APPENDIX J

Memorandum, GHG Emission Analysis, September 28, 2010

Memorandum, GHG Emission Analysis, June 30, 2010

WRIGHT-PIERCE
Engineering a Better Environment

MEMORANDUM

TO:	George Meservey - Town of Orleans	DATE:	28 September 2010
FROM:	Ed Leonard, Mike Giggey	PROJECT NO.:	10645G
SUBJECT:	Orleans Comprehensive Wastewater Management Plan (CWMP) Greenhouse Gas Emissions Analysis		

MEPA and DOER jointly prepared a 6 August 2010 memorandum which provided comments on the Greenhouse Gas Emissions Analysis dated 30 June 2010. This memorandum summarizes the comment (italics) and the response to each comment (standard font) below.

1) *To cross-check the GHG emissions for the Proponent's Baseline WWTF design, the Proponent employed the EPA Portfolio Manager program. The EPA Portfolio Manager calculated the baseline design as having Direct & Indirect GHG emissions totaling 429 tons CO2eq/year and rated the Orleans' Baseline WWTF with Benchmark Score of 34 out of 100 (100 being highest score). Although the design of the Baseline WWTF incorporates good practice efficiency measures such as variable speed drives and premium efficiency motors, the Proponent has indicated that the Baseline design does not perform well from an energy perspective compared to the EPA Portfolio Manager's database because of unique factors associated with the Orleans WWTF. According to the Proponent, the factors listed below make the Orleans WWTF an outlier from a data input perspective.*
   - *the Orleans WWTF will have very strong (460 mg/l BOD) influent concentrations; and,*
   - *strong seasonality to its wastewater flows and loads.*

   The Proponent should provide a detailed explanation of how 1) strong influent concentrations and 2) strong seasonality of wastewater flows and loads anticipated for the Orleans WWTF will negatively impact the energy efficiency of the proposed Orleans WWTF when compared to the EPA Portfolio Manager database.

   The *EPA Portfolio Manager* program was developed based on research funded by the American Water Works Association (AWWA) Research Foundation (*Energy Index Development for Benchmarking Water and Wastewater Utilities*, 2007). The research involved statistical analysis of 266 wastewater facilities throughout the United States. The facilities sizes ranged from 0.6 mgd to over 150 mgd, with the majority of respondents in the 1.5-mgd to 12-mgd range. The recommended range of facility sizes for which the *EPA Portfolio Manager* is considered applicable is from 0.6-mgd to 150-mgd. Influent concentrations for the surveyed plants ranged from 75 mg/l to 325 mg/l, with the majority of the respondents in the 150-mg/l to 250-mg/l range. This range is consistent with the weak to average sewage strength. The *EPA Portfolio Manager* tool was developed to give existing facilities a way to see how they "match up" to other facilities and a way to see how any implemented energy improvements actually impact their site energy use and/or GHG emissions.

Based on our experience with the *EPA Portfolio Manager* program, and our knowledge of the existing Tri-Town Septage Treatment Facility (which is locating on the proposed WWTF Site) and with other similarly sized seasonal wastewater treatment, we believe that the proposed Orleans facility is an outlier for the reasons identified below.

- Strong Influent Concentration - From a general perspective, a hypothetical 1.0-mgd facility with an "average" influent BOD concentration of 200 mg/l will have a lower energy use than a second 1.0-mgd facility with a "strong" influent BOD concentration of 460-mg/l because the organic load that must be oxidized is 1,670 pounds per day vs 3,840 pounds per day. This increased load requires more energy for aeration as well as more energy for solids handling and dewatering .

- Strong Influent Concentration - The reason for the strong influent concentration at this facility is relatively high percentage of septage and grease which would be received at the facility. This will require large equalization storage tanks for septage and grease, each with aeration, mixing, pumping and odor control requirements, all with attendant energy use.

- Strong Influent Concentration - As noted in the 30 June 2010 memorandum, the facility compares favorably when utilizing the "Source Energy per BOD Removed" metric (Orleans at 9.1 btu/mg BOD removed per day vs. average value of 11.5 btu/ mg BOD removed per day at other New England facilities). This metric is tracked by EPA staff for facilities in New England (Jason Turgeon, personal communication) but is not an output from the *EPA Portfolio Manager*.

- Seasonality - A wastewater treatment facility in a seasonal community has a higher peaking factor than a typical community. Peaking factors of 5-10 are not uncommon when one considers the broad range of flow requirements for average conditions (minimum weekly flow in the winter versus the maximum weekly flow in the summer) and then peak daily flows in the summer,. This results in mechanical systems that must run across a broad range of conditions, and not necessarily at optimum efficiencies over the whole range, compared with a typical community or facility.

- Stringent Effluent Limits - This facility was conceptually size for 5-mg/l effluent total nitrogen. In 2007, "typical" nutrient removal was in the range 7-mg/l to 10-mg/l effluent total nitrogen.

- Size of the Facility - The proposed facility is sized at 0.64 mgd. It is just above the minimum recommended threshold for use of the program.

The Town fully intends to construct the most energy efficient treatment plant that is cost effective in order to minimize its long-term operational costs and its impacts to sewer user rates and taxation. The *EPA Portfolio Manager* program was utilized primarily as a means to cross-check our baseline GHG emission calculations and was not intended to be basis for which the facility was evaluated. Once we were satisfied that the our GHG emission calculation methodology was reasonable, the GHG emission reduction measures were evaluated using our calculation methodology.

2) *The Proponent has committed to GHG reduction measures identified as Preferred Measures. The SEIR should include additional information and analysis of other energy efficient measures identified as (Measures to be Considered in Final Design) and should provide a detailed explanation as to why these measures were not included as part of the Proponent's Preferred Measures design alternative.*

Detailed information and analysis were provided for all energy efficiency measures described in the 30 June 2010 memorandum -- including Preferred Measures, Not Preferred Measures and Measures to be Considered in Final Design (narrative information on pages 7 to 15 and numerical information in Table 5 on page 21). Table 5 summarizes the percentage reductions from baseline as well as estimated capital cost, annual operation and maintenance cost and payback period for all measures. Based on this analysis, measures were categorized as Preferred and Not Preferred; however, numerous additional measures were considered desirable <u>if</u> they can be determined to be feasible from a technical and cost perspective. This latter category was titled "Measures to be Considered in Final Design".

This project is currently a planning-level study and is not detailed design; accordingly, there are numerous items for which there is not sufficient technical information available to commit the Town to an approach which may not be feasible. For example, a wind turbine would allow a substantial reduction in GHG emission if sufficient wind speed were available at the project site and if it could be permitted in the Old King's Highway Historic District. We are not aware of wind studies performed at this site to substantiate the investment. A second example is the potential to process septage as biosolids versus liquids. This alternative could reduce the GHG emissions from the site, but would result in increased GHG emissions off-site (carbon dioxide and/or methane generation will occur elsewhere), potentially increased odor generation on-site, and potentially less long-term viability from the perspective of off-site sludge receptors. These two examples summarize the subtleties and complexities of the Measures to be Considered in Final Design category. The Town does commit to reviewing these measures when sufficient technical information is available to make informed decisions.

3) *Proponent should discuss any increase in energy intensity (kWh/gal-day) due to the selection of the Bartonpho process as opposed to a chemical-based method of controlling nitrogen and phosphorous.*

Nitrogen - There are no financially viable or sustainable chemical-based methods to remove nitrogen to the effluent limitations required for this project. The two chemical/physical methods for ammonia reduction are breakpoint chlorination and air stripping, both of which results in nitrogen gas emissions to the atmosphere (with subsequent deposition). Breakpoint chlorination is very costly to operate and requires significant chlorine doses.

Phosphorus - Based on the hydrogeologic modeling done for the project by the Town/Wright-Pierce and based on the Massachusetts Estuaries Project (MEP) work, there are no downstream freshwater receptors and, therefore, there have been no effluent phosphorus limitations proposed or discussed. If a phosphorus limit were imposed at a later date, it is expected that it would be addressed via a chemical-based approach (i.e. add chemical to primary clarifier influent and to secondary clarifier influent).

Given the above, there is no increase in energy intensity for the proposed project over a feasible chemical-based approach.

WRIGHT-PIERCE
Engineering a Better Environment

MEMORANDUM

TO:	George Meservey - Town of Orleans	DATE:	30 June 2010
FROM:	Ed Leonard, Mike Giggey	PROJECT NO.:	10645G
SUBJECT:	Orleans Comprehensive Wastewater Management Plan (CWMP) Greenhouse Gas Emissions Analysis		

BACKGROUND

The Executive Office of Energy and Environmental Affairs (EOEEA) requires that project proponents evaluate Greenhouse Gas (GHG) emissions as a part of the Massachusetts Environmental Policy Act (MEPA) process in accordance with the MEPA GHG Emissions Policy and Protocol. The requirements for the Orleans project are outlined in the 10 July 2009 Certificate of the Secretary of EOEEA on the Expanded Environmental Notification Form (EENF). The purpose of this memorandum is to summarize the methodology utilized to estimate the "project baseline" condition, to analyze options to achieve GHG emission reductions and to develop a listing of recommended measures for implementation. The content of this memorandum and analysis is based on the "Core Plan" as defined in the draft CWMP.

Wright-Pierce prepared a preliminary estimate of GHG emissions based on the Orleans CWMP recommended plan (documented in two memoranda, dated 17 September 2009 and 15 October 2009). These previous documents provide a preliminary estimate of "current" or "existing" GHG emissions. Following submittal of these documents to MEPA, Wright-Pierce and MEPA participated in a conference call on 17 December 2009 to discuss the scope and breadth of this GHG analysis. The parameters for inclusion in and exclusion from the analysis were agreed upon during this conference call and are summarized on Table 1. Direct emissions from septic systems, related septage truck hauling, and the wastewater collection system have been excluded from this analysis. By agreement of all parties, we have focused this analysis on the two principal GHGs, carbon dioxide (CO_2) and methane (CH_4).

RESOURCE MATERIALS

The following materials and data sources were utilized as references for this analysis:

- "MEPA Greenhouse Gas Emissions Policy and Protocol".
- "Unit Conversions, Emissions Factors, and Other Reference Data", US EPA, 2004. http://www.epa.gov/climatechange/emissions/downloads/emissionsfactorsbrochure2004.pdf
- "Calculation Tool for Direct Emissions from Stationary Combustion", WRI/WBCSD, V3, July 2005.
- "EBRD Methodology for Assessment of Greenhouse Gas Emissions" (Feb 2009)
- "2007 New England Marginal Emission Rate Analysis", ISO New England, July 2009.

GENERAL APPROACH

The analysis followed six steps, as summarized below:

1. Establish the "project baseline condition". This step took significant effort to establish detailed parameters (e.g. motor sizes, equipment runtime, building square footage, etc.) which are not normally developed during the planning phases of a project.
2. Estimate the GHG emissions for the project baseline condition.
3. Identify a wide range of options for GHG emission reduction.
4. Analyze each option and estimate GHG emission reductions associated with each option.
5. Estimate the cost impacts, capital and operation and maintenance, associated with each option.
6. Segregate options into "preferred" measures" and "not preferred" measures.

DESCRIPTION OF PROJECT BASELINE

The project baseline was formulated using an "industry standard" approach to designing robust and reliable wastewater collection, treatment and disposal facilities. With regard to the design of the wastewater "process components", the project baseline and CWMP recommended plan was developed based on document entitled "Guides for the Design of Wastewater Treatment Works, Technical Report 16" (New England Interstate Water Pollution Control Commission, 1998). Where appropriate, other "industry standard" approaches to energy efficiency were utilized (e.g. using variable frequency drives for pumps and blowers, using premium efficiency process motors, etc.). Process components include pumping, mixing, aeration, odor control, biosolids handling and dewatering systems as well as standby power systems. The preliminary equipment list and annual electrical load profile for the "process components" project baseline condition are presented in Appendix A Table A-1 and A-2.

With regard to the "general building systems", the project baseline and CWMP recommended plan was developed based on the 7th Edition Building Code, 780 CMR Chapter 13 (IECC 2009 with Massachusetts Amendments). The design parameters utilized for eQuest model inputs are summarized in tabular format in Appendix A.

Since this project is only in the "planning phase" (i.e. no detailed design information is available), we have utilized engineering judgment and available information for similar projects in order to develop the required information. These values can be better refined in the "design phase" of the project in the upcoming years. A summary of these major categories and the key assumptions utilizing is presented below.

Building Systems

As shown on Figure 11-2 of the Draft CWMP, the site buildings are oriented with large west/east faces primarily due to site access, site traffic flow and site abutter considerations. These buildings are identified as follows:

- Headworks & Septage Building
- Solids Handling & Control Building
- Disinfection & Effluent Pumping Building

Based on recent projects of similar size and treatment processes, and based on the configuration of the site, we estimate the building configurations as listed below. Each building will include concrete block exterior walls with continuous rigid insulation, wood truss roofs with R-38 batt insulation above the ceiling level, double pane glazing, ventilation supply duct insulation and other standard energy efficiency items, as required by the state building code. We have assumed that natural gas will be used for the heating system on-site.

- The Headworks & Septage Building will be a one-story, approximately 60' x 70' building with an average exterior wall height of 14'. The building will also have a full basement under the building. The floor-to-floor height of the basement floor to the main floor will be approximately 14'. The first floor will consist of a septage receiving bay, a septage receiving room, a headworks room, a mechanical room and an electrical room. The basement will consist of a septage storage chamber, a grit vortex space and a pump room.
- The Solids Handling & Control Building will be a one-story, approximately 50' x 130' building with an average exterior wall height of 14'. The building will also have a full basement under the building. The floor-to-floor height of the basement floor to the main floor will be approximately 14'. The building will have solids handling equipment spaces, mechanical/electrical spaces, pump rooms, a control room, offices, a workshop, a lab and locker rooms.
- The Disinfection & Effluent Pumping Building will be a one-story, approximately 40' x 60' building with an average exterior wall height of 12'. The main floor will be slab-on-grade with no lower level, and an exterior wetwell. The building will have a disinfection room, an effluent pumping room and mechanical and electrical spaces.

Process Systems

The wastewater treatment process (activated sludge, four-stage Bardenpho configuration) and the wastewater collection and treatment systems are as outlined in the draft CWMP. Energy consumption and indirect emissions were estimated in the following manner.

- Electricity for Collection System: Baseline electricity use in the collection was estimated by developing a pump station list based on information contained in Appendix D of the April 2009 Draft CWMP (Table 11-1). Estimated electrical consumption was derived by estimating average pumping rate and total dynamic head, pump efficiency, motor efficiency and total hours per year in service. This estimate assumes that variable frequency drives are provided on large pumping stations.
- Electricity for Wastewater Treatment Facility Process: Baseline electricity use was estimated by developing an equipment list from the information and process flow diagram contained in Appendix D of the April 2009 Draft CWMP as well as an estimated influent flow and load profile generated for this analysis. Estimated electrical consumption was derived by estimating motor size, amount of full motor load required and total hours per year in service. This estimate assumes that variable frequency drives are provided on major equipment systems, specifically including activated sludge aeration blowers, return sludge pumping, and sludge storage tank aeration blowers.
- Standby Power for Wastewater Treatment Facility: Wastewater treatment systems also require standby power. Accordingly, a standby generator size was estimated (from the loads on Table 4) at 500 kw based on a diesel fuel source. A total of 1,730 gallons of fuel oil per year was calculated based on weekly 30-minute exercise under load and three 12-hr power loss events (62 hrs per year) for an assumed 500 kw generator set (28 gallons per hour at 75% load).

Transportation

Transportation components related to the project consist of WWTF staff vehicles as well as Collection System staff and maintenance vehicles. As noted previously, septage hauling vehicles are excluded from this analysis.

ESTIMATE OF GHG EMISSIONS FOR PROJECT BASELINE

GHG emissions are either "direct" and are generated on-site (e.g. by the burning of fuel in a heating system) or "indirect" and generated off-site by others (e.g. by purchasing electricity from the grid where the electricity is generated elsewhere). This memorandum presents direct and indirect emissions for the following major categories: Building Systems; Process Systems; Transportation; and Renewable Sources. To establish the baseline GHG emissions for building systems, we have modeled the energy use of the above structures with a MEPA-recommended software model (eQuest) using criteria meeting the 7^{th} Edition Building Code 780 CMR Chapter 13 (IECC 2009 with amendments) and using a Chatham weather file. The eQuest model output was used for the direct and indirect GHG emissions associated with the buildings. Process system components have been treated as indirect emissions (i.e. electric motors) and direct emissions (i.e. standby power only). Transportation components have been treated as direct emissions (gasoline, diesel) and estimated utilization figures (number of trips per day, miles per trip, etc.). No transportation-related indirect emissions have been identified.

The estimated GHG emissions for the "Baseline Project" are presented in Table 2. The Baseline GHG emissions are 900 tons CO_2eq/year, of which approximately 50% is related to electrical energy required to treat the wastewater.

CROSS-CHECK OF BASELINE GHG EMISSIONS FOR WWTF

To cross check the baseline GHG emissions estimates for the WWTF, we have utilized the internet-based *EPA Portfolio Manager* program. (For more information go to: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager). This program was developed from research funded by the American Water Works Association (AWWA) Research Foundation (Energy Index Development for Benchmarking Water and Wastewater Utilities, 2007).

Input parameters to this program are relatively straight-forward and are summarized as follows:

- Plant name/ location/ zip code: Orleans WWTF (Future)/ Orleans, MA/ 02653
- Annual Average Flow: 0.64 mgd (Appendix D-12)
- Annual Average Influent BOD Concentration: 460 mg/l (Appendix D-12)
- Annual Average Effluent BOD Concentration: 10 mg/l (Appendix D-12)
- Whether the facility has Trickling Filters: No
- Whether the facility has Nutrient Removal: Yes
- Twelve months, minimum, of energy use for all energy sources (e.g. electricity, fuel oil, natural gas, propane, etc.): estimated energy inputs as described above.

Based on these input parameters, the *EPA Portfolio Manager* program rates the proposed Orleans facility with a *Benchmark Score of 34* (0-100, 100 is best) and calculates the Direct and Indirect GHG emissions as 429 tonsCO2eq/year . Based on the values in Table 2, our estimate of Direct and Indirect GHG emissions for the comparable items is 470 tonsCO2eq/year (i.e. Building-Direct at 6 tonsCO2eq/year, Building-Indirect at 19 tonsCO2eq/year, WWTF-Direct at 19 tonsCO2eq/year, and WWTF-Indirect at 426 tonsCO2eq/year. These values indicate a reasonable correlation between the EPA Portfolio Manager and our estimates of the project baseline.

This cross-check analysis also suggests that the proposed Orleans WWTF does not perform well from an energy perspective when compared to the EPA Portfolio Manager database. We believe that this is due to two key factors:

- This plant will have a very strong influent concentration (i.e. 460 mg/l BOD) due to large anticipated septage and off-site sludge loadings (~40% of total BOD loadings), which makes it an outlier from a data input perspective.
- This plant will have a strong seasonality to its flows and loads, which also makes it an outlier from a data input perspective. We are involved with several seasonal communities in Maine which are energy efficient operations but which score similarly poorly in the EPA Portfolio Manager program.

Conversely, based on information provided by EPA staff for facilities in New England (Jason Turgeon, personal communication), the proposed Orleans WWTF does compare well from an energy perspective based on the "Source Energy per BOD Removed" metric (Orleans at 9.1 btu/ mg BOD removed per day vs average value of 11.5 btu/ mg BOD removed per day at other New England facilities). Based on the foregoing discussion, we believe that the information presented herein represents a reasonable baseline for evaluating possible options for reducing GHG emissions.

IDENTIFICATION OF OPTIONS FOR GHG EMISSION REDUCTIONS

The following concepts were considered as options to reduce GHG emissions from the proposed WWTF and collection system:

Process

1. Process all septage and off-site sludges received at the WWTF via the biosolids treatment process. Process thickening/dewatering filtrate only through the liquid treatment process.
2. Use high efficiency aeration blowers and aeration diffusers for the liquid treatment processes.
3. Use high efficiency biological nutrient removal (BNR) activated sludge mixing devices and optimize placement (i.e. number and location).
4. Consider alternate BNR processes and alternative effluent quality goals.
5. Eliminate effluent pumping, if possible, by carefully reviewing hydraulic gradeline.
6. Add sludge reduction/digestion process.
7. Reduce odor control requirements.

Building, Siting and Site Energy

8. Orient the buildings with larger southern and northern faces to maximize daylighting and to reduce heating and cooling loads.
9. Use sun shades to allow for daylighting while minimizing heat gain in the summer.
10. Use high-efficiency lighting.
11. Use effluent heat pumps (or geothermal heating system) to recover waste heat from the effluent.
12. Increase the building R-value through additional insulation at the roof, walls and floors.
13. Use high-efficiency windows instead of code-compliant windows.

14. Use motion sensors for interior lighting control and ventilation/climate control (while maintaining compliance with NFPA 820)
15. Add a solar photovoltaic system(s) to provide some of the facility's base electrical needs.
16. Add an on-site wind turbine to provide some of the facility's base electrical needs.

Management

17. Add BOD reduction measures to the Sewer Use Ordinance -- specifically banning garbage grinders and recommending waterless and/or urine diverting toilets.
18. Use low pressure sewers in areas susceptible to infiltration/inflow to minimize extraneous flow to the WWTF.
19. Use large sludge hauling trucks (30-cy roll-offs) vs small sludge trucks (10-cy truck).
20. Use of supplemental carbon chemicals (if needed) that result in relatively lower GHG emissions.

Based on the values shown on Table 2, it is clear that the largest sources of GHG emissions are indirect emissions related to the process systems. Accordingly, more explanatory discussion is provided for these items in the analysis section of this memorandum. These process systems are required to collect, convey, treat and dispose of the town's wastewater and in some cases can not be compromised.

ANALYSIS OF OPTIONS FOR GHG EMISSION REDUCTIONS

Each of the concepts identified above has been evaluated for applicability and for the potential to reduce GHG emission for the Orleans facility. The resolution of each item is summarized below and the options are categorized as the following:

- *Preferred Measure* - these items are preferred and recommended for implementation.
- *Not Preferred Measure* - these items are not preferred and not recommended for implementation; however, the GHG emission reductions have been calculated and are presented in the "All Measures Scenarios".
- *Measure to be Considered in Final Design* - these items may be preferred but the analysis requires more details to make an informed decision. Placeholder values, when applicable, have been presented under the All Measures Scenarios.
- *Not Applicable* - these items do not meet project goals and requirements and are not recommended for implementation.

As required by the GHG Emissions Policy any measures which are not preferred measures are grouped in an "All Measures" category. Accordingly, the direct and indirect GHG emissions for these categories are presented in Table 2 (Baseline Measures), Table 3 (Preferred Measures) and Table 4 (All Measures).

Process

1. **Process all septage and off-site sludges received at the WWTF via the biosolids treatment process. Process thickening/dewatering filtrate only through the liquid treatment process.**
   Septage and off-site sludge represent approximately 30 to 40 percent of the loading to the proposed facility. These trucked wastes can be handled as "wastewater" and blended with incoming sewage, or they can be handled separately as "sludge" or biosolids with only the filtrate (i.e. the liquid that results from dewatering the septage) treated as wastewater. The Baseline project includes treating septage as wastewater because it produces a more stable biosolid for handling and disposal. Processing septage/off-site sludges through the biosolids treatment process will reduce the aeration system requirements but will increase primary sludge storage volume requirements (from 50,000 gallons to 75,000 gallons) and its associated aeration/mixing requirements. Dewatering system run-time was held constant. Since the thickening/dewatering filtrate will still require treatment, the liquid treatment process loadings associated with septage was reduced to 25% of the original values.

	CWMP WWTF Load	Septage Load (100%)	Reduction in Septage Load (75%)	Revised WWTF Load	% Total Reduction
BOD, lb/day	2,480	775	580	1,900	24%
TSS, lb/day	3,230	1,290	970	2,260	30%
TKN, lb/day	400	90	65	335	16%
TP, lb/day	60	12	10	50	17%

   For the purposes of this analysis, activated sludge aeration system blower size was reduced by 20% and the primary sludge storage tank aeration system blower size was increased by 50%. In the Baseline scenario, BOD is exerted on-site in the presence of biomass and aeration (electrical energy). In this alternative, a large percentage of BOD is sent off-site in the form of waste biosolids; however, this loading will manifest itself in the form of carbon dioxide and/or methane production at its disposal location, which is outside the parameters of this analysis per Table 1. This item is a Measure to be Considered in Final Design.

2. **Use high efficiency aeration blowers and aeration diffusers for liquid treatment processes.**
   The baseline scenario consists of four 50 hp, dual-lobe positive displacement blowers with 9" disk diffusers. Alternative scenarios could include tri-lobe positive displacement blowers, high speed centrifugal blowers ("turbo blowers"), and/or high-efficiency plate diffusers. Tri-lobe blowers are marginally more efficient than dual-lobe blowers (approximately 5%) and high speed centrifugal blowers are substantially more efficient than dual-lobe blowers (approximately 25%). High speed centrifugals are typically not cost effective on a present worth basis for less than 75 hp; while they are very cost effective on a present worth basis for

greater than 100 hp. High-efficiency plate diffusers are substantially more efficient than disk diffusers but run at a higher back pressure (net approximately 10% more efficient). There are very few high-efficiency plate diffusers in the United States at this time, primarily in large treatment plants (i.e., >10 mgd) where power costs are high (i.e., California). Centrifugal blowers would not be recommended for an SBR application (Item 6 below). The Preferred Measure (shown as Item "2A") is tri-lobe blowers with standard disk diffusers and, for this analysis, we have used a 5% reduction in blower horsepower for the activated sludge aeration system and the sludge storage tank aerations systems. Although a Not Preferred Measure for a plant of this size, a 25% reduction in activated sludge aeration system blower horsepower (turbo blowers and high-efficiency plate diffusers) and a 5% reduction in the sludge storage tank aeration systems (tri-lobe blowers) has been utilized to compute the "All Measures" emissions (shown as Item "2B").

3. **Use high efficiency BNR activated sludge mixing devices and optimize placement (i.e. number and location).**
The Baseline scenario consists of submersible mixers with optimized placement for mixing and process efficiency. Available high-efficiency mixers for BNR systems currently include hyperbolic mixers, which work best in square or circular tanks/zones. Standard submersible mixers are well-suited for use in rectangular tanks or zones. Activated sludge anoxic zone mixing energy represents approximately 10% of the overall plant energy and is unlikely to be significantly reduced. This item is a Measure to be Considered in Final Design. As a placeholder value, a 5% reduction in activated sludge anoxic zone mixing energy has been used.

4. **Consider alternate BNR processes and alternative effluent quality goals.**
The proposed effluent quality goals for the proposed project are fundamental to long-term TMDL compliance and <u>can not</u> be relaxed or modified for GHG emissions reduction. The proposed process configuration (4-Stage Bardenpho) is the "industry benchmark" for effluent limits less than 5-mg/l total nitrogen. In addition, the proposed configuration was selected to allow for optimum tank sizing in a multi-phased implementation schedule. An alternative design approach could consist of utilizing sequencing batch reactors (SBRs) configured to operate like a 4-Stage Bardenpho. This alternative approach has the advantage of being similar to numerous other facilities in Barnstable and Plymouth Counties (e.g., Falmouth, Plymouth, Pine Hills, etc.) and being a relatively simpler operation. A detailed description of advantages and disadvantages of Conventional Bardenpho versus SBR Bardenpho is presented in Appendix D of the draft CWMP. This item will not be evaluated as a GHG emission reduction approach at this time but will be considered in detailed design.

5. **Eliminate effluent pumping, if possible, by carefully reviewing hydraulic gradeline.**
The Baseline scenario consists of a "pump in/ pump out" treatment facility. This conservative assumption is based on the fact that effluent must be conveyed to the appropriate elevation for disposal at rapid infiltration basins. This elevation could be

obtained in one of two ways: 1) by constructing "low profile" treatment tanks which closely match existing earth grade and pumping to the disposal elevation (similar to the existing Tri-Town facility); or 2) by constructing "raised" or "tall" treatment tanks which would require additional concrete volume but which could eliminate effluent pumping. Ultimately, this analysis and decision will require careful consideration and will involve detailed cost analyses related to site work (e.g., earth grades, cuts and fills), structural work (e.g., concrete tanks) as well as local permitting and zoning considerations. In addition, there are numerous construction-related GHG emissions factors that are outside the analysis based on Table 1. It is premature to evaluate this item as a GHG emission reduction approach at this time but this is a Measure to be Considered in Final Design.

6. Add sludge reduction/digestion process.

Sludge reduction/digestion processes typically consist of either: 1) proprietary, side-stream, batch treatment reactors designed to endogenously break down sludge; 2) aerobic digestion processes; or 3) anaerobic digestion processes. Of these three approaches, only aerobic digestion would be considered applicable for a plant the size of the proposed Orleans facility. Historically, anaerobic digestion has only been considered to be realistic for plants greater than 5-10 mgd due to the operational complexity and cost associated with these processes. Aerobic digestion is generally considered energy intensive. For this analysis, we have assumed that an aerobic digester would involve the following:

- Digestion of waste sludge only (i.e, excluding primary sludges).
- Increase sludge storage time from 4.6 days (100,000 gallons) to 15 days (300,000 gallons).
- Increase sludge storage tank aeration system blower size from 20 HP to 60 HP, based on providing 40 scfm/thousand cubic feet for the larger volume.
- Increase sludge storage tank aeration system runtime from 50% to 100% of annual hours.
- Initial volatile solids content of 80% with volatile solids reduction of 40%. Net sludge reduction is 32% or total net volume is 68% of original volume. Reduction of thickening system runtime, dewatering system runtime and sludge truck hauling trips accordingly.
- Reduce sludge hauling truck trips from 26,000 miles per year to 17,500 miles per year. Reduce GHG emissions associated with truck trips by 18,500 lbsCO2eq/year.
- Increase WWTF electricity use from 845,000 kw-hrs/year to 997,000 kw-hrs/year. Increase WWTF GHG emissions by 153,000 lbsCO2eq/year. Net GHG emissions increase by 134,500 lbsCO2eq/year (+15%).

The added electricity use more than offsets the reduction in biosolids handling and transportation; accordingly, this item is considered Not Applicable and is not carried forward.

7. **Reduce odor control requirements.**
   Odor control involves large ventilation fans to collect potentially odorous air and electricity use can be significant. The Baseline project includes odor control for the major odor sources at the proposed facility (e.g., septage receiving, sludge storage and biosolids processing). The odor control requirements for the proposed project are fundamental to the Town's desire to be a good neighbor to owners of property closely surrounding the plant site. The Town is not willing to reduce or eliminate odor control requirements for GHG emissions reduction; however, during final design, opportunities for "odor prevention" will be evaluated. While this may not decrease the installed cost of the odor control systems, it may allow for reduced operating time during cooler weather and lower loadings; accordingly, this item is considered Not Applicable and is not carried forward.

Building, Siting and Site Energy

8. **Orient the buildings with larger southern and northern faces to maximize daylighting and to reduce heating and cooling loads.**
   The site layout is based on maximizing effluent disposal areas, maximizing distances to property lines and minimizing impacts to Eastern Box Turtle habitat. The use of daylighting, via skylights and large windows, was reviewed for the site buildings. In the context of the total WWTF electricity use, lighting represents approximately 4% of the total use. Several other factors are related to this item: 1) the site is in the Old King's Highway historic district, which will restrict the architectural design features allowed; 2) due to site constraints, the buildings must be located relatively close together which limits the effectiveness of daylighting; and 3) the use of solar photovoltaic systems would reduce the ability to utilize skylights for daylighting. This item is a Measure to be Considered in Final Design.

9. **Use sun shades to allow for daylighting while minimizing heat gain in the summer.**
   Refer to Item 8. Sun shades provide limited value if large windows are not possible. This item is a Measure to be Considered in Final Design.

10. **Use high-efficiency lighting.**
    High-efficiency lighting is highly occupied spaces (>25% occupancy) will result in electrical energy reductions. High-efficiency lighting in occupied spaces is a Preferred Measure. High-efficiency lighting in all spaces is a Not Preferred Measure.

11. **Use effluent heat pumps (or geothermal heating system) to recover waste heat from the effluent.**
    The buildings have a relatively low heat load due to the state building code energy efficiency requirements and to the heat generated from electric motors. Effluent heat pumps have a relatively low impact on energy consumption at the facility. For the purposes of this analysis, effluent heat pumps are categorized as a Measure to be Considered in Final Design with an assumed reduction in Solids Handling & Control Building heat load by 10%.

12. Increase the building R-value through additional insulation at the roof/walls/floors.
The Baseline scenario is based on the 2009 IECC building envelope standards which are already very high. Additional building insulation at the roofs, walls and floors had a negligible impact on overall energy consumption at the facility. This is a Not Preferred Measure.

13. Use high-efficiency windows instead of code-compliant windows.
Based on the building model, increasing the window efficiency over code-compliant windows had a negligible impact on overall energy consumption at the facility. This is a Not Preferred Measure.

14. Use motion sensors for interior lighting control and ventilation/climate control (while maintaining compliance with NFPA 820)
Setback thermostats were included in the Baseline scenario to reduce energy costs associated with unoccupied spaces or times. Motion sensors for interior lighting control and ventilation/climate controls systems can be added to turn off lighting automatically and could also be used to reduce ventilation requirements in some spaces when not occupied. Motion sensors are a Preferred Measure.

15. Add solar photovoltaic system(s) to provide some of the facility's base electrical needs.
Solar photovoltaic (PV) systems provide for renewable electrical energy. These systems tend to be quite costly. There are two potential types of solar PV systems -- roof mounted and ground mounted. Given that the majority of the available land is dedicated to effluent disposal (in the form of rapid infiltration basins) and access drives, there is not expected to be much excess available land for a ground mounted solar PV system. For the purposes of this analysis, we have incorporated a 20-kW roof mounted system, which would generate an estimated 25,000 kWh annually. This item is included in the Measures to be Considered in Final Design. During design, it will be important to consider any grant and/or Solar Renewable Energy Credit (SREC) programs in place at that time. These programs could improve the cost effectiveness of a solar PV system. Regardless, the buildings would be designed such that solar PV systems could be easily added at a later date.

16. Add on-site wind turbine to provide some of the facility's base electrical needs.
This site has been considered by the Town as a potential site for an on-site wind turbine; however, we are not aware of any studies performed to document the long-term direction and intensity of wind at the site. For the purposes of this analysis, we have incorporated a 100-kW turbine which would generate an estimated 400,000 kWh annually. This item is included in the Measures to be Considered in Final Design. During design, it will be important to consider any grant and/or renewable energy credit programs in place at that time. These programs could improve the cost effectiveness of a wind turbine system. Regardless, the site would be designed such that a wind turbine could be readily added at a later date.

Management

17. **Add BOD reduction measures to the Sewer Use Ordinance -- specifically banning garbage grinders and recommending waterless and/or urine diverting toilets.**
    As reported in the draft CWMP (pg. 5-4), eliminating garbage grinders would result in an estimated 25% reduction in conventional constituents (BOD, TSS, etc) and a 5% reduction in nitrogen per household. As recommended in the draft CWMP, this measure should be implemented in the sewered and non-sewered areas, which would result in reductions in wastewater strength and in septage quantities. Banning garbage grinders by Sewer Use Ordinance would likely grandfather existing units until failure and ban all new installations. This measure would be relatively easy to adopt but may take 5 to 10 years to fully see the reductions. For the purposes of this analysis, we have assumed that 20% of all homes in Orleans have garbage grinders which, if eliminated, would result in a reduction in BOD loading of 5% (say 25% reduction of 20% of homes) and a reduction in nitrogen loading of 1% loading (say 5% reduction of 20% of homes). This is a Preferred Measure (shown as Item "17A"). For the purposes of this analysis, the activated sludge aeration system blower size was reduced by 5% and the primary and waste sludge storage tank aeration systems blower sizes were reduced by 5% each.

    Urine represents approximately 1% of the wastewater flow but contains about 50% of the phosphorus and 80% of the nitrogen. The use of waterless or urine diverting toilets in a typical household or building would require a urine holding tank, which would need to be pumped out at some frequency. The collected urine could be treated through the WWTF processes (for smaller flows) or through a specialized side stream treatment process (for larger flows). For this analysis, we have assumed that the urine would be trucked to the Orleans WWTF, equalized and added to the liquid treatment process on a uniform basis throughout the day. Under this scenario, this would be an enhancement to the treatment process (i.e., more stable and equalized loadings) but would not impact the total nutrient loadings at the WWTF or GHG emissions from the plant. Based on Table 1, the primary GHG emission comparison for this analysis is between the methods of conveyance of the urine (i.e., collection system vs trucking). For this analysis, we have assumed:

    - Urine generated is 0.4 gpcd.
    - Flushwater associated with urine is 3.2 gpcd (1.6 gallons per flush, twice per day).
    - Total number of properties in town served by sewer in core plan is 2,830 (Table 11-1, draft CWMP). Total number of properties in town under practical buildout scenario in the Core Plan is 5,150.
    - Total number of properties supporting urine diversion is 10%. Average occupancy is 2.0 people per household.
    - Each home or business has a urine storage tank sized for 2 pickups per year.

	All Measures
% Properties Adopting Urine Diversion	10%
Properties/ Population for Urine Diversion	600/ 1,000
Urine Flow	400
Flushwater Flow	3,200
Total Annual Flow	3,600
Truck Trips/ Round Trip Mileage	1,000/ 10
Total Miles	10,000
Reduction of Electrical Consumption in Collection System Associated with Total Annual Flow (vs 640,000 gpd)	0.7%

Additional GHG emission reductions associated with urine diversion would accrue via the reduction of the extent of the collection system needed to meet the TMDLs in various watersheds; however, these reductions are primarily associated with construction-related GHG emissions. Because of this potential benefit, as well as others not included in this analysis, urine diversion warrants additional study. A pilot study of urine diversion was recommended in the draft CWMP. This is a Measure to be Considered in Final Design (shown as Item "17B").

18. **Use low pressure sewers in areas susceptible to infiltration/inflow to minimize extraneous flow to the WWTF.**
The Baseline scenario includes an annual average allowance of 100,000 gallons per day of infiltration/inflow (I/I) based on 300 gpd/inch/mile of sewer for 248,000 linear feet of sewers (conservative value). The Baseline scenario also included an allowance for use of low pressure sewers in flat, low lying or seasonal areas. We estimate that approximately 50,000 linear feet of the collection system is located in areas of perched water table or shallow water table. Based on this figure, we estimate that 20,000 gpd of I/I is related to areas susceptible to infiltration/inflow. For the purposes of this analysis, we have estimated a reduction of 10,000 gpd assuming that 50% of the susceptible area I/I can be removed via the use of low pressure sewers in these areas. For the purposes of this analysis, the electrical energy (kw-hrs) associated with collection system pumping less water will reduced by 1.6% (10,000 gpd out of total of 640,000 gpd). This item is a Measure to be considered in Final Design. If more I/I can be removed through the use of low pressure sewers, then the allowance carried in the draft CWMP should be increased.

19. **Use large sludge hauling trucks (30-cy roll-offs) vs small sludge trucks (10 cy truck).**
The use of larger sludge hauling trucks would reduce the number of truck trips required to convey dewatered sludge cake to off-site facilities for post-processing. The use of larger trucks would require that the Town purchase a roll-off truck and roll-off containers (2) in lieu of continuing to utilize the existing sludge trucks. This item is a Preferred Measure.

20. Use of supplemental carbon chemicals (if needed) that result in relatively lower GHG emissions.
Biological nitrogen removal is limited by the amount of carbon available for the biomass to consume. Once the available carbon is depleted, additional nitrogen removal is typically not achieved; accordingly, supplemental carbon may be needed to achieve the total nitrogen effluent goal of 5 mg/l. If it is required, the industry standard has historically been liquid methanol; however, due to safety issues associated with the handling of this product, there is a growing list of supplemental carbon sources. This list includes ethanol, acetic acid, potassium acetate, MicroC (manufactured chemical made from agricultural products) and, in some cases, nutrient deficient wastewater from food processing plants. These alternative sources may have relatively higher or lower GHG emissions associated with their generation. We would typically design a chemical storage and feed system to accommodate multiple products sources, if feasible. The GHG emissions for these alternatives are outside the scope of this analysis per Table 1. This item is a Measure to be Considered in Final Design.

SUMMARY AND CONCLUSIONS

The MEPA Greenhouse Gas Emissions Policy requires that the project proponent evaluate measures to reduce GHG emissions as alternate metric. This requirement is instructive in focusing on the items that result in GHG emissions reductions, particularly those that produce reductions at little cost. Ultimately, MEPA requires that the Town commit to implementing the Preferred Measures. It is interesting to note that the five Preferred Measures will achieve a 6% reduction in GHG emissions over the Baseline Project, while 11 more Measures to be Considered in Final Design could achieve a much greater reduction (26%). This situation is testimony to the fact that the proposed Orleans WWTF can now be described only in conceptual terms (typical of any CWMP), and that the details needed to commit to other options simply will not be developed until later phases of the project. The MEPA staff recognizes that its new policy best applies to a "typical project" going through the MEPA process, where project details are more developed. Application of this policy to a CWMP can only result in a great deal of uncertainty. We have attempted to deal with that uncertainty by using the category of Measures to be Considered in Final Design to identify possibilities, without committing the Town to measures that may later turn out to be less favorable than now thought.

The Preferred Measures produce an estimated 6% reduction in GHG emissions from the proposed Baseline scenario. The Measures to be Considered in Final Design could produce an additional 26% reduction in GHG emissions over the Preferred Measures. Clearly, each of these measures has an impact on the capital cost of the project as well as the on-going operation and maintenance (O&M) costs of the facility. Table 5 summarizes the estimated GHG emission reduction, capital cost impact, O&M cost impact and "payback period" for each measure.

Although outside the parameters of this analysis, a significant number of septic systems would be removed and replaced with a sewer connection. Based on our initial estimated (17 September 2009 memorandum), the net impact of septic system removals including septage hauling is a significant reduction in GHG emissions.

Some of these measures could be eligible for energy incentive grant monies (e.g., high-efficiency lighting, solar photovoltaic, wind turbines, etc.) in order to make the payback period much more reasonable. The grant, energy incentive and renewable energy credit programs *available at the time the project is designed/constructed* will need to be reviewed in detail during the design phase of the project.

Several measures have a "0 year payback" - meaning the payback is immediate - and have GHG emission reductions. These items should be given strong consideration for implementation. Examples in this category are Item No. 17A (BOD Reduction Measures program), Item No. 1 (Process Septage as Biosolids) and Item 17B (Urine Diversion).

Several measures have relatively low costs and should be considered for implementation even if the GHG emission reduction is modest. Examples in this category are Item No. 10 (High Efficiency Lighting) and Item No. 14 (Motions Sensors for Lighting and Ventilation).

Item No. 16 (Wind Turbine) has a relatively high capital cost, a relatively reasonable payback period and substantial GHG emission reduction. The Town should commission a study to determine long-term wind speed, direction and frequency on-site.

TABLE 1 - PARAMETERS OF GREENHOUSE GAS EMISSION ANALYSIS

	Included in Analysis	**Not Included in Analysis**
Greenhouse Gases	CO_2, CH_4	NOx, SOx, VOCs
Direct Sources	WWTF building boiler/ heating WWTF standby generator Staff vehicles Sludge trucks (plant to disposal) Urine trucks (homes to plant)	Treatment process (biogenic) Individual septic systems Septage trucks (homes to plant) Collection system
Indirect Sources	Electricity for collection system Electricity for treatment process Electricity for building systems	Electricity for chemical production (e.g. methanol)
Project Phases	Operations	Construction
Scenarios	1. Standard Design 2. High-Efficiency Design	
Other Issues		Purchased offsets

TABLE 2 - ESTIMATE OF GHG EMISSIONS FOR CORE PLAN
SUMMARY OF BASELINE SCENARIO

Sources	Quantity	Units	Conversion	Units	Tons CO_2eq/yr
Building Systems					
Direct	107,800	cf/yr (NG)	0.120	lbsCO2eq/cf	6
Indirect	37	mwh/yr	1008	lbsCO2eq/mwh	19
Process Systems					
Direct - Standby Generator	1,736	gal (Diesel)	22.2	lbsCO2eq/gal	19
Indirect - Collection System	750	mwh/yr	1008	lbsCO2eq/mwh	378
Indirect - WWTF	845	mwh/yr	1008	lbsCO2eq/mwh	426
Transportation					
Direct - WWTF Staff	347	gal (Gas)	19.4	lbsCO2eq/gal	3
Direct - Collection System Staff	1,300	gal (Diesel)	22.2	lbsCO2eq/gal	14
Direct - Sludge Hauling	3,120	gal (Diesel)	22.2	lbsCO2eq/gal	35
Direct - Urine Hauling	n/a	n/a	n/a	n/a	0
Indirect (not applicable)	n/a	n/a	n/a	n/a	0
Renewable Energy On-Site					
Direct	n/a	n/a	n/a	n/a	0
Indirect	0	mwh/yr	1008	lbsCO2eq/mwh	0
SUBTOTAL					
Direct					78
Indirect					822
TOTAL					901

TABLE 3 - ESTIMATE OF GHG EMISSIONS FOR CORE PLAN
SUMMARY OF PREFERRED MEASURES

Sources		Quantity	Units	Conversion	Units	Tons CO_2eq/yr
Building Systems						
	Direct	129,800	cf/yr (NG)	0.120	lbsCO2e/cf	8
	Indirect	25.0	mwh/yr	1008	lbsCO2e/mwh	13
Process Systems						
	Direct - Standby Generator	1,736	gal (Diesel)	22.2	lbsCO2e/gal	19
	Indirect - Collection System	738	mwh/yr	1008	lbsCO2e/mwh	372
	Indirect - WWTF	804	mwh/yr	1008	lbsCO2e/mwh	405
Transportation						
	Direct - WWTF Staff	347	gal (Gas)	19.4	lbsCO2e/gal	3
	Direct - Collection System Staff	1,300	gal (Diesel)	22.2	lbsCO2e/gal	14
	Direct - Sludge Hauling	1,040	gal (Diesel)	22.2	lbsCO2e/gal	12
	Direct - Urine Hauling	0	gal (Diesel)	22.2	lbsCO2e/gal	0
	Indirect (not applicable)	n/a	n/a	n/a	n/a	0
Renewable Energy On-Site						
	Direct	n/a	n/a	n/a	n/a	0
	Indirect	0	mwh/yr	1008	lbsCO2eq/mwh	0
SUBTOTAL						
	Direct					56
	Indirect					790
TOTAL						846
	% Reduction from Baseline					-6.0%

TABLE 4 - ESTIMATE OF GHG EMISSIONS FOR CORE PLAN
SUMMARY OF ALL MEASURES

Sources	Quantity	Units	Conversion	Units	Tons CO_2eq/yr
Building Systems					
Direct	146,100	cf/yr (NG)	0.120	lbsCO2e/cf	9
Indirect	25.0	mwh/yr	1008	lbsCO2e/mwh	13
Process Systems					
Direct - Standby Generator	1,736	gal (Diesel)	22.2	lbsCO2e/gal	19
Indirect - Collection System	735	mwh/yr	1008	lbsCO2e/mwh	370
Indirect - WWTF	685	mwh/yr	1008	lbsCO2e/mwh	345
Transportation					
Direct - WWTF Staff	347	gal (Gas)	19.4	lbsCO2e/gal	3
Direct - Collection System Staff	1,300	gal (Diesel)	22.2	lbsCO2e/gal	14
Direct - Sludge Hauling	1,040	gal (Diesel)	22.2	lbsCO2e/gal	12
Direct - Urine Hauling	1,000	gal (Diesel)	22.2	lbsCO2e/gal	11
Indirect (not applicable)	n/a	n/a	n/a	n/a	0
Renewable Energy On-Site					
Direct	n/a	n/a	n/a	n/a	0
Indirect (Solar PV & Wind)	-407	mwh/yr	1008	lbsCO2eq/mwh	-205
SUBTOTAL					
Direct					68
Indirect					523
TOTAL					592
% Reduction from Baseline					-34.3%

Note: This summary is cumulative and includes the Preferred Measures, Measures to be Considered in Final Design and Not Preferred Measures.

TABLE 5 - SUMMARY OF GHG EMISSION REDUCTION MEASURES

Measures		GHG % Reduction from Baseline	Capital Cost Impact	Annual O&M Savings	Payback Period (yrs)
PREFERRED MEASURES					
2A	Use High Efficiency Blowers and Aeration (Preferred)	1.0%	$50,000	$3,920	13
10	Use High Efficiency Lighting	0.1%	$12,500	$350	36
14	Motion Sensors for Lighting and Ventilation	0.3%	$10,000	$850	12
17A	Add BOD Reduction Measures Program	3.0%	-$104,000	$14,200	0
19	Use Large Sludge Hauling Truck	1.5%	$250,000	$11,240	22
	SUM - Preferred	6.0%	$218,500	$30,560	7
ALL MEASURES					
MEASURES TO BE CONSIDERED IN FINAL DESIGN					
1	Process Septage as Biosolids not Liquid	2.5%	-$88,000	$9,190	0
3	Use High Efficiency BNR Mixers	0.2%	$120,000	$560	214
4	Alternate BNR Process and Limits	n/a	n/a	n/a	n/a
5	Eliminate Effluent Pumping	n/a	n/a	n/a	n/a
8	Adjust Building Orientation	n/a	n/a	n/a	n/a
9	Use Sun Shades	n/a	n/a	n/a	n/a
11	Use Effluent Heat Pumps	0.2%	$50,000	$700	71
15	Use Solar Photovoltaic (20kw)	1.5%	$150,000	$3,500	43
16	Use Wind Turbine (100kw)	21.2%	$650,000	$56,000	12
17B	Add Urine Diversion Toilet Program	0%	-$530,000	$9,520	0
18	Use Low Pressure Sewers to Reduce I/I	0.5%	$0	$1,540	0
	SUM - Consider in Final Design	26.1%	$352,000	$81,010	4
NOT PREFERRED/ NOT APPLICABLE MEASURES					
2B	Use High Efficiency Blowers and Aeration	2.0%	$140,000	$12,530	11
6	Add Sludge Reduction/ Digestion	n/a	n/a	n/a	n/a
7	Reduce Odor Control	n/a	n/a	n/a	n/a
10	Use High Efficiency Lighting	0.2%	$25,000	$400	63
12	Increase Building Envelope R-value	n/a	n/a	n/a	n/a
13	Use High Efficiency Windows	n/a	n/a	n/a	n/a
	SUM - Not Preferred or Applicable	2.2%	$165,000	$12,930	13
ALL MEASURES					
	SUM - All	34.3%	$735,500	$124,500	6

Note: Capital Cost increase is shown as a positive number and decrease is shown as a negative number.
Refer to 27 May 2010 memorandum for a description of each of the measures.

ORLEANS CWMP

23-Jun-2010

ATTACHMENT A - GREEN HOUSE GAS EMISSIONS ANALYSIS

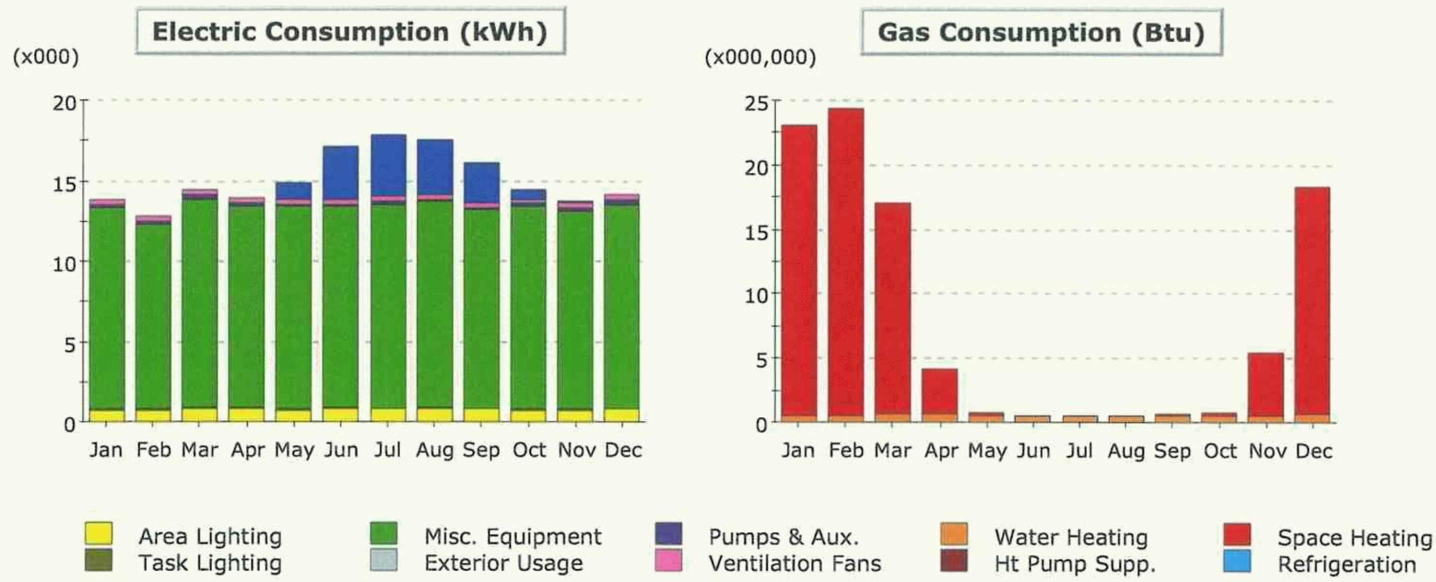
Design Conditions -- Core Plan	BASELINE	PREFERRED	ALL	
Wastewater Collection System -- Direct Emissions				
Not included, presumed to be negligible	- -	- -	- -	
Wastewater Treatment Process -- Direct Emissions				
Not included, biogenic	- -	- -	- -	
Wastewater Treatment Buildings -- Direct Emissions				
On-Site Heating Plant				
Fuel	Nat Gas	Nat Gas	Nat Gas	
Fuel consumption, BTU/yr	110,700,000	133,300,000	150,000,000	<< Modelled, eQuest
Fuel consumption, cf/yr	107,800	129,800	146,100	<< 1027BTU/cf
CO2 emissions,. lbs per cf	0.120	0.120	0.120	<<US EPA, 2004
GHG emissions, lbs CO2 eq/yr	12,936	15,576	17,532	
Standby Generator				
Fuel	Diesel	Diesel	Diesel	
Runtime, hrs/yr	62	62	62	
Estimated Genset Size, kW	500	500	450	<<Caterpillar
Fuel consumption, gal/hr	28	28	28	<<Caterpillar, 75% load
Fuel consumption, gal/yr	1736	1736	1736	
CO2 emissions,. lbs per gallon	22.2	22.2	22.2	<<US EPA, 2004
GHG emissions, lbs CO2 eq/yr	38,539	38,539	38,539	
Staff Vehicles -- Direct Emissions				
Fuel	Gasoline	Gasoline	Gasoline	
Vehicle miles per year--current				
Miles per day, weekday	15	15	15	
Miles per day, weekend	0	0	0	
Miles per year	3,900	3,900	3,900	
Vehicle miles per year--Phase 4				
Miles per day, weekday	20	20	20	
Miles per day, weekend	0	0	0	
Miles per year	5,200	5,200	5,200	
Miles per gallon	15	15	15	
Gallons per year	347	347	347	<<Gasoline
lb CO2 per gallon	19.4	19.4	19.4	<<US EPA, 2004
lb CO2 per year	6,725	6,725	6,725	
Collection System Maintenance				
Fuel	Diesel	Diesel	Diesel	
Vehicle miles per year--current				
Miles per day, weekday	0	0	0	
Miles per day, weekend	0	0	0	
Miles per year	0	0	0	
Vehicle miles per year--Phase 4				
Miles per day, weekday	50	50	50	
Miles per day, weekend	0	0	0	
Miles per year	13,000	13,000	13,000	
Miles per gallon	10	10	10	
Gallons per year	1,300	1,300	1,300	<<Diesel
lb CO2 per gallon	22.2	22.2	22.2	<<US EPA, 2004
lb CO2 per year	28,860	28,860	28,860	
Sludge Hauling to Disposal				
Fuel	Diesel	Diesel	Diesel	
Vehicle miles per year--current				
Miles per day, weekday	80	80	80	
Miles per day, weekend	0	0	0	

ORLEANS CWMP

23-Jun-2010

ATTACHMENT A - GREEN HOUSE GAS EMISSIONS ANALYSIS

Design Conditions -- Core Plan	BASELINE	PREFERRED	ALL
Miles per year	20,800	20,800	20,800
Vehicle miles per year--Phase 4			
Miles per day, weekday	120	40	40
Miles per day, weekend	0	0	0
Miles per year	31,200	10,400	10,400
Miles per gallon	10	10	10
Gallons per year	3,120	1,040	1,040 <<Diesel
lb CO2 per gallon	22.2	22.2	22.2 <<US EPA, 2004
lb CO2 per year	69,264	23,088	23,088
Urine Hauling to Treatment			
Fuel	Diesel	Diesel	Diesel
Vehicle miles per year--current			
Miles per day, weekday	0	0	0
Miles per day, weekend	0	0	0
Miles per year	0	0	0
Vehicle miles per year--Phase 4			
Miles per trip	0	0	10 10 miles
Trips per year	0	0	1000 500 trips/ 1000 trips
Miles per year	0	0	10,000
Miles per gallon	10	10	10
Gallons per year	0	0	1,000 <<Diesel
lb CO2 per gallon	22.2	22.2	22.2 <<US EPA, 2004
lb CO2 per year	0	0	22,200
		0	*22,200*
Wastewater Collection - Indirect emissions			
Power usage, KWH per year	750,000	738,000	735,000 << TABLE A-1
Power usage, MWH per year	750	738	735
GHG emissions, lbs CO2/ Million KWH	1,008	1,008	1,008 <<ISO-NE, 2007
GHG emissions, lbs CO2/ yr	756,000	743,904	740,880
		-12,096	*-15,120*
Wastewater Treatment Process - Indirect emissions			
Power usage, KWH per year	845,000	804,000	685,000 << TABLE A-2, 3, 4
Power usage, MWH per year	845	804	685
GHG emissions, lbs CO2/ Million KWH	1,008	1,008	1,008 <<ISO-NE, 2007
GHG emissions, lbs CO2/ yr	851,760	810,432	690,480
Wastewater Treatment Bldgs - Indirect emissions			
Power usage, KWH per year	36,800	25,000	25,000 << Modelled, eQuest
Power usage, MWH per year	36.8	25.0	25.0
GHG emissions, lbs CO2/ Million KWH	1,008	1,008	1,008 <<ISO-NE, 2007
GHG emissions, lbs CO2/ yr	37,094	25,200	25,200
Renewable Energy Sources - Indirect emissions			
Power usage, KWH per year	0	0	-407,100 << Estimated
Power usage, MWH per year	0.0	0.0	-407.1
GHG emissions, lbs CO2/ Million KWH	1,008	1,008	1,008 <<ISO-NE, 2007
GHG emissions, lbs CO2/ yr	0	0	-410,357

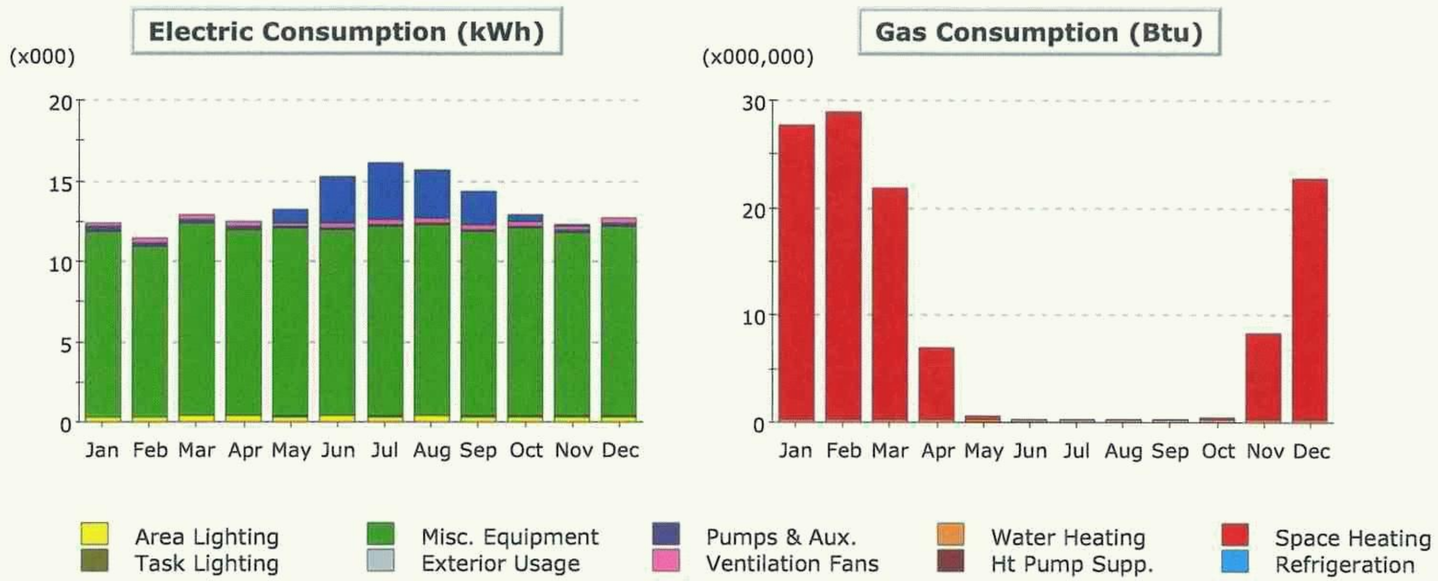


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.04	1.03	3.34	3.89	3.41	2.41	0.61	0.12	0.02	14.87
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.01	0.01	0.01	0.00	-	-	-	-	-	-	0.00	0.01	0.05
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.28	0.28	0.34	0.33	0.30	0.33	0.31	0.33	0.31	0.30	0.30	0.31	3.71
Pumps & Aux.	0.23	0.21	0.23	0.20	0.14	0.12	0.12	0.12	0.12	0.16	0.21	0.22	2.08
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	12.46	11.46	12.90	12.46	12.57	12.46	12.68	12.79	12.35	12.57	12.24	12.68	149.64
Task Lights	0.06	0.06	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.85
Area Lights	0.73	0.72	0.87	0.84	0.76	0.84	0.80	0.84	0.80	0.76	0.76	0.80	9.51
Total	13.78	12.75	14.43	13.94	14.87	17.15	17.88	17.56	16.06	14.47	13.70	14.12	180.71

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	22.52	23.82	16.32	3.46	0.19	-	-	-	0.10	0.23	4.86	17.77	89.26
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.56	0.58	0.70	0.65	0.56	0.57	0.51	0.51	0.48	0.48	0.52	0.58	6.69
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	23.08	24.40	17.01	4.11	0.74	0.57	0.51	0.51	0.58	0.72	5.37	18.35	95.95

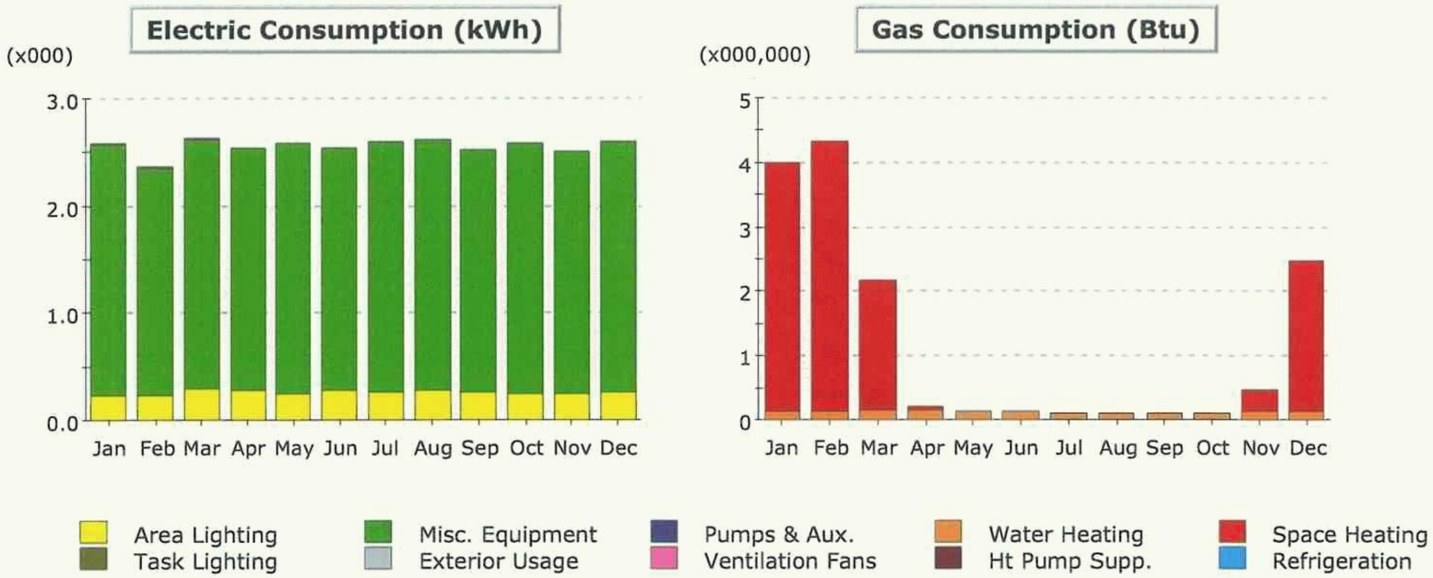


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.03	0.82	2.94	3.51	3.02	2.07	0.45	0.09	0.00	12.93
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.01	0.02	0.01	0.00	0.00	-	-	-	-	0.00	0.01	0.01	0.06
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.25	0.25	0.30	0.29	0.26	0.29	0.27	0.29	0.27	0.26	0.26	0.27	3.27
Pumps & Aux.	0.23	0.21	0.23	0.20	0.14	0.12	0.12	0.12	0.12	0.16	0.21	0.22	2.08
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	11.55	10.62	11.96	11.55	11.65	11.55	11.76	11.86	11.45	11.65	11.34	11.76	138.70
Task Lights	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.43
Area Lights	0.32	0.31	0.38	0.36	0.33	0.36	0.35	0.36	0.35	0.33	0.33	0.35	4.13
Total	12.39	11.44	12.92	12.47	13.24	15.30	16.04	15.68	14.30	12.89	12.27	12.65	161.60

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	27.36	28.63	21.51	6.57	0.27	0.01	-	-	0.12	0.18	8.02	22.47	115.13
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.30	0.31	0.37	0.35	0.30	0.30	0.27	0.27	0.26	0.26	0.28	0.31	3.56
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	27.66	28.94	21.88	6.92	0.56	0.30	0.27	0.27	0.37	0.44	8.30	22.78	118.69

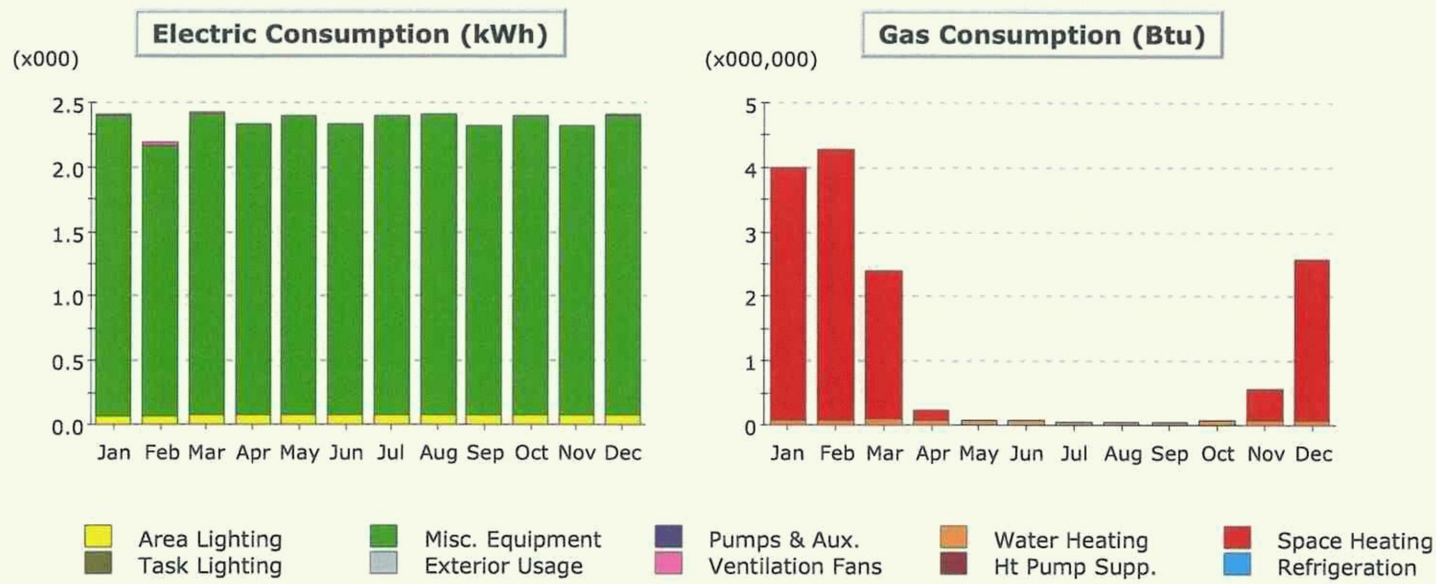


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.02	0.02	0.01	0.00	-	-	-	-	-	-	0.00	0.01	0.06
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	2.33	2.10	2.33	2.25	2.33	2.25	2.33	2.33	2.25	2.33	2.25	2.33	27.43
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.24	0.24	0.29	0.28	0.25	0.28	0.26	0.28	0.26	0.25	0.25	0.26	3.15
Total	2.59	2.36	2.63	2.53	2.58	2.53	2.59	2.61	2.52	2.58	2.51	2.61	30.64

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	3.87	4.19	1.99	0.06	-	-	-	-	-	-	0.35	2.34	12.79
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.14	0.16	0.15	0.13	0.13	0.11	0.12	0.11	0.11	0.12	0.14	1.55
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	4.00	4.32	2.16	0.21	0.13	0.13	0.11	0.12	0.11	0.11	0.47	2.47	14.35

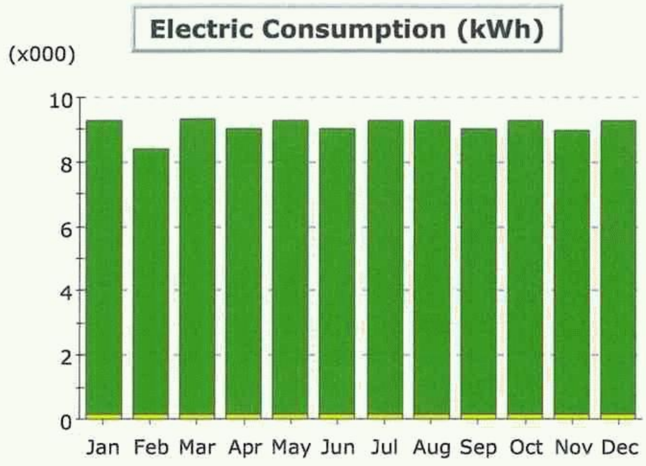


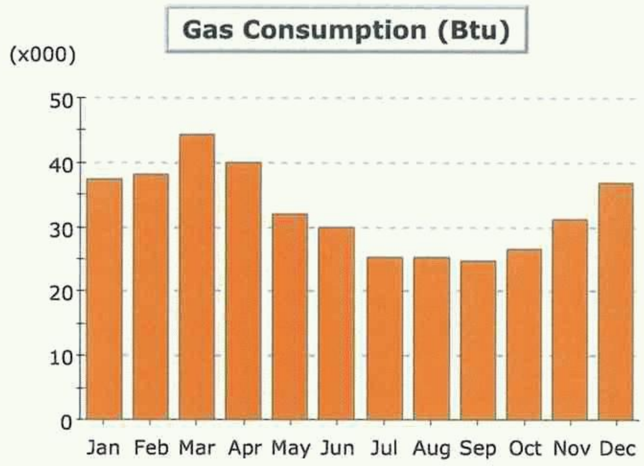
Electric Consumption (kWh x000)

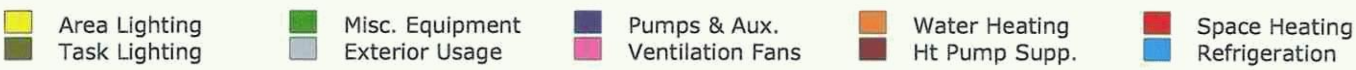
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.02	0.02	0.01	0.00	-	-	-	-	-	-	0.00	0.01	0.07
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	2.32	2.10	2.33	2.25	2.33	2.25	2.33	2.33	2.25	2.33	2.25	2.33	27.38
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.07	0.07	0.08	0.08	0.07	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.89
Total	2.41	2.19	2.42	2.33	2.40	2.33	2.40	2.40	2.33	2.40	2.32	2.41	28.34

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	3.91	4.20	2.30	0.14	-	-	-	-	-	-	0.50	2.50	13.54
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.08	0.08	0.09	0.09	0.07	0.07	0.06	0.06	0.06	0.07	0.07	0.08	0.88
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	3.99	4.28	2.39	0.22	0.07	0.07	0.06	0.06	0.06	0.07	0.57	2.58	14.43





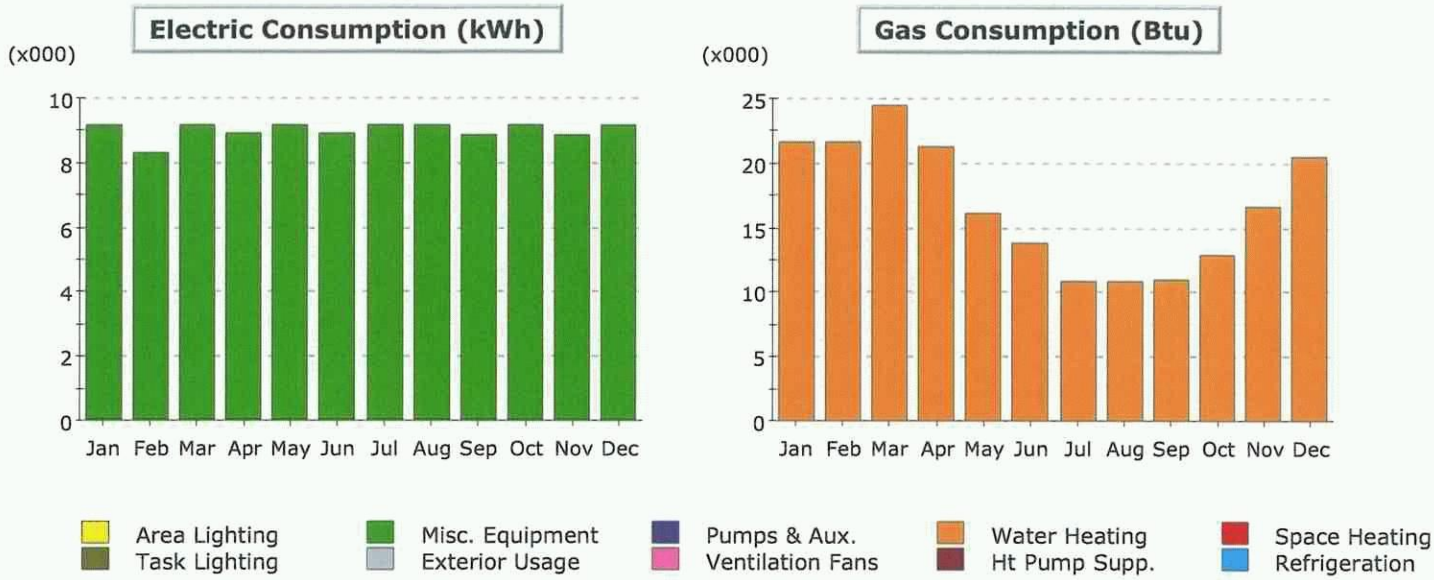


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	9.14	8.26	9.14	8.85	9.14	8.85	9.14	9.14	8.85	9.14	8.85	9.14	107.64
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.14	0.14	0.17	0.16	0.14	0.16	0.15	0.16	0.15	0.14	0.14	0.15	1.80
Total	9.28	8.39	9.31	9.01	9.29	9.01	9.29	9.30	9.00	9.29	8.99	9.29	109.44

Gas Consumption (Btu x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	37.48	38.03	44.37	40.02	31.98	29.96	25.31	25.21	24.63	26.48	31.10	36.92	391.50
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	37.48	38.03	44.37	40.02	31.98	29.96	25.31	25.21	24.63	26.48	31.10	36.92	391.50



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	9.14	8.26	9.14	8.85	9.14	8.85	9.14	9.14	8.85	9.14	8.85	9.14	107.64
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.51
Total	9.18	8.30	9.19	8.89	9.18	8.89	9.19	9.19	8.89	9.18	8.89	9.19	108.15

Gas Consumption (Btu x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	21.60	21.60	24.42	21.26	16.08	13.75	10.88	10.80	10.91	12.89	16.57	20.48	201.25
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	21.60	21.60	24.42	21.26	16.08	13.75	10.88	10.80	10.91	12.89	16.57	20.48	201.25

ORLEANS - COMPREHENSIVE WASTEWATER MANAGEMENT PLAN *25-May-2010*

PRELIMINARY EQUIPMENT LIST AND ANNUAL ELECTRICAL LOAD PROFILE *Wright-Pierce*

APPENDIX TABLE A-1 - COLLECTION SYSTEM

TAG NO.	EQUIP. NAME	NO. OF SITES	EST AVG FLOW	EST AVG TDH	EST PUMP EFF	EST MOTOR EFF	ELECTRICAL INFO AVG HP	% FL	% Running	Annual KWH	% of TOTAL
	Wetwell/ Drywell (500 - 1,500 gpm)	6									
	1500 gpm peak flow	1	450	50	70%	92%	8.8	100%	90%	51,940	6.9%
	1000 gpm peak flow	1	300	50	70%	92%	5.9	100%	90%	34,630	4.6%
	750 gpm peak flow	2	200	50	70%	92%	3.9	100%	90%	46,170	6.1%
	500 gpm peak flow	2	150	50	70%	92%	2.9	100%	90%	34,630	4.6%
	Submersible (100 - 500 gpm)	56									
	400 gpm peak flow	10	400	45	60%	91%	8.3	100%	30%	163,380	21.7%
	300 gpm peak flow	10	300	45	60%	91%	6.3	100%	30%	122,530	16.3%
	200 gpm peak flow	18	200	45	60%	91%	4.2	100%	30%	147,040	19.5%
	100 gpm peak flow	18	100	45	60%	91%	2.1	100%	30%	73,520	9.8%
	Grinder Pump Station (10-50 gpm)	78									
	50 gpm peak flow	5	50	40	50%	92%	1.1	100%	30%	10,770	1.4%
	40 gpm peak flow	5	40	40	50%	92%	0.9	100%	30%	8,620	1.1%
	30 gpm peak flow	23	30	40	50%	92%	0.7	100%	30%	29,730	3.9%
	20 gpm peak flow	25	20	40	50%	92%	0.4	100%	30%	21,550	2.9%
	10 gpm peak flow	20	10	40	50%	92%	0.2	100%	30%	8,620	1.1%
	Total Pump Stations	140							**Total KWH**	**753,130**	
	Average KWH per Pump Stations	5,380								**per year**	

Preferred **-2.0%**

All **-2.3%**

TOTAL KWH, PREFERRED MEASURES -->> 738,067

TOTAL KWH, ALL MEASURES -->> 735,808

ORLEANS - COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

25-May-2010

PRELIMINARY EQUIPMENT LIST AND ANNUAL ELECTRICAL LOAD PROFILE

Wright-Pierce

APPENDIX TABLE A-2 - WASTEWATER TREATMENT FACILITY

TAG NO.	EQUIP. NAME	NO. OF UNITS	NO. RUNNING	NO. OF UNITS ON STANDBY	ELECTRICAL INFO HP	% FL	% Running	Annual KWH	% of TOTAL
	MECHANICAL SCREEN	1	1	0	2	50%	20%	1,310	0.2%
	SCREEN WASH PRESS	1	1	0	2	50%	20%	1,310	0.2%
	SEPTAGE RECEIVING UNIT	3	2	1	3	50%	20%	3,920	0.5%
	SEPTAGE TRANSFER PUMP	2	1	1	5	50%	20%	3,270	0.4%
	SEPTAGE BLOWERS	2	1	1	20	50%	50%	32,670	3.9%
	GRIT CHAMBER	1	1	0	1.5	50%	100%	4,900	0.6%
	GRIT PUMP	1	1	0	7.5	50%	25%	6,130	0.7%
	GRIT CLASSIFIER	1	1	0	1	50%	25%	820	0.1%
	PRIMARY CLARIFIER DRIVES	2	2	0	1.0	50%	100%	6,530	0.8%
	PRIMARY SLUDGE PUMP/MIXING	2	1	1	10	50%	25%	8,170	1.0%
	PRIMARY SCUM PUMP	1	1	0	5	50%	25%	4,080	0.5%
	AERATION BLOWERS	5	2	3	50	50%	100%	326,750	38.7%
	BNR MIXERS	24	12	12	2	50%	100%	78,420	9.3%
	IR PUMPS	4	2	2	2	50%	100%	13,070	1.5%
	SECONDARY CLARIFIERS	3	2	1	1	50%	100%	6,530	0.8%
	RETURN SLUDGE PUMP	3	2	1	10	50%	100%	65,350	7.7%
	WASTE SLUDGE PUMP	2	1	1	3	50%	25%	2,450	0.3%
	SECONDARY SCUM PUMP/MIXING	1	1	0	5	50%	25%	4,080	0.5%
	UV DISINFECTION (4 KW, Ann Avg)	3	2	1	4	50%	100%	25,980	3.1%
	EFFLUENT PUMPING	4	2	2	10	50%	100%	65,350	7.7%
	FOAM SPRAY WATER SYSTEM	2	1	1	15	50%	25%	12,250	1.5%
	PLANT WATER SYSTEM	2	1	1	15	50%	50%	24,510	2.9%
	ON-SITE RECYCLE PUMP STATION	2	1	1	5	50%	25%	4,080	0.5%
	SLUDGE STORAGE - WASTE/ BLOWERS	2	1	1	20	50%	50%	32,670	3.9%
	SLUDGE STORAGE - PRIMARY/ BLOWERS	2	1	1	20	50%	50%	32,670	3.9%
	SLUDGE STORAGE - BLENDED/ BLOWERS	2	1	1	15	50%	20%	9,800	1.2%
	MECHANICAL THICKENING SYSTEM	1	1	0	5	50%	20%	3,270	0.4%
	DEWATERING SLUDGE FEED GRINDERS	2	1	1	5	50%	20%	3,270	0.4%
	DEWATERING SLUDGE FEED PUMPS	2	1	1	15	50%	20%	9,800	1.2%
	DEWATERING SYSTEM (BFP)	2	1	1	20	50%	20%	13,070	1.5%
	ODOR CONTROL SYSTEM #1	1	1	0	7.5	50%	75%	18,380	2.2%
	ODOR CONTROL SYSTEM #2	1	1	0	7.5	50%	75%	18,380	2.2%
							Total KWH	**843,240**	
					BASELINE MEASURES			**per year**	

ORLEANS - COMPREHENSIVE WASTEWATER MANAGEMENT PLAN *3-Jun-2010*

PRELIMINARY EQUIPMENT LIST AND ANNUAL ELECTRICAL LOAD PROFILE *Wright-Pierce*

APPENDIX TABLE A-3 - WASTEWATER TREATMENT FACILITY/ PREFERRED MEASURES

TAG NO.	EQUIP. NAME	NO. OF UNITS	NO. RUNNING	NO. OF UNITS ON STANDBY	ELECTRICAL INFO HP	% FL	% Running	Annual KWH	% of TOTAL
	MECHANICAL SCREEN	1	1	0	2	50%	20%	1,310	0.2%
	SCREEN WASH PRESS	1	1	0	2	50%	20%	1,310	0.2%
	SEPTAGE RECEIVING UNIT	3	2	1	3	50%	20%	3,920	0.5%
	SEPTAGE TRANSFER PUMP	2	1	1	5	50%	20%	3,270	0.4%
	SEPTAGE BLOWERS	2	1	1	20	50%	50%	32,670	4.1%
	GRIT CHAMBER	1	1	0	1.5	50%	100%	4,900	0.6%
	GRIT PUMP	1	1	0	7.5	50%	25%	6,130	0.8%
	GRIT CLASSIFIER	1	1	0	1	50%	25%	820	0.1%
	PRIMARY CLARIFIER DRIVES	2	2	0	1.0	50%	100%	6,530	0.8%
	PRIMARY SLUDGE PUMP/MIXING	2	1	1	10	50%	25%	8,170	1.0%
	PRIMARY SCUM PUMP	1	1	0	5	50%	25%	4,080	0.5%
	AERATION BLOWERS	5	2	3	45	50%	100%	294,070	36.6%
	BNR MIXERS	24	12	12	2	50%	100%	78,420	9.8%
	IR PUMPS	4	2	2	2	50%	100%	13,070	1.6%
	SECONDARY CLARIFIERS	3	2	1	1	50%	100%	6,530	0.8%
	RETURN SLUDGE PUMP	3	2	1	10	50%	100%	65,350	8.1%
	WASTE SLUDGE PUMP	2	1	1	3	50%	25%	2,450	0.3%
	SECONDARY SCUM PUMP/MIXING	1	1	0	5	50%	25%	4,080	0.5%
	UV DISINFECTION (4 KW, Ann Avg)	3	2	1	4	50%	100%	25,980	3.2%
	EFFLUENT PUMPING	4	2	2	10	50%	100%	65,350	8.1%
	FOAM SPRAY WATER SYSTEM	2	1	1	15	50%	25%	12,250	1.5%
	PLANT WATER SYSTEM	2	1	1	15	50%	50%	24,510	3.0%
	ON-SITE RECYCLE PUMP STATION	2	1	1	5	50%	25%	4,080	0.5%
	SLUDGE STORAGE - WASTE/ BLOWERS	2	1	1	18	50%	50%	29,410	3.7%
	SLUDGE STORAGE - PRIMARY/ BLOWERS	2	1	1	18	50%	50%	29,410	3.7%
	SLUDGE STORAGE - BLENDED/ BLOWERS	2	1	1	15	50%	20%	9,800	1.2%
	MECHANICAL THICKENING SYSTEM	1	1	0	5	50%	20%	3,270	0.4%
	DEWATERING SLUDGE FEED GRINDERS	2	1	1	5	50%	20%	3,270	0.4%
	DEWATERING SLUDGE FEED PUMPS	2	1	1	15	50%	20%	9,800	1.2%
	DEWATERING SYSTEM (BFP)	2	1	1	20	50%	20%	13,070	1.6%
	ODOR CONTROL SYSTEM #1	1	1	0	7.5	50%	75%	18,380	2.3%
	ODOR CONTROL SYSTEM #2	1	1	0	7.5	50%	75%	18,380	2.3%
							Total KWH	**804,040**	
					PREFERRED MEASURES			**per year**	

ORLEANS - COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

25-May-2010

PRELIMINARY EQUIPMENT LIST AND ANNUAL ELECTRICAL LOAD PROFILE

Wright-Pierce

APPENDIX TABLE A-4 - WASTEWATER TREATMENT FACILITY/ ALL MEASURES

TAG NO.	EQUIP. NAME	NO. OF UNITS	NO. RUNNING	NO. OF UNITS ON STANDBY	ELECTRICAL INFO HP	% FL	% Running	Annual KWH	% of TOTAL
	MECHANICAL SCREEN	1	1	0	2	50%	20%	1,310	0.2%
	SCREEN WASH PRESS	1	1	0	2	50%	20%	1,310	0.2%
	SEPTAGE RECEIVING UNIT	3	2	1	3	50%	20%	3,920	0.6%
	SEPTAGE TRANSFER PUMP	2	1	1	5	50%	20%	3,270	0.5%
	SEPTAGE BLOWERS	2	1	1	20	50%	50%	32,670	4.8%
	GRIT CHAMBER	1	1	0	1.5	50%	100%	4,900	0.7%
	GRIT PUMP	1	1	0	7.5	50%	25%	6,130	0.9%
	GRIT CLASSIFIER	1	1	0	1	50%	25%	820	0.1%
	PRIMARY CLARIFIER DRIVES	2	2	0	1.0	50%	100%	6,530	1.0%
	PRIMARY SLUDGE PUMP/MIXING	2	1	1	10	50%	25%	8,170	1.2%
	PRIMARY SCUM PUMP	1	1	0	5	50%	25%	4,080	0.6%
	AERATION BLOWERS	5	2	3	25	50%	100%	163,370	23.8%
	BNR MIXERS	24	12	12	1.9	50%	100%	74,500	10.9%
	IR PUMPS	4	2	2	2	50%	100%	13,070	1.9%
	SECONDARY CLARIFIERS	3	2	1	1	50%	100%	6,530	1.0%
	RETURN SLUDGE PUMP	3	2	1	10	50%	100%	65,350	9.5%
	WASTE SLUDGE PUMP	2	1	1	3	50%	25%	2,450	0.4%
	SECONDARY SCUM PUMP/MIXING	1	1	0	5	50%	25%	4,080	0.6%
	UV DISINFECTION (4 KW, Ann Avg)	3	2	1	4	50%	100%	25,980	3.8%
	EFFLUENT PUMPING	4	2	2	10	50%	100%	65,350	9.5%
	FOAM SPRAY WATER SYSTEM	2	1	1	15	50%	25%	12,250	1.8%
	PLANT WATER SYSTEM	2	1	1	15	50%	50%	24,510	3.6%
	ON-SITE RECYCLE PUMP STATION	2	1	1	5	50%	25%	4,080	0.6%
	SLUDGE STORAGE - WASTE/ BLOWERS	2	1	1	18	50%	50%	29,410	4.3%
	SLUDGE STORAGE - PRIMARY/ BLOWERS	2	1	1	28	50%	50%	45,740	6.7%
	SLUDGE STORAGE - BLENDED/ BLOWERS	2	1	1	15	50%	20%	9,800	1.4%
	MECHANICAL THICKENING SYSTEM	1	1	0	5	50%	20%	3,270	0.5%
	DEWATERING SLUDGE FEED GRINDERS	2	1	1	5	50%	20%	3,270	0.5%
	DEWATERING SLUDGE FEED PUMPS	2	1	1	15	50%	20%	9,800	1.4%
	DEWATERING SYSTEM (BFP)	2	1	1	20	50%	20%	13,070	1.9%
	ODOR CONTROL SYSTEM #1	1	1	0	7.5	50%	75%	18,380	2.7%
	ODOR CONTROL SYSTEM #2	1	1	0	7.5	50%	75%	18,380	2.7%
							Total KWH ALL MEASURES	**685,750 per year**	

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Control Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
GENERAL INFORMATION		
Building Type (retail or other)	Manufacturing, General	
Location Set	All eQuest Locations	
State	Massachusetts	
City	Chatham	
Building Area (square feet)	9,750	
Number of Floors, Above Grade	1	
Number of Floors, Bbove Grade	.5	
Cooling Equipment	DX Coils	
Heating Equipment	Furnace	
Analysis Year	2010	
Daylighting Controls (Y/N)	N	
Usage Details	Simplified Schedules	
BUILDING FOOTPRINT		
Footprint Shape	Rectangle	
Zoning Pattern	By Activity Area	
Building Orientation	North	
Footprint Dimensions, X1 (feet)	50.00	
Footprint Dimensions, Y1 (feet)	130.00	
Floor to Floor Height (feet)	14.0	
Floor to Ceiling Height (feet)	13.5	
Pitched Roof	33 deg./1.3' overhang	
BUILDING ENVELOPE CONSTRUCTION		
Roof Construction Type	Wood Advanced Frame, 24" oc	
Roof Finish	Shingle	
Roof Color (solar reflectance)	Gray, light oil	
Roof Insulation	R-38	
Exterior Wall Construction Type	8" CMU, grout 24" oc & empty cells	
Exterior Wall Color	Medium (abs=.06)	
Exterior Wall Insulation	3" polystyrene (R-12)	
Ground Floor Exposure	Earth contact	
Ground Floor Construction	12" concrete	
Ground Floor Insulation	R-5 at 2' wide	
Ground Floor Finish	No finish	
Below Grade Walls, Construction	12" Concrete	
Below Grade Walls, Insulation	R-5, 8' deep	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Control Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
EXTERIOR DOORS/WINDOWS		
Door Type 1, type	Opaque	
Door Type 1, # of doors by orientation	0-N, 1-S, 2-E, 2-W	
Door Type 1, size	7'h x 3'w	
Door Type 1, construction	Steel, Polyurethane core w/o brk	
Door Type 2, type	Overhead	
Door Type 2, # of doors by orientation	0-N, 0-S, 0-E, 3-W	
Door Type 2, size	12'h x 12'w	
Door Type 2, construction	Insulated Steel	
Window U-factor	U-Value=0.40, SC=0.84, VT=0.81	
ACTIVITY AREAS ALLOCATION		
Area 1, Type	Mech/Elec Room	
Area 1, % of total area	15.4	
Area 1, design max. occ. (sf/person)	300.0	
Area 1, design ventilation	0.00	
Area 2, Type	Comm/Ind Work (General, Low Bay)	
Area 2, % of total area	41.5	
Area 2, design max. occ. (sf/person)	300.0	
Area 2, design ventilation	400.00	
Area 3, Type	Office (General)	
Area 3, % of total area	43.1	
Area 3, design max. occ. (sf/person)	400.0	
Area 3, design ventilation	20.00	
OCCUPIED LOADS BY ACTIVITY AREA		
Area 1, Lighting (W/sf)	1.00	0.85
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	0.20	
Area 2, Lighting (W/sf)	1.00	0.85
Area 2, Task Lt (W/sf)	0.00	
Area 2, Plug Lds (W/sf)	15.61	14.35

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Control Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
Area 3, Lighting (W/sf)	1.30	1.10
Area 3, Task Lt (W/sf)	0.20	
Area 3, Plug Lds (W/sf)	1.50	
UNOCCUPIED LOADS BY ACTIVITY AREA (% OF OCCUPIED LOADS)		
Area 1, Occupancy (%)	0.00	
Area 1, Lighting (W/sf)	0.00	
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	20.0	
Area 2, Occupancy (%)	0.00	
Area 2, Lighting (W/sf)	0.00	
Area 2, Task Lt (W/sf)	0.00	
Area 2, Plug Lds (W/sf)	100.0	
Area 3, Occupancy (%)	0.00	
Area 3, Lighting (W/sf)	0.00	
Area 3, Task Lt (W/sf)	0.00	
Area 3, Plug Lds (W/sf)	20.0	
MAIN SCHEDULE INFORMATION		
Day 1 (Days)	Mo, Tu, We, Th, Fr, CD, HD	
Day 1, Schedule	Opens at 8 am/ Closes at 5 am	
Occup %	90.0	45.0
Lites Ld %	90.0	45.0
Equip Ld %	100.0	
Day 2, (Days)	Sa, Su, Hol	
Day 1, Schedule	Unoccupied	
HVAC SYSTEM DEFINITIONS		
Cooling Source	DX Cooling	
Heating Source	Furnace	
System Type	Split System Single Zone DX with Furnace	
Return Air Path	Ducted	
HVAC ZONES: TEMPERATURES AND AIR FLOWS		
Cooling Set Point, Occupied	76 F	
Cooling Set Point, Unoccupied	82 F	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Control Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
Heating Set Point, Occupied	70 F	
Heating Set Point, Unoccupied	64 F	
Cooling Design Temp, Indoor	75 F	
Cooling Design Temp, Supply	55 F	
Heating Design Temp, Indoor	72 F	
Heating Design Temp, Supply	95 F	
Minimum Design Air Flow (cfm/f^2)	0.50	
PACKAGED HVAC EQUIPMENT		
Cooling, Overall Size	Auto-size	
Cooling, Typical Unit Size	90-135 kBtu or 7.5-11.25 tons	
Cooling, Condenser Type	Air-cooled	
Cooling, Efficiency	EER, 8.900	
Heating, Size	Auto-size	
Heating, Typical Unit Size	< 225 kBtu	
Heating, Efficiency	AFUE, 0.780	
HVAC SYSTEM FANS		
Supply Fan, Power & Mtr Eff	1.00 in. WG, High	
Fan Flow & OSA	Auto-size Flow (w/ 1.15 safety fac.)	
Fan Schedule	Operate fans 1 hour before open and 1 hour after close	
HVAC ZONE HEATING, VENT AND ECONOMIZERS		
Baseboards	Hot Water, -195.0 kBtu	
BBD HW Src	Hot Water Loop	
Economizers, Type	Drybulb Temperature	
Economizers, High Limit	65.0 F	
HEATING PRIMARY EQUIPMENT		
HW Loop, Head	36.6 ft	
HW Loop, Design DT	40.0 F	
Pump Configuration	Single System Pump Only	
Number of System Pumps	1	
HW Loop Flow	Constant	
Motor Efficiency	High	
Boiler Type	HW Boiler Forced Draft	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Control Building - 6/30/2010

Model Input	***Baseline***	***Preferred****
Boiler Fuel	Nat. Gas	
Boiler Count	1	
Boiler Output	Auto-size, < 300 kBtuh	
Boiler Efficiency	80.0	
Efficiency Spec	Efficiency	
HOT WATER SYSTEM CONTROL AND SCHEDULE		
Setpoint is	Fixed	
Setpoint Value	180.0 F	
Operation	Standby	
DOMESTIC WATER HEATING		
Heater Fuel	Natural Gas	
Heater Type	Storage	
Hot Water Use (gal/person/day)	1.00	
Input Rating (kBtuh)	19.3	
Efficiency Spec	Energy Factor	
Energy Factor	0.59	
Storage Capacity (gal)	15	
Insulation R-Value (h-ft2-F/Btu)	12.0	
Supply Temperature	135 F	
Inlet Water Temperature	Ground Temp	
Recirculation (%)	0	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Headworks Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
GENERAL INFORMATION		
Building Type (retail or other)	Manufacturing, General	
Location Set	All eQuest Locations	
State	Massachusetts	
City	Chatham	
Building Area (square feet)	7,200	
Number of Floors, Above Grade	1	
Number of Floors, Bbove Grade	.7	
Cooling Equipment	No Cooling	
Heating Equipment	Furnace	
Analysis Year	2010	
Daylighting Controls (Y/N)	N	
Usage Details	Simplified Schedules	
BUILDING FOOTPRINT		
Footprint Shape	Rectangle	
Zoning Pattern	By Activity Area	
Building Orientation	North	
Footprint Dimensions, X1 (feet)	60.00	
Footprint Dimensions, Y1 (feet)	70.00	
Floor to Floor Height (feet)	14.0	
Floor to Ceiling Height (feet)	13.5	
Pitched Roof	33 deg./1.3' overhang	
BUILDING ENVELOPE CONSTRUCTION		
Roof Construction Type	Wood Advanced Frame, 24" oc	
Roof Finish	Shingle	
Roof Color (solar reflectance)	Gray, light oil	
Roof Insulation	R-38	
Exterior Wall Construction Type	8" CMU, grout 24" oc & empty cells	
Exterior Wall Color	Medium (abs=.06)	
Exterior Wall Insulation	3" polystyrene (R-12)	
Ground Floor Exposure	Earth contact	
Ground Floor Construction	12" concrete	
Ground Floor Insulation	R-5 at 2' wide	
Ground Floor Finish	No finish	
Below Grade Walls, Construction	12" Concrete	
Below Grade Walls, Insulation	R-5, 8' deep	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Headworks Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
EXTERIOR DOORS/WINDOWS		
Door Type 1, type	Opaque	
Door Type 1, # of doors by orientation	2-N, 2-S, 3-E, 3-W	
Door Type 1, size	7'h x 3'w	
Door Type 1, construction	Steel, Polyurethane core w/o brk	
Door Type 2, type	Overhead	
Door Type 2, # of doors by orientation	0-N, 0-S, 1-E, 1-W	
Door Type 2, size	13.5'h x 14'w	
Door Type 2, construction	Insulated Steel	
Window U-factor	U-Value=0.40, SC=0.84, VT=0.81	
ACTIVITY AREAS ALLOCATION		
Area 1, Type	Comm/Ind Work (General, Low Bay)	
Area 1, % of total area	28.6	
Area 1, design max. occ. (sf/person)	300.0	
Area 1, design ventilation	400.00	
Area 2, Type	Comm/Ind Work (Precision)	
Area 2, % of total area	42.9	
Area 2, design max. occ. (sf/person)	300.0	
Area 2, design ventilation	800.00	
Area 3, Type	Mech/Elec Room	
Area 3, % of total area	28.6	
Area 3, design max. occ. (sf/person)	300.0	
Area 3, design ventilation	0.00	
OCCUPIED LOADS BY ACTIVITY AREA		
Area 1, Lighting (W/sf)	1.00	0.85
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	1.72	
Area 2, Lighting (W/sf)	1.00	0.85
Area 2, Task Lt (W/sf)	0.00	
Area 2, Plug Lds (W/sf)	0.56	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Headworks Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
Area 3, Lighting (W/sf)	1.00	0.85
Area 3, Task Lt (W/sf)	0.00	
Area 3, Plug Lds (W/sf)	0.20	
UNOCCUPIED LOADS AS % OF OCCUPIED LOADS		
Area 1, Occupancy (%)	0.00	
Area 1, Lighting (W/sf)	0.00	
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	100.0	
Area 2, Occupancy (%)	0.00	
Area 2, Lighting (W/sf)	0.00	
Area 2, Task Lt (W/sf)	0.00	
Area 2, Plug Lds (W/sf)	100.0	
Area 3, Occupancy (%)	0.00	
Area 3, Lighting (W/sf)	0.00	
Area 3, Task Lt (W/sf)	0.00	
Area 3, Plug Lds (W/sf)	20.0	
MAIN SCHEDULE INFORMATION		
Day 1 (Days)	Mo, Tu, We, Th, Fr, CD, HD	
Day 1, Schedule	Opens at 8 am/ Closes at 10 am	Opens at 8 am/ Closes at 9 am
Occup %	100.0	50.0
Lites Ld %	100.0	50.0
Equip Ld %	100.0	
Day 2, (Days)	Sa, Su, Hol	
Day 1, Schedule	Unoccupied	
HVAC SYSTEM DEFINITIONS		
Cooling Source	No Cooling	
Heating Source	Furnace	
System Type	Gas or Fuel Furnace w/ No zone ventilation	
HVAC ZONES: TEMPERATURES AND AIR FLOWS		
Heating Set Point, Occupied	55 F	
Heating Set Point, Unoccupied	55 F	
Heating Design Temp, Indoor	55 F	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Headworks Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
Heating Design Temp, Supply	95 F	
Minimum Design Air Flow (cfm/f^2)	0.50	
PACKAGED HVAC EQUIPMENT		
Size	Auto-size	
Typical Unit Size	>= 225 kBtu	
Efficiency	0.806	
HVAC SYSTEM FANS		
Supply Fan, Power & Mtr Eff	0.75 in. WG, High	
Fan Flow & OSA	Auto-size Flow (w/ 1.15 safety fac.)	
Fan Schedule	Operate fans 1 hour before open and 1 hour after close	
HVAC ZONE HEATING, VENT AND ECONOMIZERS		
Baseboards	None	
DOMESTIC WATER HEATING		
Heater Fuel	Natural Gas	
Heater Type	Storage	
Hot Water Use (gal/person/day)	0.20	
Input Rating (kBtuh)	3.7	
Efficiency Spec	Energy Factor	
Energy Factor	0.61	
Storage Capacity (gal)	6	
Insulation R-Value (h-ft2-F/Btu)	12.0	
Supply Temperature	135 F	
Inlet Water Temperature	Ground Temp	
Recirculation (%)	0	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Disinfection Building - 6/30/2010

Model Input	***Baseline***	***Preferred****
GENERAL INFORMATION		
Building Type (retail or other)	Manufacturing, General	
Location Set	All eQuest Locations	
State	Massachusetts	
City	Chatham	
Building Area (square feet)	2,400	
Number of Floors, Above Grade	1	
Number of Floors, Bbove Grade	0	
Cooling Equipment	No Cooling	
Heating Equipment	Furnace	
Analysis Year	2010	
Daylighting Controls (Y/N)	N	
Usage Details	Simplified Schedules	
BUILDING FOOTPRINT		
Footprint Shape	Rectangle	
Zoning Pattern	One Per Floor	
Building Orientation	North	
Footprint Dimensions, X1 (feet)	40.00	
Footprint Dimensions, Y1 (feet)	60.00	
Floor to Floor Height (feet)	12.0	
Floor to Ceiling Height (feet)	11.5	
Pitched Roof	33 deg./1.3' overhang	
BUILDING ENVELOPE CONSTRUCTION		
Roof Construction Type	Wood Advanced Frame, 24" oc	
Roof Finish	Shingle	
Roof Color (solar reflectance)	Gray, light oil	
Roof Insulation	R-38	
Exterior Wall Construction Type	8" CMU, grout 24" oc & empty cells	
Exterior Wall Color	Medium (abs=.06)	
Exterior Wall Insulation	3" polystyrene (R-12)	
Ground Floor Exposure	Earth contact	
Ground Floor Construction	12" concrete	
Ground Floor Insulation	R-5 at 2' wide	
Ground Floor Finish	No finish	
Below Grade Walls, Construction	12" Concrete	
Below Grade Walls, Insulation	R-5, 8' deep	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Disinfection Building - 6/30/2010

Model Input	***Baseline***	***Preferred****
EXTERIOR DOORS/WINDOWS		
Door Type 1, type	Opaque	
Door Type 1, # of doors by orientation	0-N, 0-S, 3-E, 3-W	
Door Type 1, size	7'h x 3'w	
Door Type 1, construction	Steel, Polyurethane core w/o brk	
Window U-factor	U-Value=0.40, SC=0.84, VT=0.81	
ACTIVITY AREAS ALLOCATION		
Area 1, Type	Mech/Elec Room	
Area 1, % of total area	100.0	
Area 1, design max. occ. (sf/person)	300.0	
Area 1, design ventilation	0.00	
OCCUPIED LOADS BY ACTIVITY AREA		
Area 1, Lighting (W/sf)	1.00	0.85
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	5.12	
UNOCCUPIED LOADS BY ACTIVITY AREA (% OF OCCUPIED LOAD)		
Area 1, Occupancy (%)	0.00	
Area 1, Lighting (W/sf)	0.00	
Area 1, Task Lt (W/sf)	0.00	
Area 1, Plug Lds (W/sf)	100.0	
MAIN SCHEDULE INFORMATION		
Day 1 (Days)	Mo, Tu, We, Th, Fr, CD, HD	
Day 1, Schedule	Opens at 8 am/ Closes at 10 am	Opens at 8 am/ Closes at 9 am
Occup %	100.0	50.0
Lites Ld %	100.0	50.0
Equip Ld %	100.0	
Day 2, (Days)	Sa, Su, Hol	
Day 1, Schedule	Unoccupied	

** Note, only differences are shown in the Preferred column.*

eQuest Modeling Inputs
Orleans - Wastewater Treatment and Disposal Facilities
Disinfection Building - 6/30/2010

Model Input	*Baseline*	*Preferred**
HVAC SYSTEM DEFINITIONS		
Cooling Source	No Cooling	
Heating Source	Furnace	
System Type	Gas or Fuel Furnace w/ No zone ventilation	
HVAC ZONES: TEMPERATURES AND AIR FLOWS		
Heating Set Point, Occupied	55 F	
Heating Set Point, Unoccupied	55 F	
Heating Design Temp, Indoor	55 F	
Heating Design Temp, Supply	95 F	
Minimum Design Air Flow (cfm/f^2)	0.50	
PACKAGED HVAC EQUIPMENT		
Size	Auto-size	
Typical Unit Size	>= 225 kBtu	
Efficiency	0.806	
HVAC SYSTEM FANS		
Supply Fan, Power & Mtr Eff	0.75 in. WG, High	
Fan Flow & OSA	Auto-size Flow (w/ 1.15 safety fac.)	
Fan Schedule	Operate fans 1 hour before open and 1 hour after close	
HVAC ZONE HEATING, VENT AND ECONOMIZERS		
Baseboards	Electric, -21.1 kW	
DOMESTIC WATER HEATING		
Heater Fuel	Natural Gas	
Heater Type	Storage	
Hot Water Use (gal/person/day)	0.20	
Input Rating (kBtuh)	1.1	
Efficiency Spec	Energy Factor	
Energy Factor	0.61	
Storage Capacity (gal)	6	
Insulation R-Value (h-ft2-F/Btu)	12.0	
Supply Temperature	135 F	
Inlet Water Temperature	Ground Temp	
Recirculation (%)	0	

** Note, only differences are shown in the Preferred column.*