Energy Efficiency Opportunities
For
Town Buildings
Durham, New Hampshire

October 18, 2011

(Updated February 15, 2012)

Prepared by:
Peregrine Energy Group, Inc.
Boston, Massachusetts
and
Breakaway Energy Services LLC
Portland, Maine

Provided by:

New Hampshire's Office of Energy and Planning

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

1.0 Introduction and Executive Summary

Peregrine Energy Group, Inc. ("Peregrine") and Breakaway Energy Services have prepared this Energy Opportunities Assessment and Roadmap to Energy Efficiency for the Town of Durham, New Hampshire. Work has been completed on behalf of the New Hampshire Office of Energy and Planning. This support is being provided through the Energy Technical Assistance & Planning for New Hampshire Communities program ("ETAP"), funded by the American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant program of the U.S. Department of Energy.

On July 28, 2011, accompanied by Doug Bullen of Durham, Peregrine toured the Courthouse, Police Station, Town Hall, Transfer Station, and Waste Water Treatment Facility to evaluate current energy use and identify opportunities for energy cost reduction.

Peregrine has completed this Energy Opportunity Assessment to guide the Town in developing and implementing an energy reduction strategy. This assessment includes specific recommendations and next steps to reduce energy use and increase energy efficiency. We include summary information on the building with recommendations that can provide a starting point for securing bids from installation contractors for suggested projects.

Findings and Recommendations

Peregrine's Opportunity Assessment focused on:

- Historical energy use
- Operating practices
- Lighting technology and requirements
- HVAC equipment and controls
- Building envelop materials and condition
- Processing equipment (waste water treatment facility)
- Future plans and requirement

We have identified several specific improvements that will result in significant energy reduction. We estimate that identified energy reduction improvements and strategies will generate up to about $7,900 in utility cost savings annually, which represents roughly 3-4% of these facilities' combined annual utility expenditure (note that the wastewater treatment plant's necessarily very high process load dominates the utility requirements of this group of facilities). The recommendations will require an investment of approximately $66,000, less incentives from PSNH, which are expected to be at least $2,000.

Suggested Next Steps

We suggest that the town move forward aggressively with the specific projects we recommend. Within the context of the ETAP program, Peregrine can support the town at no cost with planning and executing these recommendations. All projects indentified in this report require further development to obtain firm pricing and to tighten up the saving projections.

Immediate next steps include:

- Commit to pursuing recommended projects and establish an implementation schedule.

- Develop request for proposal documents and/or contact preferred mechanical and lighting contractor(s). Unitil may require use of specific vendors for work supported by their program.
- Secure quotes for projects and select contractor(s).

Table 1 – Energy Reduction Program Potential Results

Approximate Implementation Cost	Utility Incentive Available	Potential Utility Savings					Annual Cost Avoidance	Simple Payback Yr
		Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr	Propane Gal/yr		
$65,700	$2,250	28	54,400	250	1,000	(1,450)	$7,100	9.3

2.0 Utility Use Summary

The town buildings use electricity, oil and natural gas as the primary utility supply. The wastewater treatment plant uses propane to heat the dewatering building. Electricity is supplied by Public Service of New Hampshire (PSNH) and distributed in facilities at 208 volts, three phases in most town facilities. The average cost of electricity for recent twelve month period was $0.150/kWh. We did not receive complete electrical use data for two of the subject buildings. The current cost of oil is reported to be $2.36/gallon. The average cost of natural gas was $1.25/Therm. The average cost of propane at the waste water treatment plant was $1.85/gallon.

Table 2 – Annual Utility Use and Energy Density

Building	Sq. Ft.	Electricity (kWh)	Oil (Gal)	Natural Gas (Therm)	Propane (Gal)	Total Utility Cost	EUI kBtu/SF[1]
Courthouse	3,450	10,200	1,800	-	-	$6,000	82
DPW	17,000	70,600	-	7,000	-	$18,000	55
Police Dept	4,260	5,100	-	Unavailable	-	Incomplete	Incomplete
Town Hall	3,040	3,600	2,900	-	-	$7,900	138
Transfer Station	Unavailable	19,700	1,300	-	-	$6,900	Incomplete
WWTP	8,540	1,500,800	-	-	5,000	$177,800	N/A

[1]Represents Btu equivalent of combined annual electricity and propane use, divided by building square footage, divided by 1,000. ENERGYSTAR reports that values can range from 30 kBtu/Sf to 340 kBtu/SF. An efficient commercial office building in the Northeast should perform at roughly 80 kBtu/SF.

3.0 Courthouse

The Durham Courthouse dates from the 1800's. The building is multi-use for Town functions including office space for the Parks and Recreation Department and Youth Association among others. The Historic Society occupies the second floor with museum space. Use varies, but the building is generally open from 6 a.m. to 6 p.m. weekdays with limited weekend and holiday use. The Museum has very limited hours.

The two story building is timber construction with brick walls and unusual curved front section. There is minimal, if any, insulation in the walls. The roof is flat and was replaced about eight years ago. There is likely to be some rigid insulation in the roof system. Windows are older wooden framed units with single pane glass. Exterior doors require repairs and are lacking weather seals.

The building is heated hydronically via fin tube radiators on the perimeter of rooms. Hot water is generated by a single 257 MBH oil-fired Weil McLain boiler. There are two heating zones, presumably 1st and 2nd floors. There is one small split unit that provides air conditioning to the museum. All thermostats in the building are older non-programmable types. There are signs posted at thermostats requesting that occupants turn down the heat to 55°F when they leave the building.

Lighting at the Courthouse is mostly T8 fluorescent which was updated. We noted incandescent candelabra lamps in use in one area. There aren't any occupancy sensors in use at this facility, although staff are reported to reliably turn off lights when they leave an area.

Recommended Opportunities

This facility has an Energy Use Index (EUI) of 82 kBtu/SF. This represents typical performance for this type and age of facility. We have four recommendations to enhance the building's performance which are summarized in the table below. These recommendations are described following the table.

Table 3 – Summary of Energy-Related Opportunities for the Courthouse

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr		
1. Update Decorative Lighting	$1,200	$450		1	600	-	-	$100	6+
2. Add Programmable Thermostats	$500	$0		-	-	100	-	$200	2 - 3
3. Make Exterior Door Repairs and Add Seals	$500	$0	A	-	-	50	-	$100	3 - 6
4. Air Seal Building	$7,500	$0		-	-	200	-	$500	10+
Estimated Program	***$9,700***	***$450***		***1***	***600***		***-***	***$900***	***10.3***

Notes ***Current Utility Budget:*** ***$6,000 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***15%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

3.1 Update Decorative Lighting

The courthouse has chandeliers with incandescent candelabra lamps. These lamps can be updated to decorative compact fluorescent to save energy. An alternative is to install fluorescent based "house lights" for normal use and to limit use of the chandeliers for special occasions.

<u>Next Step:</u> Confirm quantity of existing incandescent lamps and select replacement lamp types or new fixtures. Consult with a lighting specialist if necessary. Peregrine is available to review bids or other documentation.

3.2 Install Programmable Thermostats

We recommend replacement of thermostats with programmable units that have a time of day function to reset space heating and cooling temperatures in the office section of the building. This is a much more reliable way to achieve night setbacks then relying on staff to turn down the thermostats. Based on the sign, it is evidently possible to achieve a 55°F setpoint during unoccupied

periods in the winter. It may be possible to "setup" temperature in the summer to 80°F. Staff will have to experiment with these setpoints and when to schedule heating and cooling to occupied setpoint temperatures in order for the building to recover to a reasonable comfort level when people arrive for work.

Next Step: Installing programmable thermostats is a very simple project that can probably be handled by a Town electrician or maintenance technician. The thermostats are inexpensive and widely available. The next step is to inventory existing thermostats and determine which model to install. If this work must be contracted out, HVAC or heating system specialists should be able to provide installation quote(s).

3.3 Make Exterior Door Repairs and Add Seals

The Courthouse has several entrance doors. We noted that the wooden back door of this building has a large crack that is exposed to the outside. In addition, the door appears to be warped and is lacking weather seals. Other doors at the courthouse are likely to be in need of attention, particularly weather stripping. During the winter heating season, any gaps cause uncomfortable drafts and create a significant demand on adjacent heating devices. We recommend replacement of door weather stripping and repairing the door(s) so they close tightly with a patch or caulking in the cracked section of the rear door. All weather stripping should be inspected and updated annually before the winter heating season.

Next Step: Conduct more detailed review of exterior doors to establish a detailed scope of work. Consult with door specialist to select and price weather strip system. A Town technician can probably install the product and repair or replace door(s). Otherwise obtain pricing from a contractor. We suggest combining similar work for other Town facilities which appear to have much of the same issues. By combining work, it is much more likely that the Town will achieve a favorable bidder response.

3.4 Airseal Building

As with many older wood framed buildings, the courthouse is a good candidate for weatherization improvements, in this case air sealing the basement area and potentially elsewhere. An air sealing / insulation contractor should be engaged to complete this work, using instrumentation to identify problem areas and measure the results of improvements made.

Next Step: We recommend bringing in a qualified air sealing contractor to conduct the first diagnostic phase of an air sealing effort. This will entail conducting a blower door test and/or infrared scans of the building envelope to determine where there might be voids and/or poor insulation properties. Easy improvements, such as sealing gaps with expanding foam and/or caulking are usually tackled at this point. In the basement, there are several windows and access ways that are obvious targets for airsealing. There may be additional discoveries during the airseal process, such as insulation voids in the walls or inadequate roof insulation. The contractor can provide a supplemental proposal for any additional weatherization that is needed.

4.0 Department of Public Works

Durham's DPW facility was erected in 1999. The newer facility includes an administrative office area with overhead mezzanine and open high bay shop area to service vehicles and other Town equipment. Vehicles are generally parked outdoors. This facility is occupied weekday from 7 a.m. to about 4 p.m. and around the clock during snow events.

The building is typical steel construction with metal siding, pitched roof and internal blanket insulation. There are ten weatherized overhead doors to the bays; however, seals on some of the doors require replacement. There few windows at this facility are operable with single pane glass. We noted that exhaust fan louvers in the bay weren't closed tightly and are probably a source of warm air loss in the winter.

This building is heated by two natural gas-fired Reznor furnace units. One unit serves the bay and the other serves the administrative area and is equipped with a DX coil to remote condensing unit. The systems are controlled by programmable thermostats. The thermostats are set to drop from 68^{o}F occupied setpoint to 64^{o}F unoccupied. The bay unit is often shutdown completely during unoccupied periods.

Lighting at the DPW is T8 fluorescent with some occupancy sensors in use to control lights.

There is a 10 hp shop air compressor. The compressed air system is shutdown at night when it's not in use.

Recommended Opportunities

This facility has simple and relatively efficient systems that are in good working condition. The Energy Use Index (EUI) for the building is 55 kBtu/SF indicating good performance which is consistent with our observations from the tour.. Our recommendations are listed in the table below and described following the table.

Table 4 – Summary of Energy-Related Opportunities for the DPW

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr		
1. Apply More Aggressive Temp Setbacks	$0	$0		-	-	-	100	$100	Immediate
2. Replace Overhead Door Seals	$1,000	$0		-	-	-	300	$400	2 - 4
3. Replace Exhaust Fan Dampers	$2,000	$0		-	-	-	100	$100	10+
Estimated Program	***$3,000***	***$0***		**-**	**-**	**-**	***500***	***$600***	***5.0***

Notes ***Current Utility Budget:*** ***$18,000 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***3%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

4.1 Apply More Aggressive Temperature Setbacks

The thermostats in the Durham's DPW are programmable. We understand that heating in the garage is shutdown at night except during a snow event when the facility is active. This is an excellent practice to minimize energy use. During unoccupied periods, the administrative area is

maintained at 64°F (winter) and 74°F (summer). We recommend adjustment of these thermostat settings for more aggressive setbacks. For example, many similar facilities are able to operate at 55-60°F (winter). Due to moisture issues, we do not anticipate that this space can be kept warmer at night in the summer.

Next Step: Confer with staff to learn how HVAC systems perform during the morning warm-up / cool-down periods so that an appropriate start time can be programmed to ensure comfort when staff and others arrive in the morning.

4.2 Replace Overhead Door Weather Seals

The DPW has a total of ten bay doors. Six doors are full size and there a four smaller units. All the doors are insulated and appear to be in reasonably good condition for their age. However, the weather stripping is damaged in some sections and should be replaced. Having tighter door seals will help reduce thermal losses and keep heating costs down. Weather seals should be inspected and updated each fall.

Next Step: Consult with door specialist or supplier of original equipment to obtain pricing for new and replacement seals. Town maintenance staff may be able to add the seals to save money and the complication of obtaining bids; otherwise the job should be priced by a general or door contractor in conjunction with other door work in Town buildings.

4.3 Replace Exhaust Fan Dampers

This DPW facility has an exhaust fan system in the high bay area. We noticed daylight through the closed louvers. Given the high location of the fan, openings in these dampers will let a considerable amount of cold air in/out during the winter depending on wind and other opening in the building. We recommend replacing the damper assembly with a model that uses gasketed weather-tight dampers.

Next Step: Consider damper options and if replacement by Town staff is an option. If necessary, invite local mechanical contractors to bid on new damper assembly.

5.0 Police Station

Durham's Police Station was originally a bank. In 1998, the Town purchased the property and put an addition on the building including booking and Patrol areas with Sallyport. Otherwise, the building includes offices, a training room, locker rooms and several server areas. This facility doesn't have a dispatch function, which is handled by Strafford County. Administrative functions are during normal business hours (weekdays 8 a.m. to 5 p.m.). Officers are on duty round the clock, so the facility remains open 24/7.

This basement and ground level facility has masonry block walls with brick facade and wood framed pitched and flat roof sections. Attic insulation has been loosely applied in the building's addition, is missing in many areas and is overall not very effective. Since the original section of the building's attic

has flooring, condition of insulation in the original building is unknown. Staff report that they saw wall insulation when a wall was opened up. Windows in the original structure are wooden framed with single pane glass. These windows are in typical condition for this age/type and offer poor weather resistance. The addition has aluminum framed sliding windows, which offer better performance. We noted that window seals on the DX unit in the server room did not fit well and that there is a gap to weather.

This building is heated by a perimeter hot water system. Hot water is supplied by a pair of oil-fired 140 MBH Peerless boilers. Heat is controlled by older Honeywell thermostats. The boiler plant is manually started/stopped seasonally.

Air conditioning is provided by several through the wall DX air conditioners. Original air handling equipment appears to have been abandoned in place in the attic space.

Lighting at the Police Station is T8 fluorescent. Exterior lights were recently updated to LED. There may be opportunity to add occupancy sensors in some areas.

Recommended Opportunities

The Police Department is small with simple systems. Aside from poor attic insulation and fit of window air conditioners, this building should be relatively efficient. However, utility data for this facility is not available at this time and we have been unable to confirm performance. We have three recommendations listed in the table below and described following the table.

Table 5 – Summary of Energy-Related Opportunities for the Police Station

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr		
1. Add Occupancy Lighting Control	$750	$100		-	400	-	-	$100	6 - 9
2. Seal Window A/C	$250	$0	A	-	300	-	-	$50	3 - 5
3. Update Attic Insulation	$8,000	$0	A	-	-	-	500	$600	7+
Estimated Program	***$9,000***	***$100***		***-***	***700***	***-***	***500***	***$750***	***11.9***

Notes ***Current Utility Budget:*** ***NA*** ***/yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***NA***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

5.1 Add Additional Occupancy Sensors

There is an opportunity to install a lighting occupancy sensor in the training room and possibly other intermittently used areas of the building. Occupancy sensors automatically turn lights off when areas aren't in use.

<u>Next Step</u>: Review all areas of the building for possible motion sensors. Determine usage patterns and where the sensors will reduce lighting run time. Consult with lighting specialist if necessary for installation service. Peregrine is available to review bids or other documentation.

5.2 Seal Window A/C

Window A/C unit window frame sealing panels should be replaced and tightly attached to air conditioner and window frame. If not already, we recommend removing the window units for the winter.

<u>Next Step</u>: Select new window to air conditioner sealing system. Town maintenance technicians should install the flashing.

5.3 Update Attic Insulation

The attic area has some fiberglass blanket insulation in the addition area and probably in the original section under flooring. In the addition area, the insulation is very poorly distributed and there are large areas with no coverage. We recommend replacement of missing insulation and blowing cellulose on top to achieve a net R value of 50 or higher. Insulation under the flooring should be checked and updated as appropriate. As part of the job, all penetrations to the space should be carefully sealed. We expect insulation improvements will provide a noticeable improvement in comfort and/or reduced fuel use.

<u>Next Step:</u> Peregrine can provide Durham with an outline specification to solicit bids for insulating the Police Station. We are also available to help the Town select a contractor.

6.0 Town Hall

Durham's Town Hall was originally two independent residences. A subsequent addition joined the two houses, which were heavily renovated to provide town department office space. The building has two main floors, plus storage space in the former finished third floor areas. The Town Hall is in use during normal business hours with some evening activity.

The building is wood construction with pitched roof sections. There is very limited or no wall insulation. We expect there is some attic /roof insulation although this could not be confirmed. Windows are about 15 years old, double-pane, operable units. We understand that the counter weight voids in the wall frame at the windows were not filled with insulation as part of the window replacement job. There are some newer fixed windows in the connector part of the building. Exterior doors don't have functional weather seals. We noted that window air conditioners are poorly fitted to windows.

This building has two independent oil-fired boiler plants that serve each side of the building. Each plant consists of a single Peerless oil-fired hot water unit. One is rated at 129 MBH and the other 112 MBH. Both boilers are older and likely to be at the end of their normal service lives. Offices and the IT room are cooled by window air conditioners. The Council Chamber has a small split system with programmable thermostat.

Lighting has been recently updated and includes mostly T8 and compact fluorescent systems. There are occupancy sensors in the bathrooms, but we didn't note their use anywhere else.

This building has a number of issues including space constraints and non-compliance with ADA requirements. While the Town plans to replace this building, funding and the timeframe for new construction have not been established. That being said, since the future of this building is uncertain,

investments in energy efficiency should be limited to projects that provide strong paybacks for immediate benefits.

Recommended Opportunities

The Energy Use Index (EUI) for the Town Hall is 138 kBtu/SF. This is a very high value and we question that the square footage data provided (3,040 square feet) is accurate since this rating is about twice as high as we would expect for a facility of this age, even with antiquated oil boilers. Electric use is minimal, therefore we conclude that focus areas for this buildings are around heating and building envelope.. Our ideas to reduce utility use are described following the table.

Given plans to replace the building in the near future, our main recommendation is Number 6.4 below: *Seal off the third floor in the winter*. Other measures also may be viable if the Town can implement projects themselves at a lower cost.

Table 6 – Summary of Energy-Related Opportunities for Town Hall

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr		
1. Add Daylighitng Control	$500	$100		-	300	-	-	$50	5+
2. Add Weather Seals ot Exterior Doors	$1,000	$0	A	-	-	50	-	$100	7+
3. Fill Window Voids with Insulation	$2,000	$0	A	-	-	50	-	$100	10+
4. Seal Off Third Floor	$0	$0		-	-	75	-	$200	Immediate
Estimated Program	***$3,500***	***$100***		**-**	***300***	***175***	**-**	***$450***	***7.6***

Notes ***Current Utility Budget:*** ***$6,900 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***7%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

6.1 Add Daylight Controls

Lights remain on during the day and in the foyer and entrance to the Town Hall. These areas receive ample natural daylight and there is no need to have the lights on. We recommend adding photocell based controls that automatically control these lights.

Next Step: Review all areas of the building for possible daylighting controls. Determine circuitry and if any rewiring is required to control only lights near windows. Consult with lighting specialist for controller and for installation service, if necessary. Peregrine is available to review bids or other documentation.

6.2 Add Weather Seals on Exterior Door

The Town Hall has several exterior doors. None of the doors have weather stripping, which is paramount to sealing drafts, particularly in the winter. Seals can easily be added to all of these doors.

Next Step: Conduct more detailed review of exterior doors to establish a detailed scope of work. Consult with door specialist to select and price weather strip system. A Town technician can probably install the product and repair door(s). Otherwise obtain pricing from a contractor. We suggest combining similar work for other Town facilities which appear to have much of the same issues. By combining work, it is much more likely that the Town will achieve a favorable bidder response.

6.3 Fill Window Voids with Insulation

Windows at the Town Hall were replaced about 15 years ago. These windows are thermal pane with vinyl frames and are reasonably efficient by today's standards. However, we understand that counterweight voids framework for prior windows were never filled. Depending on how the new windows were installed, it may be possible to fill these voids with expanding foam to minimize draft into the building and to provide some insulating properties.

Next Step: Conduct more detailed review of window installation with an airseal or building science specialist. Peregrine can help the Town generate bid specification for a public solicitation, if contracting the work is an avenue the Town wants to pursue.

6.4 Seal Off Third Floor

The Town Hall has stairs to a third floor area in one of the prior residences. This area is used principally for storage, although there is also an office. We understand the office isn't used regularly. We suggest relocating the person(s) assigned to this office space to another part of the building and sealing off the area for the winter and shutting off the heat. Ideally a doorway could be installed at the second floor level of the stairway. Otherwise plastic can be applied at a higher level to mitigate natural flow of warm air into the space.

Next Step: Discuss options with building staff. Have Town building maintenance technician install door or seal off area for the winter.

7.0 Transfer Station

Durham's Transfer Station consists of gatehouse, main shop and a series of outdoor bins to collect recyclable material. The main shop has an open high bay area for vehicles as well as a cardboard bailing machine. The building has a break room and mezzanine with office area. Staff are at the site from 6:30 a.m. to about 5 p.m. The transfer station is open to the public on Tuesdays and Saturdays from 7 a.m. to 3:30 p.m.

The cardboard bailing machine is typically in operation for two to three days every other week. The unit has an approximately 50 hp hydraulic pump.

The main building is typical shop construction with metal framing and siding. The building is insulated from the interior with blanket insulation. There are several openings in the building that should be sealed. There is one overhead door that likewise has a poor weather seal. The few windows at this facility are in rough condition. We did not look at the small gatehouse.

The shop is heated by a Duomatic Olsen oil-fired furnace. The unit is controlled by an older non-programmable thermostat. Heat is reported to be turned off at the end of the workday. We presume that the gatehouse is conditioned by a heat pump.

The bay is lit by six 400 watt metal halide fixtures. Otherwise there are a few T8 fluorescent lights. There is minimal exterior light use.

Recommended Opportunities

The transfer station uses a significant amount of electricity that is associated with cardboard bailing. Fuel (oil) use is typical at just over 1,300 gallons per season. We do not have accurate square footage data and therefore can't perform an Energy Use Index (EUI) evaluation. We identified two simple measures that can be easily implemented to save energy. Our ideas are described following the table. **Further, we recommend review of how the bailer is operated to assure that the unit isn't idled for extended periods during the work day. The way this unit is configured, it uses nearly full load power continuously - loaded or unloaded. We recommend turning it off when it isn't actively bailing cardboard.**

Table 7 – Summary of Energy-Related Opportunities for the Transfer Station

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Gas Therm/yr		
1. Replace HID Lights with Fluorescent	$3,000	$300		1	2,100	-	-	$300	8+
2. Air Seal Building	$500	$0		-	-	75	-	$200	2 - 5
Estimated Program	***$3,500***	***$300***		***1***	***2,100***	***75***	***-***	***$500***	***6.4***

Notes ***Current Utility Budget:*** ***$6,900 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***7%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

7.1 Replace HID Lights with Fluorescent

The transfer station main shop has six metal halide fixtures, probably 400 watts each. These lights are generally on during the work day, especially in cooler weather when the overhead door is closed. It may make sense to replace these fixtures with T5 or T8 fluorescent fixtures which provide better light quality using less energy.

Next Step: Confirm quantity, wattage and operating hours of existing HID fixtures and select replacement fixtures. We suggest consulting with a lighting specialist. Peregrine is available to review bids or other documentation.

7.2 Airseal Building

The transfer station has relatively poor thermal performance, as is typical with most metal sided shop buildings. It is usually difficult to justify significant investments required to make meaningful improvements on these types of low cost building structures. However, we noted several minor improvements that can be easily pursued: (1) there are unused pipe penetrations from a prior incinerator that can be removed with the holes patched and sealed; (2) the weather seals on the overhead door should be replaced in several sections; and (3) there are several other wall penetration for electrical conduit, door/window frames, etc with minor gaps and it would be beneficial to go over the entire building with caulk or expanding foam to seal up all openings.

Next Step: This work can be completed by Town maintenance technician as time allows. The materials are common and not expensive. It wouldn't hurt to bring in a qualified air sealing contractor to be coordinated with other airsealing scope in other Town buildings.

8.0 Waste Water Treatment Plant

Durham's waste water treatment facility processes waste water from both the Town of Durham as well as the University of New Hampshire (UNH). Process rate is up to 1.3 million gallon per day (MGD) during the school year and otherwise about 0.5 MGD. The facility consists of the main plant with headworks, aeration blowers, Sodium Hypochloride dosing room, multiple process pumping areas, lab, administrative area and maintenance shops. There is a separate sludge dewatering and processing building that includes a truck bay. The plant is manned 7 a.m. to 5 p.m. weekdays. The dewatering process takes place 4 -5 days a week during the school years down to one day a week when the UNH is not in session.

There have been extensive process updates at this plant, which is technologically up to date and appears to be as energy efficient as possible. There are four new low pressure aeration blowers: two 75 hp units and two 100 hp units. All blowers are equipped with variable frequency drives (VFD) that are controlled by dissolved oxygen levels in the treatment basin. The plant has relatively new headworks solids separation and handling equipment as well. Clarifier basins are older but do have energy intensive mixing. Plant process water and transfer pumps are VFD controlled. We also noted that all significant electric motors are newer premium efficiency models.

The main processing building is concrete and concrete block construction with steel deck and built up membrane roof. There is one ground level with multiple below grade processing areas. We do not have details on building insulation, which is expected to be minimal at best. The dewatering building is a large steel framed high bay structure with main processing and truck loading area. This building has three overhead doors that are lacking weather seals. As above, the building is not expected to be well insulated.

Occupied parts of the main building are conditioned by four water-source heat pumps. Condenser water is circulated by a pair of 5 hp centrifugal pumps (one standby). Condenser heat is rejected by rooftop BAC evaporative cooler. Heat is added to the loop in the winter by a 24 kW electric boiler. The heat pumps are controlled by local thermostat. Space temperature is generally maintained around 70^{o}F year round. This system is beyond its useful service life and the plant would like to see a better HVAC system installed.

There are two electric unit heaters in the headworks area which require some heating in very cold conditions. Other processing areas in the building are below grade and don't require heating.

The dewatering building is heated by four propane-fired ceiling Reznor unit heaters. This space is maintained at 70^{o}F during active processing and 60^{o}F standby. It is not possible to reduce temperature during standby due to adverse affects on restarting hydraulic processing equipment.

Lighting at both buildings is primarily T12 fluorescent. The laboratory and possibly other administrative offices were updated to T8s. Hallways are overlit. The headworks area uses metal halide lights that are generally left on 24/7, probably due to re-strike time. Fluorescent lights in other processing areas are reported to be turned off when staff leave for the day.

Recommended Opportunities

Energy use at the wastewater treatment plant is dominated by process equipment. Technologically Durham's wastewater treatment facility is up to date and appears to be as efficient as possible without getting into very aggressive changes, such as adding a digester to generate methane for power production.

We focused our attention on lighting and HVAC systems, which have not received recent attention. Opportunities to reduce energy are listed in the table below. Our ideas are described following the table.

Table 8 – Summary of Energy-Related Opportunities for the Waste Water Treatment Plant

Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings				Annual Cost Avoidance	Simple Payback Yr
				Demand kW	Electric kWh/yr	Oil Gal/yr	Propane Gal/yr		
1. Update Fluorescent Lighting	$7,500	$1,000	B, D	1	6,900	-	-	$900	5 - 8
2. Replace HID Lights with Fluorescent	$4,000	$300	D	1	11,800	-	-	$1,500	3 - 5
3. Add Weather Seals on Overhead Doors	$500	$0		-	-	-	50	$100	5+
4. Replace Electric Boiler with Propane Unit	$25,000			24	32,000	-	(1,500)	$1,400	15+
Estimated Program	***$37,000***	***$1,300***		***26***	***50,700***	***-***	***(1,450)***	***$3,900***	***9.2***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: *$177,800 /yr*
Percent Reduction: *2%*

8.1 Update Fluorescent Lighting

Most areas within this plant and the adjacent dewatering building are lit with fluorescent fixtures. It appears that a large percentage of these fixtures use T12 lamps and older ballasts. There is an immediate advantage to updating all lamps and ballasts to T8 technology with low power electronic ballasts. New 28 watt super T8s should be considered. It appears that the dewatering building is overlit and the lighting layout should be redesigned to improve the effectiveness of the lighting system. It should be possible to reduce plant lighting energy use by 30 percent or more.

Next Step: Conduct a full lighting survey and fixture count. We recommend using a qualified lighting contractor who will provide this service at no cost and will subsequently generate a fixed price proposal for an engineered solution that may include some new fixtures, reflectors, rewiring and/or lighting level adjustments. The lighting contractor's proposal would normally include energy savings and PSNH rebate projection. These calculations must meet PSNH's rebate application requirements. Peregrine can assist the Town of Durham by sourcing contractor(s) and overseeing the effort.

8.2 Replace HID Lights with Fluorescent

We noted six fixtures in the headworks building. There are likely a few additional HID fixtures at this plant. These fixtures are on 24/7, we presume largely because of the several minute warm-up time required for them to produce usable light. These fixtures make good candidates for replacement with T8 fluorescent technology that can be flipped on/off at will when staff enters the area(s). We

recommend considering fixtures with integral occupancy sensors to assure that lights stay off when nobody is working in the area. Any exterior HID lighting can be replaced with LED technology.

Next Step: Confirm quantity and wattage of existing HID fixtures and select replacement fixtures. We suggest consulting with a lighting specialist as part of the bigger fluorescent light project mentioned above. Peregrine is available to review bids or other documentation.

8.3 Add Weather Seals on Overhead Door Weather Seals

The dewatering building has several overhead doors. One door has some semblance of a weather seal, but nothing on the bottom edge to seal the door to the floor. Other doors have no seals at all. Having tighter door seals will help reduce thermal losses and keep heating costs down. Weather seals should be inspected and updated annually in the fall.

Next Step: Consult with door specialist or supplier of original equipment to obtain pricing for new and replacement seals. Coordinate with other door seal scope in other Town buildings.

8.4 Replace Electric Boiler with Propane Fired Unit

The main building's HVAC system is based on four water-source heat pump air handling units. In winter operations, heat is added to the condenser loop by a 24 kW electric boiler. This system is older, and operating staff would prefer to have a simpler system such as DX rooftop units. However, water source heat pumps are fairly efficient when setup properly and components, albeit old, appear to be functional. It will not be possible to economically justify a wholesale HVAC replacement until the system becomes unreliable and must be replaced as a capital project. In the meantime, there are cost benefits to replacing the electric boiler with a propane fired unit. A high efficiency condensing model can be used at the plant which costs much less to operate than the current electric unit.

Next Step: Further engineering is required develop a scope of work for boiler replacement and the addition of a propane storage and delivery system. One of the complications will be finding a suitable route for combustion make-up air and exhaust. Building thermal load should also be evaluated to correctly size the boiler and to more accurately determine savings potential. Peregrine is available to provide further technical support and to help the Town develop outline specifications to be used in a request for proposal.

8.5 Other Options to Consider

Convert Heat Pump Loop to "Ground Source". While unconventional, there is potential to thermally link the heat pump condenser water loop to wastewater effluent via heat exchanger. The effluent would act as moderate temperature heat sink that depending on temperature profile can probably maintain appropriate condenser water loop temperature year-round without using the rooftop evaporative cooler or the electric boiler. This would simplify the system operation and make it more energy efficient. The thermal load from the HVAC system is small compared to volumes processed

daily and we would not expect there to be any noticeable wastewater temperature impact. However, the weak link for this system is the heat exchanger which is subject to fouling and will require periodic maintenance. There are numerous wastewater specific heat exchanger systems available that would be suitable for this application. **If there is interest in this approach, Peregrine can provide an initial feasibility analysis.**

Relocate Water Sampling Station: There is a small (<1 hp) pump that provides a continuous flow of wastewater to the laboratory for periodic sampling. Once in the lab, the water drains to the plant's own wastewater system and is pumped again back into the main wastewater stream. The dominate source of wastewater in the plant's system is from this sampling flow. To save pumping, operating staff have suggested relocating the sampling station to a prospective new outbuilding adjacent to one of the basins. A pump will still be required, but it can be much smaller; and all water can be gravity drained directly back into the basin. We expect that the cost of building and maintaining a new structure will outweigh the advantages of reduced energy use from the building's current pumping systems. **We recommend relocating the sampling station if a more suitable space becomes available that doesn't require new construction.**

Add Hydraulic Heaters: We wonder if there could be an advantage to add hydraulic sump heaters to the equipment in the dewatering area so that space temperature can be maintained at a much lower temperature in the winter. There would be a significant energy and cost advantage if the building could be kept at 40-50^{o}F in the winter.