	167,500	136,136	124,381	117,567	135,306	187,426	222,482	190,507	158,723	145,762	115,959	160,074
LES (kW)*	324.781	310.941	341.704	419.862	530.336	655.745	723.090	656.890	608.704	544.846	358.780	324.781
Energy Charge	3,333.25	2,709.11	2,475.18	2,339.59	2,692.60	5,097.98	6,051.50	5,181.79	4,317.28	2,900.67	2,307.59	3,185.47
Demand Charge	7,285.13	7,285.13	7,285.13	7,285.13	8,220.21	10,164.04	11,207.89	10,181.79	9,434.91	8,445.11	7,285.13	7,285.13
Customer Charge	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90
Total Monthly Electrical Charge	10,820.28	10,196.14	9,962.21	9,826.62	11,114.71	15,463.92	17,461.29	15,565.48	13,954.09	11,547.68	9,794.62	10,672.50
Natural Gas Consumption (therm)	36,309	24,205	22,215	19,152	19,003	19,044	19,925	19,787	18,760	19,085	21,534	33,044
Natural Gas Peak (therm/hr)	72.11	56.99	54.91	57.42	80.31	189.74	255.44	203.84	111.92	75.69	57.32	69.21
Natural Gas Charge	34,896.22	24,263.54	24,020.36	22,197.91	18,585.29	18,916.41	17,993.62	16,385.18	14,403.34	16,151.11	20,550.25	31,858.97

Projected Annual Energy Costs	
Electrical Energy	45,014.79
Electrical Demand	101,364.75
Natural Gas	260,222.22
Total Annual Energy Costs	406,601.76

Total Capital Cost	$17,196,312

Total Annualized Costs

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121
Projected Annual Energy Cost	406,602	418,800	431,364	444,305	457,634	471,363	485,504	500,069	515,071	530,523	546,439	562,832	579,717
Projected Annual O&M Cost	344,853	355,199	365,855	376,830	388,135	399,779	411,773	424,126	436,849	449,955	463,454	477,357	491,678
Projected Annual Replacement Cost													
Total Projected Annual Costs	1,971,575	1,994,119	2,017,339	2,041,256	2,065,890	2,091,263	2,117,397	2,144,315	2,172,041	2,200,599	2,230,013	2,260,310	2,291,515

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Capital Recovery	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121	1,220,121
Projected Annual Energy Cost	597,108	615,022	633,472	652,476	672,051	692,212	712,979	734,368	756,399	779,091	802,464	826,538	851,334
Projected Annual O&M Cost	506,428	521,621	537,270	553,388	569,989	587,089	604,702	622,843	641,528	660,774	680,597	701,015	722,046
Projected Annual Replacement Cost			935,518					1,498,683					6,039,564
Total Projected Annual Costs	2,323,657	2,356,763	3,326,380	2,425,985	2,462,161	2,499,422	2,537,801	4,076,014	2,618,048	2,659,986	2,703,182	2,747,673	8,833,064

Total 25 Year LifeCycle Cost	$69,167,767
Net Present Value of LCC	$34,988,615

*LES Rate = Large Light and Power

Option #8 - Heat Recovery Chillers and Gas-Fired Boiler Serving DHW

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)	45,300	33,375	25,465	46,070	121,643	264,429	332,084	270,771	188,762	130,145	29,107	44,524
LES (kW)	80.083	66.517	106.709	250.535	443.471	636.553	747.376	637.957	563.696	460.540	158.235	80.083
Energy Charge	901.47	664.16	506.75	916.78	2,420.70	7,192.47	9,032.70	7,364.98	5,134.33	2,589.88	579.22	886.03
Demand Charge	7,529.81	7,529.81	7,529.81	7,529.81	7,529.81	9,866.57	11,584.33	9,888.33	8,737.28	7,529.81	7,529.81	7,529.81
Customer Charge	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90	201.90
Total Monthly Electrical Charge	8,633.19	8,395.88	8,238.46	8,648.50	10,152.41	17,260.94	20,818.93	17,455.21	14,073.51	10,321.59	8,310.94	8,617.75
Natural Gas Consumption	47,242	31,215	27,216	17,825	4,930	0	0	0	0	3,837	25,696	42,594
Natural Gas Peak	151.7	128.4	114.9	86.9	23.3	0.0	0.0	0.0	0.0	18.1	113.8	144.8
Natural Gas Charge	45,397.65	31,284.13	29,423.55	20,660.64	4,836.66	20.14	20.14	20.05	20.05	3,262.90	24,518.61	41,060.79

Projected Annual Energy Costs	
Electrical Energy	40,612.27
Electrical Demand	100,315.04
Natural Gas	200,525.32
Total Annual Energy Costs	341,452.63

Total Capital Cost	$17,781,608

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649
Projected Annual Energy Cost	341,453	351,696	362,247	373,115	384,308	395,837	407,712	419,944	432,542	445,518	458,884	472,650	486,830
Projected Annual O&M Cost	344,853	355,199	365,855	376,830	388,135	399,779	411,773	424,126	436,849	449,955	463,454	477,357	491,678
Projected Annual Replacement Cost													
Total Projected Annual Costs	1,947,954	1,968,544	1,989,750	2,011,593	2,034,092	2,057,265	2,081,134	2,105,718	2,131,040	2,157,122	2,183,986	2,211,656	2,240,156

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649	1,261,649
	501,435	516,478	531,972	547,931	564,369	581,300	598,739	616,701	635,202	654,259	673,886	694,103	714,926
	506,428	521,621	537,270	553,388	569,989	587,089	604,702	622,843	641,528	660,774	680,597	701,015	722,046
			935,518					1,892,500					5,736,824
	2,269,512	2,299,748	3,266,408	2,362,968	2,396,007	2,430,038	2,465,090	4,393,693	2,538,379	2,576,681	2,616,132	2,656,767	8,435,444

Total 25 Year LifeCycle Cost	$67,826,880
Net Present Value of LCC	$34,360,065

*LES Rate = Large Light and Power