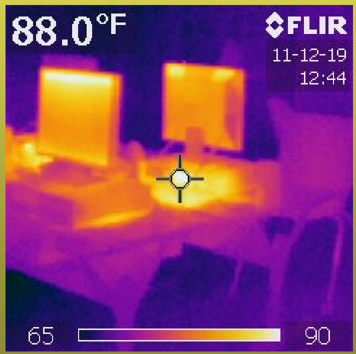

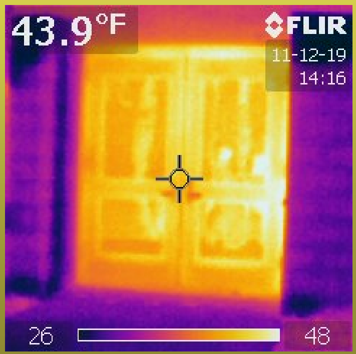

Facility Audit Report
Hollis Upper Elementary School

FINAL

May 2012

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

A. EXECUTIVE SUMMARY

Program Introduction

Figure 1: Hollis Upper Elementary School

The Town of Hollis requested investment grade audits for seven (7) municipal buildings and five (5) school buildings located within the Town. Funding was provided by the United States Department of Energy (DOE) through the New Hampshire Office of Energy and Planning (NHOEP) Energy Efficiency Conservation Block Grant (EECBG) program.

Phase one of the evaluation process involves site assessment planning including evaluating utility bills, benchmarking, reviewing building and mechanical plans where available, and coordinating site and visits. Phase two involves conducting a comprehensive and holistic facility evaluation to gather relevant information and data. Analyzing the collected data and developing recommendations for energy efficiency measures is completed in Phase three. This information is presented to the Town and school district within this report.

The objective of the building evaluation completed at the Hollis Upper Elementary School (HUES) (Figure 1) is to identify measures that reduce the net energy consumption thereby reducing operating costs and the consumption of non-renewable fossil fuel energies. In addition to energy conservation, the evaluations and recommendations presented herein consider occupant comfort and holistic building performance consistent with its intended use and function. The information obtained as part of this evaluation has been used to develop recommended Energy Efficiency Measures (EEMs). These EEMs provide the basis for future building improvements and modifying the manner in which the building systems are operated.

Procedure

Facility audits or evaluations identify all appropriate EEMs and a financial analysis that considers implementation costs, operating costs, and attainable savings. The objective is to identify the predicted energy savings, the amount the measure will cost, and the estimated payback period for each EEM. The evaluation also identifies any changes to operations and maintenance procedures that will reduce energy consumption. A comprehensive field survey of the facility is completed to evaluate the following:

- *Building Characteristics*
- *Building Use and Function*
- *Envelope Systems*
- *Heating and Cooling Systems*
- *Ventilation Systems*
- *Electrical and Lighting Systems*
- *Domestic Hot Water Systems*
- *Plug Loads*

Following completion of the field evaluation, the data and information are reviewed to develop proposed recommendations for the facility. All information, data, and recommendations are then compiled into a comprehensive report. The final report is then distributed to the municipality or school to assist with implementation and budgeting of the proposed EEMs. The information provided in the reports will assist the owner with determining the best value EEMs for their facilities. The reports also identify potential financial resources available to help fund the EEMs.

On December 19th and 27th, 2011 AEC personnel completed building site reviews at the HUES to obtain the information necessary to complete an assessment of overall building performance. All building systems that impact energy consumption were evaluated including the building envelope, heating and cooling, ventilation, electrical, plumbing, and mechanical. Secondary observations are also reported herein and include building code compliance, life safety, structural systems, and roofing systems. This evaluation also considers whole building performance that measures how well the integrated building systems in the HUES function as a composite system.

AEC completed a desktop review of the data provided by the School Administrative Unit 41 (SAU 41) including historical energy consumption data. The field review included an evaluation of all building systems and data collection including an infra-red thermal imaging survey, indoor air quality measurements, lighting density measurements, and metering of lighting fixtures and HVAC equipment. The HUES building was modeled using a building energy modeling computer program (eQUEST®) and calibrated to historical energy data. A series of energy efficiency measures (EEMs) were then simulated in the 3-D building model to measure their effect on energy consumption. Capital investment costs for each EEM were developed, and based upon the predicted cost savings associated with the energy efficiency measure, the payback term is calculated. A savings to investment ratio (SIR) for each EEM is then calculated based on the cost of implementation, the predicted energy cost savings, and the predicted service life of the measure/equipment. Other noted recommendations relate to indoor air quality, occupant comfort, code compliance, accessibility, and life safety.

Summary of Findings

The building performance evaluation at the HUES revealed that the building energy consumption is about average for an elementary school facility however there are a number of factors which attribute to a higher energy consumption than necessary. Major factors attributing to the energy use include:

1. Inefficient heating supply system comprised of ten (10) low efficiency boilers.
2. An inefficient heating distribution system.
3. A poorly insulated envelope (floor, wall, and roof assemblies).
4. Electricity used for the Town domestic water supply system is metered through the HUES.

Notable Observations

The following notable observations were made during the desktop data review and/or the building evaluation. Notable observations may be related to data that is outside the normal or expected range, irregularities in building use or function, or problematic systems.

- Energy use intensities (EUI) for the building are within the expected range for a K-12 facility. The ENERGY STAR® rating for the HUE School facility is a 49, meaning it is uses 1% more energy than the average K-12 school.
- The domestic water supply pump system servicing multiple schools and Town-owned buildings and a few residential dwellings is connected to the HUES electrical meter. Presumably, the pump and water treatment systems use a significant amount of energy skewing the energy consumption for the HUES.
- A direct digital controls (DDC) system was recently installed in the building and appears to be optimized. Equipment is scheduled to operate consistent with occupancy schedules. Facilities with optimized DDC systems generally use 10% less energy.

- Ten (10) boilers are interconnected for heating supply systems. This multi-unit configuration is not optimal and the dated oil-fired boiler units have low combustion efficiencies. Service and maintenance of the boilers is difficult due to physical access constraints. The older boilers have endured beyond their expected service life.
- The K-12 facility contains a higher number of appliances relative to typical K-12 facilities. Appliances include compact refrigerators (15), microwaves (17), and water fountains (10).
- Domestic hot water (DHW) equipment and capacity exceeds the expected demand.
- Gaps in entry doors and windows provide a significant amount of thermal energy transfer (typical of older K-12 facility).
- Lighting densities throughout the building consistently exceed the recommended industry standards (IESNA) for the prescribed space use. This was designed as part of the lighting upgrade project of 2011. Refer to *Lighting* section portion of Section D for further investigation and recommendations.
- Temperatures were not consistent throughout the building and most spaces exceed the recommended setpoint for a K-12 facility. The recommended setpoints are between 66°F and 69°F and twenty (20) of twenty-six (26) locations measured exceeded this range with a facility average of 71.8°F.
- Mechanical exchange air ventilation in some areas of the building is inadequate and carbon dioxide levels exceed the EPA recommended threshold.

Summary of Recommendations

Following is a summary table identifying the proposed recommendations, EEM investment costs, predicted annual energy cost savings, simple payback period and savings to investment ratio. Part G provides a more detailed explanation of these recommendations.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. There are interdependencies among measures that will affect the net composite energy savings. Interdependent measures are parametrically related therefore the net energy savings from two dependent measures do not equal the resulting savings determined by the addition of the two measures considered independent of each other. Investment costs are provided for budgetary planning only. They are estimated based on current industry pricing. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures. Budgetary cost estimates for the Tier III and more costly Tier II measures are presented in Appendix J.

Table 1: Energy Efficiency Measure Modeling

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
TI-1	Disconnect water fountain condensers in the building (10).	$0	$600	0	-
TI-2	Remove vending machines (2) or replace with ENERGY STAR® rated units	$0	$726	0	-
T1-3	There are seventeen (17) microwaves located throughout the building. Recommend consolidating with fewer units (3 or 4).	$0	$97	0	-
T1-4	Repair open makeup air damper in boiler room and interlock with boiler operation.	$350	$600	0.6	17.1
T1-5	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior).	$450	$890	0.5	13.8
T1-6	Consolidate fifteen (15) compact refrigerators with three (3) ENERGY STAR® rated standard size refrigerator units.	$1,500	$1,440	1.0	9.6
T1-7	Power down all electronic equipment when not in use. Install time or motion controlled power strips.	$900	$676	1.3	7.5
T1-8	Install additional interior lighting controllers to reduce lighting density and runtime (photosensors, dimming controls, motion sensors, timers).	$2,600	$1,270	2.0	7.3
T1-9	Install eCube® unit on the walk-in freezer.	$500	$180	2.8	4.3
T1-10	Install exhaust fan controllers using either multi-point time scheduled controllers or demand controllers to reduce operating frequency.	$2,200	$480	4.6	2.6
T2-1	Replace three (3) DHW tank units with two (2) demand-tankless electric condensing units.	$4,000	$700	5.7	2.6
T2-2	Reduce lighting densities throughout the building. Replace some lamps with lower wattage lamps and remove unnecessary fixtures.	$3,000	$450	6.6	1.9
T2-3	Replace walk-in Freezer condenser with high efficiency unit with economizers	$3,039	$396	7.7	1.9
T2-4	Install four (4) de-stratification fans in the cafeteria and six (6) in the gymnasium.	$4,500	$800	5.6	1.7
T2-5	Replace exterior metal halide wallpack fixtures with LED units (14).	$7,970	$915	8.7	1.7
T2-6	Install VFD controls on Munters® ERV fan motors.	$2,800	$300	9.3	1.6
T2-7	Install commercial thermal insulated shades on windows and close at night during heating periods.	$7,200	$700	10.3	1.0
T3-1	Replace all electrical transformers older than 15 years with high efficiency units.	$51,578	$12,000	4.3	3.5
T3-2	Install CO_2 demand controls on ventilation equipment.	$10,000	$1,800	5.6	2.7
T3-3	Replace the ten (10) oil-fired boilers with two (2) 90% high efficiency units. The new system will be interconnected to the domestic hot water system and DDC system. Install new NEMA rated circulation pumps with VFD controls.	$222,410	$13,066	17.0	1.5
T3-4	Sub meter the pump house to measure electric consumption.	$2,600	NA	NA	NA
T3-5	Install exchange air ventilation systems with energy recovery units and demand controls in all areas not served by the existing ERV unit (1st floor). *(IAQ measure)*	$119,715	NA	NA	NA

The following table summarizes the renewable energy technologies that were considered for the Hollis Police Department. Scores are determined based upon the feasibility of the technology for the facility. A more focused feasibility study should be completed prior to considering any renewable energy system(s).

Table 2: Renewable Energy Technology Feasibility Scoring Results

Renewable Energy Technology	Grade
Roof Photovoltaic	82%
Biomass Heating	80%
Geothermal Heating/Cooling	79%
Solar DHW	78%
Wind Turbine Generator	75%
Ground Photovoltaic	74%
Solar Thermal	69%
Combined Heat & Power	64%

Insulation resistance values (R-values) were determined based on given information, time of construction and visual observations. The industry standard *International Energy Conservation Code (IECC), 2009* for Commercial Buildings in Climate Zone 5 required values are provided along with the installed values in Table 3. The IECC values are for new construction only, however provide a guide as to how this facilities insulation compares with new construction.

Table 3: Facility Insulation Summary

	Insulation Values		
Space	Required (IECC, 2009)	Recommended	Installed
Ground Floor	NA	10	1.1
1980 Mass Wall	11.4 ci	11.4 ci	16.4 + 9.0 ci
1997 Mass Wall	11.4 ci	11.4 ci	2.0 + 9.0 ci
Pitched Metal Roof	38.0	38.0	20.3
Flat Roof	20.0 ci	20.0 ci	1.2 + 13.5 ci

Master Planning Considerations

Prior to implementing EEMs and making significant capital investments in the HUES and Hollis Primary School (HPS) facilities, a district-wide master plan should be developed. The HPS facility was constructed in 1952 with later additions through 1978 when student populations were dramatically rising. In general, public school buildings of this era were designed and constructed on an expedited schedule and low budget. The designers and constructors did not adequately consider spatial layout and function, efficiency, or durability. Modern design considerations for K-12 facilities include energy efficiency, occupant comfort, indoor air quality, sustainability, accessibility, and an environment conducive to learning and social development.

Modernization of the HPS facility consistent with current K-12 facility standards would require a significant financial investment. Modern energy efficient and sustainable K-12 facilities are designed as multi-story buildings. This reduces the building footprint, reduces the roof area where most thermal transfer occurs, and reduces construction costs. The existing HPS structure is very flat in configuration and structural elements would likely not support vertical expansion. As presented in the HPS audit report, issues include:

- Accessibility compliance.
- Inefficient heating and cooling systems and poor distribution.
- Inefficient and unbalanced ventilation systems.
- A building envelope with very low thermal integrity.
- Poor spatial layout and function.

The current facility full-time enrollment (FTE) density is high compared to other schools. That is, at 137 square feet (SF) per FTE there are relatively more students in the building compared to other regional elementary schools (average of 198 SF/FTE). However, consistent with most local communities, projected FTE numbers are declining over the foreseeable future. Master planning of the Hollis elementary school district should consider the following:

- Facilities operations and maintenance costs for the HPS are expectedly high.
- Modernizing the HPS facility to current standards will require a substantial cost investment.
- FTE density in the Hollis Upper Elementary School (HUES) is very low (292 SF/FTE).

Consolidating the HPS grades (pre-K-3) into the HUES (4-6) would provide a student density of 213 SF/FTE (lower student density than average). Modernizing and improving the efficiency of the HUES facility to accommodate additional grades and students is a practical consideration.

B. PROCEDURES & METHODOLOGY

Standards and Protocol

The American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has developed the most widely accepted process for completing energy audits at commercial facilities. ASHRAE document RP-669, SP-56, *Procedures for Commercial Building Energy Audits* defines several levels of audits. The appropriate level of audit for a particular facility depends on the availability of existing data and information, owner objectives, and owner budget. Levels range from simple benchmarking to a comprehensive review of all building systems. The most comprehensive audit is a Level III. Level III audits are commonly referred to as "Investment Grade Audits".

Basic elements of a Level III Investment Grade Audit include the following:

- A review of existing facility data including energy usage.
- Benchmarking the facilities energy usage relative to similar use facilities.
- An on-site inspection and survey of all facility systems.
- On-site measurements and data collection.
- Informal interviews with owners, facility managers, and occupants.
- Energy use analysis and development of efficiency measures.
- Developing a simple payback cost estimate for each recommended measure.
- Development of a comprehensive report that clearly presents all findings and provides recommended energy conservation measures and the associated costs.

In addition to the ASHRAE standard for commercial audits, there are industry and code-based standards that must be considered when analyzing building systems and evaluating energy conservation measures. All recommendations must be consistent with the intent of these standards. For example, the US Environmental Protection Agency (EPA) has established a recommended carbon dioxide (CO_2) threshold concentration of 1,000 parts per million (ppm) to promote a healthy indoor air environment. ASHRAE defines recommended temperatures, relative humidity levels, minimum ventilation rates, and energy standards. The Illuminating Engineering Society of North America (IESNA) prescribes recommended lighting densities based on the designated space use. The International Code Council (ICC) is the adopted standard for all building and energy codes (2009) in the state of New Hampshire. New Hampshire has also adopted ASHRAE Standards 62.1 and 90.1.

Table 4: Relevant Industry Codes and Standards

Standard	Description
28 CFR Part 36	ADA Standards for Accessible Design
ANSI/ASHRAE Standard 55	Thermal Environmental Conditions for Occupancy
ANSI/ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ANSI/ASHRAE/IESNA Standard 90.1	Energy Standards for Buildings Except Low-Rise Residential Buildings
ICC 2009	International Building Code (IBC)
ICC 2009	International Existing Building Code (IEBC)
ICC 2009	International Energy Conservation Code (IECC)
ICC 2009	International Mechanical Code (IMC)
ICC 2009	International Fuel Gas Code (IFGC)
IESNA Lighting Handbook	Reference and Application
NFPA 70	National Electrical Code (NEC)

While the primary objective of an energy audit is identify energy conservation measures, such measures cannot adversely affect occupant comfort and indoor air quality. For example, if a building ventilation system is inadequate then it would be recommended that additional ventilation capacity be added. The electrical power required to operate the added ventilation equipment would increase energy consumption. Typically, the net energy usage incorporating the sum of the recommended conservation measures would still be less than the current usage even with the added ventilation equipment.

It is noted that although there is a prescriptive approach to commercial building audits, that every building is unique in many ways. Buildings should be evaluated consistent with the characteristics that define its need and appropriate function. This includes the following:

- *Use*: Current building use and occupant needs.
- *Systems*: Building system characteristics and how each system integrates within the composite facility ultimately determining building function and energy usage.
- *Control*: The manner in which the facility manager utilizes the existing controls for building systems.

Desktop Data Review

Ideally, the building owner provides all available information to the engineering firm prior to initiating the facility site review. Information such as utility bills, building plans, repair records, planned improvements, and occupant concerns will help the building engineer identify potential issues before initiating the site review. The Building Engineer can then focus the site review toward problematic and energy intensive building systems.

Facility Site Review

Following the desktop data review, the Engineer initiates the facility site review. This review includes all major building systems including the envelope, electrical, mechanical, heating, cooling, and ventilation. The Engineer not only determines the performance and operating characteristics of all building systems, they also evaluate how the users operate the systems and how they perceive building performance. Photographs of representative systems, major equipment, and any identified issues are obtained to help document existing conditions. Field notes are maintained by the Engineer to further document building and user characteristics.

Data Measurements

In addition to collecting equipment information, several data measurements are obtained as part of the facility site review. This data is necessary to identify potential building issues and to collect the information needed to develop an accurate energy analysis. Measurements include:

- Infra-red thermal imaging survey of the building envelope.
- Indoor air quality (IAQ) measurements (temperature, relative humidity, and CO_2).
- Lighting metering to determine energy use and operating schedules.
- Lighting output density.
- Metering of energy intensive electrical equipment (e.g., motors, compressors, heaters) to determine energy use and operating schedules.
- Metering of energy intensive plug-loads to determine energy use and operating schedules.

Data Gap Review

Once the facility site review and data measurements are substantially complete, the Engineer begins reviewing and processing all of the collected data. Any data gaps discovered during this process are addressed prior to completing the audit report.

Energy Modeling and Conservation Measures

To identify the best value ECMs and ensure that the calculated energy and cost savings are relatively accurate, a DOE approved energy modeling software program is utilized. A three-dimensional model of the building is created using the simulation program. This includes all characteristic envelope systems, HVACR systems, domestic hot water systems, and mechanical systems. The geographic position and orientation of the building is input and regional climatic data is imported from the program database.

After the building is accurately modeled, the program simulates building performance and provides the estimated energy use for electric and heating fuel(s). The Engineer then compares the energy data to actual building data. The cause for any significant differences is determined and the building is re-simulated until the model closely matches the actual data. AEC utilizes eQUEST© for all building simulations and energy modeling.

With the base model complete, the Engineer then implements various energy reducing measures and simulates the performance of the building with the new measure. The resulting energy consumption is then compared to the baseline model and predicted energy savings are analyzed.

Cost Estimating and Payback

The cost for implementing each evaluated ECM is then estimated by the Engineer. This provides a net estimated energy savings per dollar invested. Simple payback calculations determine the number of years required for the capital investment cost to equal the present day cost savings realized from energy reductions. The savings to investment ratio (SIR) is the accumulated annual cost savings (as determined by the expected service life of the material or equipment associated with the EEM) divided by the cost of investment. A SIR equal to 1.0 indicates that the EEM has a “break-even” or net-zero cost. The higher the SIR, the more favorable the return on investment is.

C. FACILITY BACKGROUND & ENERGY CONSUMPTION

Setting

The Hollis Upper Elementary School (HUES) is located in Hollis, NH within a light commercial setting (Figure 2). The building and facilities are located on a land parcel owned by the Town of Hollis. The school is located at the end of Drury Lane, due west of the Hollis Primary School on Silver Lake Road (State Route 122). A parking lot for staff is located along the southern face of the building and an access road wraps around the building. The playground is located at the southwest corner of the parcel and a residence is located beyond the tree line. The remaining boundary of the property is defined by forested land. The gross area of the HUES is 96,258 square feet.

Figure 2: Aerial Photograph of HUES (2010)

History

The Hollis Upper Elementary School was built in 1980 and originally served as the local middle school. As the district student population was trending upward a need for additional school facilities was identified. When the new high school was constructed in 1997, the existing high school was converted into the middle school and the upper elementary grades (4-6) were moved to the HUES facility with the lower grades (Pre-K-3) remaining in the Hollis Primary School.

In 1997 two major additions were added to the east and west sides of the existing structure (Figure 2). The existing structure included the entire space below the pitched roof while the addition includes all spaces below the flat roofs. This new space included the gymnasium on the second floor as well as additional classrooms and other functional space.

During the 2009-2010 school year mold was identified in the classrooms on the first (bottom) floor of the building. This section of the building was restricted for five months until remediation of the mold was completed. To improve ventilation of this area and reduce the potential for re-occurrence of mold, a large energy recovery ventilator unit with humidity control was installed servicing this section of the building.

Use, Function & Occupancy Schedule

The Hollis Upper Elementary School and the land it occupies are owned by the Town of Hollis. The building is a four-story structure situated on a south to north sloping parcel. The fourth floor is a loft area, the third floor at the parking lot level, and the first and second floors transition from below grade on the south side to at-grade on the north side of the site (sloping lot). Spatial configuration and functional use appear to adequately serve the needs of the school.

Student density is rather low compared to regional school facilities and there is significant capacity for additional students. Spaces include classrooms, administrative areas, nurse office, multi-purpose room, gymnasium, locker rooms, lavatories, maintenance offices, and closets and mechanical rooms. The operating schedule is consistent with a K-12 facility (Table 5) with class sessions Monday through Friday from 8:30 AM to 3:02 PM.

Table 5: School Calendar (2011 - 2012)

Month	School Days	Breaks
August	1	Start 8/31
September	21	Labor Day (9/5)
October	19	Columbus Day (10/10) Teacher Professional Day (10/28)
November	17	Teacher Workshop Day (11/08) Veterans Day (11/11) Thanksgiving Recess (11/23-11/25)
December	17	Holiday Recess (12/26-01/02)
January	20	Holiday Recess (12/26-01/02) Teacher Workshop Day (01/10) Martin Luther King Day (01/16)
February	17	Teacher Workshop Day (02/03) Winter Recess (02/27-03/02)
March	20	Winter Recess (02/27-03/02)
April	16	Spring Recess (04/23-04/27)
May	22	Memorial Day (05/28)
June	11	End 6/22

Anecdotal Information

Anecdotal information includes all relevant information collected during the desktop review, as part of occupant interviews, or general observations noted during the site evaluation. Generally, anecdotal information corresponds to issues or concerns that may not be apparent during the building evaluation. It includes complaints about seasonal occupant comfort, maintenance issues, systems or equipment performance issues, recent improvements or changes in use, and previous reports prepared by others. Anecdotal information obtained during the HUES evaluation includes the following:

- Asbestos containing materials were abated from the building in 1989.
- There are numerous (10) boilers which are difficult to individually control.
- The school recognizes the need to replace the dated and poorly configured boiler system. They recently received a quote to replace the system.
- The pump house supplying potable water to multiple Town-owned buildings and a few residential dwellings is connected to the school's electric meter.
- Due to the large roof area, snow slides off and accumulates along the north driveway. This creates limited access during the winter and snow has to be frequently removed.

Utility Data

Utility data for the Hollis Upper Elementary School (HUES) was provided by the School Administrative Unit 41 (SAU 41). Table 6 summarizes the total energy consumption for the year including electric and fuel oil. Energy consumption and cost for electricity per pay period is shown in Table 7 and Figure 3. The regional electric utility supplier is Public Service Company of New Hampshire (PSNH) and heating fuel oil (No. 2) is provided by a local supplier.

Table 6: Annual Energy Consumption (2011)

Energy	Period	Consumption	Units	Cost
Electric	February 2010 – January 2011	689,800	Kilowatt hours	$101,834
Fuel Oil (No. 2)	February 2010 – January 2011	24,302	Gallons	$51,573
			Total Annual Energy Cost:	$153,407
Electric	February 2011 – January 2012	627,800	Kilowatt hours	$101,453
Fuel Oil (No. 2)	February 2011 – January 2012	20,959	Gallons	$56,488
			Total Annual Energy Cost:	$157,941

The monthly electrical usage (Figure 3) reveals that demand peaks during the summer months indicating a significant amount of energy is consumed for cooling of the facility. Over the twelve (12) month period (2011), February is the peak demand month, consuming 67,600 kWh of electricity.

Table 7: Monthly Electric Consumption (2011)

Period	Year	Electric Use (kWh)	Cost
Feb	2010	60,600	$8,702
Mar	2010	62,800	$8,887
Apr	2010	52,200	$7,876
May	2010	56,800	$8,409
June	2010	55,600	$8,266
July	2010	47,400	$7,083
Aug	2010	43,600	$6,457
Sep	2010	55,400	$8,470
Oct	2010	61,000	$9,059
Nov	2010	64,600	$9,507
Dec	2010	62,600	$9,254
Jan	2011	67,200	$9,864
Totals:	*'10 - '11*	*689,800*	*$101,834*
Feb	2011	67,600	$9,638
Mar	2011	59,600	$8,950
Apr	2011	64,000	$9,446
May	2011	58,800	$8,457
June	2011	62,000	$8,762
July	2011	47,800	$8,520
Aug	2011	34,400	$6,222
Sep	2011	42,600	$7,748
Oct	2011	58,600	$9,710
Nov	2011	48,400	$8,638
Dec	2011	40,600	$8,465
Jan	2012	43,400	$6,896
Totals:	*'11 - '12*	*627,800*	*$101,453*

Annual electric usage for the HUES based on the most recent data provided by the school district (February 2011 through January 2012) is 627,800 kWh at a cost of $101,452. Based on the building size and function, this usage is relatively high compared to similar use K-12 facilities. Trend analysis of the energy consumption reveals that usage is not consistent with typical K-12 facilities.

The normal trendline (yellow dashed line in Figure 3) for a K-12 facility is a smooth curved line peaking in February and the lowest point occurring in July or August. The atypical electric consumption for the HUES is explained by the Town water supply system which has a peak demand in the summer. That is, the curvilinear trendline for water supply system is opposite the trendline for a K-12 facility resulting in a more linear combined usage trend. The low usage for August is likely attributable to a Town-imposed water ban.

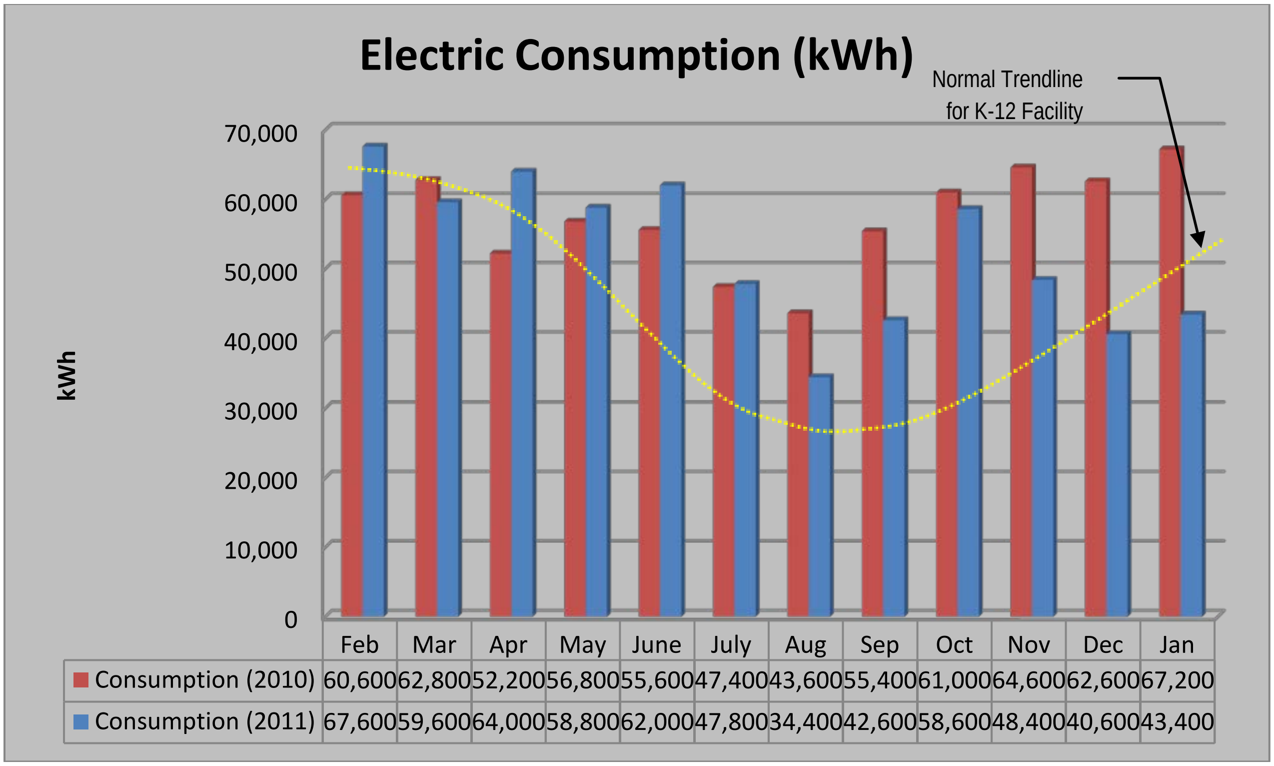


Figure 3: Electric Consumption (2011)

To determine the most accurate predictions of energy reduction, the energy consumption according to end use was determined. Table 8 presents the estimated electrical usage by category including lighting, plug loads, and mechanical. Mechanical equipment includes all hard-wired, permanently installed equipment including ventilation, exhaust, heating, cooling, pumps, etc. These values were determined based on an equipment inventory and electric consumption. A more detailed accounting of all electrical equipment by end-use is presented in Part C of this Report.

Table 8: Categorized Electrical Consumption (est) (2011)

Equipment Type	Annual Consumption (kWh/yr)	Percent of Total Consumption	Annual Cost
Mechanical Equipment	445,888	72%	$73,572
Lighting Fixtures	95,103	15%	$15,692
Plug Loads	79,999	13%	$13,200
Totals:	620,990	100%	$102,464

Accounting for 72% of electrical energy, mechanical loads consume the greatest amount of electricity at the HUES. This is due in part to the few air handling units that provide exhaust ventilation for the facility. The equipment in the Rocky Pond water supply pump house are estimated to consume a considerable amount of electricity. At 95,103 kWh per year, lighting fixtures account for 15% of the electrical demand in the building. Plug loads account for the lowest electrical demand, representing 13% of the annual electrical energy or 79,999 kWh. Figure 4 presents the relative energy use for each of the three categories.

At 72%, mechanical equipment represents an unusually high fraction of annual electric consumption. This is explained by the water supply system. The expected range for mechanical consumption for the HUES is 30% to 50%. Assuming the HUES mechanical equipment accounts for 40% of usage, the water supply is estimated to account for 30% of the annual electric consumption in the HUES.

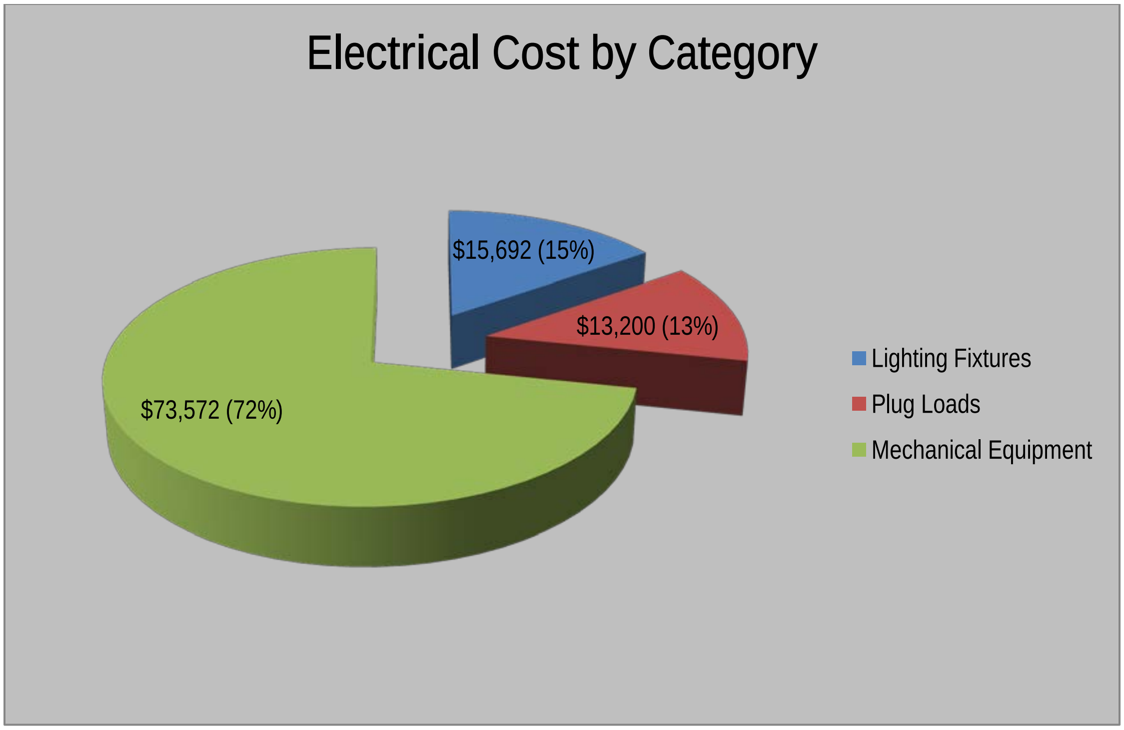


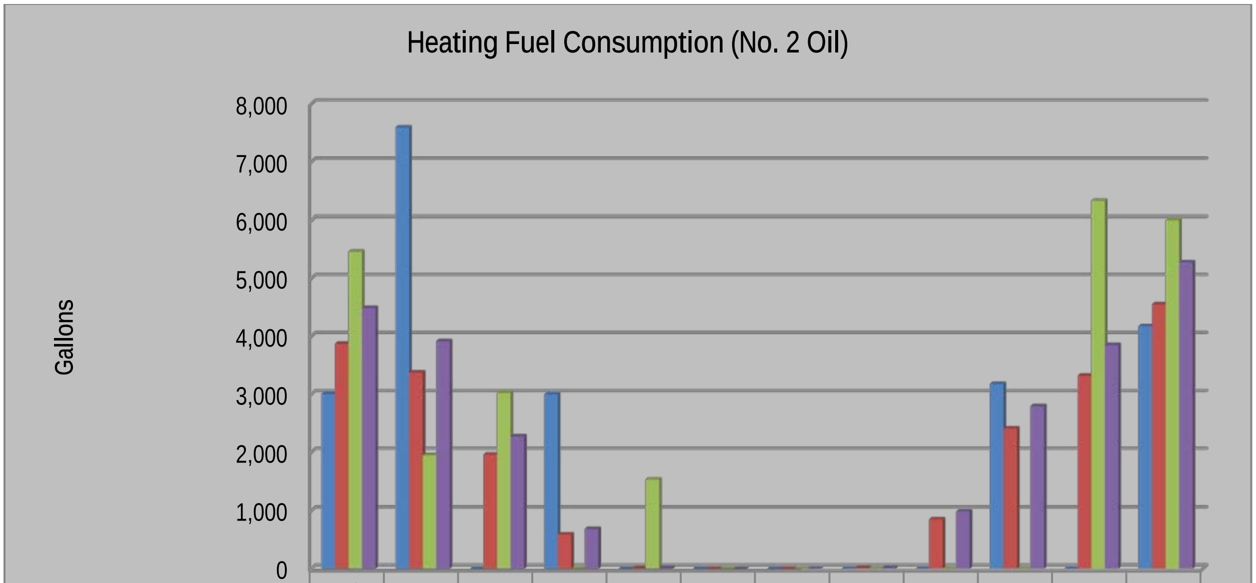
Figure 4: Hollis Upper Elementary School Electrical Cost by Category (2011-2012)

The annual electrical cost for mechanical equipment is estimated at $73,572 (2011-2012). Lighting fixtures consume a moderately high amount of electricity accounting for an estimated cost of $15,692 annually. It is noted that a lighting retrofit project was recently completed (2011) for the building. Plug loads are moderately higher than expected and include office equipment, computers, electronics, and appliances at an estimated cost of $13,200. Simple measures further explained in this report can reduce the cost of each category.

Table 9: Monthly Heating Fuel Consumption (2011)

Month	Year	Oil Purchased (Gallons)	Cost of Purchase	Oil Consumption (Gallons)	Cost of Consumption
Feb	2010	5,460	$9,609	4,490	$9,529
Mar	2010	1,946	$3,424	3,916	$8,310
Apr	2010	3,024	$5,322	2,272	$4,823
May	2010	0	$0	686	$1,456
June	2010	1,540	$3,478	11	$24
July	2010	0	$0	0	$0
Aug	2010	0	$0	0	$0
Sep	2010	0	$0	14	$29
Oct	2010	0	$0	987	$2,095
Nov	2010	0	$0	2,795	$5,931
Dec	2010	6,329	$15,261	3,850	$8,171
Jan	2011	6,004	$14,478	5,279	$11,204
Totals:	*10 - '11*	*24,302*	*$51,573*	*24,302*	*$51,573*
Feb	2011	3,008	$7,255	3,872	$10,437
Mar	2011	7,596	$18,318	3,377	$9,102
Apr	2011	0	$0	1,960	$5,282
May	2011	3,001	$7,239	592	$1,595
June	2011	0	$0	10	$27
July	2011	0	$0	0	$0
Aug	2011	0	$0	0	$0
Sep	2011	0	$0	12	$32
Oct	2011	0	$0	851	$2,294
Nov	2011	3,178	$10,270	2,410	$6,497
Dec	2011	0	$0	3,321	$8,950
Jan	2012	4,174	$13,407	4,553	$12,271
Totals:	*11 - '12*	*20,957*	*$56,488*	*20,957*	*$56,488*
Totals:	*10 - '12*	*45,259*	*108,061*	*45,259*	*108,061*

Heating fuel for space heating at the HUES is provided by a local supplier (Table 9, Figure 5). The facility purchased an annual total of 20,957 gallons of heating fuel oil (February 2011 to January 2012) at a cost of $56,488. Oil consumed was calibrated through modeling based on the equipment in use and the number of heating and occupancy days. Based on the modeling software, the peak consumption month is predicted to occur in January.



	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan
Fuel Purchased (2011)	3,008	7,596	0	3,001	0	0	0	0	0	3,178	0	4,174
Fuel Consumed (2011)	3,872	3,377	1,960	592	10	0	0	12	851	2,410	3,321	4,553
Fuel Purchased (2010)	5,460	1,946	3,024	0	1,540	0	0	0	0	0	6,329	6,004
Fuel Consumed (2010)	4,490	3,916	2,272	686	11	0	0	14	987	2,795	3,850	5,279

Figure 5: Heating Fuel Usage (2011-2012)

Heating fuel usage for the HUES is higher than expected for a K-12 facility of this size (96,285 sf). This is most attributable to an inefficient heating supply system consisting of multiple (10) dated low-efficiency boilers and poor insulation in the building envelope of the original building. There are two models of boilers with maximum heating output of 128 MBH and 1,580 MBH. The smaller units (4) are residential sized units and the larger output units (6) are small commercial units. Presumably the six larger units were installed when the building was constructed (1980) and the smaller units were installed when the building was renovated in 1997. Based on the unit condition and age the de-rated thermal efficiencies (AFUE) are 65% for the older boilers and 75% for the newer units (1997). Modern oil-fired units can achieve efficiencies up to 90% and gas condensing units can achieve 99% efficiency.

Other explanations for the high usage include heating setpoints that are higher than recommended and poor heating distribution throughout the building. For example, twenty (20) of the twenty-six (26) recorded temperatures exceed 69°F and the average recorded temperature was 71.8°F. Recommended heating setpoints for an elementary school range between 66°F and 69°F depending on the space function.

D. FACILITY SYSTEMS

Building Envelope

The following sections present the building envelope systems and insulation values for each assembly. Assembly values are compared to the *International Energy Conservation Code (IECC), 2009* for commercial buildings located in Climate Zone 5. The IECC code is used as a standard of comparison only and existing buildings are not required to comply with the code unless it undergoes a substantial renovation. Building additions or new constructions are required to comply with current energy codes. A set of building design plans were not available at the time of the audit, therefore construction methods are assumed to be those of best practice at the time of original construction (1980) and renovations (1997).

Floor Systems

The concrete slab-on-grade floor on the first floor is four (4) inches in thickness with a laminate floor covering or carpeting. The floor system has an installed assembly insulation resistance (R) value of 1.1 (Table 10). Although the IECC does not specify an insulation requirement for an unheated slab-on-grade floor in Climate Zone 5, a minimum value of R-10 to 24 inches below grade is generally recommended.

Table 10: Floor Insulation Values

Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Floor Tile	0.1	0.1	1.0	0.1
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	1.1
			2009 IECC Requirement:	NR
			Best Practice Recommendation	10.0

Wall Systems

The building is four-stories with concrete masonry unit (CMU) framed walls on the 1997 additions including the east, south, west and partial north walls. The partially below grade foundation walls are cast-in-place concrete. Portions of the concrete walls extend above grade as the lot slopes south to north and significant thermal transfer was evident during the thermal imaging survey. It is assumed that no foundation wall insulation exists below grade.

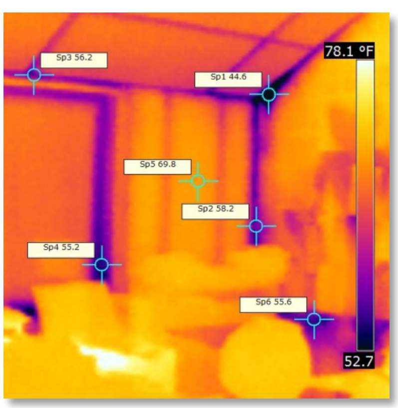


Figure 6: IR Image of 1st Floor Walls

Construction plans for the 1980 or 1997 structures are not available. The exterior walls consist of an exterior insulation finishing system (EIFS). It appears that the 1980 walls were improved with the EIFS system as part of the 1997 renovations. The EIFS wall systems shown in Table 11 are presumed based on observations and construction methods typical of c. 1997. Interior walls are finished with exposed fiberglass panels (1980), gypsum board, and exposed CMU. The original 1980 walls do have fiberglass batt insulation in the framed wall cavities.

The 1980 wall systems appear to comply with current energy code standards (IECC 2009) however the 1997 walls do not comply. Inspection of the walls with an infra-red (IR) thermal imaging camera revealed that the walls on the north side of the first level (c. 1980) allows substantial thermal transfer (Figure 6). The remaining exterior walls perform reasonably well.

Table 11: Wall Assembly Insulation Values

Mass Wall – EIFS (c. 1980 walls)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Stucco Finish	NA	0.2	NA	0.2
EPS Insulation Board	2.0	10.0	0.9	9.0
Fiberglass Batt Insulation	6.0	18.6	0.8	14.9
Gypsum Board	0.5	0.5	0.9	0.4
Interior air film	NA	0.7	NA	0.7
			Installed Assembly:	16.4 + 9.0 ci
			2009 IECC Requirement:	13.0 + 3.8 ci
			Code Compliant?	YES
Mass Wall – EIFS (c. 1997 walls)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Stucco Finish	NA	0.2	NA	0.2
EPS Insulation Board	2.0	10.0	0.9	9.0
CMU (painted)	8.0	1.1	0.8	0.9
Interior air film	NA	0.7	NA	0.7
			Installed Assembly:	2.0 + 9.0 ci
			2009 IECC Requirement:	13.0 + 3.8 ci
			Code Compliant?	NO

Ceiling Systems

Ceilings throughout the building are suspended acoustical tile (SAT) systems. The above ceiling plenum space is used for routing of ducting, piping, conduit, and electrical cable. Fiberglass batt insulation exists in the ceiling of the loft. The gymnasium on the second floor has a high, exposed ceiling while the multipurpose room on the third level has a SAT system. Substantial air leakage was observed in the pitched ceiling sections on the north side of the 1980 structure. It is recommended that all wall and roof penetrations are sealed to reduce air leakage.

Figure 7: Ceiling Insulation on 1980 Roof

Roofing Systems

The roofing system on the 1980 structure consists of pitched metal framed members clad in a brown galvanized steel roof. The interior is finished in oriented strand board and foil-faced fiberglass insulation (Figure 7).

Roofing insulation values are presented in Table 12. The insulation does not comply with current code standards. The roof system of the addition is composed of ballast built up system.

Table 12: Roof Systems Insulation

Pitched Metal Roof (original building c. 1980)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Metal Roofing	NA	0.1	1.0	0.1
Strand Fiberglass Board	2	6.0	0.9	5.4
FF FG Batt Insulation	4	14.0	0.7	9.8
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	16.2
			2009 IECC Requirement (roof):	38.0
			Code Compliant?	NO
Flat Built-Up Roof (additions c. 1997)				
Exterior Air Film	NA	0.2	NA	0.2
EPDM	NA	0.3	1.0	0.3
Polyisocyanurate Insulation Board	3	15.0	0.9	13.5
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	1.2+13.5 ci
			2009 IECC Requirement (roof):	20.0 ci
			Code Compliant?	NO

Fenestration Systems

Fenestration systems on the HUES building include operable windows, fixed window units, glazed entry doors, and fixed storefront entry units. Window units in the building are metal and vinyl framed units with double-pane glass. Consistent with IECC requirements, fenestration performance is measured by the U-factor, the solar heat gain coefficient (SHGC), and air leakage as determined by the unit manufacturer. No manufacturer information was available for the windows or doors in the HUES and therefore compliance with IECC standards for commercial buildings located in Climate Zone 5 cannot be established.

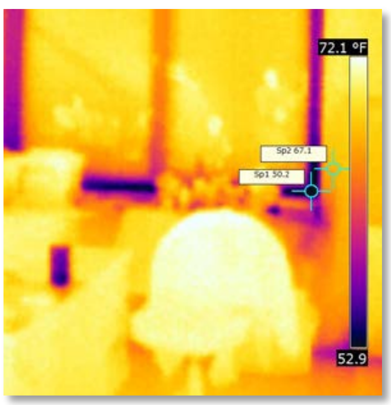


Figure 8: First Floor Window

In general, based on visual inspection and survey with the infra-red thermal camera the glazed units performed marginal, allowing significant thermal transfer through the frames. Typical of older units and even modern units, most thermal transfer and air leakage occurs at the seals of operable windows and the interface between the window and the wall opening (Figure 8). The uninsulated metal frames also provide substantial thermal transfer (Figure 9). Water damage due to leaking skylight units was evident in the art room and the loft area.

Recommendations include exterior and interior inspection and re-caulking of window jambs, headers, moldings, and sills. If the operable window units have adjustable jambs, they should be inspected and adjusted as necessary to maintain a complete air seal. Weather-stripping should be inspected and replaced as needed.

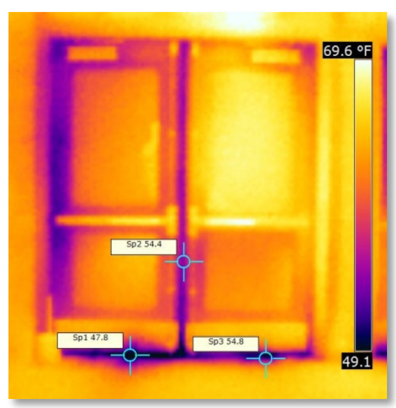


Figure 9: Gymnasium Vestibule Exterior Door

Doors

The door units in HUES are hollow metal units with thermal breaks. Units include full glazed sections (front entry doors) and solid doors (utility areas and rear doors). Glazed door units appear to be uninsulated providing high thermal transfer through the frame. Solid doors appear to be insulated. Based on visual observations and thermal imaging, the seals on door jambs, partings, and thresholds are incomplete allowing substantial air leakage (Figure 9). Daylight can be seen through many door thresholds and double-door partings.

Air Sealing

Based on the thermal imaging survey and visual observations, air leakage occurs at roof penetrations (Figure 10), windows, entry doors (Figure 11), and wall to roof interfaces. Although this is typical even for modern buildings, simple measures can significantly reduce air leakage. Recommended measures for windows include: 1) adjusting jamb seals on operating windows; 2) adding weather-stripping; 3) caulking interior frames and moldings; and 4) locking/clasping windows to maintain a complete seal. Air sealing of all door units can be improved with new weather-stripping and sweeps. All door and window units should be regularly inspected (every 2 to 3 years) to ensure proper operation, identify faulty seals, and to identify any deteriorated caulking requiring replacement.

Figure 10: Air Leakage at Roof Penetration

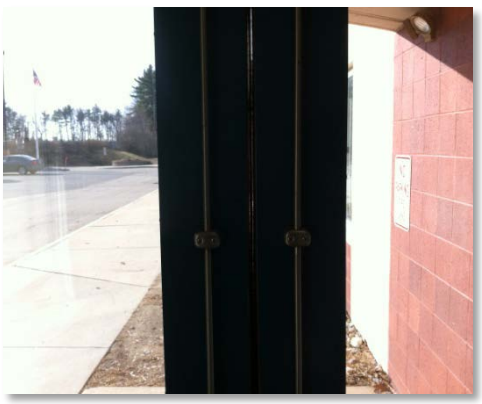


Figure 11: Gap in Door Parting (typ.)

All wall and roof penetrations should be inspected and entirely sealed at the interface of the conditioned space with a fire-rated sealant/caulking.

Other air sealing recommendations include inspecting all exhaust and ventilation ducts to determine if they have a positive pressure actuated damper. Dampers are recommended on all exterior ducting to prevent passive air leakage.

Thermal Imaging Survey

A thermal imaging survey was completed on the mornings of December 19th and 20th, 2011. Outdoor ambient temperature was between 27°F and 30°F. The survey was conducted using a FLIR© B-CAM infra-red (IR) camera. The building exterior and interior envelope and major mechanical and electrical equipment were surveyed with the IR camera. IR camera surveys not only identify heat transfer through building envelopes, they also identify trapped moisture, electrical system overloading, heat loss through ducting and piping, high energy lighting fixtures, and energy intensive plug load equipment. Appendix B presents the survey report.

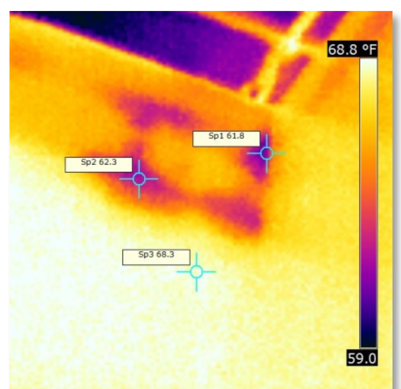


Figure 12: Moisture from Leaking Skylight

The IR surveys revealed the following notable observations at the HUES:

- The thermal integrity of the envelope (walls and roof) is consistent with the construction methods.
- A substantial amount of thermal transfer and air leakage occurs at the wall and roof interface on the north face and at roof penetrations on the sloped roof section (1980).
- Windows and doors provide a significant amount of thermal transfer and air leakage.
- The concrete foundation wall extending above grade provides substantial thermal transfer.
- Moisture is evident in the ceiling tiles surrounding skylight units (Figure 12).

- Electronic equipment including photocopiers and computers/monitors operate at high temperatures and increase heat loading of the building interior.

Electrical Systems

Supply & Distribution

Grid electricity is supplied to HUES to the main electrical room by an underground service provided by a large pad mounted transformer located west of the boiler room. The main electrical room is located off the administration office. Several sub-distribution electrical rooms with panels and transformers are located throughout the building. Three-phase grid power is supplied to the building by PSNH via overhead transmission lines.

Electrical rooms were easily accessible and clear of stored items. Old and outdated transformers are inefficient and lose a significant amount of energy in the form of heat. This excess heat is typically removed from the building with exhaust fans further increasing electric consumption. Replacing old transformers with new, energy efficient units (Figure 13) typically provides a simple payback of less than seven (7) years.

Figure 13: High-Efficiency Transformer (Powersmiths®)

Lighting Systems

As presented in Table 13, there are a variety of lighting fixtures and lamp types in the HUES. Recessed mounted high performance T8 fluorescent fixtures accounting for the majority of lighting capacity at 59,880 watts. Incandescent bulbs installed in the spot lights on the cafeteria stage and account for the second most capacity at 2,775 watts. Exterior wall-packs account for 2,100 watts. Other exterior lighting fixtures include pole mounted and compact fluorescent (CFL) fixtures. Interior fixtures include metal halide (MH) in the cafeteria, CFL in the main office and LED in exit signs. According to district personnel, a lighting retrofit project was completed in 2011.

Table 13: Lighting Fixture Schedule

Fixture Lamp Type	Location(s)	Control	No. Lamps	Watts	Qty.	Total Watts
Fluorescent T8	Throughout	Switch, motion	1-4	30	811	59,880
Incandescent	Cafeteria stage	Switch	1	100, 125	27	2,775
MH Wallpack	Exterior	Photocell	1	150	14	2,100
MH Suspended	Cafeteria	Switch	1	70	9	630
MH Pole Mounted	Exterior	Photocell	1	150	3	450
CFL	Main office, exterior	Switch	1	16, 20	18	348
LED	Exit signs	Always on	1	5	52	260
				Totals:	934	66,443

Table 14 presents the energy consumption by lighting fixture type. The high performance T8 fluorescent fixtures are the main source of lighting and account for an estimated 87% of all lighting energy consumption annually at 82,577 kWh. Wallpack (metal halide lamps) fixtures on the exterior account for 6,661 kWh/yr at 7% of the total consumption. LED, pole mounted metal-halides (MH), CFL fixtures, suspended MH units, and incandescent fixtures account for the remaining 6% of lighting consumption.

Table 14: Lighting Fixture Energy Consumption

Fixture Lamp Type	Location(s)	Est. Usage (KWH/yr)	% of Total
Fluorescent T8	Throughout	82,577	87%
Incandescent	Exterior	6,661	7%
MH Wallpack	Exit signs	2,271	2%
MH Suspended	Exterior	1,427	2%
MH Pole Mounted	Cafeteria	1,008	1%
CFL	Main office, exterior	1,048	1%
LED	Cafeteria stage	111	<1%
	Totals:	95,103	100%

Lighting density measurements in HUES were obtained to establish if building illumination is consistent with the *Illuminating Engineer Society of North America* (IESNA) standards for the prescribed use. These measurements were obtained during normal operating conditions on December 19th, 2011 between the hours of 1135 and 1400. Table 15 presents the lighting density measurements obtained in units of foot-candles (FCs).The T8 lamp fixtures are relatively efficient units. These units are controlled by occupancy sensors in most spaces. This is an appropriate method in controlling lighting in these spaces. New high-efficiency exterior LED fixtures are becoming a cost effective replacement for outdated metal halide fixtures. LED fixtures consume 75% less energy and produce a superior light quality (brighter and whiter luminance). Maintenance costs for LED fixtures are significantly reduced with lamps lasting up to 15 times longer than MH and HPS lamps.

Illumination Densities

In general, lighting/illumination densities in the HUES exceed the recommended standards (IESNA Lighting Handbook). These fixtures were designed to be over-lit as part of the 2011 lighting upgrade project and slowly reduce densities over time to the recommended setpoint. Some methods to reduce illumination densities include reducing the quantity of fixtures and installing lower wattage bulbs in the existing fixtures. Other methods to reduce illumination densities include replacing overhead lighting with task lighting, adding multiple control zones, and adding controllers (motion, daylight, dimming, time scheduled). Complete lighting density data for the HUES is included in Appendix C.

Lighting densities in many classrooms are significantly higher than the standard recommended values resulting in increased energy consumption. Most of the fixtures are modern efficient fixtures installed as part of a recent lighting retrofit (2011). Recommendations to reduce illumination densities in classrooms include adding zone control and daylighting control. Illumination densities in common areas such as corridors can be reduced by a combination of time scheduled controllers, zoning control, and motion controllers. Limiting frequency in which lights operate will maximize the life of the bulbs and fixtures.

At 40 footcandles (FCs) the measured illumination density in the gymnasium is lower than recommended (75 FCs). Replacing the T8 fixtures with high-intensity (super) T5 fixtures will increase illumination density by an approximately 30%.

Table 15: Illumination Densities

Location	Measured Density (FC)	Recommended Density (FC) (1)
Classroom 307	54	30
4th Grade SE Corridor	33	10
Classroom 305	50	30
Classroom 303	50	30
Classroom 302	73	30
Classroom 301	70	30
Gymnasium	40	75
Gymnasium Vestibule	27	10
Classroom 201	48	30
Classroom 203 (art)	51	50
Classroom 205 (media)	42	30
Teachers Lounge	43	30
Classroom 208	69	30
Classroom 209	65	30
2nd fl Corridor	44	10
Classroom 123	109	30
Classroom 109	67	30
Classroom 108	41	30
Classroom 114	54	30
Classroom 112	53	30
Classroom 105	41	30
Classroom 102	54	30
Classroom 103	52	30
1st fl Corridor	43	10
Nurse Office	50	30
Main Office	45	30
Principal Office	28	30

(1) Based upon IESNA standards.

Plug Loads

Plug loads for the HUES were determined based on equipment nameplate information. The operating time for each item is based on observations, occupant loading, schedule, and typical operating time for the equipment. Plug loads are categorized as appliances, electronics, and office equipment. Table 16 presents a summary of plug loads by category and Appendix F presents an inventory of all plug load equipment.

Based on this analysis, the total annual plug load is 79,999 kWh. Office equipment and computers account for the majority of plug load energy consumption (49%). Appliances also account for a large percentage of the plug load for an estimated 47% of total energy consumption. Miscellaneous electronics account for 4% of consumption.

Table 16: Plug Load Energy Consumption

Category	Location(s)	Est. Usage (kWh/year)	% of Total
Office Equipment, Computers	Throughout	38,814	49%
Appliances	Throughout	37,631	47%
Electronics, Others	Throughout	3,553	4%
	Totals:	79,999	100%

Many computers and electrical devices were observed to be powered on when not in use which contribute to the high office equipment and computer plug loads (Figure 14). There are total of fifteen (15) compact refrigerators which consume a considerable amount of energy. No full sized units are within the building. It is recommended all compact units be removed and that two or three ENERGY STAR® rated units are purchased to replace them. There are a total of one-hundred forty-five (145) desktop computers and twenty-seven (27) laptops throughout the school which when left on can consume a considerable amount of electricity. Suggestions include replacing desktop computers with ENERGY STAR® rated laptop units. A new ENERGY STAR® rated laptop unit consumes approximately 1/4 of the electricity that a conventional desktop unit consumes.


Figure 14: Unoccupied Desktop Computers

Thirty-four (34) fans were identified in the HUES which are an indication of low occupant comfort. Two (2) space heaters were observed in the building.

Motors

Electrical motors are used for the Munters® energy recovery unit, elevator, ventilator units, well pumps, and circulation pumps. It is recommended that all replacement motors over five (5) horsepower have variable frequency drives (VFDs) and are premium efficiency NEMA rated motors.

Emergency Power Systems

There is no emergency power system located at HUES. Because the HUES electrical service provides power to the Rocky Pond Pump Station that supplies drinking water to many other buildings (including town owned and a few residents) it recommended that a backup power supply system be installed. This was indicated in the report conducted by Provencher Engineering LLC dated 11/5/2010. Current code requires an emergency power system for water supplies servicing fire hydrants.

Plumbing Systems

Domestic Water Supply

Due to trace contaminants (heavy metals) found in the water, an investigation into the entire water system was conducted starting September 24th, 2010 and presented November 5th, 2010 by Provencher Engineering, LLC with discoveries presented herein.

Domestic water supply for the HUES is provided by the Rocky Pond Pump Station located to the south. A pressure booster-pump and tank system increases water pressure in HUES. Water demand for the building is limited to lavatory facilities (toilets and sinks) and kitchen use (cooking and dishwashing). Use of the shower facilities in the locker rooms is limited.

The pump station provides water to multiple municipal facilities in the Town and several Hollis residences. The three-phase, 480-volt service supplying the pump house is connected to the service meter for the HUES. Because there is no sub-meter for the pump house, the electrical usage for the HUES is skewed.

Domestic Water Pump Systems

The domestic water service for the HUES is provided from the Rocky Pond Pump Station. Water is provided to the HUES by two (2) well pumps. A pressurized vault tank supplies the building with water. There are two (2) domestic hot water (DHW), pumps (1/4 hp and 1 hp) are located within the school.

Domestic Water Treatment Systems

A water treatment system in the pump house treats well water for high pH (acidity) with soda ash and orthophosphate to reduce metal content. The treatment system is required by the NH Department of Environmental Services (NHDES) after elevated metals (copper and / or lead) concentrations were detected.

Domestic Hot Water Systems

Figure 15: 119 Gallon Domestic Hot Water Tank

Domestic hot water is provided by a single 119-gallon and two (2) 85-gallon electric-fired tank heating units providing a combined capacity of 289 gallons (Figure 15). The two 85-gallon tanks were manufactured in November 2010. The system capacity exceeds occupant demand requirements. Recommendations include replacing the three units with two (2) demand-tankless electric condensing units and insulating the distribution piping.

Hydronic Systems

Space conditioning is provided by hot water coils connected to a hydronic loop. Water is circulated by two large pumps located in the boiler room and two smaller pumps located on the first floor. Sections of piping insulation throughout the building are missing or in poor condition. Recommendations include replacing the missing insulation. The circulation pumps appeared to be in adequate condition. The hydronic system is charged with glycol to prevent freezing of piping in unconditioned spaces.

Fire Suppression System

The building is equipped with a pressurized wet fire suppression system. A sprinkler head in the art room was observed to be leaking during the field review.

Mechanical Systems

Heating Systems

Heating is provided to the building by a six (6) Hydro-Therm® and four (4) Weil-McLain® oil-fired boilers. Considering the age of the units, the de-rated thermal efficiency is expected to be less than 79%. Thermal efficiencies are determined by the input and output of heat energy in Btu/hr and labeled by the manufacturer, accounting for jacket losses. Combustion efficiencies are higher than thermal efficiencies since they do not account for jacket heat loss. In 2009, the Weil-McLain boilers No. 1 and No. 2 had rated combustion efficiencies of 84.6% and 83.9% and the Hydro-Therm boiler had a combustion efficiency of 81.2%. Modern boilers are measured by annual fuel utilization efficiency (AFUE). AFUE accounts for stack and jacket losses as well as heat loss when the boiler idles to maintain a minimum temperature.

Figure 16: Hydro-Therm® Oil-Fired Boilers

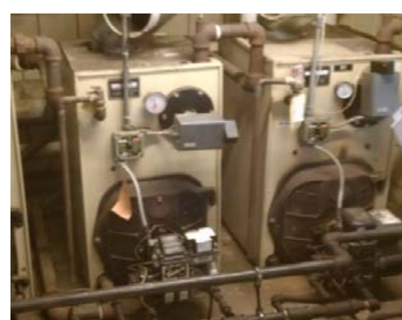


Figure 17: Weil-McLain® Oil-Fired Boilers

Recommendations include replacing the ten (10) boilers with two (2) high-efficiency oil-fired modulating units. These could be connected to the current domestic hot water and DDC systems. The units would be operated on lead-lag schedule to increase unit service life and provide system redundancy.

Other recommendations include installing NEMA rated premium efficiency rated circulation pumps with VFD controllers.

Table 17: Heating Supply Systems

Heating Unit	Unit Description	Area(s) Served	Output (MBH)	Age (yrs.)	Combustion Efficiency (2009)	Control Type
Boiler No. 1-4	Weil-McLain®	Throughout	184	15	84.6% (#1) 83.9% (#2)	DDC
Boiler No. 5-10	Hydro-Therm®	Throughout	1,580	32	81.2%	DDC


Figure 18: Mitsubishi® AC Unit Serving Computer Room

Cooling Systems

Two (2) computer rooms on the first floor are cooled by two (2) exterior split-condensing units. The administration is cooled with three (3) split-condensing units which is located on the roof. All units are charged with R-22. It is noted that the use of R-22 is not permitted for use as a refrigerant in new equipment based on its high ozone depletion potential (per USEPA).

The Mitsubishi unit is listed to have an Energy Efficiency Ratio (EER) of 12.5 and a Seasonal Energy Efficiency Ratio (SEER) of 19. Split units serving the administration are (Carrier) have an EER of 10.45 and a SEER of 12. Operating efficiency tends to decrease with system age. As cooling condensing units fail, they should be replaced with the highest rated equipment available.
As prescribed by the 2009 IECC, the current minimum SEER for smaller cooling systems is 13 and larger units are rated at a minimum EER of 11.2. Modern cooling systems can achieve SEERs up to 24. As example, replacing a unit with a SEER rating of 8 with a new unit rated at 16 would reduce energy consumption by 50% and provide an equivalent cooling capacity. The Carrier unit has an EER and SEER under the current minimum code, in addition to using R-22 which is not permitted in new units.

Refrigeration

The kitchen of the HUES is equipped with a walk in freezer. Recommendations include replacing failed condensers with high efficiency units. Other recommendations include installing eCube® food temperature sensing thermostat controls. By measuring constant food temperature instead of more variable air temperatures, eCube® controllers significantly reduce the frequency of condenser operation (www.getecube.com).

Pumps

A total of four (4) circulation pumps circulate heated water though the building. Two (2) water circulation pumps are located in a first floor mechanical room and two (2) are located in the boiler room. Two (2) pumps are also located within the boiler room to supply the boilers with oil from the underground storage tank. The pumps appeared to be in good condition. It is recommended that the pumps be replaced with NEMA premium efficiency rated motors when these eventually fail. Adding variable frequency drives (VFD) is also recommended to reduce energy consumption and to extend the service life of the pumps.

Controls Systems

Heating for the building is controlled by a schedule-based digital demand controls (DDC) system. There are no individual room or zone heating controls or thermostats. Operation of the Munters® energy recovery ventilator (ERV) is also controlled by the DDC system. The air conditioning split-units that service the first floor system computer labs are controlled individually within the rooms (Figure 19). The DDC schedules should continually be optimized according to occupancy schedules. Real time temperatures should periodically be recorded and compared to setpoints within the DDC system to identify any discrepancies and modify DDC setpoints to optimize the system. Eight (8) temperatures were measured throughout the first floor (five of the rooms were unoccupied) and all temperatures exceeded the recommended setpoint range of 67°F to 69°F. The average measured temperature was 73.2°F which is substantially higher than recommended.

Figure 19: Cooling Controls in Computer Lab

Mechanical Equipment Energy Consumption

The electrical energy consumption for mechanical equipment was determined according to equipment nameplate information and building function and occupancy schedules. Table 18 presents a summary of the mechanical equipment and annual energy usage. Appendix E presents the detailed inventory and the associated energy consumption for each piece of mechanical equipment.

Based on the equipment inventory and expected operation frequencies, the predicted consumption of mechanical equipment was calculated. At 445,888 kWh per year mechanical equipment represents the highest usage among the three categories including lighting (95,103 kWh) and plug loads (79,999 kWh). The expected fraction of annual energy consumption for mechanical equipment in a K-12 facility is 40% to 50%. The unusually high consumption at HUES is largely attributable to the water supply pump and treatment system which accounts for an estimated 25% of the annual mechanical energy demand.

Table 18: Mechanical Equipment Energy Consumption

Equipment Type	Qty.	Item Manufacturer(s)	Consumption (kWh/yr)	% of Total
Split Air Conditioning Units	5	Mitsubishi®, Carrier®	19,002	4%
Unit Heater	7	NA	1,887	0%
Unit Ventilator	4	NA	18,595	4%
Refrigeration	1	Keepright®	14,150	3%
Air Handling Units	3	Munters®, Greenheck®, McQuay®	144,410	32%
Exhaust Fans	17	Greenheck®	23,747	5%
Circulation Pumps	2	Emerson®, Marathon®	15,070	3%
Septic System Pumps	2	Hydromatic®	7,152	2%
Circulation Pumps	2	Balder®	37,548	8%
Rocky Pond Pump House Pumps	2	Aquavar®	111,571	25%
Electric Hot Water Heater	3	State® Select, Ruud® Commercial	35,360	8%
Other (boiler, elevator etc.)	NA	Webster®, HB Smith®, Beckett®	17,396	4%
		Totals:	445,888	100%

Ventilation Systems

Exhaust Air Ventilation Systems

Exhaust fan units provide several functions including humidity control, odor control, venting of VOC containing materials (e.g., cleaning solvents), chemical gas venting in laboratories, and venting of cooking fumes. Operation frequency and schedules for the fans units should be consistent with the use type and intensity of the vented space. For example, lavatories may be demand (interlocked with light switch) or they may operate constantly at a low rate during occupied periods. Spaces equipped with exhaust fans are commonly over-ventilated resulting in increased energy consumption. All exhaust controls and rates should be consistent with ASHRAE Standard 62.1. Fan ducting should have pressure actuated dampers to restrict passive air flow and heat loss when the units are not operating.

Exhaust ventilation fans in the HUES are located in lavatories, corridors, the boiler room, mechanical room, and kitchen. Control of the exhaust fans is provided by time schedule controllers with single point on/off settings. Recommendations include controlling the fans on an intermittent schedule with either multi-point time controllers or demand controllers with CO_2 sensors.

Exchange Air Ventilation Systems

Classrooms on the third floor are equipped with unit ventilators to control airflow within their specific room. The multipurpose room is conditioned by a unit located on the roof of the 1997 addition. The second floor of the building is serviced by a large unit located on the roof by the gymnasium. The fourth floor of the building is conditioned by the unit residing in the loft. Indoor air quality measurements as described below help quantify the disparities. The gymnasium is conditioned by a large, ceiling mounted unit.

As evidenced by the measured CO_2 concentrations, unit ventilators do not provide adequate air exchange in normally occupied classrooms. Installing modern ventilation systems in all spaces of the HUES is recommended (code requirement). Ventilation rates and system capacity should be designed consistent with minimum prescribed code standards (ASHRAE 62.1). Systems should be demand (CO_2) controlled (ASHRAE 90.1) include energy recovery units similar to the existing Munters® ERV unit.

Energy Recovery Ventilation Systems

An energy recovery ventilation system is installed on the Munters® unit. This inhibits direct exhaust of conditioned air during heating and cooling periods resulting in decreased equipment operation, increased equipment service life, and decreased energy consumption. The unit also reduces the potential for mold formation in the building by removing moisture from the air and reducing relative humidity. It is recommended that energy recovery units (ERUs) be installed on all exhaust and exchange air ventilation systems.

Indoor Air Quality

Indoor air quality (IAQ) is measured based upon temperature (°F), relative humidity (%), and carbon dioxide (CO_2) concentrations (parts per million) or (ppm). This data provides the best representation of building conditioning, ventilation performance, and total occupant comfort. The data is also indicative of conditions that are detrimental to building systems including moisture and the potential for fungi growth (mold and mildew) and related damage of building materials.

Recommended temperatures vary based upon the season, occupant activity, and relative humidity levels. Generally, recommended setpoint heating temperatures in northern New England range between 66°F and 69°F and recommended cooling setpoint temperatures range between 74°F and 78°F. Relative humidity (RH) levels fluctuate consistent with seasonal atmospheric conditions. A range between 30% and 65% is recommended (ASHRAE 62.1). While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute adverse affects including headaches, drowsiness, lethargy, and nausea. The U.S. Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ in the HUES was measured on December 19th and 20th, 2011 between the hours of 1135 and 1400. The building was normally occupied when the measurements were obtained. Twenty-six (26) IAQ measurements were obtained at representative locations throughout the building. Appendix C presents all of the measurements. Results of the IAQ measurements are summarized as follows:

- Temperatures in the building varied significantly from 67.1°F in the Art Room (203), to 76.4°F in the Principal's Office. The average recorded temperature was 71.8°F.
- Relative humidity levels varied throughout the building ranging from 12% in Classroom 105 to 24.8% in Classroom 307. The average measured relative humidity was 16.5%.
- CO_2 concentrations varied significantly ranging from 560 ppm in the Media Room 205 to 1,746 ppm in Classroom 307. Eleven (11) of the twenty-six (26) measurements exceeded the EPA recommended threshold of 1,000 ppm.

Table 19: Summary of IAQ Data

IAQ Metric	Low	High	Avg.	Range of Variance	Recommended
Temperature (°F)	67.1	76.4	71.8	9.3	66 – 69
Relative Humidity (%)	12.0	24.8	16.5	12.8	30 – 65
Carbon Dioxide (ppm)	560	1,746	984	1,186	<1,000

Measured IAQ in the spaces served by the Munters® ERV unit is satisfactory. Eight (8) measurements in this area yielded relative humidity levels between 12% and 18% with an average of 15%. CO_2 levels in six (6) of the eight (8) locations were below the EPA recommended threshold. Temperatures on the first floor were higher than the recommended setpoint with an average of 73.2°F (higher than the school average). Five (5) of the eight (8) locations were also unoccupied during the data collection. It is recommended CO_2 demand controls and VFDs be installed on the Munters® unit.

The third floor which is less conditioned yielded eight of nine locations that had CO_2 concentrations exceeding 1,000 ppm, ranging from 1,010 to as high as 1,746 in Classroom 307. Relative humidity levels were elevated averaging 19.1% compared to the school average of 16.5%. Temperatures in the third floor classrooms were closer to recommended levels with three (3) of six (6) within the recommended range. However, three (3) spaces within the administrative area significantly exceeded the recommended temperature with an average of 75.5°F.

Figure 20 presents the data trending for the three IAQ parameters. This trending graphically depicts the high variations in IAQ throughout the building.

In summary:

- IAQ varies significantly throughout the HUES.
- Temperatures consistently exceed recommended setpoint values resulting in increased heating fuel consumption.
- With the exception of the first floor spaces served by the new ERV unit, ventilation of the building is inadequate and does not comply with current code standards (ASHRAE 62.1).

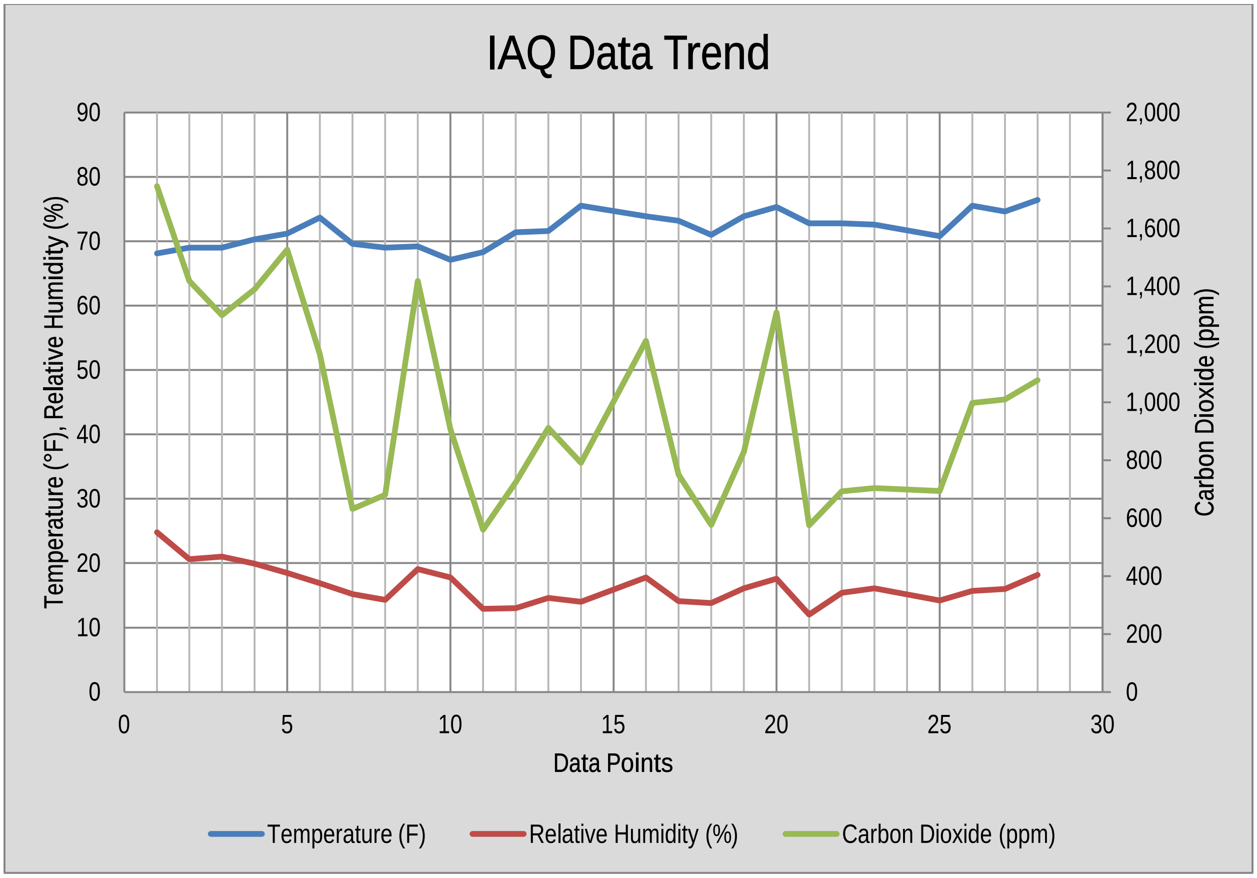


Figure 20: IAQ Data Trends

Secondary Observations

Observations noted herein are not directly related to the objective of the energy audit. Investigation of these items is beyond the defined scope of services and these observations are not intended to be inclusive of all building issues and code infractions. They are provided as anecdotal information for the District's consideration and may warrant further investigation.

Structural Systems

No structural issues were noted.

Roofing Systems

There was evidence of roof leaks in the library and penthouse (skylights). It is recommended that this issue be addressed to mitigate further damage and to reduce the potential for mold formation.

Building Code

As noted in the preceding sections, the capacity and control of mechanical exchange air ventilation do not comply with current code standards (ASHRAE 62.1).

Life Safety Code

No significant life safety code issues were noted during the evaluation.

ADA Accessibility

No apparent ADA accessibility issues were identified during the building assessment.

Hazardous Building Materials

According to facility personnel, asbestos containing materials were abated in 1989. Based on the date of construction (1980) it is assumed that no other hazardous building materials are present.

E. BUILDING ENERGY MODELING

Source Data

Required source data input for the eQUEST© model includes geographical location, building use type(s), occupancy schedules, building dimensions, envelope systems, fenestration systems, lighting systems, and all mechanical systems (heating, cooling, ventilation domestic hot water). The building characteristics and systems data was obtained during the building site review. Energy usage was provided by the Town for grid electricity and heating oil.

Model Calibration

The quality of the output data is a function of the accuracy of the input data. While eQUEST© is a sophisticated computer simulation program, like any program there are limitations resulting from unusual building characteristics and operating variables that cannot be discretely defined in the program. To ensure that the model simulates the building operation with high accuracy, an iterative model calibration process is completed where actual building energy usage data is checked against the model output values. This process is repeated until the deviation between the energy usage derived from the baseline building simulation and the actual energy consumption is within an acceptable range.

Summary of Model Results

The HUES facility was modeled using eQUEST© computer simulation program. Developing an accurate baseline model of the building presented certain challenges including accounting for the high electrical usage and the high heating fuel usage. Once the baseline calibration was completed, several major Energy Efficiency Measures (EEMs) were simulated within the model including:

- Replacing the ten (10) boilers with two high efficiency models.
- Replacing the exterior lighting with LED fixtures.

The resulting energy savings and costs for these measures are presented in Section G (Recommendations) and the model output is provided in Appendix I. Tables 20 and 21 present a summary of the model predicted annual energy usage by category for electrical and heating fuel. The actual electrical consumption of 627,800 kWh/yr is slightly higher than the model prediction of 627,170 kWh/yr.

Table 20: Model Predicted Baseline Electrical Usage

Electric Category	Annual Usage (kWh x 1,000)
Space Cooling	2.84
Heat Rejection	15.94
Refrigeration	14.15
Hot Water	35.32
Ventilation	192.58
Pumps & Aux.	191.14
Exterior Lighting	9.09
Misc. Equipment	79.95
Area Lights	86.16
Total Predicted:	627.2
Total Actual:	627.8

Actual heating fuel consumption (2,907 MBtu) is slightly lower than the model predicted value (2,981 MBtu) based on available data through January 2012. This variation is within the expected range of deviation.

Table 21: Model Predicted Heating Fuel Usage

Electric Category	Annual Usage (MBtu)
Space Heating	2,980.5
Total Predicted:	2,980.5
Total Actual:	2,906.8

The energy modeling results are depicted graphically by a monthly bar graph (Figure 21) which breaks down the energy consumption for electricity and gas consumption separately by category. For example, "Area Lighting" is relatively consistent throughout the year while "Space Cooling" consumes a variable amount of electricity depending on the time of year.

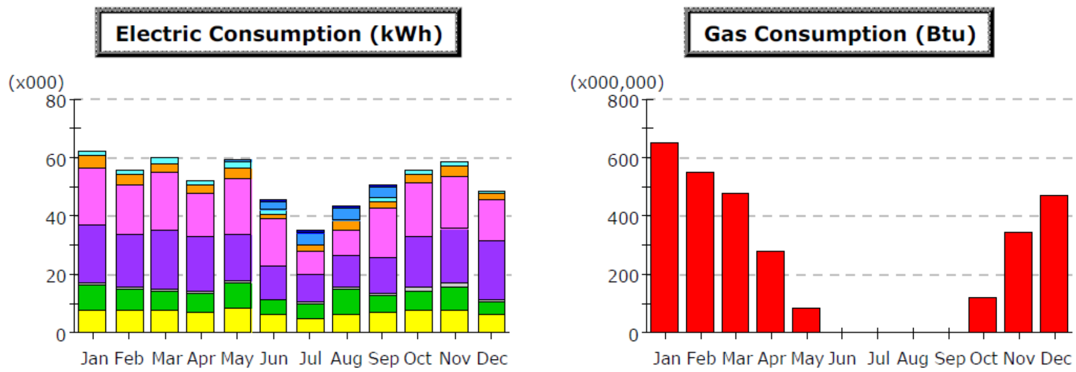


Figure 21: Predicted Monthly Energy Use by Category (Baseline)

Annual energy consumption by category is also graphed using eQUEST® (Figure 22). This information is depicted in a pie graph and helps determine the largest overall use categories. For the HUES the "Ventilation Fans" category (31%) and "Pumps and Aux." category (30%) are determined to use the most electrical energy while "Space Heating" consumes the most all of the oil. A final comparison between the baseline and modeled energy efficiency measures is also provided in the appendices in bar graph format to illustrate changes in energy use with each measure. This provides an indication of where the EEM savings occur and any possible increased energy use from the new measure. That information is then used to formulate whether the EEM is economically sound for the particular application.

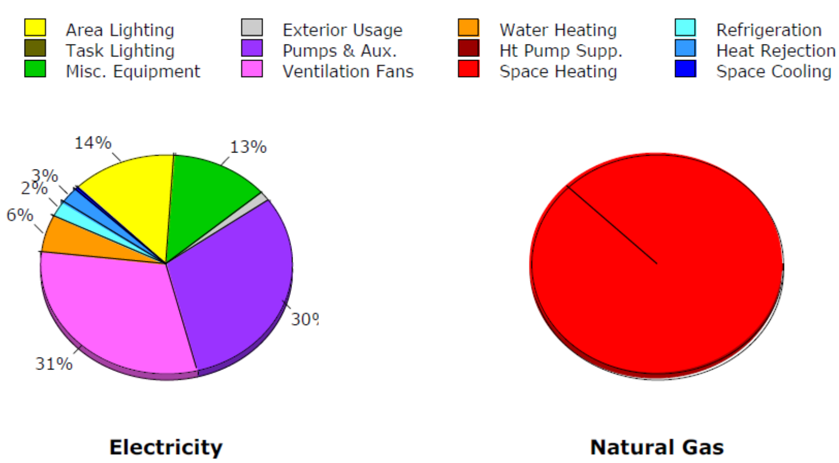


Figure 22: Predicted Annual Energy Use by Category (Baseline)

F. FACILITY BENCHMARKING

ENERGY STAR for Commercial Buildings

The HUES was benchmarked using the EPA's ENERGY STAR® Portfolio Manager for Commercial Buildings. This benchmarking program accounts for building characteristics, regional climatic data, and user function. It then ranks a building within its defined category amongst all other buildings entered in the program to date. The defining metric is the building Energy Use Intensity (EUI). If a building scores at or above the 75th percentile within its category then it becomes eligible for ENERGY STAR® certification pending an on-site validation review by a licensed Professional Engineer.

Currently the program does not have categories for every commercial building type but they can still be entered into the program and checked against similar buildings to determine where the building ranks compared to the current national average. The average energy intensity for every building type category is constantly changing and theoretically is it reducing as more efficient buildings are constructed and existing buildings implement energy efficiency measures. Therefore, buildings that currently meet the eligibility requirements may not be eligible next year when they apply for annual re-certification.

The Hollis Upper Elementary School facility is defined as a "K-12 School". Utility data for electric and heating fuel for the preceding twelve (12) months was input into the benchmarking program. Table 22 presents the annual energy use (through January 2012) and Table 23 presents a summary of the Statement of Energy Performance (SEP) benchmarking results. The SEP is presented in Appendix G.

Table 22: Annual Energy Consumption

Energy	Site Usage (kBtu)
Electric – Grid	2,142,054
Fuel Oil (No. 2)	2,906,786
Total Energy:	5,048,840

Table 23: SEP Benchmarking Summary

Location	Site EUI (kBtu/ft²/yr)	Source EUI (kBtu/ft²/yr)
Hollis Upper Elementary School	52	105
National Median (K-12 facility)	52	104
	% Difference:	1%
	Portfolio Manager Score:	49

Compared to other K-12 schools that have entered data into Portfolio Manager to date, the HUES energy use is at the national average. The source EUI for the HUES is 105 kBtu/ft²/yr while the national average is 104 kBtu/ft²/yr, meaning the HUES uses 1% more energy than the average K-12 school. The Portfolio Manager score is 49 and because it is below the 75th percentile it is not eligible for ENERGY STAR® certification.

Regional Benchmarking

Regional benchmarking provides a valuable comparison of local facilities that are similar in use, function, and size. Two data groups were used to complete independent benchmark comparisons for:

1. Regional School Full Time Enrollment Densities.
2. ENERGY STAR® Energy Use Intensities (source and site).

Table 24 below compares the densities of the building square footage (SF) to full time enrollment (FTE) for each representative school facility.

Table 24: Regional School FTE Densities

School	Location	Area (SF)	FTE	Density (SF/FTE)
Newington Public School	Newington, NH	14,300	40	358
Hollis Upper Elementary School	Hollis, NH	96,258	330	292
Greenland Central School	Greenland, NH	91,226	361	253
Lincoln Akerman School	Hampton Falls, NH	46,736	271	172
Maude H. Trefethen School	New Castle, NH	8,700	54	161
Rye Elementary School	Rye, NH	50,500	317	159
Hollis Primary School	Hollis, NH	46,918	343	137
Mast Way Elementary School	Lee, NH	43,700	334	131
Moharimet Elementary School	Madbury, NH	43,740	372	118
			Average:	198

Figure 23 presents the source and site Energy Use Intensities (EUIs) for the nine schools. EUIs are measured in units of energy per area or kBtu per square foot (kBtu/SF). Source EUIs consider all of the energy required to develop the energy and distribute the energy to the site location including inefficiency losses such as through electrical distribution grids. Site energy is the energy consumed at the point of service or meter. The source EUI of 105 kBtu/SF/yr for HUES is consistent with the other schools. The site EUI is tied with Moharimet Elementary for the lowest of the schools compared with an EUI of 52 kBtu/SF/yr.

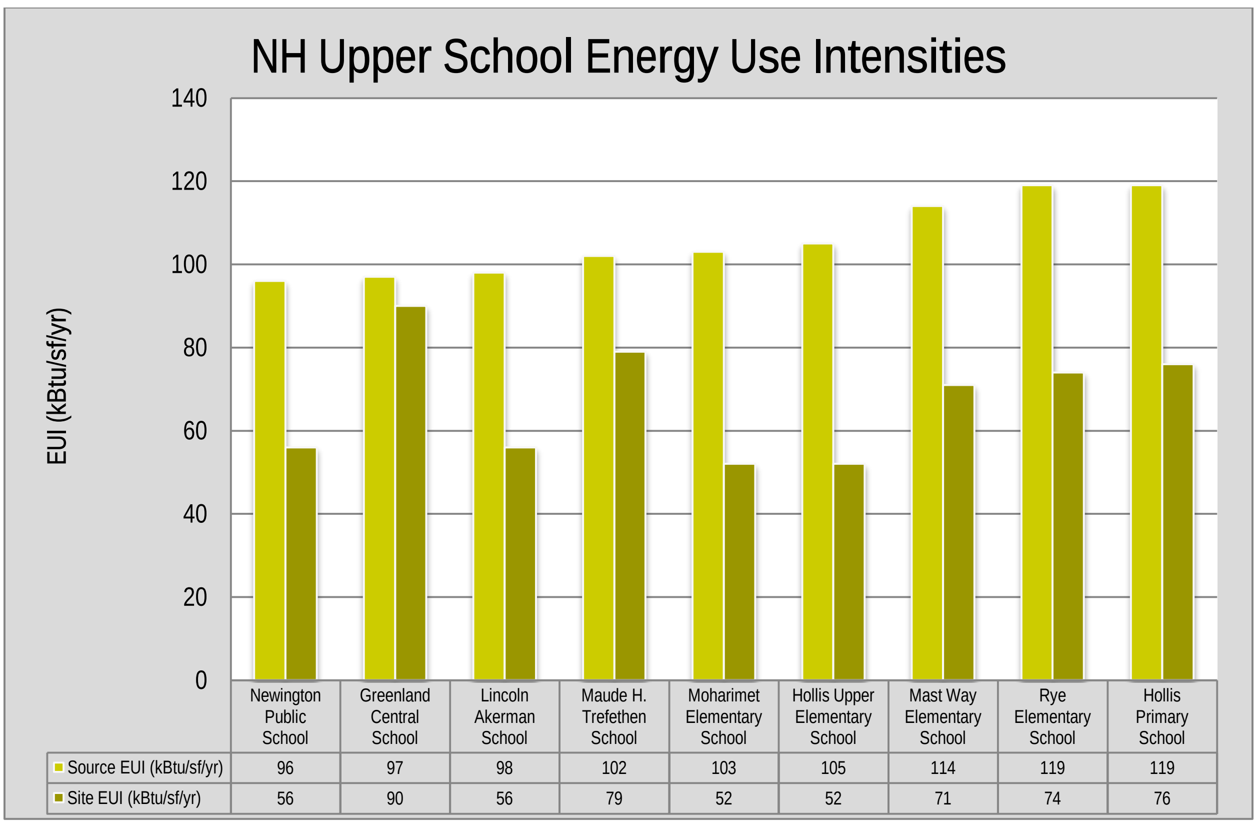


Figure 23: NH Upper School Energy Use Intensities

G. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the HUES, several energy conservation measures (EEMs) are proposed for consideration (Tables 25 to 27). These recommendations are grouped into three tiers based on the cost and effort required to implement the EEM. EEMs are ranked within each tier based on the cost investment for implementation versus the net estimated energy cost savings.

Tier I EEMs are measures that can be quickly implemented with little effort for no or little cost. They include routine maintenance items that can often be completed by facility maintenance personnel and changes in occupant behavior or building operation. Tier II items generally require contracted tradesmen to complete but can generally be implemented at low cost and within operating building maintenance budgets. EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures.

Simple payback is calculated for the proposed EEMs. The cost to implement the measure is estimated based on current industry labor and equipment costs and the annual cost savings represents the reduced costs for energy savings. The net energy and cost savings for smaller EEMs is based on the estimated reduction of the associated energy consumption as defined in the model and equipment inventory. Using these costs, the payback period is then calculated as the number of years at which the capital cost of implementation equals the accumulated energy cost savings.

The savings to investment ratio (SIR) is the accumulated annual cost savings (as determined by the expected service life of the material or equipment associated with the EEM) divided by the cost of investment. A SIR equal to 1.0 indicates that the EEM has a "break-even" or net-zero cost. The higher the SIR, the more favorable the return on investment is.

Other qualitative considerations that do not influence the Simple Payback Method calculation but should be considered by the owner during the decision-making process include:

- Occupant comfort.
- Relative operation and maintenance requirements.
- Remaining useful life of equipment and systems to be replaced.
- Future plans for facility modifications (improvements or renovations) or changes in facility use.

Energy cost savings are based on the average net electric utility charge of $0.165 per kWh between February 2011 and January 2012 at HUES (PSNH) and a heating fuel cost of $3.96 per gallon (NHOEP February 22, 2012).

Tier I Energy Efficiency Measures

Tier I EEMs are measures that can be quickly implemented with little effort for zero or little cost (Table 25). They include routine maintenance items that can often be completed by facility maintenance personnel, and changes to occupant behavior or building operation. Ten (10) Tier I EEMs are recommended.

Table 25: Tier I Energy Efficiency Measures

EEM No.	EEM Description	Investment	Annual Cost Savings	Payback (yrs.)	SIR
TI-1	Disconnect water fountain condensers in the building (10).	$0	$600	0	-
TI-2	Remove vending machines (2) or replace with ENERGY STAR® rated units	$0	$726	0	-
T1-3	There are seventeen (17) microwaves located throughout the building. Recommend consolidating with fewer units (3 or 4).	$0	$97	0	-
T1-4	Repair open makeup air damper in boiler room and interlock with boiler operation.	$350	$600	0.6	17.1
T1-5	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior).	$450	$890	0.5	13.8
T1-6	Consolidate fifteen (15) compact refrigerators with three (3) ENERGY STAR® rated standard size refrigerator units.	$1,500	$1,440	1.0	9.6
T1-7	Power down all electronic equipment when not in use. Install time or motion controlled power strips.	$900	$676	1.3	7.5
T1-8	Install additional interior lighting controllers to reduce lighting density and runtime (photosensors, dimming controls, timers).	$2,600	$1,270	2.0	7.3
T1-9	Install eCube® unit on the walk-in freezer.	$500	$180	2.8	4.3
T1-10	Install exhaust fan controllers using either multi-point time scheduled controllers or demand controllers to reduce operating frequency.	$2,200	$480	4.6	2.6

Water coolers and fountains consume a moderate amount of electricity to condition the water and there are ten (10) throughout the school. Disconnecting the condensers while still being able to supply water is estimated to save $600 annually. Vending machines are another moderate energy consumer which are typically seldom used and are estimated to save $726 annually if disconnected. Seventeen (17) microwaves are located throughout the school and consume a moderate amount of electricity when in standby. An estimated savings of $97 is expected from reducing standby and a slight drop in use if a microwave is not as readily accessible. The makeup air damper in the boiler room does not function as designed which allows for thermal loss. Repairing this and interlocking with the boiler operation to maximize efficiency is estimated to save $600 annually with a low payback period and a high savings to investment ratio (SIR).

Air sealing of the building envelope will provide substantial savings. This includes simple measures such as new weather-stripping on doors, windows, and sealing all wall and roof penetrations which is estimated to save $890 a year. Fifteen (15) compact refrigerators are located throughout the school with five (5) in the administration area which consume a substantial amount of energy and are left mostly empty. These can cost over $100 each to run each year. Consolidating these to three (3) ENERGY STAR® rated units is projected to save $1,440 annually. Most equipment plugged into the wall uses energy even when not in use. Powering down this equipment completely, either by a timed or motion power strip is estimated to save $626 a year.

Although the building recently underwent a lighting systems retrofit (2011), there are low-cost measures to further reduce lighting energy consumption. These include augmenting overhead lighting with task lighting, table, desk, and floor lamps. When natural lighting is present, the task light fixtures would provide sufficient lighting and the overhead units could be turned off (this could be facilitated with daylighting controllers). Dimming controls, motion and time sensors are other methods for reducing lighting densities and runtime. Exterior lighting can be reduced with photosensors which detect the amount of natural light there is and adjust the lighting accordingly.

Adding low-cost multi-point time schedule or demand controllers to the rooftop exhaust fans will reduce electricity and heating fuel consumption. Installing an eCube® thermostat controller on the walk-in freezer unit will reduce the operating frequency and cycling of the compressor unit. The temperature setpoint for the unit can also be reduced.

If the school prefers to keep a vending machine at the facility, it is recommended the current unit be replaced with an Energy Star qualified machine. Since machines are typically rented from a supplier, the school would have to specifically request an Energy Star rated machine. Energy Star qualified machines typically use half the energy a standard unit uses and are typically provided by the supplier at no additional cost depending on the contract between the supplier and the department.

Tier II Energy Efficiency Measures

Tier II items generally require contracted tradesmen to complete but can be implemented at low cost and within operating building maintenance budgets. Six (6) Tier II EEMs are provided in Table 26 for the HUES facility.

Table 26: Tier II Energy Efficiency Measures

EEM No.	EEM Description	Investment	Annual Cost Savings	Payback (yrs.)	SIR
T2-1	Replace three (3) DHW tank units with two (2) demand-tankless electric condensing units.	$4,000	$700	5.7	2.6
T2-2	Reduce lighting densities throughout the building. Replace some lamps with lower wattage lamps and remove unnecessary fixtures.	$3,000	$450	6.6	1.9
T2-3	Replace walk-in Freezer condenser with high efficiency unit with economizers	$3,039	$396	7.7	1.9
T2-4	Install four (4) de-stratification fans in the cafeteria and six (6) in the gymnasium.	$4,500	$800	5.6	1.7
T2-5	Replace exterior metal halide wallpack fixtures with LED units (14).	$7,970	$915	8.7	1.7
T2-6	Install VFD controls on Munters® ERV fan motors.	$2,800	$300	9.3	1.6
T2-7	Install commercial thermal insulated shades on windows and close at night during heating periods.	$7,200	$700	10.3	1.0

There are three (3) electric-fired DHW tanks which are estimated to exceed the necessary amount of water needed for the building resulting in unnecessary energy consumption. Replacing these with two (2) demand-tankless electric condensing units is estimated to have a 5.7 year payback and a 2.6 SIR. Lighting densities exceeded the recommended standards in all but two locations throughout the building. Reducing densities by installing lower wattage fixtures or removing unnecessary fixtures is estimated to have a payback of 6.6 years.

Figure 24: LED Wall Pack (MaxLite®)

Areas with high ceilings such as the cafeteria and gymnasium more heat to rise further up. De-stratification fans recirculate this air from the ceiling downwards, resulting in less conditioned air and therefore better energy efficiency. The Munters® ERV motors should be equipped with VFD's which will optimize their efficiency by reducing operating frequency and extending the service life of the equipment. The exterior metal halide lights are high wattage fixtures (70w) that operate a significant number of hours annually. Replacing these with 20w LED units (Figure 24) has a savings to investment ratio of 1.7 indicating that they are economically practical. Additional benefits of the LED fixtures include improved lighting quality, longer lamp service life, and reduced lighting pollution. Discounted fixtures are available through the nhsaves® program (www.nhsaves.com). As evident by thermal imaging heat is lost through window panes and frames. Thermally insulated shades can reduce the amount of thermal transfer if closed at night during heating periods.

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures. Five (5) Tier III EEMs are provided in Table 27 for the Hollis Upper Elementary School. The costs assume a phased approach including a comprehensive engineering evaluation, developing a list of corrective actions that reduce energy consumption and improve occupant comfort, and implementation of the corrective actions.

Transformers within the building which are older than 15 years should consider replacement with high efficiency units. This is estimated to save $12,000 a year with a 4.3 year simple payback and a 3.5 SIR. Ventilation quality varied throughout the school with some spaces under-ventilated while others were over-ventilated. Installing CO_2 demand controls on ventilation equipment will optimize the runtime and provide sufficient ventilation throughout. This is estimated to have a 5.6 year payback and a 2.7 SIR.

Table 27: Tier III Energy Efficiency Measures

EEM No.	EEM Description	Investment	Annual Cost Savings	Payback (yrs.)	SIR
T3-1	Replace all electrical transformers older than 15 years with high efficiency units.	$51,578	$12,000	4.3	3.5
T3-2	Install CO_2 demand controls on existing ventilation equipment (Munters® ERV).	$7,300	$1,800	4.0	3.0
T3-3	Replace the ten (10) oil-fired boilers with two (2) 90% high efficiency oil-fired units. The new system will be interconnected to the domestic hot water system and DDC system. Install new NEMA rated circulation pumps with VFD controls.	$222,410	$13,066	17.0	1.5
T3-4	Sub meter the pump house to measure electric consumption.	$2,600	NA	NA	NA
T3-5	Install exchange air ventilation systems with energy recovery units and demand controls in all areas not served by the existing ERV unit (1st floor). *(IAQ measure)*	$119,715	NA	NA	NA

There are ten (10) residential sized boilers which supply heat to the school. This is not the most efficient application for these boilers, and due to their age and use (15 and 32 years old), their efficiencies have decreased. Replacing these units with high efficiency models (over 90%) and interconnecting with the DHW system and DDC controls system as well as installing pumps with VFD controls is projected to significantly reduce energy consumption, increase efficiency of all heating systems, decrease maintenance and produce a savings of $13,066 annually. With a 16.8 year simple payback and 1.5 SIR, economically it is a viable proposition, and considering improved occupant comfort and decreased maintenance makes it more worthwhile. The boilers are also reaching the end of their useful life.

The water supply pump system consumes a substantial amount of energy and skews the EUI ratings and benchmarking for the HUES. As EEMs are implemented, it will be difficult to quantify the resulting energy savings based on the variable and high electrical use of the pump system. Sub-metering the water system will quantify the HUES electrical consumption and reductions as EEMs are implemented.

With the exception of the first floor area served by the modern ERV unit, exchange air ventilation systems in the HUES are inadequate and do not comply with current code standards. As an IAQ measure, installing air exchange systems for the other spaces in the building is recommended. Design and installation of the systems should comply with current code standards (ASHRAE 62.1 and 90.1). For this analysis, three ERV units are presumed.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. There are interdependencies among measures that will affect the realized energy savings. For example, replacing lighting fixtures with lower energy units reduces heat load to the building thereby requiring more heating fuel to compensate for the loss in heat from the inefficient light fixtures. Also, many of the larger capital Tier III EEM projects may include some of the smaller dependent EEMs.

Investment costs are provided for budgetary planning only. They are estimated based on current industry pricing for materials and labor. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures.

EEMs Considered but not Recommended

The following measures were considered as part of the building evaluation but are not recommended as best-value EEMs. Considerations include the cost practicality and payback term and occupant comfort concerns.

1. Insulation of the existing building roof systems (1980 and 1997) do not comply with current energy conservation code standards (IECC, 2009). Substantially improving the envelope in a relatively modern building is a costly undertaking that provides a very long payback. However, any future major renovations should consider improving the existing envelope systems.
2. As evidenced in the thermal imaging survey, the exposed concrete foundation walls have very low thermal performance resulting in significant heat loss. Typical methods to improve thermal integrity of foundation walls include adding rigid foam insulation to the wall. Because there are no below grade walls, insulation would have to installed on the exterior walls. Adding insulation would be a costly measure with a long payback term.
3. While district heating systems can be economical solutions, the cost practicality depends on several factors including infrastructure cost, the number of buildings served, the aggregate size of building area served, and the aerial proximity of the district buildings. Considering such, a district heating system is not recommended for the HUES and HPS based on the associated costs to develop the infrastructure relative to the heating demands for the buildings.

O&M Considerations

O&M and considerations are provided for existing systems and for proposed EEMs. They are intended to provide best-value practices for the building manager and to identify any O&M requirements for the proposed EEMs.

- Replacing older mechanical equipment with modern equipment generally reduces maintenance and repair requirements and costs. Most significantly, it reduces repair costs for outside vendors.
- Installing demand CO_2 controllers on the ventilation equipment will reduce the operating frequency of the units, reduce maintenance and repair costs, and extend the service life of the equipment.
- Replacing the existing heating systems will significantly reduce maintenance and repair costs. Servicing the new boiler units will be much easier with readily available parts.
- Induction and LED lamps have much longer service life than HPS lamps. While induction lamps are more expensive than LED lamps, they have the longest service life.

- Replacing the older electrical transformers reduces the potential for failure resulting in impacts to facility operations.

Indoor Air Quality Considerations

IAQ considerations identify any potential changes to existing conditions as EEMs are implemented. Periodic monitoring of IAQ conditions including temperature, relative humidity, and CO_2 concentrations is recommended to ensure that minimum IAQ standards are maintained as EEMs are implemented and the building systems are optimized. IAQ data also directly correlates to the performance efficiency of building conditioning and ventilation systems.

- Improving the building envelope by air sealing will reduce the volume of air exchanged through passive leakage. Mechanical ventilation becomes more critical as air leakage is reduced.
- Installing demand CO_2 controllers on the ventilation systems will optimize the system operation. Location of the sensors is critical to ensure that minimum indoor air quality standards are met.

Renewable Energy Considerations

While renewable energy systems generally require a higher capital investment, they provide a significant reduction in the consumption of non-renewable fossil fuel energies. Other obvious benefits include a reduction in ozone depleting gas emissions (as measured by CO_2 equivalency), otherwise referred to as the "carbon footprint". Renewable energy systems also reduce the reliance upon fossil fuels derived from foreign nations and mitigate pricing fluctuations in a volatile and unpredictable market.

Evaluating the technical and economic practicality of a renewable energy system for a specific facility should consider several facility specific variables including:

- Geographical location.
- Building orientation.
- Adjacent and abutting land features.
- Site footprint and open space.
- Building systems configuration and condition.
- Local zoning or permitting restrictions.
- Currently available financial resources (grants, utility provider rebates, tax incentives).

Qualitative considerations for renewable energies include owner initiatives and public awareness and education.

Table 28 provides a summary description of the more common and proven renewable energy technologies. The Table also provides a preliminary feasibility assessment for implementing each technology at the HUES facility. Additionally, each renewable energy technology is scored and graded based on technology and facility specific characteristics. Appendix H presents the criteria used to develop the score and grade for each renewable energy technology. A more rigorous engineering evaluation should be completed if the Town is considering implementing any renewable energy system.

Table 28: Renewable Energy Considerations

Renewable Energy System	System Description & Site Feasibility
Roof-Mounted Solar Photovoltaic Systems	System Description: Photovoltaic (PV) systems are composed of solar energy collector panels that are electrically connected to DC/AC inverter(s). The inverter(s) then distributes the AC current to the building electrical distribution system. Surplus energy is sent into the utility grid via net metering and reimbursed by the utility at a discounted rate. The capital investment cost for PV systems is high but the technology is becoming increasingly more efficient thereby lowering initial costs.
Score: 82%	*Site Feasibility:* *Based on the area of the southern facing roof, the inclination, and the condition of the roof, a small to medium roof-mounted system (10kW-30kW) could be installed on the building. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system. A structural evaluation of the roof framing system would be required to ensure that it could accommodate the increased loading.*
Biomass Heating Systems	System Description: Biomass heating systems include wood chip fueled furnaces and wood pellet fueled furnaces. For several reasons, wood chip systems are generally practical only in large scale applications. Wood pellet systems can be practical in any size. Wood chip systems are maintenance intensive based on the market availability and procurement of woodchip feedstock and variability of woodchip characteristics (specie, size, moisture content, bark content, Btu value) which affect the operating efficiency of the furnace and heating output. They require a constant feed via a hopper and conveyor system and feed rates must vary according to feedstock Btu value and heating demand. For these reasons they typically require full-time maintenance and are practical only in large scale applications. Wood pellet systems are much less maintenance intensive and feedstock availability and consistency is less of an issue. Both systems reduce the dependency on fossil-fuels and feedstock can be harvested locally.
Score: 80%	*Site Feasibility:* *A conventional pellet boiler unit is a practical heating system for the building however this requires additional effort for procurement of pellets, storing pellets, periodic filling the pellet hopper during the heating season, and emptying the ash. However, there are new systems with automated feed and ash removal systems that would be a practical application at the HUES facility.*
Geothermal Heating & Cooling	System Description: Geothermal heating systems utilize solar energy residing in the upper crust of the earth. Cooling is provided by transferring heat from the building to the ground. There are a variety of heating/cooling transfer systems but the most common consists of a deep well and piping loop network. All systems include a compressor and pumps which require electrical energy. Geothermal systems are a proven and accepted technology in the New England region. Site constraints and building HVAC characteristics define the practicality.
Score: 79%	*Site Feasibility:* *A geothermal heating and cooling system is a practical consideration for the building. The parcel provides adequate area for a well and piping network. Considering the existing hydronic heating and cooling equipment is compatible with a ground-source water heat pump system, it is a practical technology for the building. Considering the high heating and cooling costs for the building, payback for the system would be relatively low.*
Solar Domestic Hot Water	System Description: Solar domestic hot water (DHW) systems include a solar energy collector system which transfers the thermal energy to domestic water thereby heating the water. These are typically used in conjunction with an existing conventional DHW system as a supplemental water heating source. Because of the high capital cost, solar DHW systems are only feasible for facilities that have a relatively high demand for DHW.
Score: 78%	*Site Feasibility:* *Based on the low demand for domestic hot water, a solar hot-water system may be a practical consideration for the building. The capital cost could be offset with substantial utility rebates and incentives. The system could provide primary DHW during summer months when demand is low. In colder months, it would provide secondary heating.*

Wind Turbine Generator	System Description: Wind turbine generators (WTGs) simply convert wind energy into electrical energy via a turbine unit. WTGs may be pole mounted or rooftop mounted however system efficiency improves with increased elevation. Due to cost and site related constraints, WTG technology in New England is only practical for select sites. Constraints include local geographical and manmade features that alter wind direction, turbulence, or velocity. Other technology constraints include local variability of wind patterns and velocity. Additionally, WTGs require permitting (local, state, FAA) and local zoning that may restrict systems due to height limitations, and/or, visual detraction of the local landscape. Presently, WTG technology is not widely used in New England based on the relatively high capital cost compared to the energy savings.
Score: 75%	*Site Feasibility:* *Considering the small parcel that the building is sited on, a large pole-mounted WTG unit may not be practical. A single or multiple smaller units (<5kW) are practical considerations for the site. These can be pole mounted (15-30 ft) or roof-mounted. As described above, there are many constraints that determine if WTG is prudent for a particular site including:* • *Local zoning restrictions.* • *Detraction of the local landscape and abutter opinion.* • *Permitting requirements (local, state, FAA).* • *Local wind characteristics.* *Determining the local wind characteristics would require a wind study of the site.*
Ground-Mounted Solar Photovoltaic Systems	System Description: A ground-mounted PV system is composed of the same solar collector panels used for a roof-mount system. The collectors are mounted on a frame support system on the ground verses a roof structure. This is advantageous when roof framing cannot accommodate the increased load of the collector panel and the ease of installation and access for maintenance and repair.
Score: 74%	*Site Feasibility:* *Based on the limited southern facing land area at the Hollis Upper Elementary School, only a small sized PV system (5-10 kW) could be sited. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system.*
Solar Thermal Systems	System Description: Similar to a roof-mounted solar PV system, solar thermal systems are most commonly installed on rooftops. These systems utilize solar energy for heating of outdoor air. The most common application is for pre-heating of outdoor air used for air exchanges systems in buildings. This reduces the heating fuel required to maintain setpoint temperatures in interior spaces.
Score: 69%	*Site Feasibility:* *Considering the lack of heating and ventilation equipment, the capital costs to install the system would not provide a reasonable payback unless substantial grant or incentive monies were obtained by the Town. Solar thermal should be re-evaluated if new air exchange equipment is installed as recommended. The southerly facing sloped metal roof is conducive to a solar energy collection system.*
Combined Heat & Power (CHP)	System Description: Combined heat and power (CHP) systems are reliant on non-renewable energies. Systems are composed of a fossil-fuel powered combustion engine and electrical generator. Electrical current is distributed to the building distribution system to reduce reliance on grid supplied electricity. Byproduct thermal energy derived from the combustion engine is recovered and used to heat the building (this is generally considered to be renewable energy). Another benefit of CHP systems is that they provide electrical energy during power outages in buildings that do not have emergency power backup. Larger CHP units require a substantially large fuel supply and if natural gas is not available then a LPG tank must be sited.
Score: 64%	*Site Feasibility:* *Considering there is no natural gas on-site or within the Town, a CHP unit may not be practical. Additionally, costs associated with the infrastructure development may not be practical. CHP systems also require substantial maintenance and have a low expected service life.*

H. ENERGY EFFICIENCY INCENTIVE AND FUNDING OPPORTUNITIES

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of municipal and school buildings through financial incentives and technical support. Some of the currently available programs are presented herein however building managers are encouraged to explore all funding and incentive opportunities as some programs end and new programs are developed. For a current listing of advertised programs and initiatives, visit www.dsireusa.org.

Northeast Energy Efficiency Partnerships

Northeast Collaborative for High Performance Schools (NE-CHPS)

NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% reimbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps .

New Hampshire Public Utilities Commission

New Hampshire Pay for Performance

This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive # 1: Is based on the area of conditioned space in square feet. Incentive #2: Per kWh saved and Per MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per kWh saved and Per MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $300,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

New Hampshire Public Utilities Commission's Renewable Energy Rebates

The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority

New Hampshire Community Development Finance Authority Revolving Loan Fund

The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

- Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
- Improvements to HVAC equipment and air exchange;
- Installation of renewable energy systems;
- Improvements to lighting, equipment, and other electrical systems; and
- Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH)

Commercial (Electric) Energy Efficiency Incentive Programs

This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HV AC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programsand-Incentives.aspx

SmartSTART

The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple – pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves. This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit: http://www.psnh.com/SaveEnergyMoney/For-BusinesslMunicipal-Smart-Start-Program.aspx

Schools Program

For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://w.Ytw.psnh.com/SaveEnergy MoneyILarge-Power/Schools-Program.aspx

Clean Air - Cool Planet

Community Energy Efficiency

CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of New Hampshire , NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergypian.net . A groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.orglfor_communities/index.php .

Environmental Protection Agency (EPA)

ENERGY STAR Challenge for Schools

EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
http://www.energystar.gov/index.cfm?c=challenge.bus_challenge

Cool School Challenge

The Cool School Challenge is a program of the Puget Sound Clean Air Agency, developed in collaboration with Redmond High School environmental science teacher Mike Town, and Puget Sound Energy's Powerful Choices for the Environment program.

Conceptually modeled after the U.S. Mayor's Climate Protection Agreement, the Cool School Challenge aims to motivate students, teachers, and school districts to reduce carbon dioxide and other greenhouse gas emissions schoolwide. At the heart of the Cool School Challenge is the philosophy that big changes start with small steps, and that taken together, simple individual actions create a world of difference.

The goals of the Cool School Challenge are to:

- Educate young people, and by proxy their families, about climate change and everyday actions they can take to reduce their impact locally and globally;
- Reduce carbon dioxide emissions and other greenhouse gas emissions in and around schools;
- Encourage student leadership and empowerment;
- Foster a community of teachers/students working together to reduce their greenhouse gas emissions; and
- Foster a new generation of environmental/air quality advocates.
- Learn more about the Cool School Challenge at: http://www.coolschoolchallenge.org/.

APPENDIX A

Photographs

SOUTH SIDE OF BUILDING


MAIN BUILDING ENTRANCE ALONG SOUTH SIDE OF BUILDING


SOUTH SIDE OF BUILDING


MAIN BUILDING ENTRANCE ALONG SOUTH SIDE OF BUILDING


ELECTRICAL TRANSFORMER ALONG SOUTH SIDE


SOUTH SIDE OF BUILDING


NOOK ALONG SOUTH SIDE OF BUILDING


SOUTH SIDE OF BUILDING

SOUTH SIDE OF BUILDING


SIDE ENTRANCE ALONG WEST SIDE OF BUILDING


SOUTH SIDE OF BUILDING


SIDE ENTRANCE ALONG WEST SIDE OF BUILDING


GYMNASIUM FOYER ENTRANCE ALONG WEST SIDE


SIDE ENTRANCE ALONG WEST SIDE OF BUILDING


WEST SIDE OF BUILDING


WEST SIDE OF BUILDING


MECHANICAL EQUIPMENT SERVICING BOTTOM FLOOR


NORTH SIDE OF BUILDING


MECHANICAL EQUIPMENT SERVICING BOTTOM FLOOR


NORTH SIDE OF BUILDING


NORTH SIDE OF BUILDING


NORTH SIDE OF BUILDING


NORTH SIDE OF BUILDING


NORTH SIDE WINDOW

NORTHWEST CORNER OF BUILDING

ELECTRICAL PANEL NOTE MISSING BREAKERS COVERED IN TAPE

ENTRANCE TO BOTTOM FLOOR AT NORTHWEST CORNER

NORTH SIDE OF BUILDING


STOVETOP BURNERS IN KITCHEN

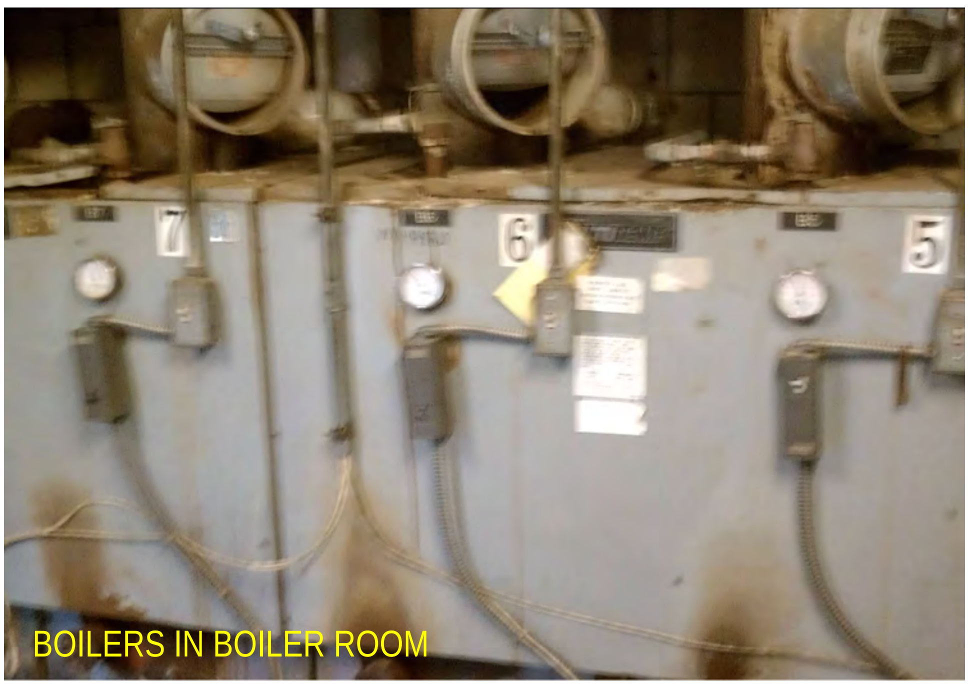

BOILERS IN BOILER ROOM

OVEN IN KITCHEN


BOILERS IN BOILER ROOM

BOILERS IN BOILER ROOM

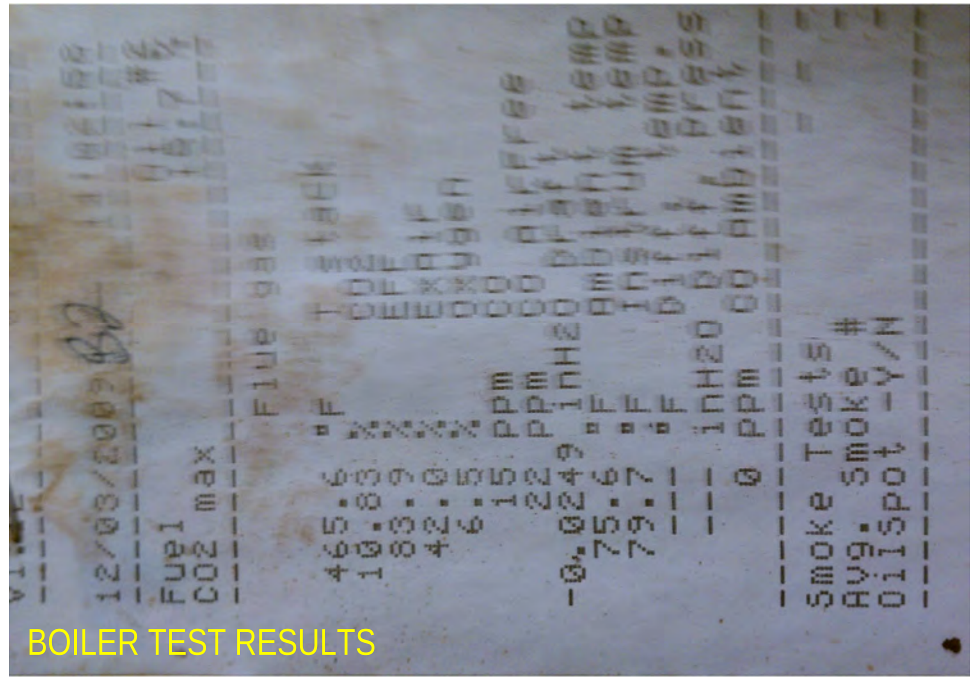
BOILER TAG



BOILERS IN BOILER ROOM

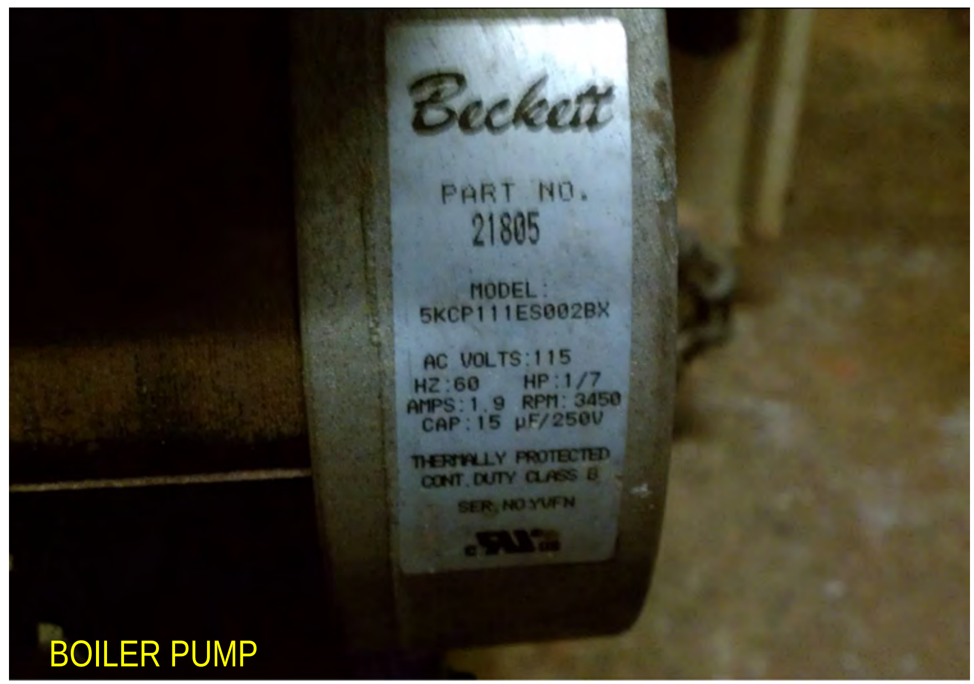

BOILER IN BOILER ROOM

BOILER TEST RESULTS



BOILER TEST RESULTS

BOILER BURNER CONTROL

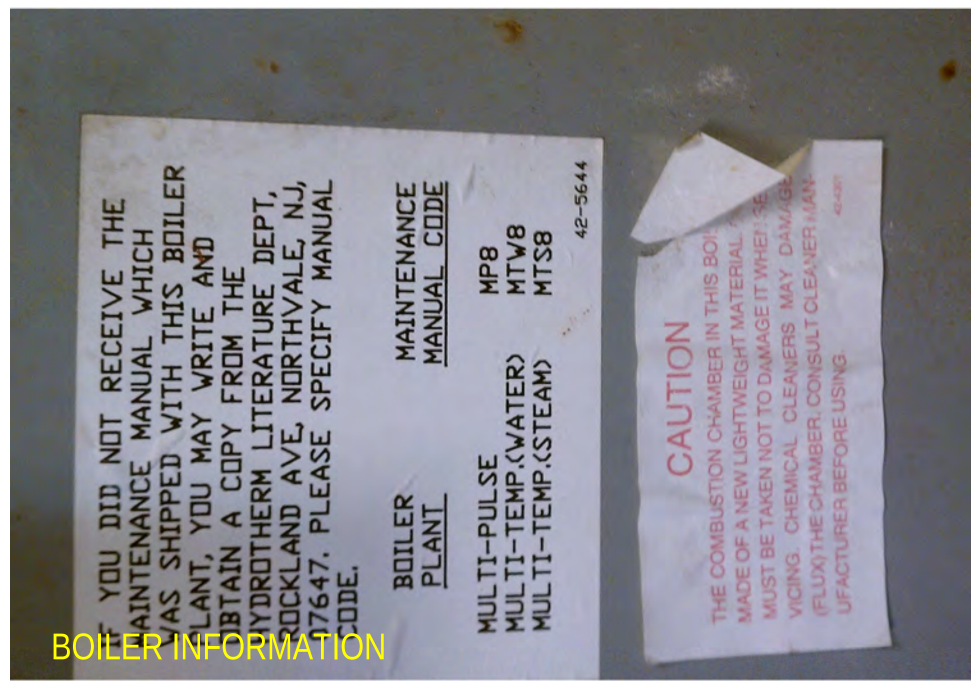


BOILER PUMP

BOILER TEST RESULTS

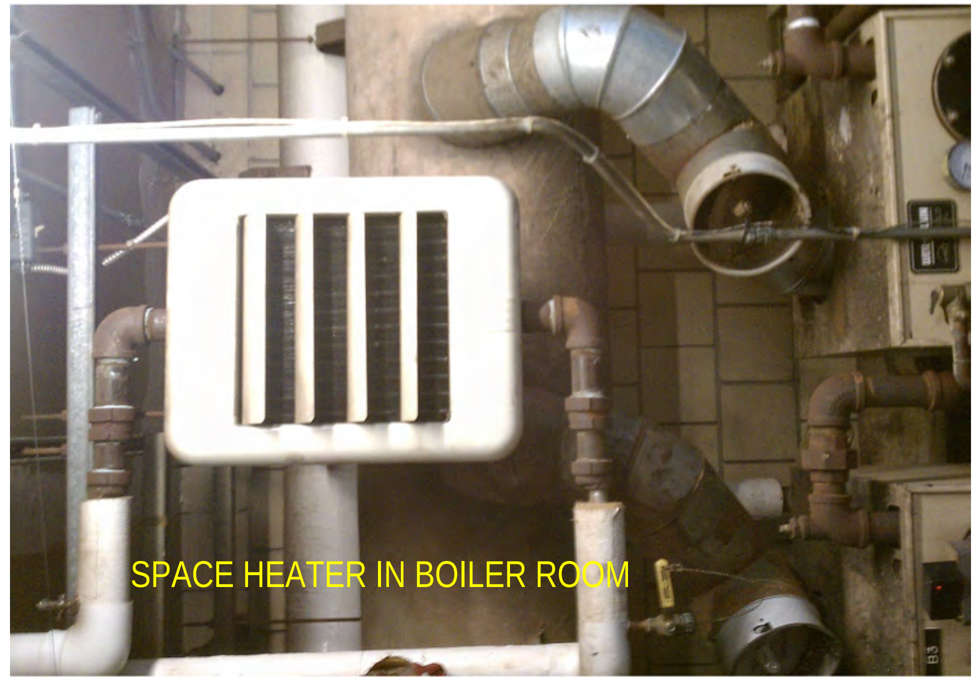
BOILER NAMETAG

WEIL-MCLAIN BOILER TAG



BOILER INFORMATION

DRAFT CONTROL IN BOILER ROOM

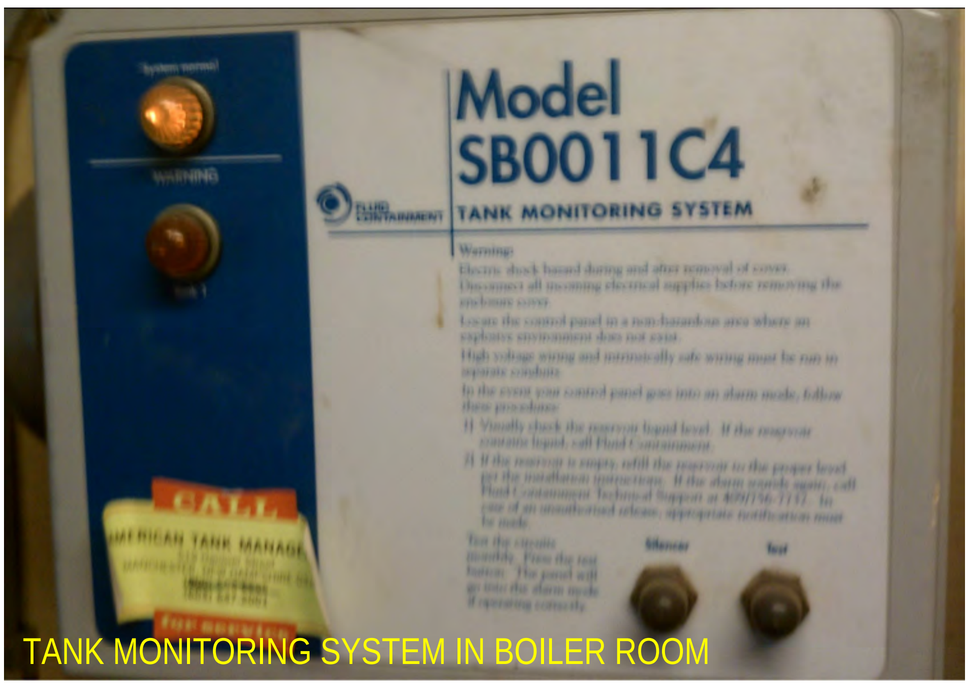

SPACE HEATER IN BOILER ROOM

BOILER OIL BURNER


DRAFT CONTROL IN BOILER ROOM

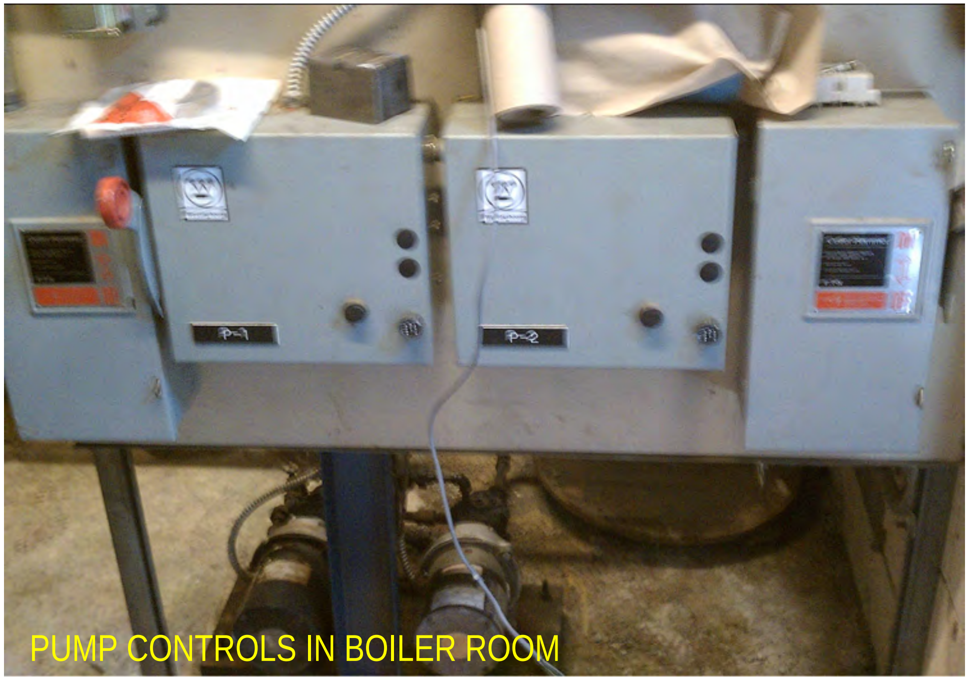
TANK SENSOR ALARM IN BOILER ROOM

BOILER CONTROLS IN BOILER ROOM

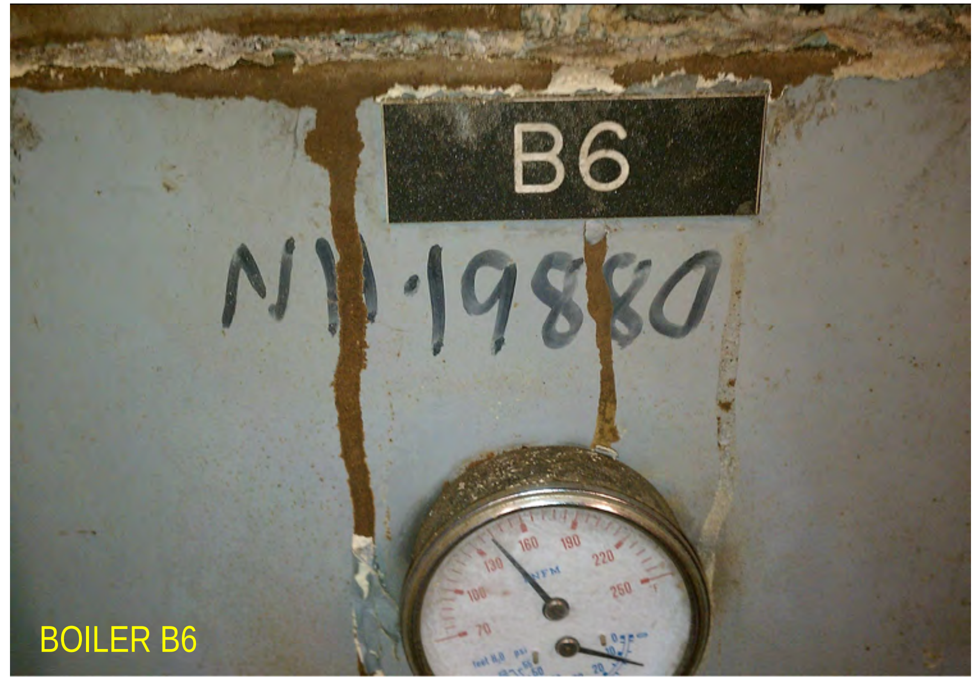


TANK MONITORING SYSTEM IN BOILER ROOM

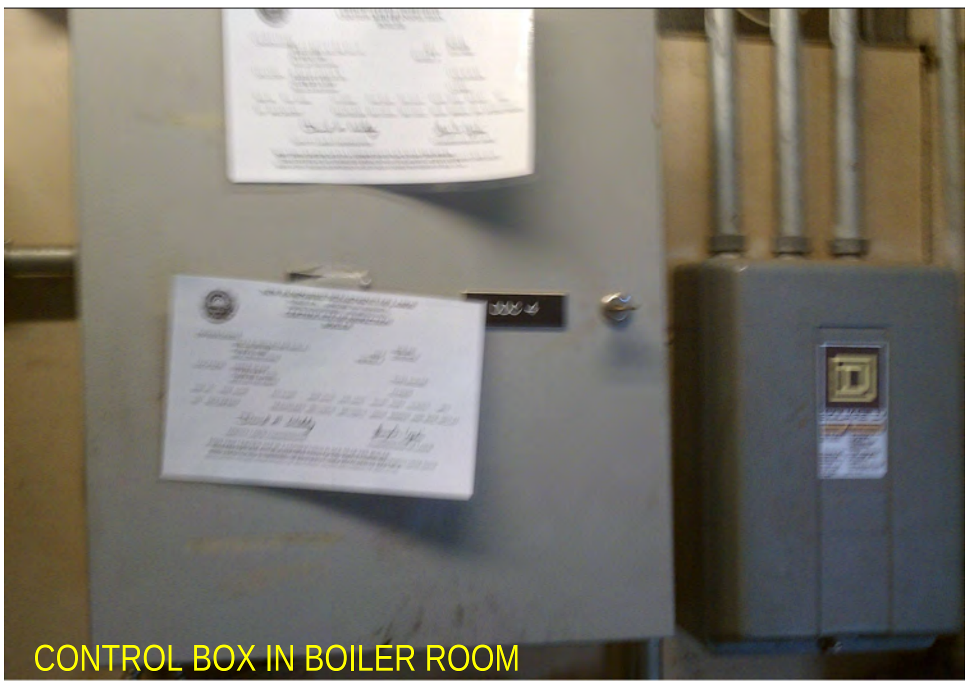
TANK MONITORING SYSTEM IN BOILER ROOM



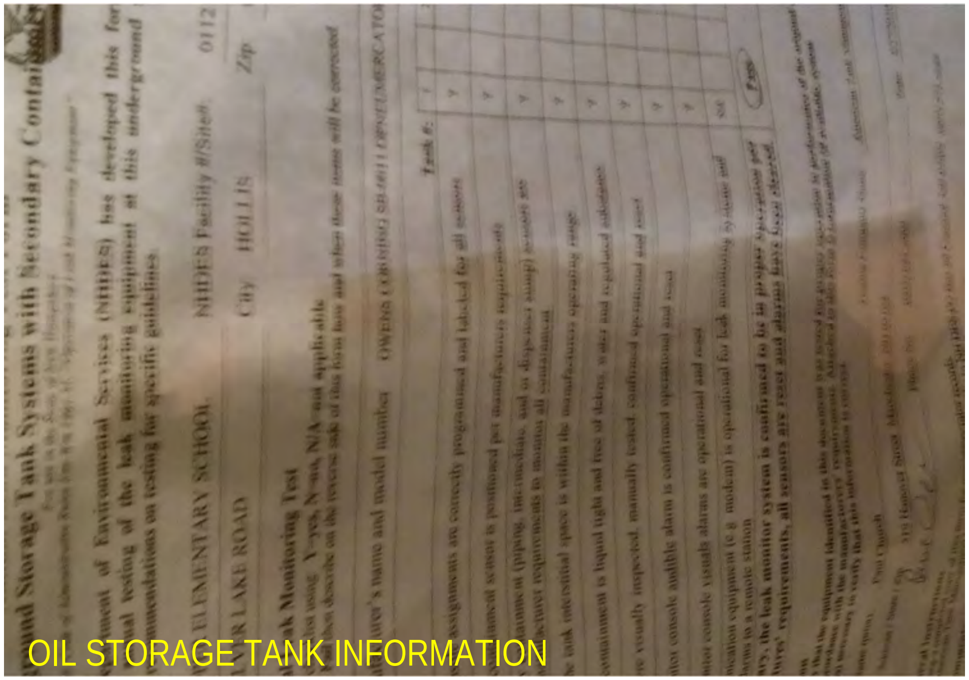
PUMP CONTROLS IN BOILER ROOM



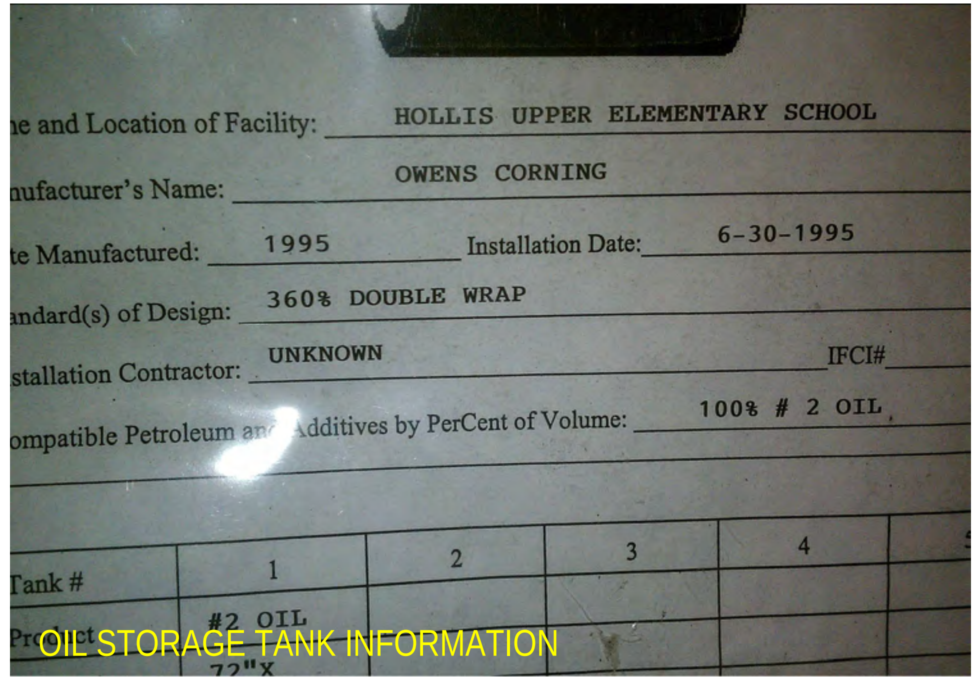
BOILER B6


CONTROL BOX IN BOILER ROOM

OIL TANK IN BOILER ROOM



OIL STORAGE TANK INFORMATION



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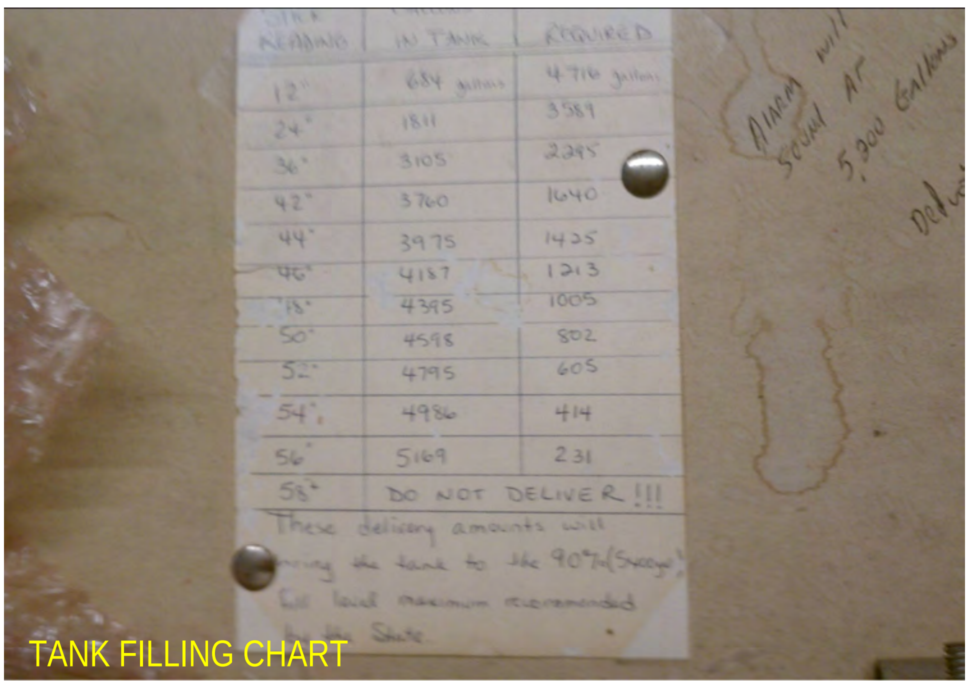
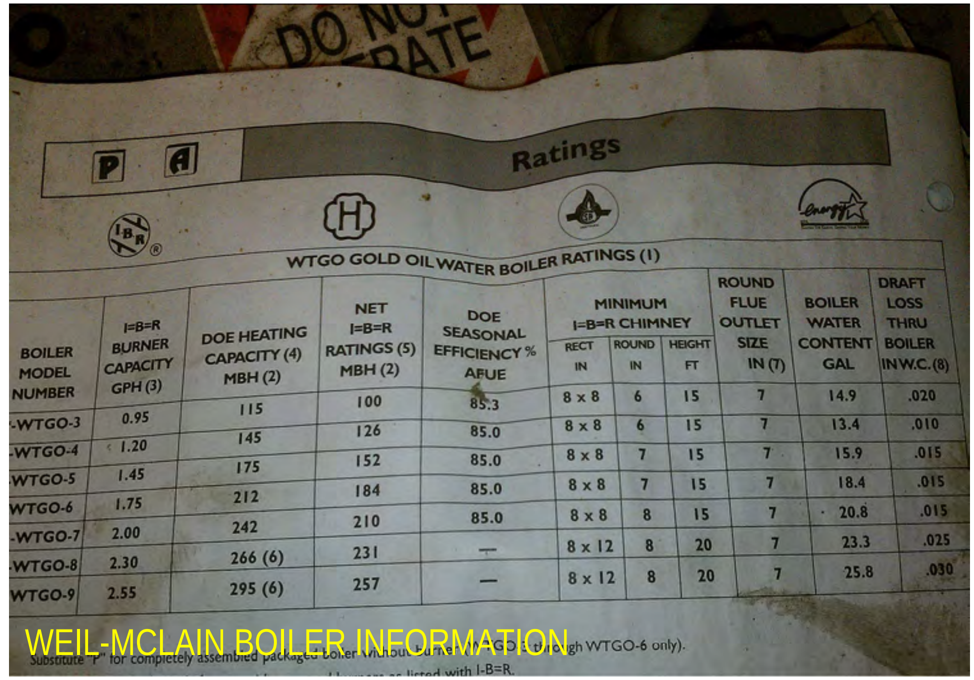


TANK FILLING CHART

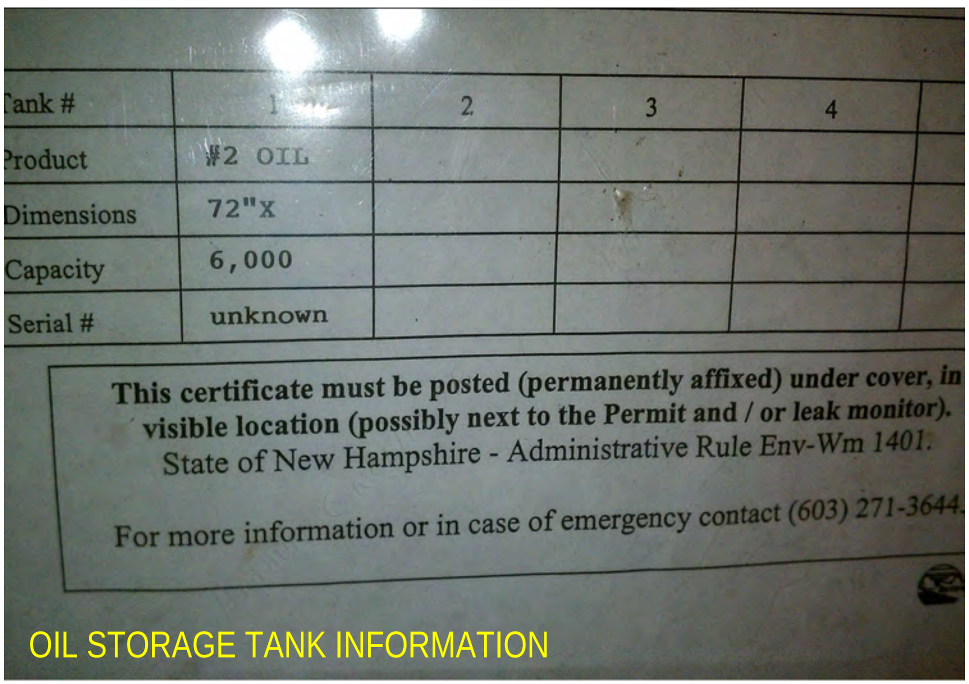
OIL STORAGE TANK INFORMATION

WEIL-MCLAIN BOILER INSTRUCTION MANUAL



BOILER MODEL NUMBER	I=B=R BURNER CAPACITY GPH (3)	DOE HEATING CAPACITY (4) MBH (2)	NET I=B=R RATINGS (5) MBH (2)	DOE SEASONAL EFFICIENCY % AFUE	MINIMUM I=B=R CHIMNEY RECT IN	ROUND IN	HEIGHT FT	ROUND FLUE OUTLET SIZE IN (7)	BOILER WATER CONTENT GAL	DRAFT LOSS THRU BOILER IN W.C. (8)
WTGO-3	0.95	115	100	85.3	8 x 8	6	15	7	14.9	.020
WTGO-4	1.20	145	126	85.0	8 x 8	6	15	7	13.4	.010
WTGO-5	1.45	175	152	85.0	8 x 8	7	15	7	15.9	.015
WTGO-6	1.75	212	184	85.0	8 x 8	7	15	7	18.4	.015
WTGO-7	2.00	242	210	85.0	8 x 8	8	15	7	20.8	.015
WTGO-8	2.30	266 (6)	231	—	8 x 12	8	20	7	23.3	.025
WTGO-9	2.55	295 (6)	257	—	8 x 12	8	20	7	25.8	.030

WEIL-MCLAIN BOILER INFORMATION

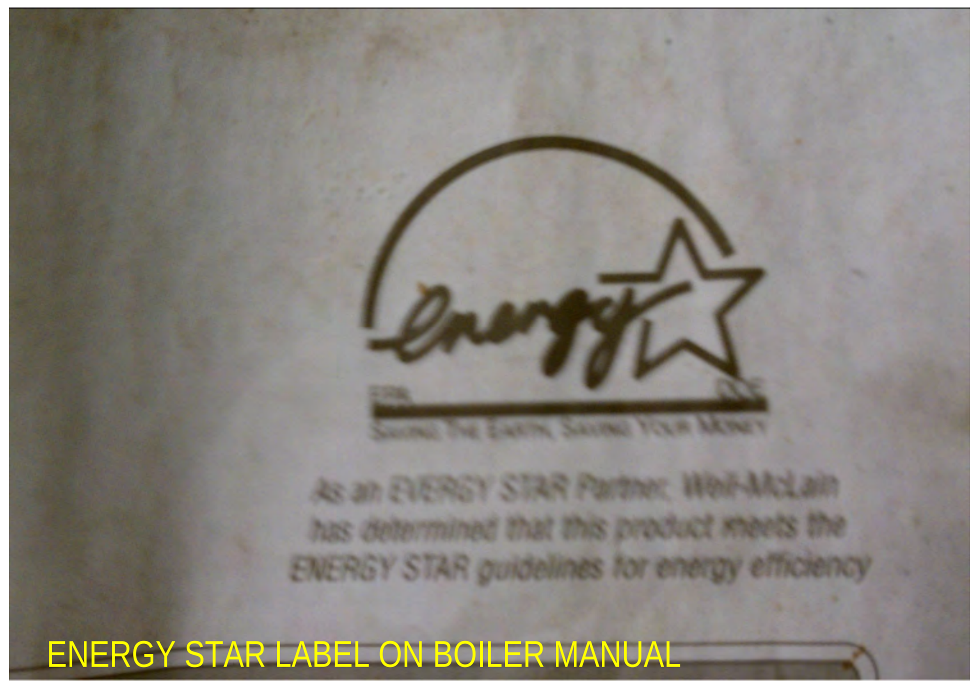


Tank #	1	2	3	4
Product	#2 OIL			
Dimensions	72"x			
Capacity	6,000			
Serial #	unknown			

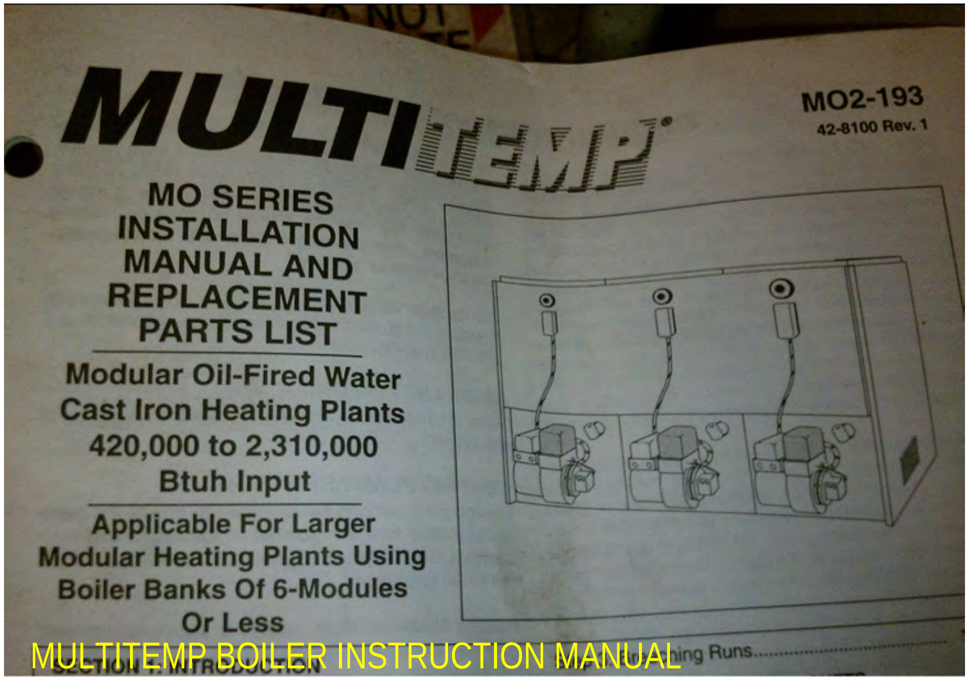
This certificate must be posted (permanently affixed) under cover, in visible location (possibly next to the Permit and / or leak monitor).
State of New Hampshire - Administrative Rule Env-Wm 1401.

For more information or in case of emergency contact (603) 271-3644.

OIL STORAGE TANK INFORMATION

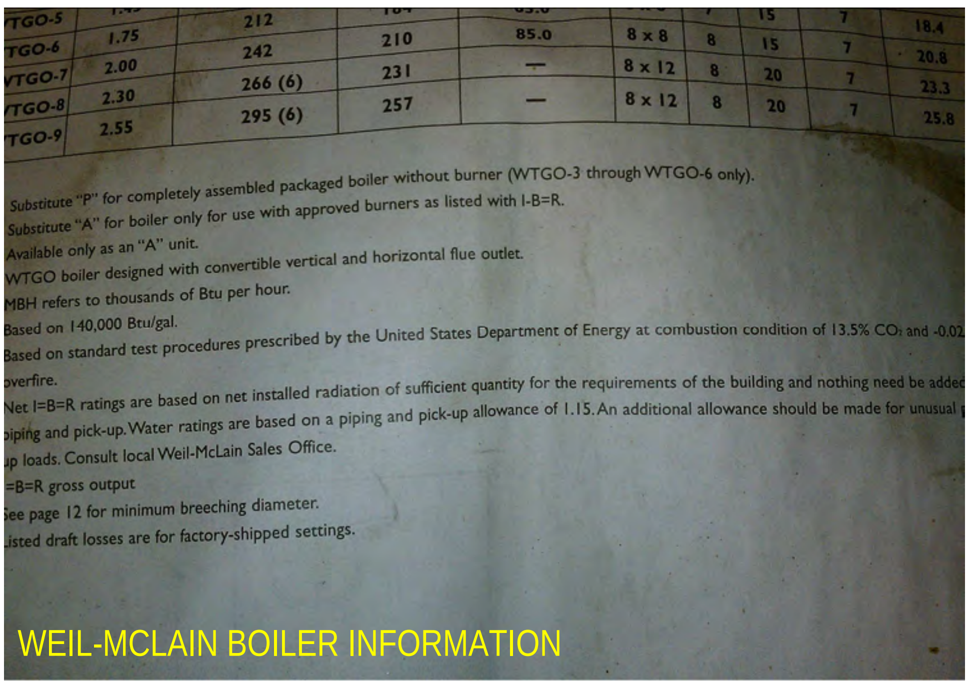


ENERGY STAR LABEL ON BOILER MANUAL



MULTITEMP BOILER INSTRUCTION MANUAL

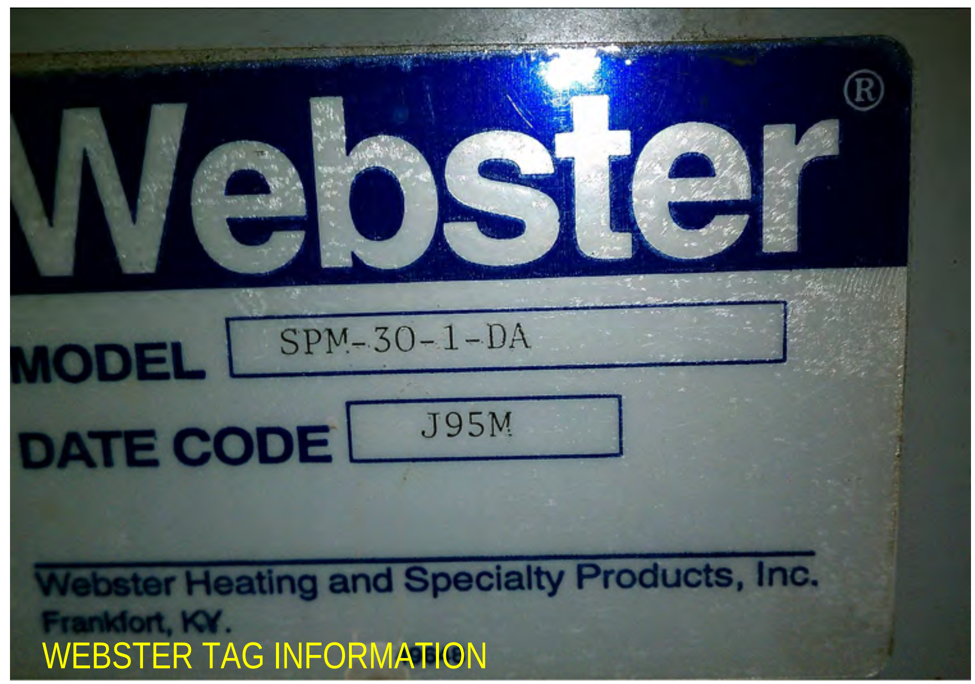
WEBSTER FUEL PUMP CONTROLS



TGO-6	1.75	212	210	85.0	8 x 8	8	15	7	18.4
TGO-6	2.00	242	231	—	8 x 12	8	15	7	20.8
WTGO-7	2.30	266 (6)	231	—	8 x 12	8	20	7	23.3
WTGO-8	2.30	295 (6)	257	—	8 x 12	8	20	7	25.8
TGO-9	2.55								

Substitute "P" for completely assembled packaged boiler without burner (WTGO-3 through WTGO-6 only).
Substitute "A" for boiler only for use with approved burners as listed with I-B=R.
Available only as an "A" unit.
WTGO boiler designed with convertible vertical and horizontal flue outlet.
MBH refers to thousands of Btu per hour.
Based on 140,000 Btu/gal.
Based on standard test procedures prescribed by the United States Department of Energy at combustion condition of 13.5% CO_2 and -0.02
overfire.
Net I=B=R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added
piping and pick-up. Water ratings are based on a piping and pick-up allowance of 1.15. An additional allowance should be made for unusual
up loads. Consult local Weil-McLain Sales Office.
=B=R gross output
See page 12 for minimum breeching diameter.
Listed draft losses are for factory-shipped settings.

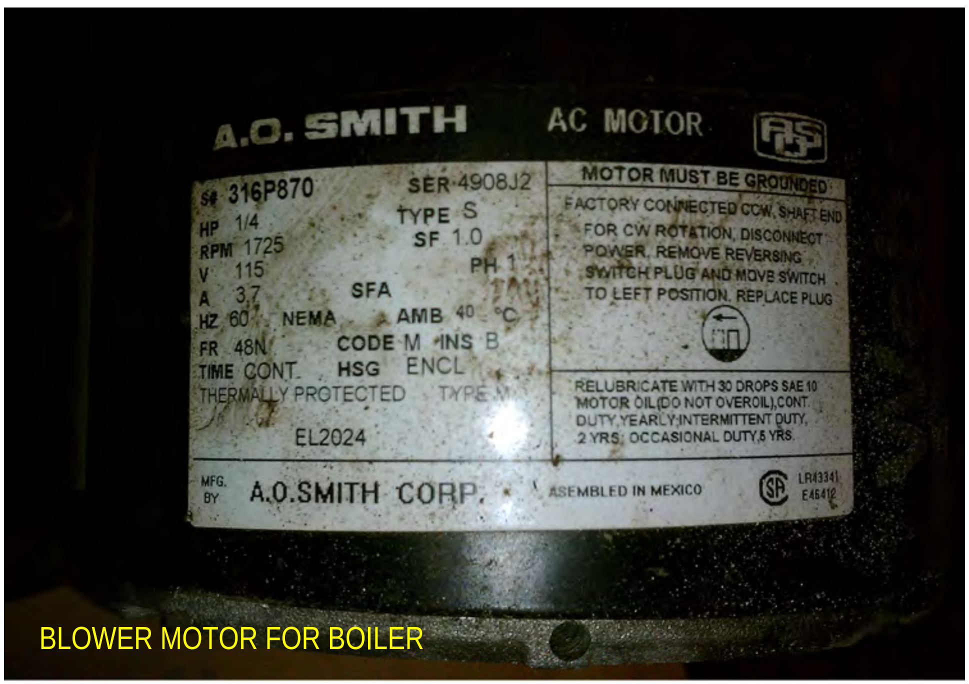
WEIL-MCLAIN BOILER INFORMATION



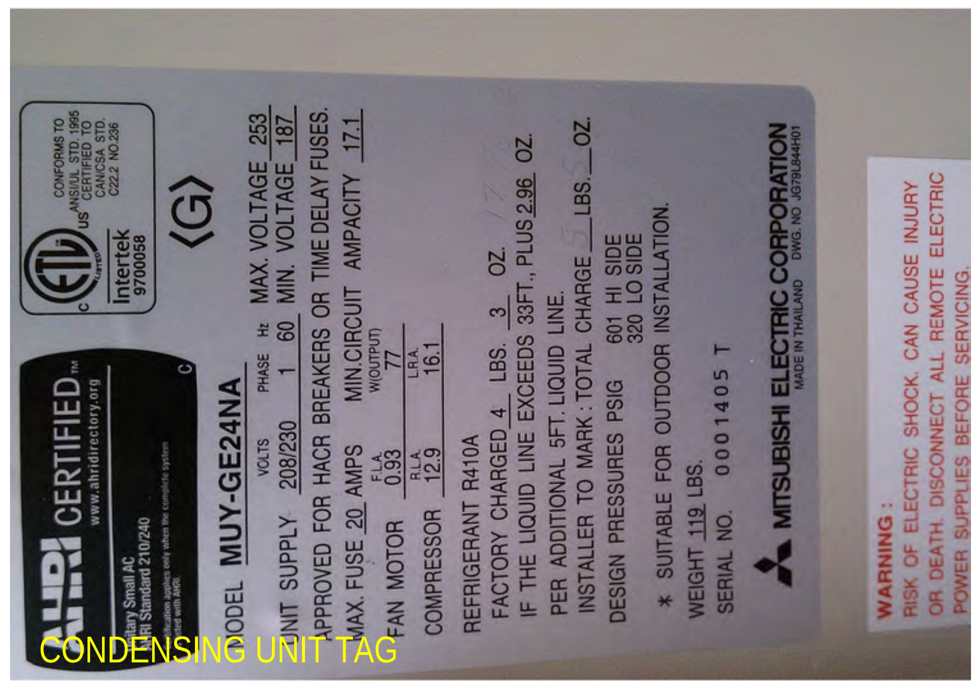
WEBSTER TAG INFORMATION

UNDERGROUND STORAGE

AIR CONDITION CONDERNSING UNIT ON NORTH SIDE OF BUILDING



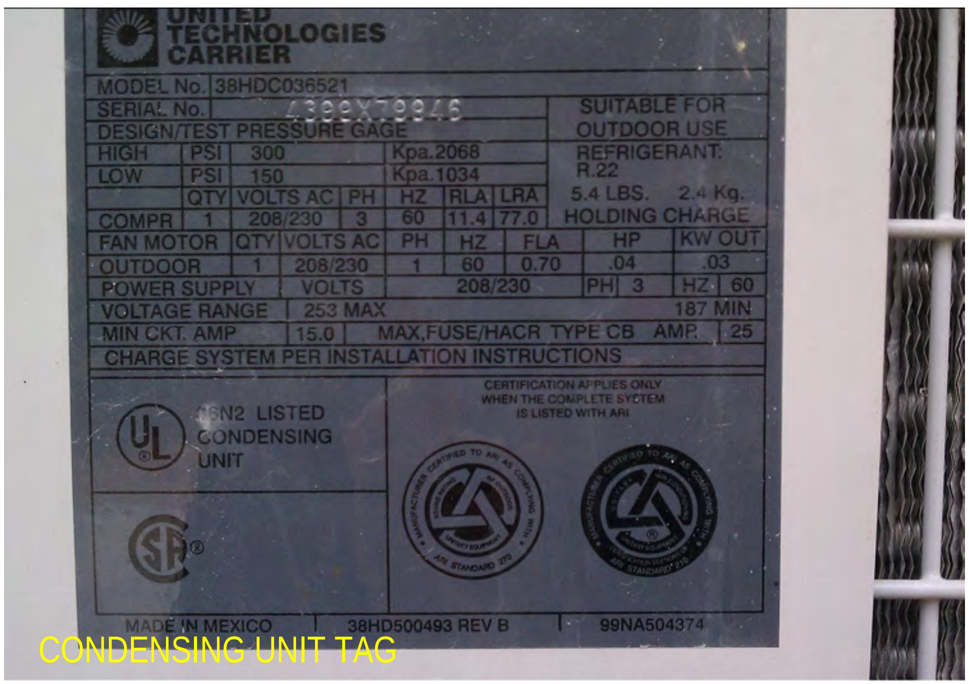
BLOWER MOTOR FOR BOILER



CONDENSING UNIT TAG


AIR CONDITION CONDERNSING UNIT ON NORTH SIDE OF BUILDING


SIDE ENTRANCE ALONG SOUTHEAST SIDE OF BUILDING



CONDENSING UNIT TAG


SIDE ENTRANCE ALONG SOUTHEAST SIDE OF BUILDING


POWERED UNOCCUPIED COMPUTERS IN CLASSROOM


OCCUPANCY SENSOR FOR LIGHTS

CLASSROOM SPACE

AC CONTROLS


POWERED UNOCCUPIED COMPUTER


RUNNING UNOCCUPIED COMPUTERS


RUNNING UNOCCUPIED COMPUTERS


COMPACT REFRIGERATOR AND MICROWAVE


DAYLIGHT SEEN THROUGH EXTERIOR DOOR SEAL, ALL SEALS SHOULD BE REPLACED


OVERHEAD SKYLIGHT


DAYLIGHT SEEN THROUGH EXTERIOR DOOR SEALS


OVERHEAD HEATER

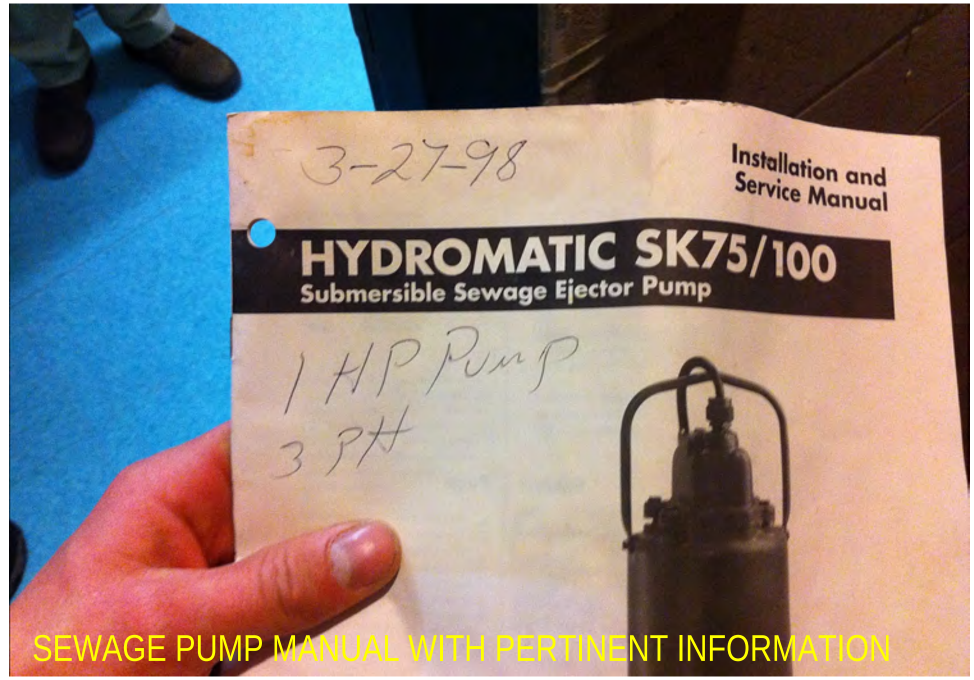

TEACHERS SPACE WITH OLD COMPACT REFRIGERATOR

RUNNING UNOCCUPIED COMPUTERS


MISSING CEILING TILE ALLOWS THERMAL LOSSES

VENDING MACHINE IN TEACHER LOUNGE

OLD COMPACT REFRIGERATOR NEAR EMPTY



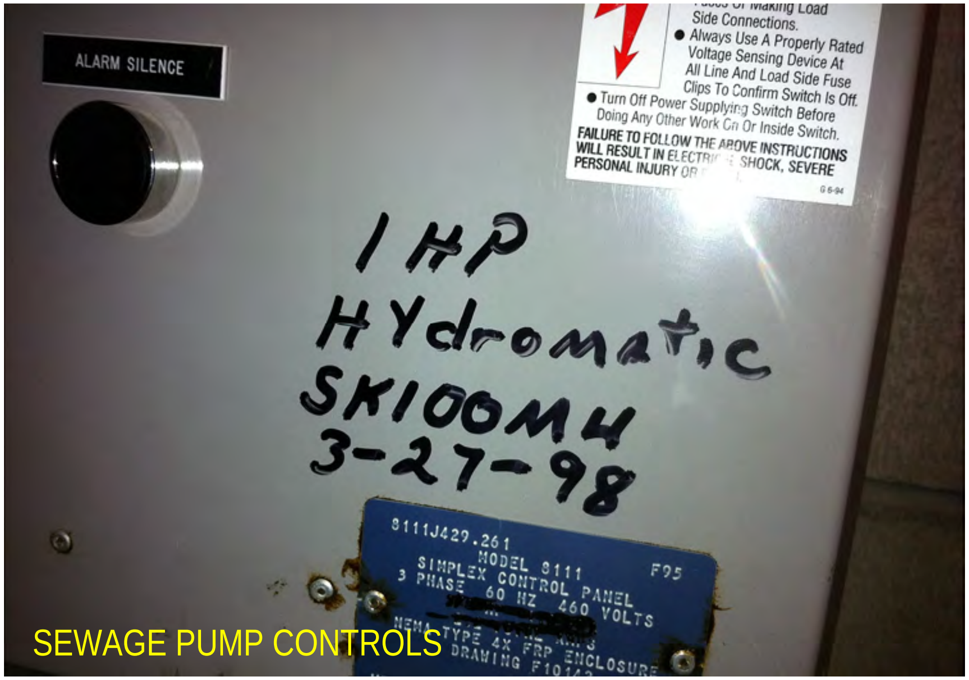
SEWAGE PUMP MANUAL WITH PERTINENT INFORMATION

OLD COMPACT REFRIGERATOR


COMPACT REFRIGERATOR NEAR EMPTY

DAYLIGHT SEEN THROUGH DOOR SEAL

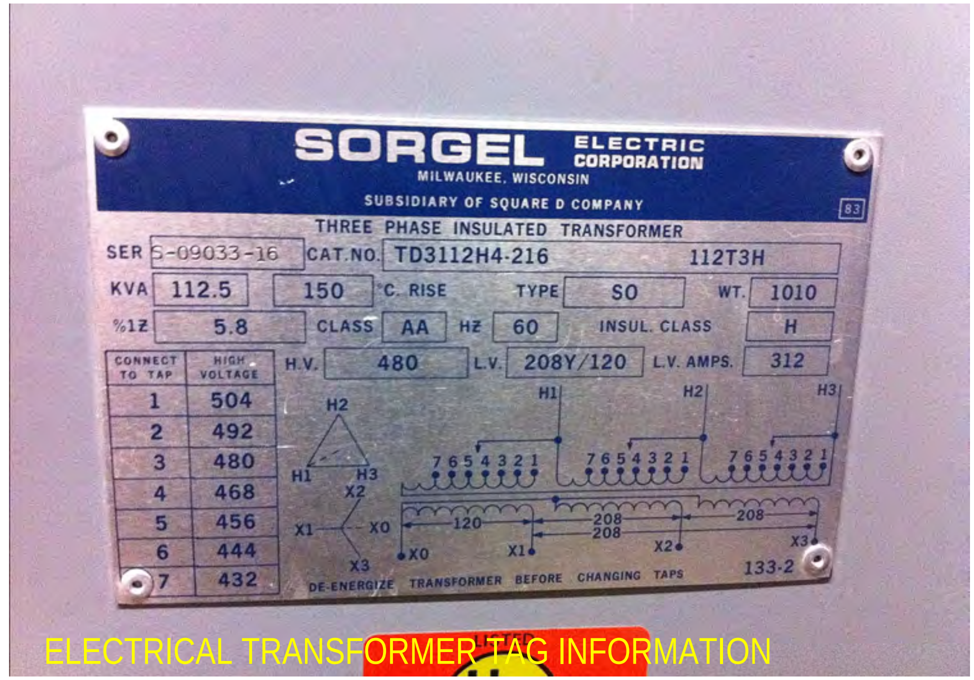
RNNING UNOCCUPIED COMPUTERS



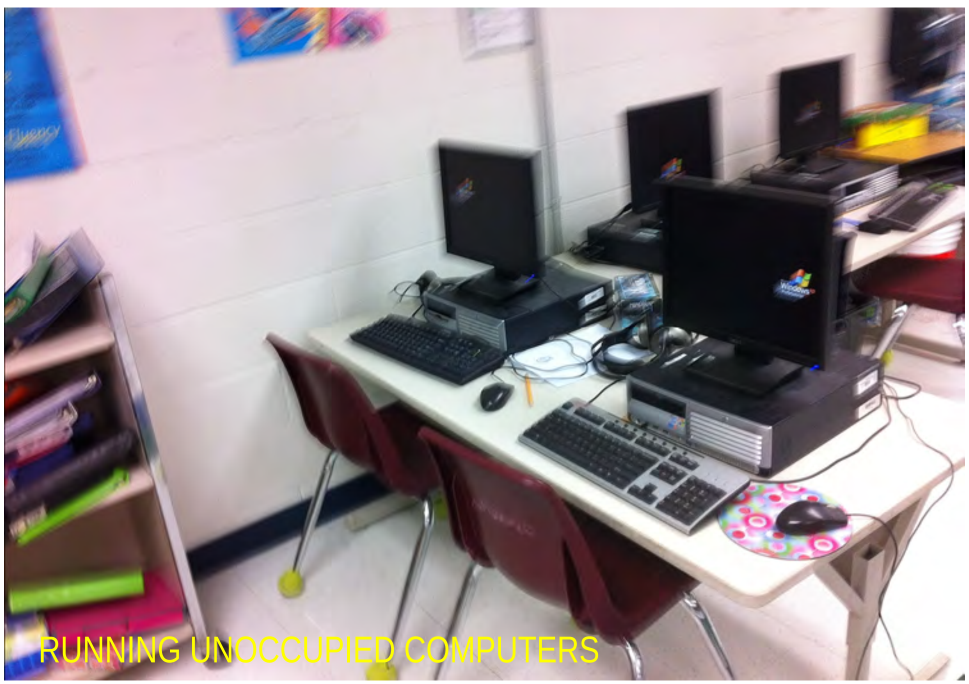
SEWAGE PUMP CONTROLS

DAYLIGHT SEEN THROUGH DOOR SEAL

COMPACT REFRIGERATOR



ELECTRICAL TRANSFORMER TAG INFORMATION

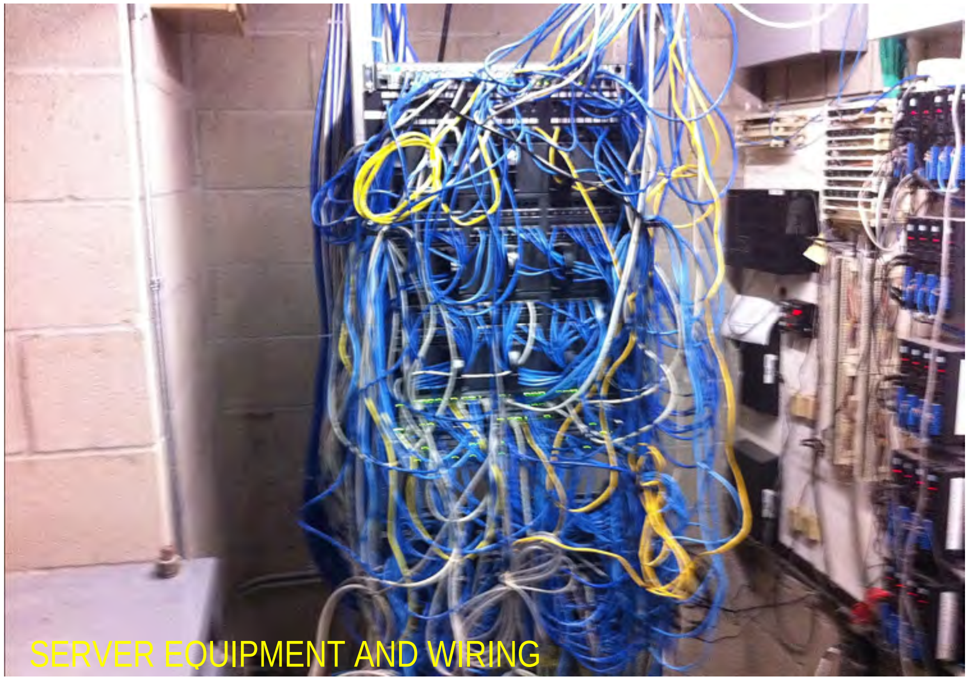


RUNNING UNOCCUPIED COMPUTERS

RUNNING UNOCCUPIED COMPUTERS

VFD CONTROL

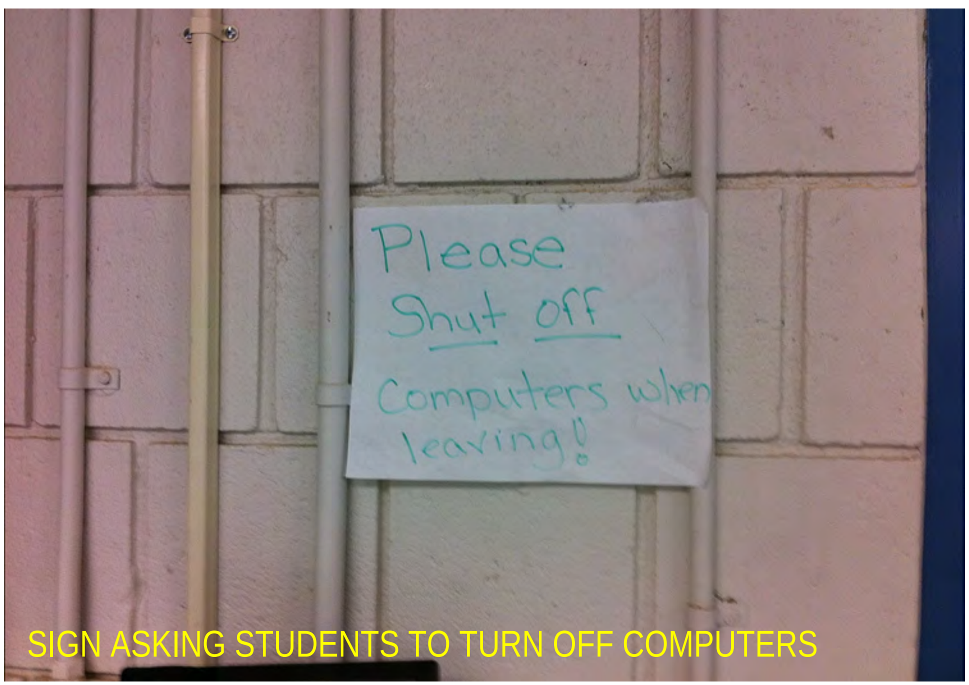
CIRCULATING PUMP CP-2


SERVER EQUIPMENT AND WIRING

CIRCULATING PUMP CP-1

ALL COMPUTERS RUNNING UNOCCUPIED

ALL COMPUTESR RUNNING UNOCCUPIED



SIGN ASKING STUDENTS TO TURN OFF COMPUTERS

THERMOSTAT ON COMPUTER LAB WALL


MECHANICAL EQUIPMENT SERVICING BOTTOM FLOOR


COMPACT REFRIGERATOR

COMPACT REFRIGERATOR


UNINSULATED DUCT AND COILS

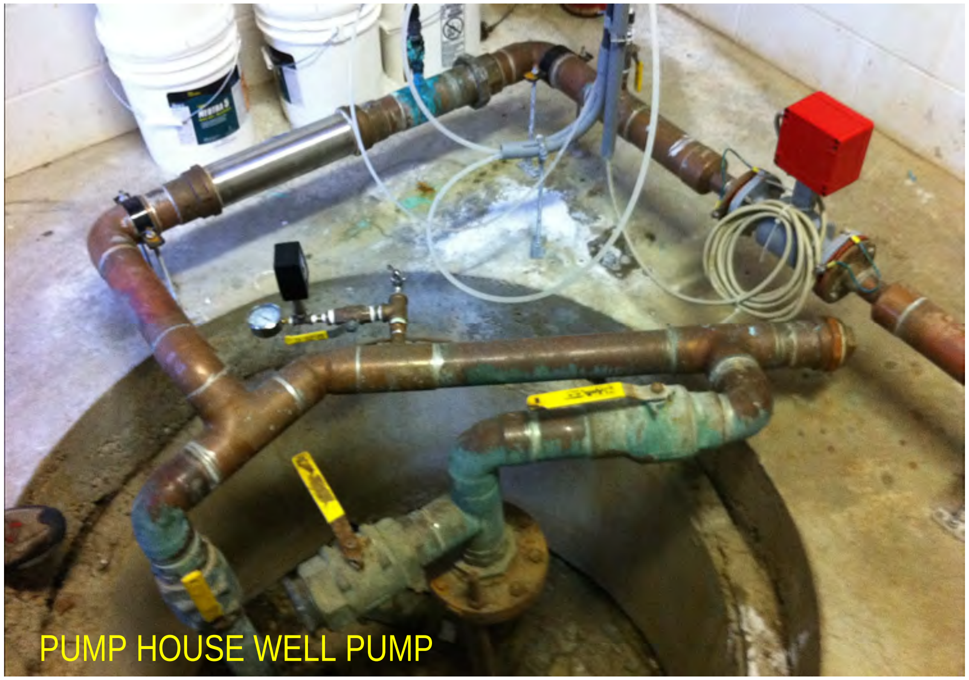
COMPACT REFRIGERATOR, WATER COOLER

OLD COMPACT REFRIGERATOR NEAR EMPTY

COMPACT REFRIGERATOR NEAR EMPTY

OLD COMPACT REFRIGERATOR

ELEVATOR MOTOR



PUMP HOUSE WELL PUMP

COMPACT REFRIGERATOR

ELEVATOR CONTROL


PUMP HOUSE WELL PUMP


Furnas
AQUAVAR
PUMP1
PUMP HOUSE CONTROLS


APOLLO
PUMP HOUSE WELL PUMP


PUMP HOUSE WATER TREATMENT


PUMP HOUSE WATER TREATMENT

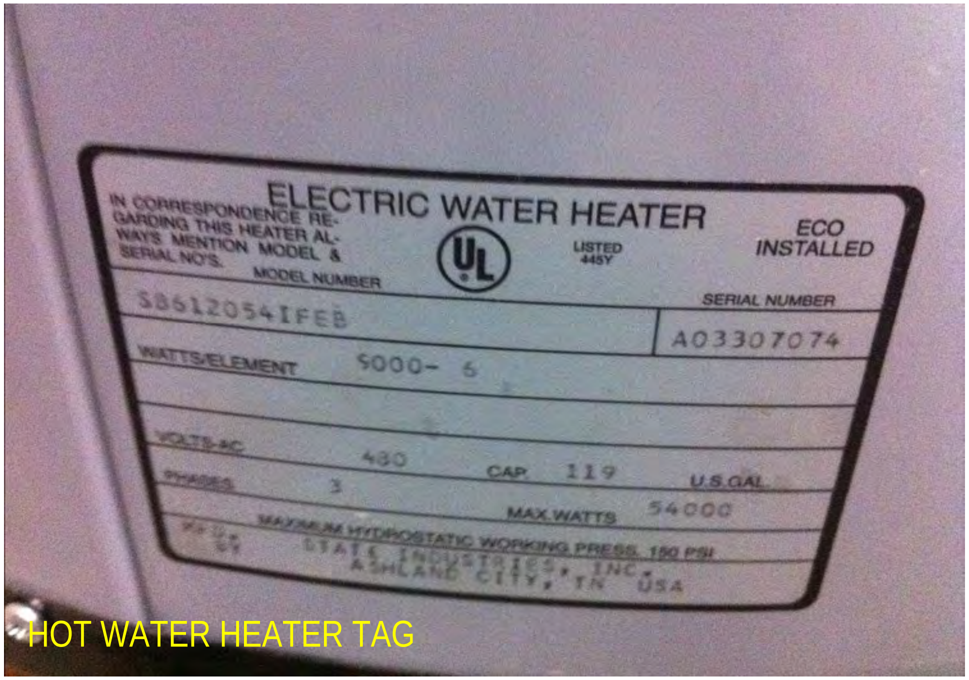

PUMP HOUSE WATER TREATMENT


PUMP HOUSE WATER TREATMENT

HOT WATER HEATER

All computers powered on over winter vacation

DAYLIGHT SEEN UNDERNEATH DOOR



HOT WATER HEATER TAG


ELECTRICAL PANEL

AHU TAG


ELECTRICAL PANEL


Loft AHU

GYMNASIUM SPACE

GYMNASIUM SPACE

Loft AHU

AHU IN GYMNASIUM

Electrical room in 202

1st floor pump room

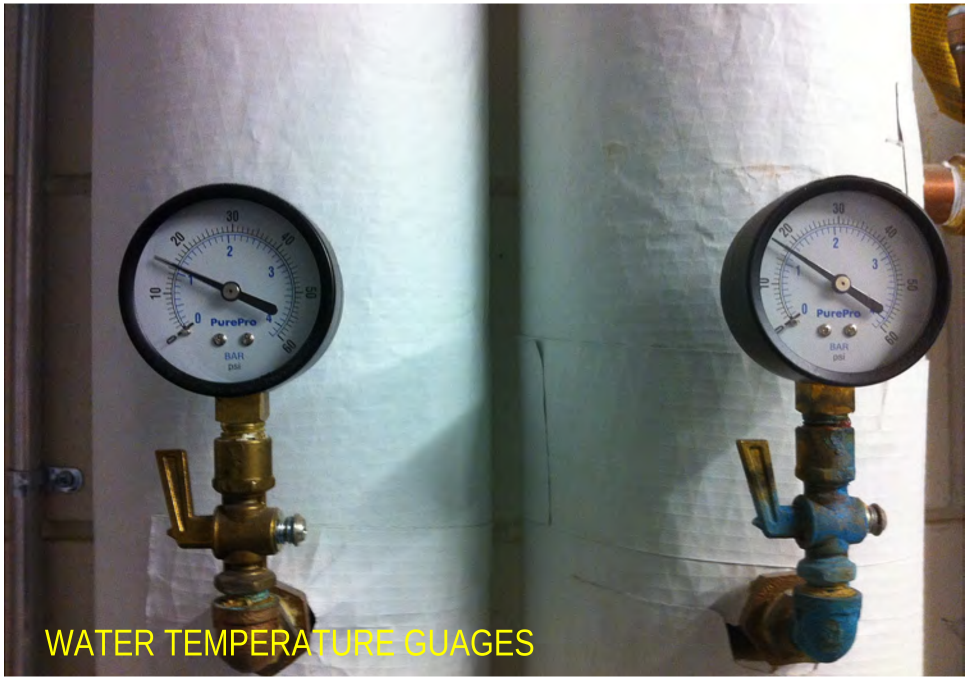
GYMNASIUM SPACE

FIRST FLOOR PUMP ROOM

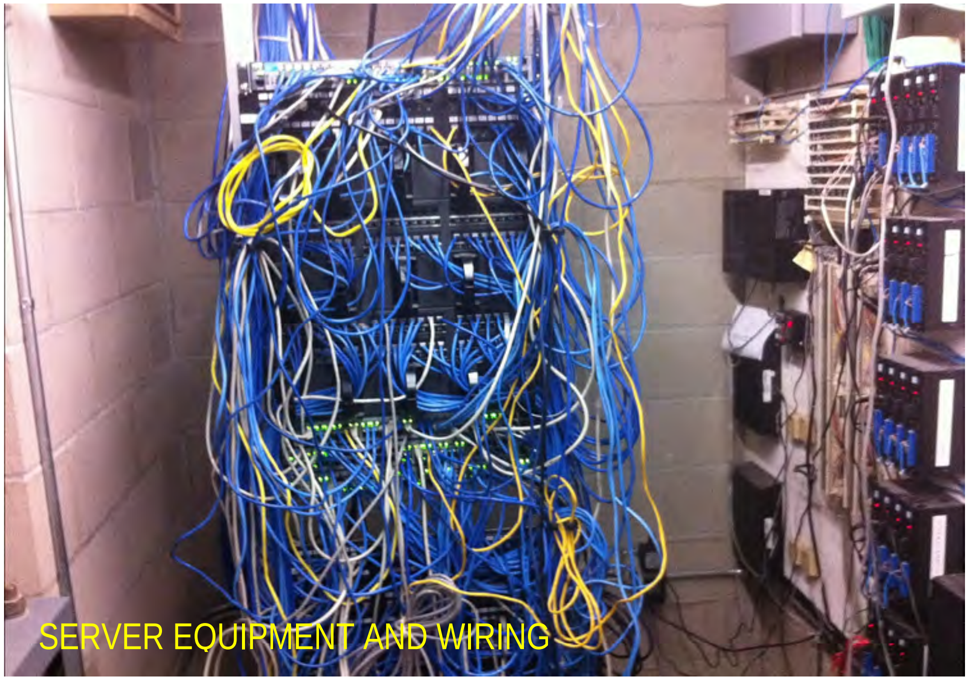
WATER TEMPERATURE GUAGE

HOT WATER HEATERS

PUMP TAG INFORMATION

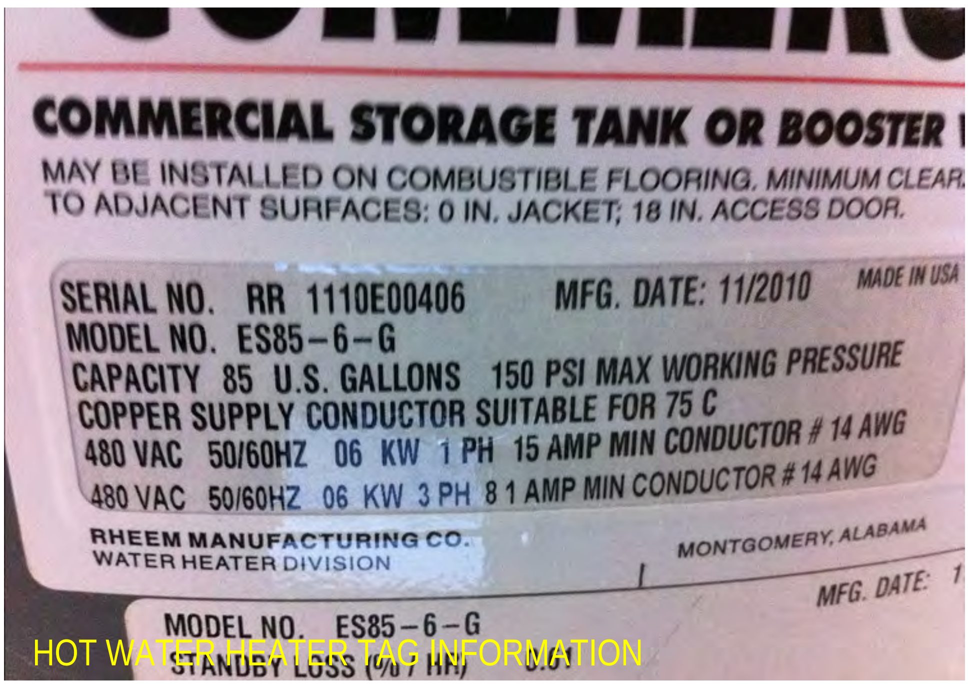


WATER TEMPERATURE GUAGES



SERVER EQUIPMENT AND WIRING

Space heater in 120



HOT WATER HEATER TAG INFORMATION

Computers on over vacation


COMPACT REFRIGERATOR

AIR CONDITION TAG INFORMATION

AIR CONDITION UNIT


AIR CONDITION NAME TAG


WATER COOLER AND FAX IN ADMINISTRATION ROOM


MULTI-PURPOSE ROOM


COMPACT REFRIGERATOR IN ADMINISTRATION ROOM


COMPACT REFRIGERATOR

ICE CREAM FREEZER


KITCHEN SPACE


MULTI-PURPOSE ROOM


KITCHEN SPACE

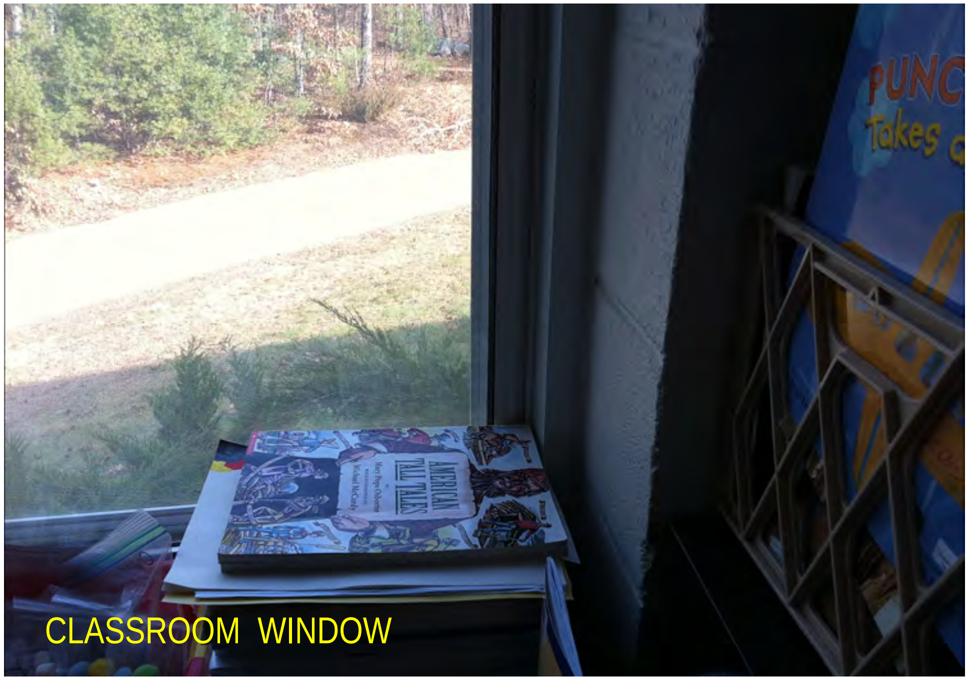

HALLWAY WATER FOUNTAIN


CLASSROOM SPACE


HALLWAY SPACE

NEAR EMPTY COMPACT REFRIGERATOR


RUNNING UNOCCUPIED COMPUTERS



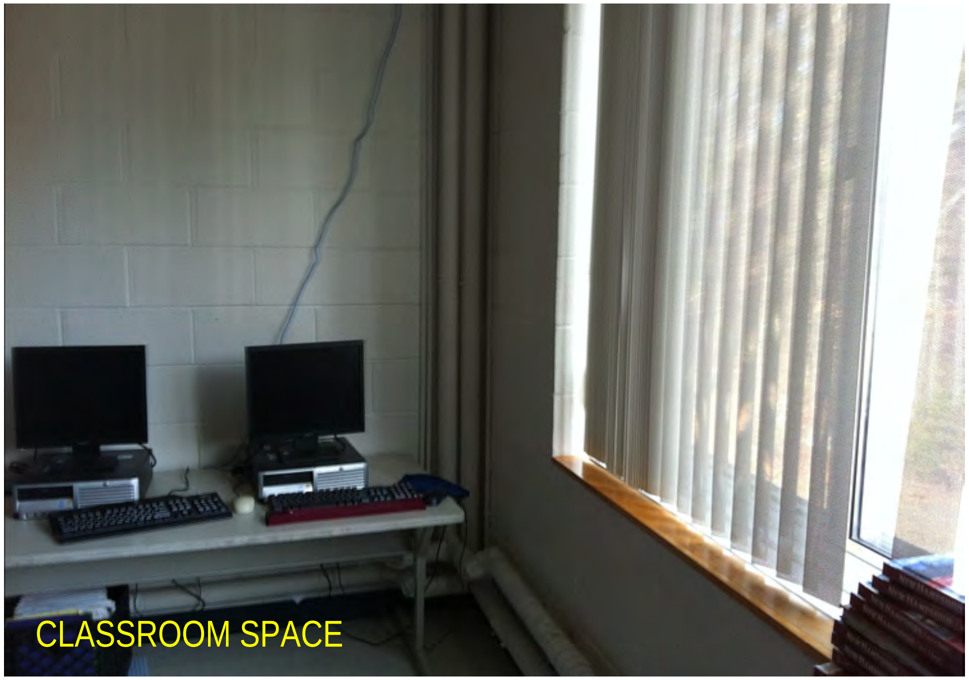
CLASSROOM WINDOW


CEILING IN CLASSROOM


CLASSROOM SPACE


HALLWAY WATER FOUNTAIN


CLASSROOM HEATER BY WINDOW


CLASSROOM SPACE


CLASSROOM HEATER


CLASSROOM WINDOW FRAME SHOWS THERMAL BREAK


RUNNING UNOCUPIED COMPUTERS


CLASSROOM WINDOW FRAME


COMPACT REFRIGERATOR AND MICROWAVE


CLASSROOM STORAGE AROUND HEATER


GYMNASIUM AHU

CLASSROOM STORAGE AROUND HEATER


GYMNASIUM CEILING


GYMNASIUM FLOOR

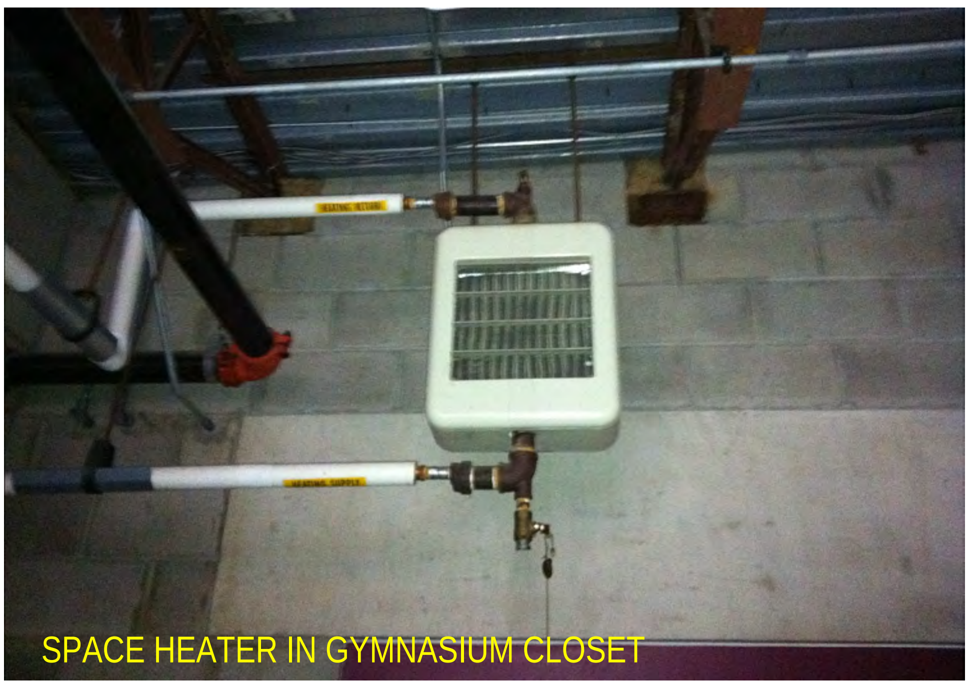

GYMNASIUM CEILING


GYMNASIUM CEILING


DAYLIGHT SEEN THROUGH GYMNASIUM DOOR SEAL


OVERHEAD HEATER


CLASSROOM WITH UNOCCUPIED RUNNING COMPUTERS


SPACE HEATER IN GYMNASIUM CLOSET


GYMNASIUM FOYER

ART ROOM SKYLIGHT

KILN IN ART ROOM

OVERHEAD HEATER IN CLASSROOM

ART ROOM SPACE


OVERHEAD EXHAUST

VEDING MACHINE IN TEACHER LOUNGE


KILN EXHAUST


PHOTOCOPIER

CLASSROOM EXTERIOR DOOR

PIPES PENETRATING THROUGH CEILING

CLASSROOM SPACE

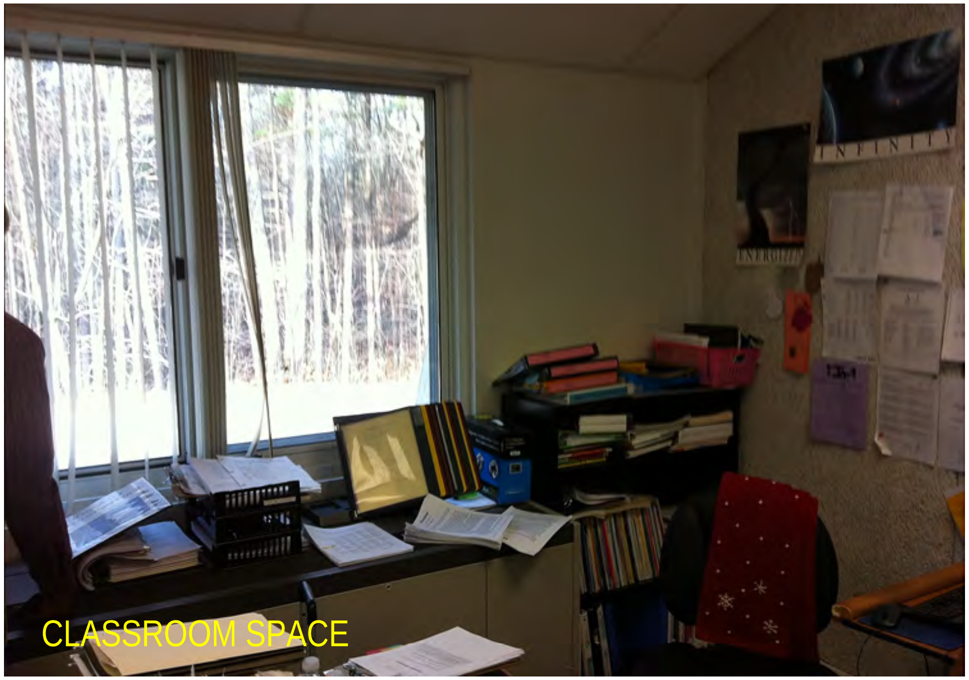
CLASSROOM COMPUTERS

CLASSROOM CORNER


AIR VENT


SPACE BETWEEN CEILING BELOW AND FLOOR ABOVE


NEAR EMPTY COMPACT REFRIGERATOR


CLASSROOM SPACE


CLASSROOM CEILING VENT


CLASSROOM HEATER


CLASSROOM HEATER IS COVERED


COMPUTER LAB SPACE

ELECTRICAL PANEL


CLASSROOM SPACE


ELECTRICAL TRANSFORMER

PENETRATION THROUGH WALL ALLOWS THERMAL TRANSFER

RUNNING UNOCCUPIED COMPUTERS

CIRCULATION PUMP CONNECTED TO VFD

RUNNING UNOCCUPIED COMPUTERS


CLASSROOM SPACE


BOSTON
RED SOX
BOSTON
RED SOX
CLASSROOM SPACE


CLASSROOM SPACE

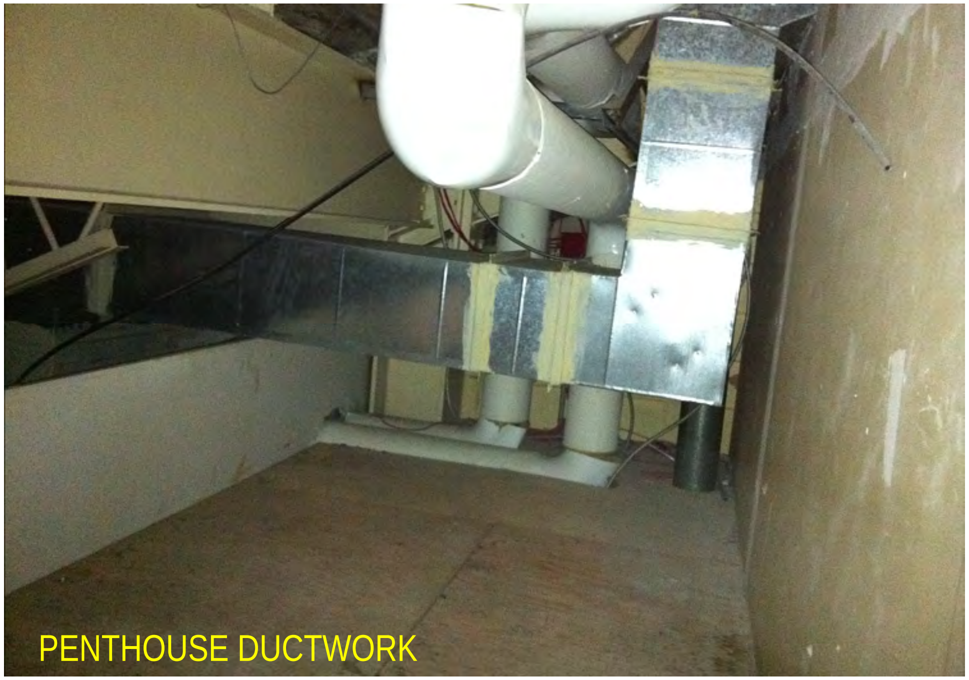

CLASSROOM SPACE


MISSING CEILING TILE FOR MECHANICAL EQUIPMENT
ALLOWS THERMAL TRANSFER


SKLIGHT IN PENTHOUSE ROOM


PENTHOUSE SPACE


SKYLIGHT WITH PEELING PAINT IN PENTHOUSE ROOM



PENTHOUSE DUCTWORK

CUSTODIAL OFFICE SPACE

MISSING INSULATION IN PENTHOUSE SPACE

MECHANICAL EQUIPMENT IN PENTHOUSE SPACE


PHOTOCOPIER


BASEBOARD RADIATOR


COMPACT REFRIGERATOR


CLASSROOM SPACE

APPENDIX B

Thermal Imaging Survey Reports

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:43:20 PM
Image Name	IR_1768.jpg
Emissivity	0.96
Reflected apparent temperature	85.0 °F
Object Distance	8.0 ft

Text Comments

Description

IR of window and blinds reveals where sun is shinning in and thermal transfer through glass, shades and window frame. Vertical blinds do not offer much resistence to thermal transfer. Recommend insulated shades. Refer to EEM T2-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

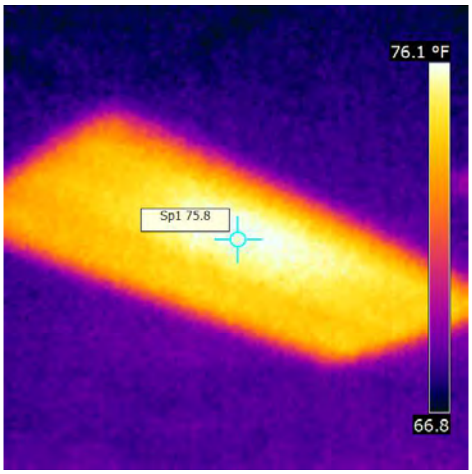


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:44:02 PM
Image Name	IR_1769.jpg
Emissivity	0.96
Reflected apparent temperature	76.0 °F
Object Distance	10.0 ft

Text Comments

Description

Overhead light emits thermal energy when in use adding heat load to the space. Recommend turning off lights when not in use and where practical, use a dual occupancy light to automatically turn lights on and off. Refer to EEM T1-8 for cost and savings.

AEC

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

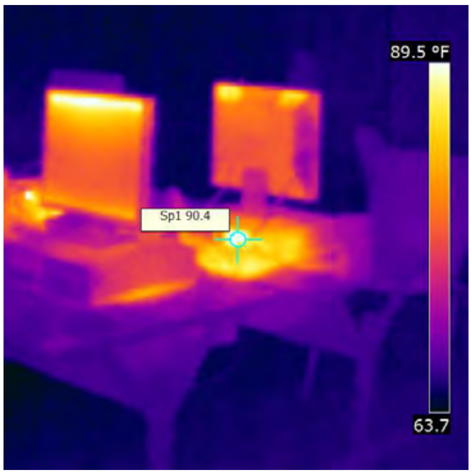


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:44:13 PM
Image Name	IR_1770.jpg
Emissivity	0.96
Reflected apparent temperature	91.0 °F
Object Distance	8.0 ft

Text Comments

Description

Running computers create thermal energy which will inefficiently heat up the space they're in. Recommend turning off all computers when unoccupied to save on wear on the computer and electrical consumption. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

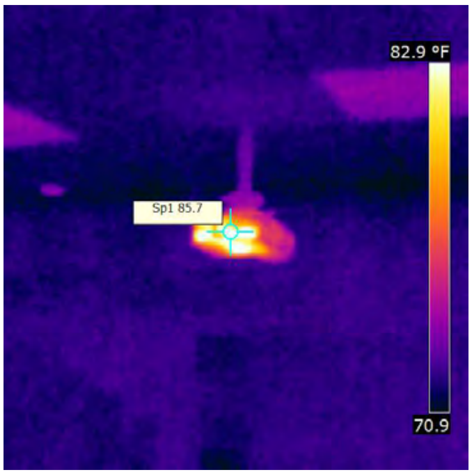


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:45:39 PM
Image Name	IR_1771.jpg
Emissivity	0.96
Reflected apparent temperature	86.0 °F
Object Distance	10.0 ft

Text Comments

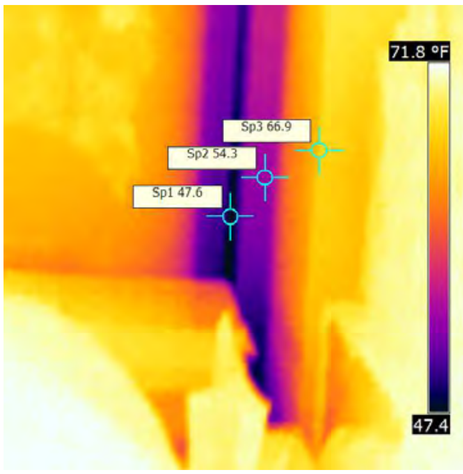
Description

Running projector creates thermal energy when in use adding to heat load of the space. Recommend powering down all electronic equipment when not in use. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



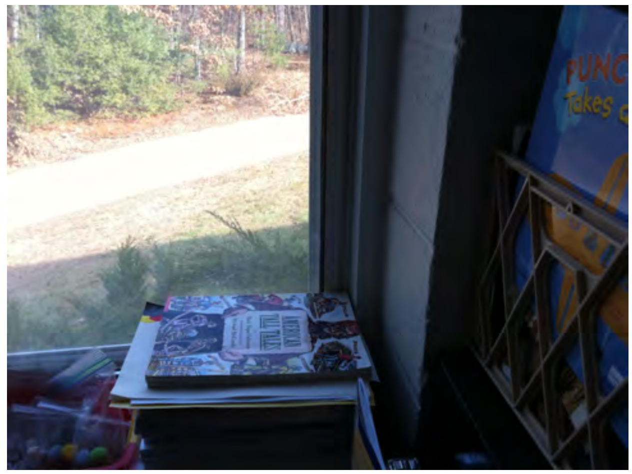


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:47:10 PM
Image Name	IR_1772.jpg
Emissivity	0.96
Reflected apparent temperature	47.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR of exterior window reveals thermal transfer between windows as well as through the window frame. Recommend weather sealing all exterior windows and doors. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

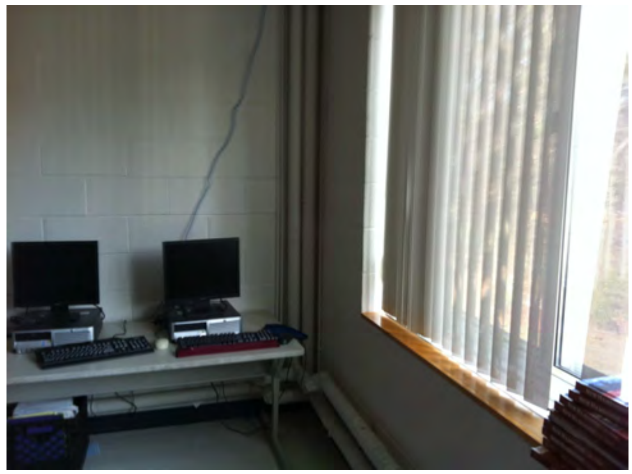


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:47:56 PM
Image Name	IR_1773.jpg
Emissivity	0.96
Reflected apparent temperature	81.0 °F
Object Distance	5.0 ft

Description

Uninsulated pipes cause unwanted thermal transfer resulting in lower efficiencies. Also shown is the corner of a window which shows thermal transfer through poor seal. Recommend insulating pipes and air-sealing windows. Refer to EEMs T1-5 for air-sealing

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

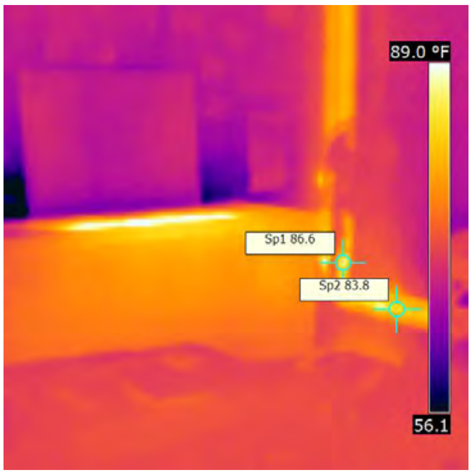


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:50:34 PM
Image Name	IR_1775.jpg
Emissivity	0.96
Reflected apparent temperature	85.0 °F
Object Distance	7.0 ft

Text Comments

Description

IR of hot water pipe reveals areas of poor insulation. Recommend insulating all hot water pipes to reduce inefficient thermal transfer.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

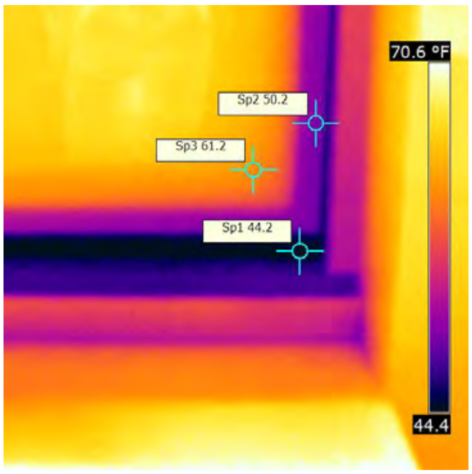


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:52:00 PM
Image Name	IR_1777.jpg
Emissivity	0.96
Reflected apparent temperature	43.0 °F
Object Distance	4.0 ft

Text Comments

Description

IR of exterior window reveals poor sealing and thermal transfer through window seal and frame. Recommend air-sealing all windows and exterior doors. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

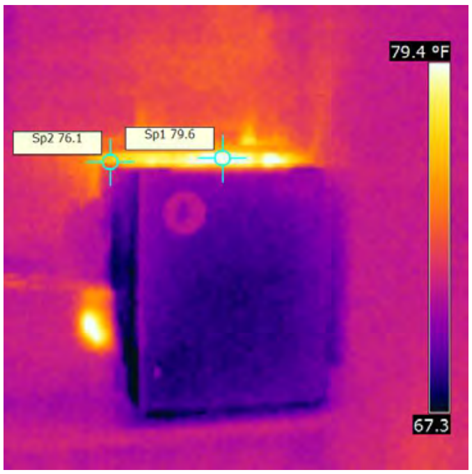


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:52:43 PM
Image Name	IR_1778.jpg
Emissivity	0.96
Reflected apparent temperature	77.0 °F
Object Distance	6.0 ft

Text Comments

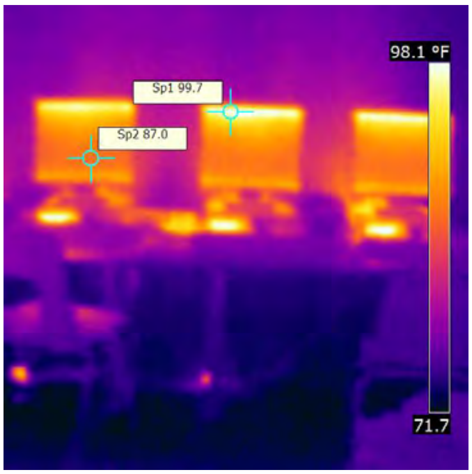
Description

Old compact refrigerator is inefficient, producing thermal energy adding heat load and consuming considerable energy. Recommend removing compact refrigerators and replacing with full energy star units. Refer to EEM T1-6 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



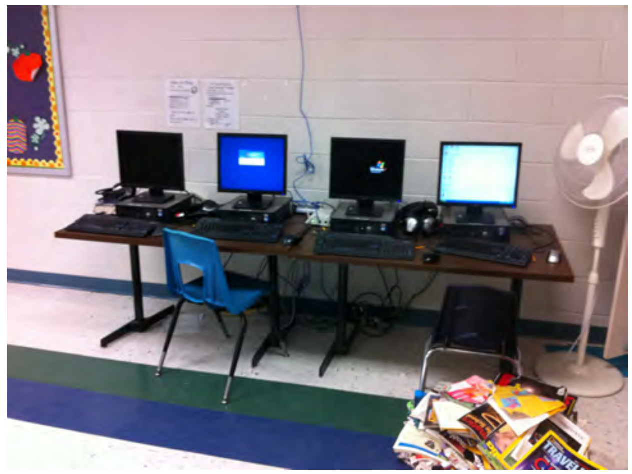


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:53:44 PM
Image Name	IR_1779.jpg
Emissivity	0.96
Reflected apparent temperature	87.0 °F
Object Distance	8.0 ft

Text Comments

Description

Running ocmputers produce thermal energy, inefficiently heating the space around it while wearing down equipment and consuming electricity. Recommend powering down all computers when not in use. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

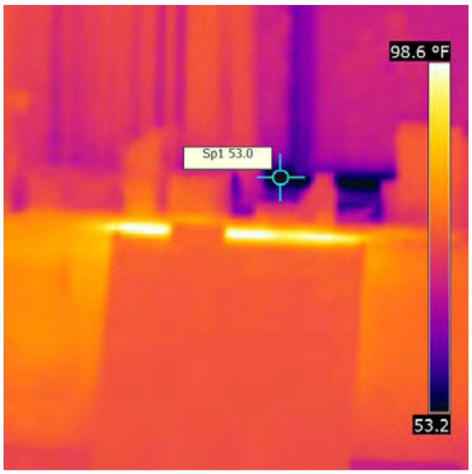


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:54:18 PM
Image Name	IR_1780.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	10.0 ft

Text Comments

Description

Exterior window reveals thermal transfer around and through window frame with heat emanating from the heater in front. Recommend air-sealing all windows. Refewr to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

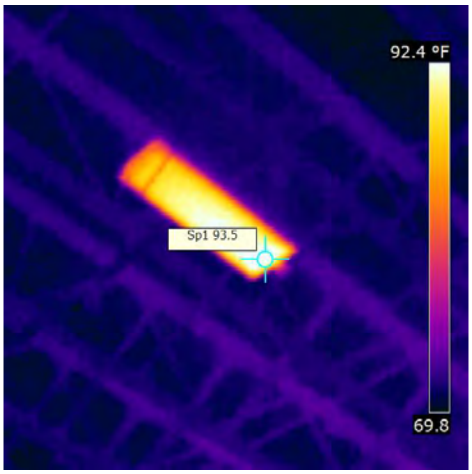


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:57:15 PM
Image Name	IR_1782.jpg
Emissivity	0.96
Reflected apparent temperature	94.0 °F
Object Distance	20.0 ft

Text Comments

Description

Overhead light in gymnasium creates high thermal energy adding heat load to the space. Recommend installing de-stratification fans in the ceiling to circulate hot air back to floor level. Refer to EEM T2-4 for associated cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

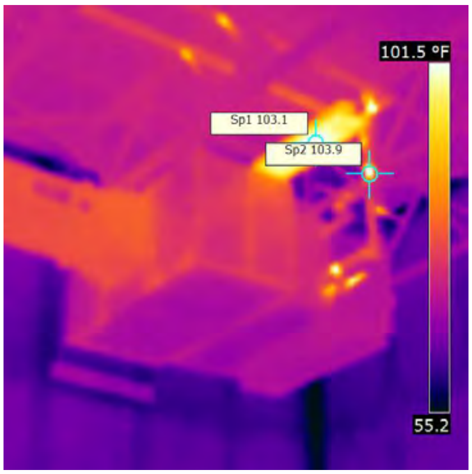


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 12:58:37 PM
Image Name	IR_1783.jpg
Emissivity	0.96
Reflected apparent temperature	104.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of air handling unit in gymnasium reveals portions of pipes not well insulated. Also pictured above is a light fixture creating thermal energy. Recommend installing de-stratification fans in the ceiling to circulate hot air back to floor level.EEM T2-4

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

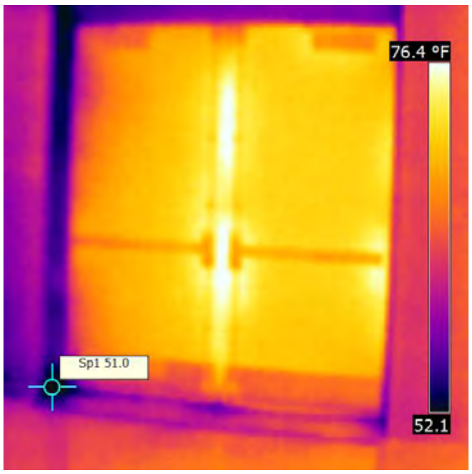


Image and Object Parameters

Text Comments

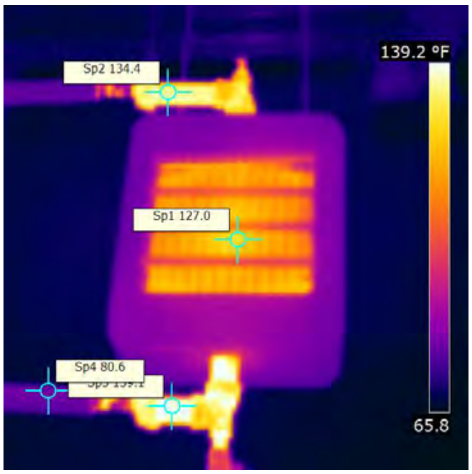
Camera Model	B-CAM Western S
Image Date	12/19/2011 1:00:53 PM
Image Name	IR_1786.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	10.0 ft

Description

IR of gymnasium door reveals thermal transfer around double doors, especially at corners. Recommend weather sealing all windows and exterior doors. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



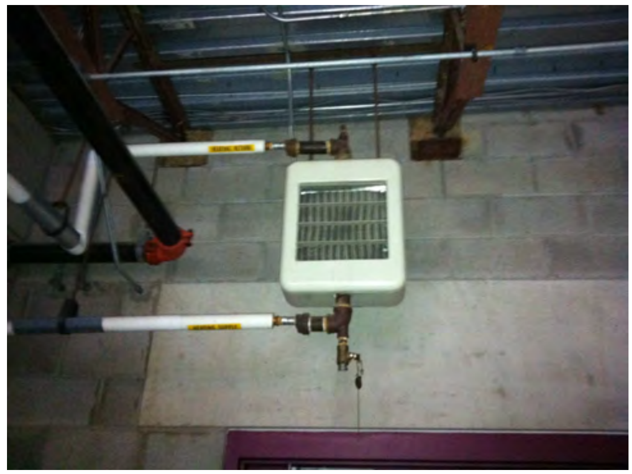


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:03:10 PM
Image Name	IR_1788.jpg
Emissivity	0.96
Reflected apparent temperature	130.0 °F
Object Distance	6.0 ft

Description

IR of unit heater reveals heat being emitted through heater as well as thermal transfer trough hot water pipes for supply and return. Insulation proves to contain thermal energy.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

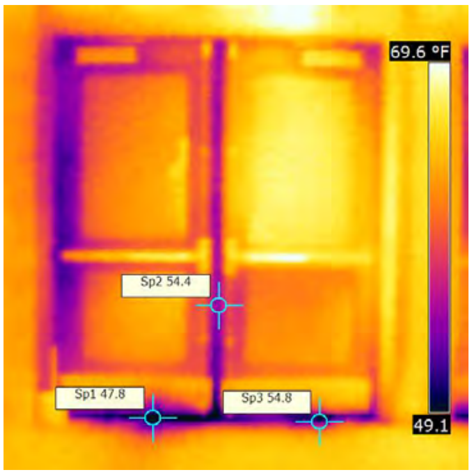


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:09:28 PM
Image Name	IR_1790.jpg
Emissivity	0.96
Reflected apparent temperature	47.0 °F
Object Distance	10.0 ft

Description

Exterior door shows signs of thermal transfer underneath and between doors. Recommend air-sealing all exterior doors and windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

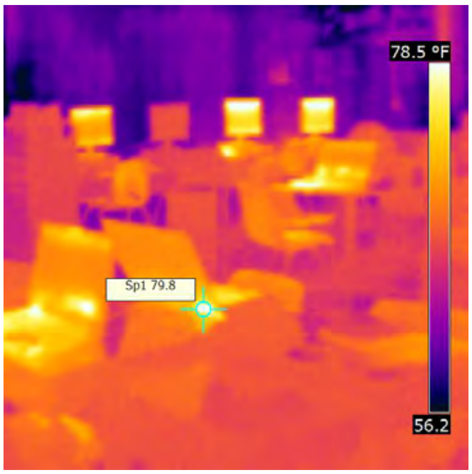


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:11:56 PM
Image Name	IR_1791.jpg
Emissivity	0.96
Reflected apparent temperature	80.0 °F
Object Distance	10.0 ft

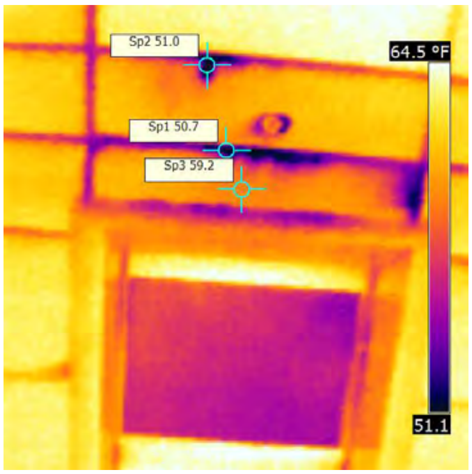
Description

Running computers create thermal energy which add heat load to space. Recommend turning off all computers when unoccupied to save on wear on the computer and electrical consumption. Refer to EEM T1-5 for cost and savings.

AEC

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



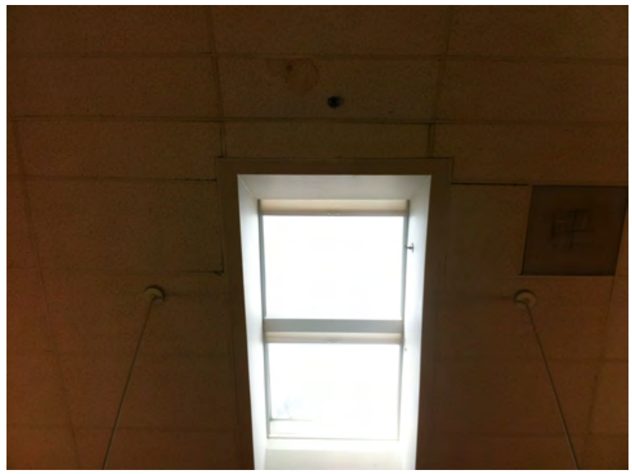


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:19:13 PM
Image Name	IR_1793.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	12.0 ft

Description

IR of overhead skylight in art room reveals areas of thermal breaching between ceiling tiles around skylight. Mold can be seen from photograph (right).

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

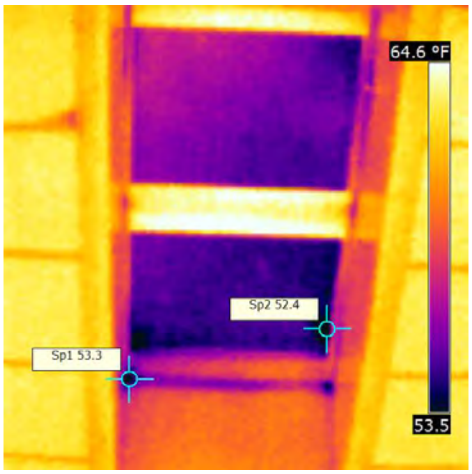


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:19:19 PM
Image Name	IR_1794.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of skylight (same as previous page) reveals areas of poor sealing around skylight. Recommend weather stripping all windows and doors. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

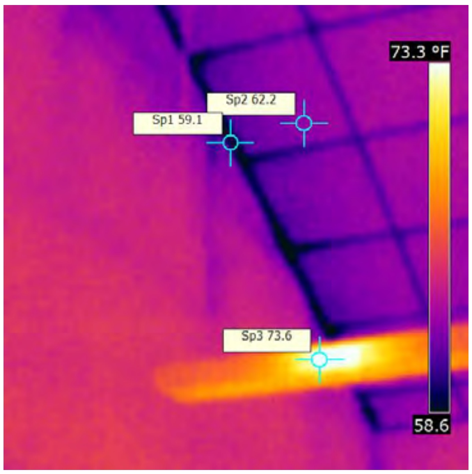


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:20:07 PM
Image Name	IR_1795.jpg
Emissivity	0.96
Reflected apparent temperature	59.0 °F
Object Distance	15.0 ft

Text Comments

Description

Thermal breaching occurring along seam between wall and ceiling. Overhead light also produces thermal energy adding to heat load of room. Recommend reducing light densities (EEM 2-2) or adding additional controls (EEM T1-8).

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

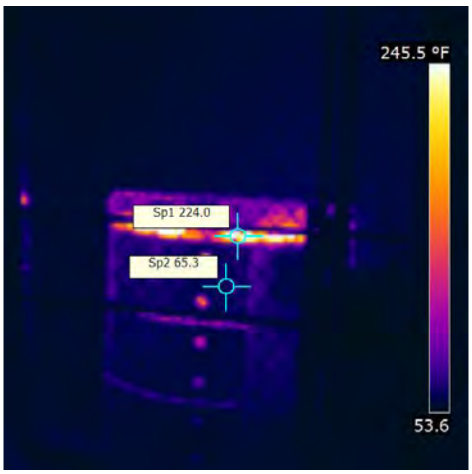


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:21:25 PM
Image Name	IR_1796.jpg
Emissivity	0.96
Reflected apparent temperature	229.0 °F
Object Distance	6.6 ft

Text Comments

Description

IR of kiln in art room reveals poor seal of the lid. Heat loss results in either longer runtime of kiln or higher temperatures produced resulting in higher electrical consumption and higher heat load. Recommend replacing seal.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

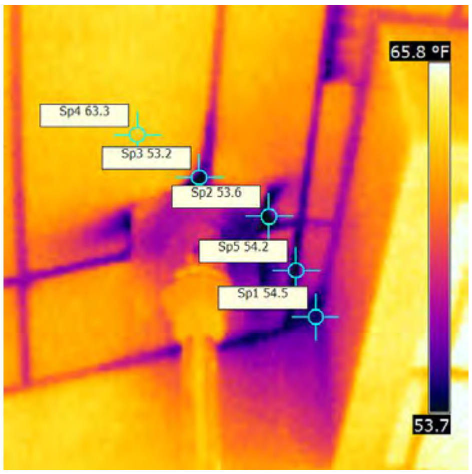


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:22:08 PM
Image Name	IR_1797.jpg
Emissivity	0.96
Reflected apparent temperature	53.0 °F
Object Distance	15.0 ft

Description

The ceiling around the kiln exhaust in the art room reveals thermal breaching occuring in various locations. Recommend checking insulation and seals around all exterior breachings. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

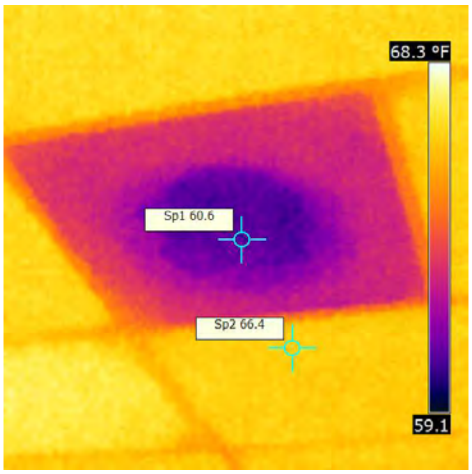


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:24:44 PM
Image Name	IR_1798.jpg
Emissivity	0.96
Reflected apparent temperature	60.0 °F
Object Distance	6.0 ft

Text Comments

Description

Ceiling vent in a second floor classroom allows for thermal transfer.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

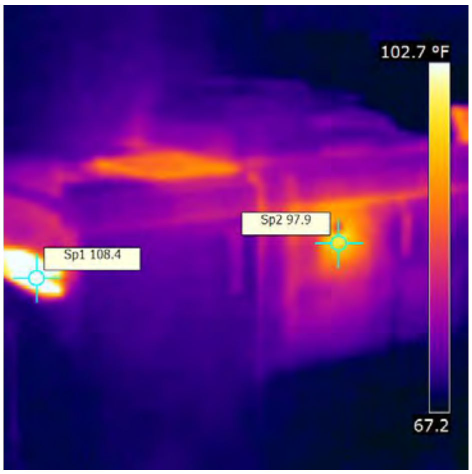


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:25:42 PM
Image Name	IR_1799.jpg
Emissivity	0.96
Reflected apparent temperature	110.0 °F
Object Distance	5.0 ft

Text Comments

Description

Photocopier produces thermal energy even in standby mode. Recommend setting all copiers on a time clock to power down when the building is unoccupied. Refer to EEM T1-7 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

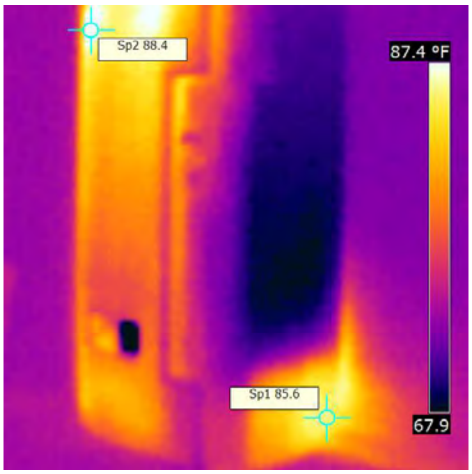


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:26:36 PM
Image Name	IR_1800.jpg
Emissivity	0.96
Reflected apparent temperature	86.0 °F
Object Distance	6.0 ft

Text Comments

Description

Vending machines produce thermal energy, inefficiently heating the space around it and consuming high amounts of electricty. Recommend removing all vending machines that are infrequently used. Refer to EEM T1-2 for savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

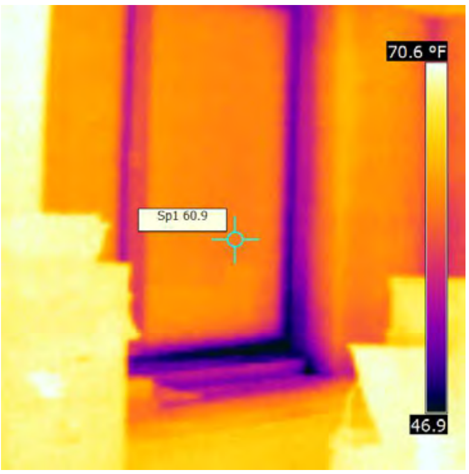


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:28:09 PM
Image Name	IR_1801.jpg
Emissivity	0.96
Reflected apparent temperature	60.0 °F
Object Distance	7.0 ft

Text Comments

Description

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

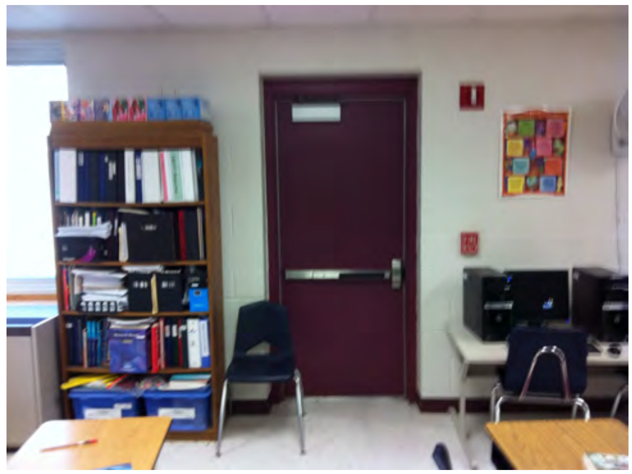


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:29:55 PM
Image Name	IR_1802.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	10.0 ft

Text Comments

Description

IR of inside of exterior door reveals poor sealing around door, especially around bottom corners. Recommend weather stripping all windows and exterior doors. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

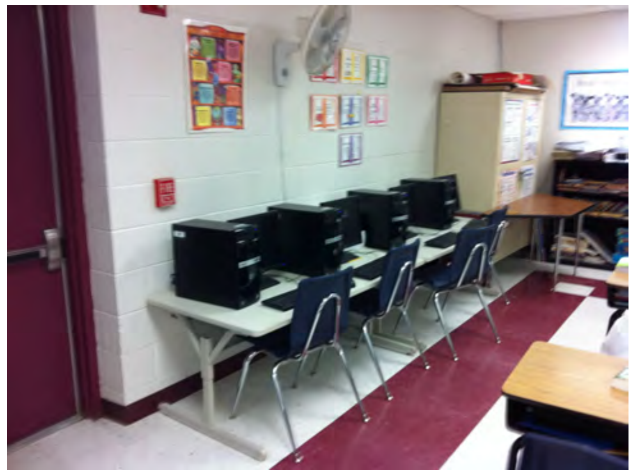


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:30:20 PM
Image Name	IR_1803.jpg
Emissivity	0.96
Reflected apparent temperature	93.0 °F
Object Distance	12.0 ft

Text Comments

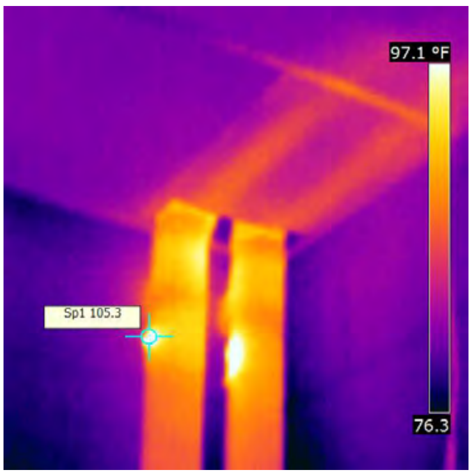
Description

Running computers produce thermal energy even when not fully powered. Recommend powering down all computer equipment when not in use to save on inefficient heating loads and unecessary electrical costs. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



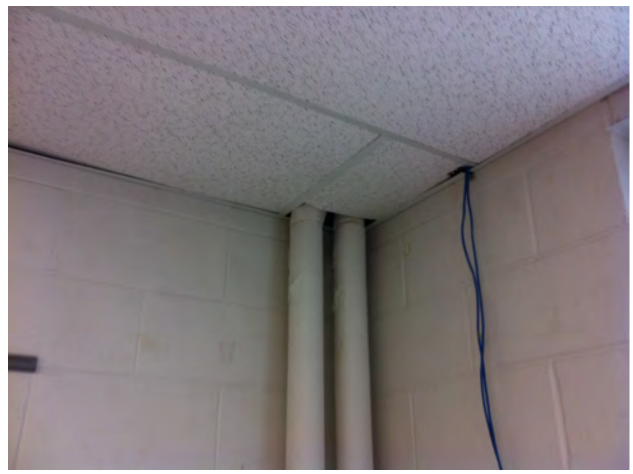


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:30:53 PM
Image Name	IR_1804.jpg
Emissivity	0.96
Reflected apparent temperature	106.0 °F
Object Distance	6.0 ft

Text Comments

Description

Hot water pipes show signs of thermal tranfer due to poor insulation even though insulation present. Appears to occur at connection of insulation pieces. Recommend insulating all hot water pipes to reduce thermal loss.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

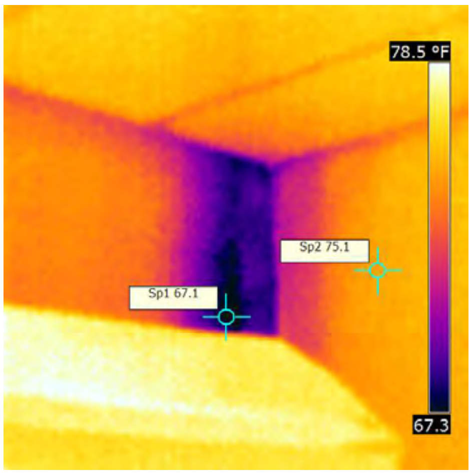


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:32:15 PM
Image Name	IR_1806.jpg
Emissivity	0.96
Reflected apparent temperature	67.0 °F
Object Distance	5.0 ft

Text Comments

Description

Corner wall of room reveals thermal breaching occurring. Recommend adding insulation to this area.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

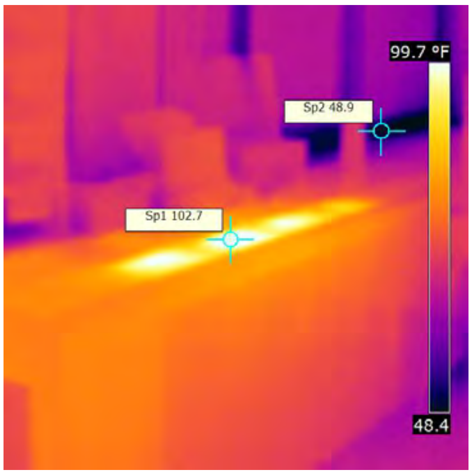


Image and Object Parameters

Text Comments

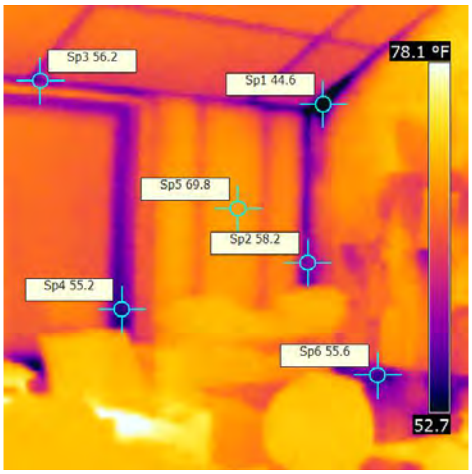
Camera Model	B-CAM Western S
Image Date	12/19/2011 1:41:00 PM
Image Name	IR_1809.jpg
Emissivity	0.96
Reflected apparent temperature	104.0 °F
Object Distance	5.0 ft

Description

Classroom IR reveals high heat being emitted through heater (foreground) while window frame shows signs of thermal transfer (background). Recommend air-sealing windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



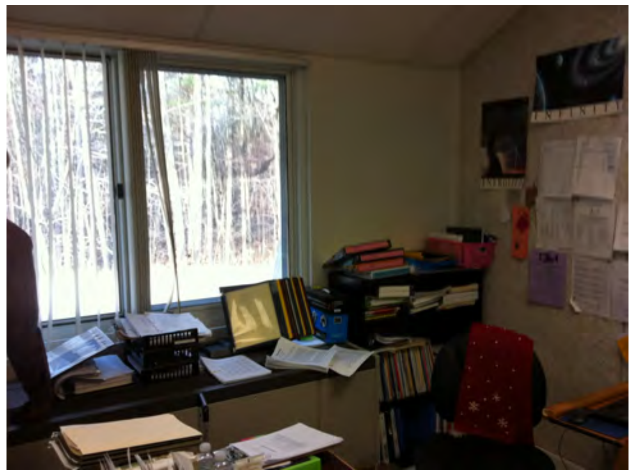


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:44:19 PM
Image Name	IR_1810.jpg
Emissivity	0.96
Reflected apparent temperature	58.0 °F
Object Distance	15.0 ft

Text Comments

Description

Corner of room IR reveals multiple areas of thermal breaching through intersections of walls and ceilings and window frame. Studs also visible in the far wall. Extensive insulation costly and not recommended.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

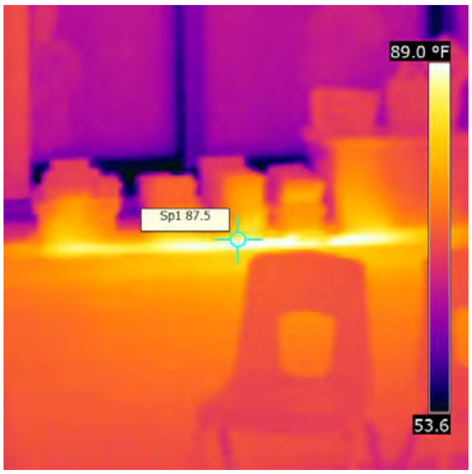


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:45:20 PM
Image Name	IR_1811.jpg
Emissivity	0.96
Reflected apparent temperature	88.0 °F
Object Distance	8.0 ft

Text Comments

Description

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

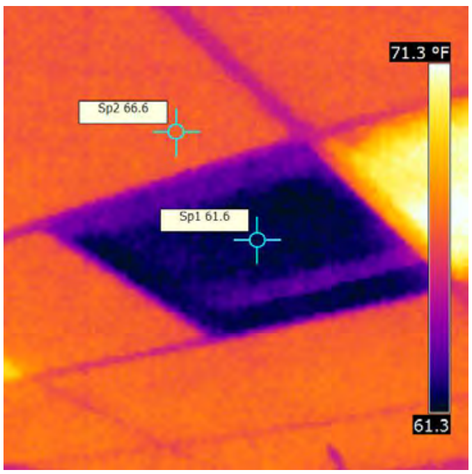


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:46:11 PM
Image Name	IR_1812.jpg
Emissivity	0.96
Reflected apparent temperature	61.0 °F
Object Distance	8.0 ft

Text Comments

Description

Missing ceiling tile in first floor classroom allows thermal energy to escape. Recommend replacing ceiling tile.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

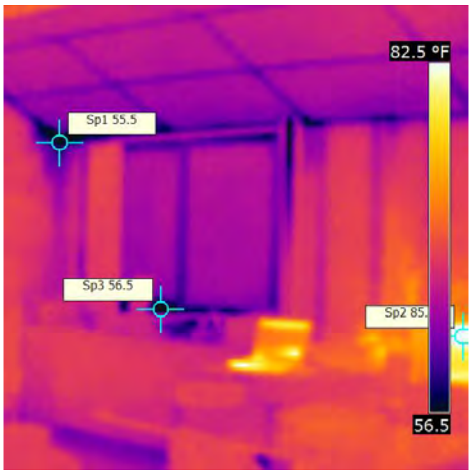


Image and Object Parameters

Text Comments

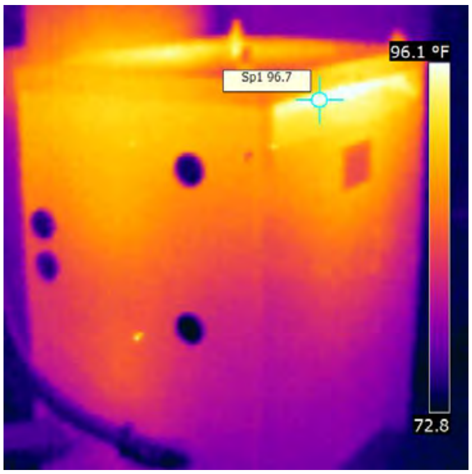
Camera Model	B-CAM Western S
Image Date	12/19/2011 1:46:55 PM
Image Name	IR_1813.jpg
Emissivity	0.96
Reflected apparent temperature	55.0 °F
Object Distance	15.0 ft

Description

Tthermal transfer occurring around window and at the intersection of the two walls and ceiling. Running computer and laptop also producing thermal energy. Recommend air-sealing windows (EEM T1-5) and powering down equipment (EEM T1-7)

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



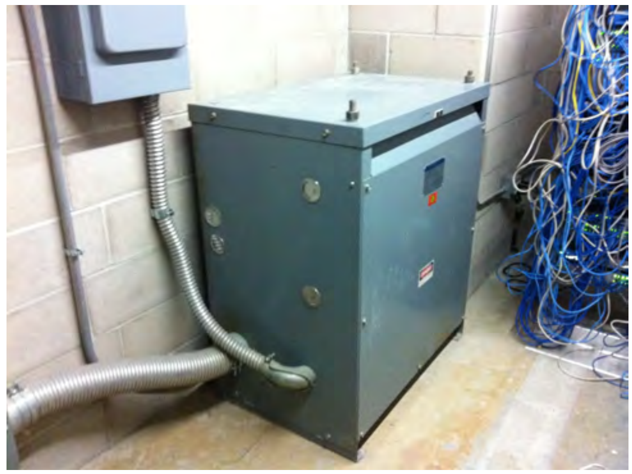


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:51:32 PM
Image Name	IR_1815.jpg
Emissivity	0.96
Reflected apparent temperature	98.0 °F
Object Distance	5.0 ft

Text Comments

Description

Electical transformer in server room produces thermal energy resulting in heated lost to the space. Recommend replacing with energy efficient unit. Refer to EEM T3-1 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

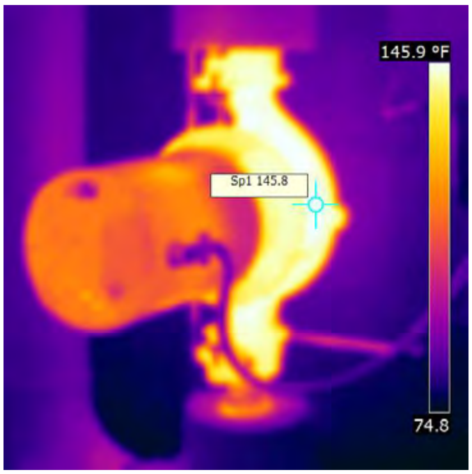


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:55:31 PM
Image Name	IR_1817.jpg
Emissivity	0.96
Reflected apparent temperature	148.0 °F
Object Distance	3.0 ft

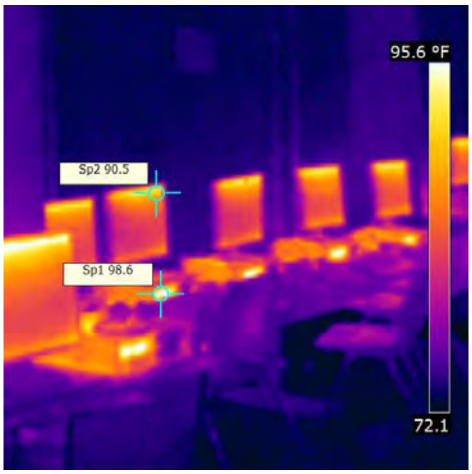
Description

Circulating pump creates thermal energy when in use adding heat to the space.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



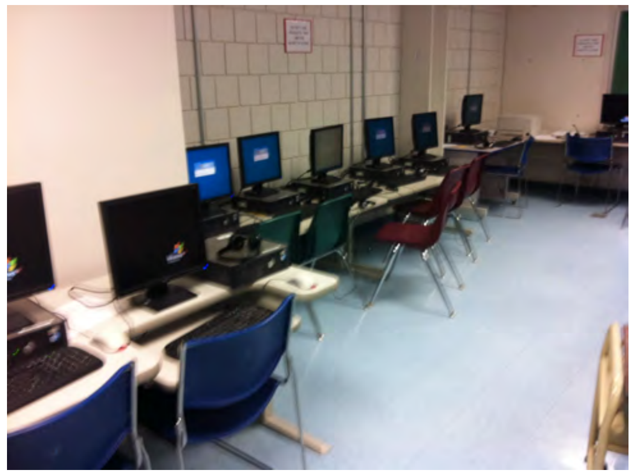


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 1:57:40 PM
Image Name	IR_1819.jpg
Emissivity	0.96
Reflected apparent temperature	92.0 °F
Object Distance	10.0 ft

Text Comments

Description

Multiple running unoccupied computers produce thermal energy adding heat load to the space and consume unnecessary electricity. Recommend powering down all electronics when not in use. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

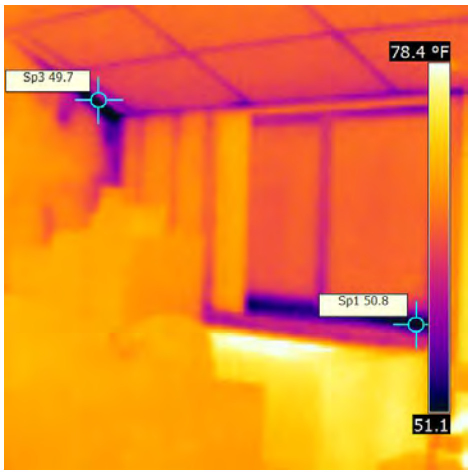


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:00:01 PM
Image Name	IR_1821.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	12.0 ft

Text Comments

Description

Corner of classroom reveals thermal breaching at intersection of walls and ceiling as well as breaching through window frame. Recommend air-sealing windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

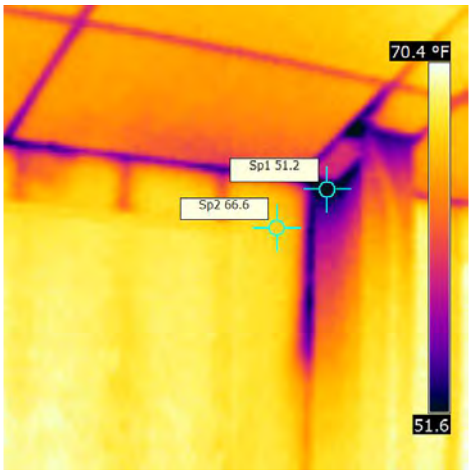


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:00:33 PM
Image Name	IR_1822.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	8.0 ft

Description

IR around support beam through the ceiling tile reveals poor sealing and thermal breaching occurring.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

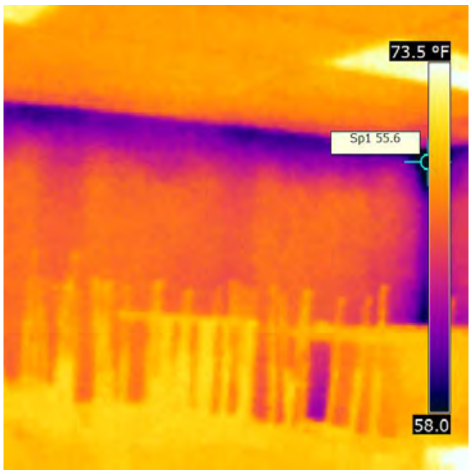


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:06:24 PM
Image Name	IR_1823.jpg
Emissivity	0.96
Reflected apparent temperature	55.0 °F
Object Distance	15.0 ft

Text Comments

Description

Corner of CMU walls in classroom reveal constant thermal transfer between walls and ceiling, most notably at the corner. Insulating walls may not provide sufficient payback.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

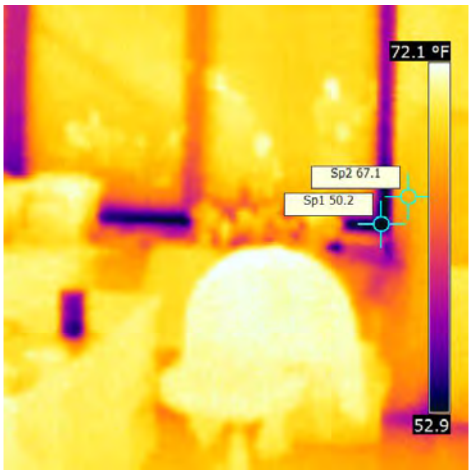


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:07:29 PM
Image Name	IR_1824.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	8.0 ft

Text Comments

Description

Classroom window shows signs of thermal transfer around window frame. Recommend air-sealing windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

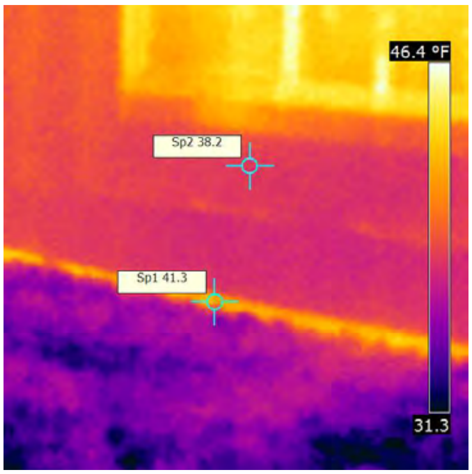


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:12:50 PM
Image Name	IR_1827.jpg
Emissivity	0.96
Reflected apparent temperature	40.0 °F
Object Distance	6.0 ft

Text Comments

Description

IR of rear exterior of the building shows thermal transfer through foundation. Wall EIFS system was installed. Further insulation may not be cost effective.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

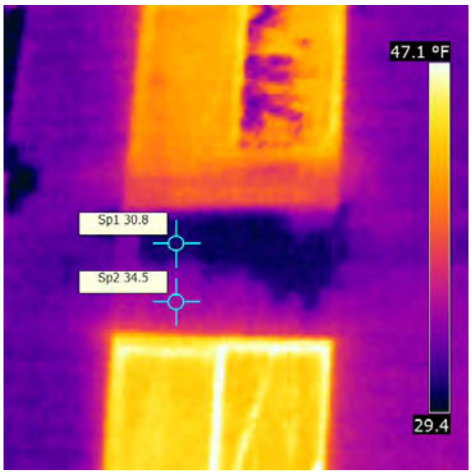


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:15:33 PM
Image Name	IR_1828.jpg
Emissivity	0.96
Reflected apparent temperature	29.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of building exterior reveals areas where thermal transfer is occurring due to leaks and deteriorating thermal barriers. Insulating exterior walls may not be cost effective.

AEC

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

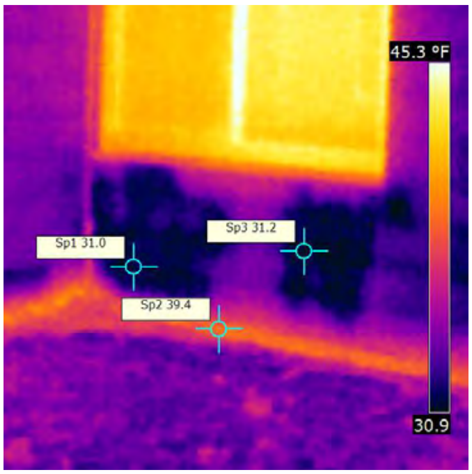


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:17:37 PM
Image Name	IR_1830.jpg
Emissivity	0.96
Reflected apparent temperature	29.0 °F
Object Distance	7.0 ft

Description

IR of exterior wall reveals areas where thermal barriers are deteriorating and thermal transfer is occurring. Concrete foundation also reveals thermal transfer. Insulating walls may not be cost effective.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

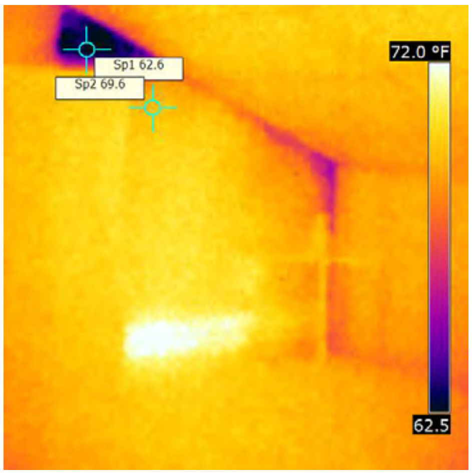


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:27:38 PM
Image Name	IR_1831.jpg
Emissivity	0.96
Reflected apparent temperature	62.0 °F
Object Distance	10.0 ft

Text Comments

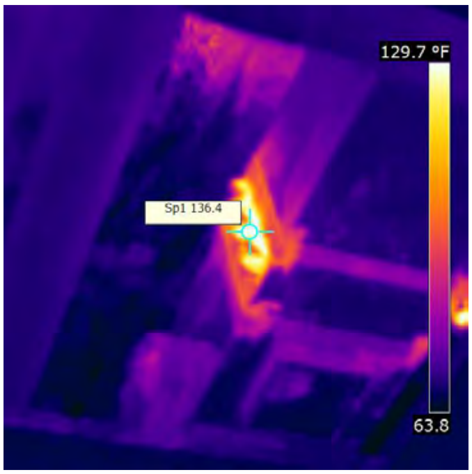
Description

IR reveals area whre insulation is poor and thermal transfer is occuring. Insulating walls may not be cost effective.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



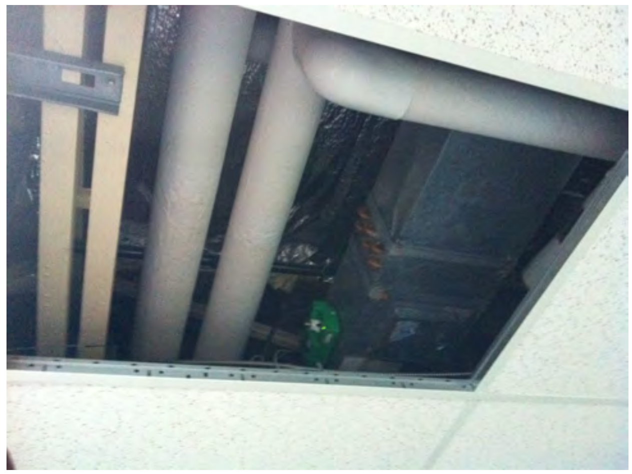


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:29:52 PM
Image Name	IR_1832.jpg
Emissivity	0.96
Reflected apparent temperature	139.0 °F
Object Distance	6.0 ft

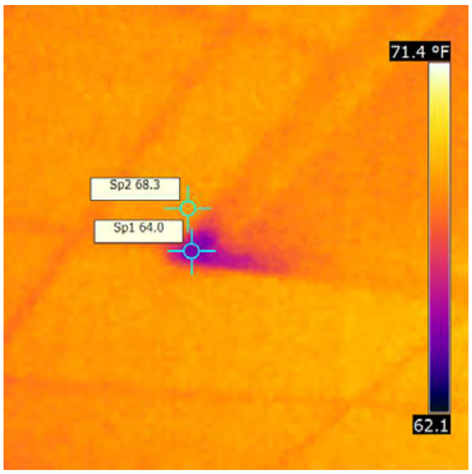
Text Comments

Description

Coils on mechanical equipment in the ceiling emit thermal energy.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



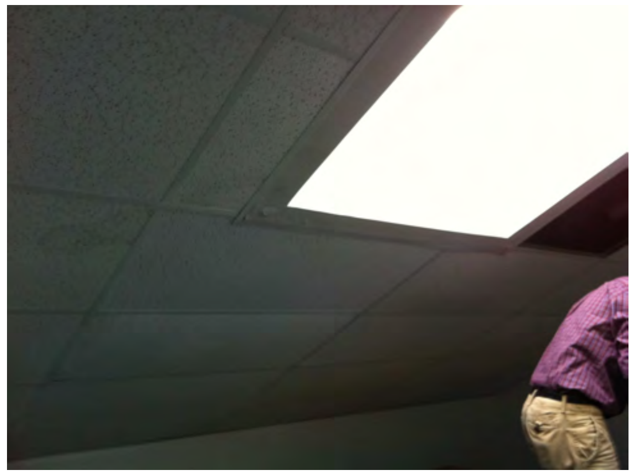


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:30:20 PM
Image Name	IR_1833.jpg
Emissivity	0.96
Reflected apparent temperature	64.0 °F
Object Distance	4.0 ft

Description

Corner of skylight shows signs of thermal transfer. Visual inpsection shows peeling paint. This indicates water could be breaching which could lead to mold. Recommend air-sealing windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

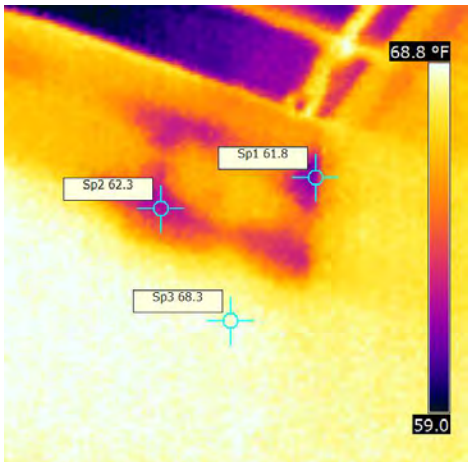


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:31:16 PM
Image Name	IR_1834.jpg
Emissivity	0.96
Reflected apparent temperature	62.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR at the top of the skylight reveals area where thermal transfer occuring.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

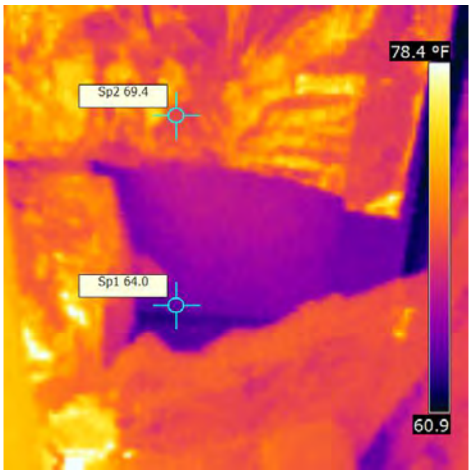


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:32:42 PM
Image Name	IR_1836.jpg
Emissivity	0.96
Reflected apparent temperature	64.0 °F
Object Distance	4.0 ft

Description

Insulation not properly installed allows thermal transfer to occur. Recommend replacing disturbed insulation.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

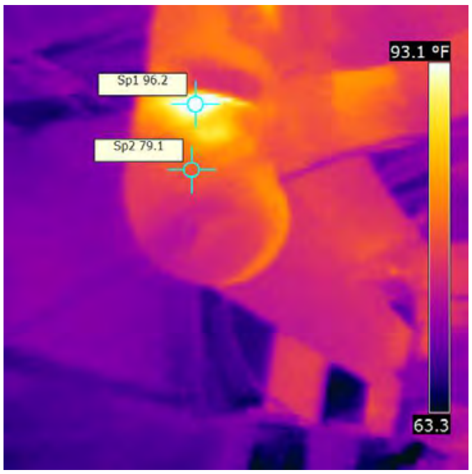


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:35:03 PM
Image Name	IR_1837.jpg
Emissivity	0.96
Reflected apparent temperature	97.0 °F
Object Distance	3.0 ft

Text Comments

Description

Insulation not properly installed allows thermal breaching to occur.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

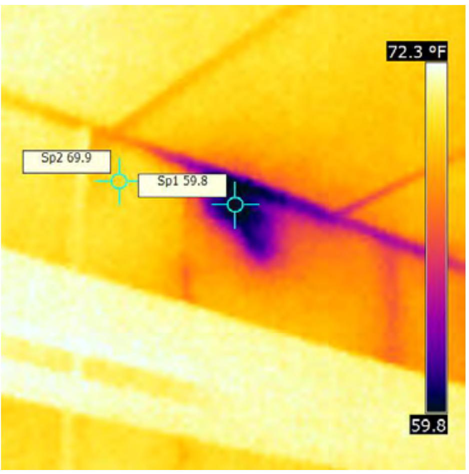


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:38:16 PM
Image Name	IR_1839.jpg
Emissivity	0.96
Reflected apparent temperature	60.0 °F
Object Distance	7.0 ft

Text Comments

Description

IR of wall in maintenance office reveals area where thermal barrier is lacking and thermal transfer is occurring. Insulating walls may not be cost effective.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

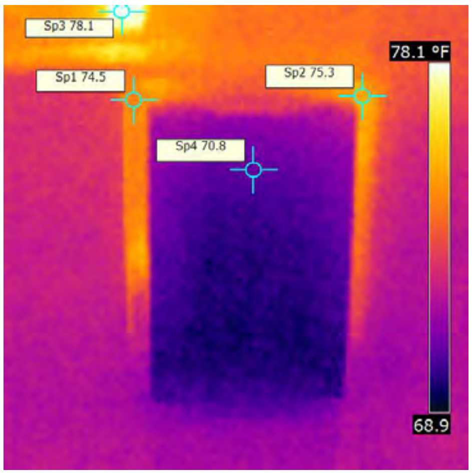


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:56:39 PM
Image Name	IR_1840.jpg
Emissivity	0.96
Reflected apparent temperature	75.0 °F
Object Distance	6.0 ft

Text Comments

Description

Compact refrigerator underneath a counter does not reveal high amounts of thermal transfer. In this instance, microwave panel (above) produces higher thermal energy than refrigerator. Recommend consolidating microwaves (EEM T1-3) and fridges (EEM T1-6).

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

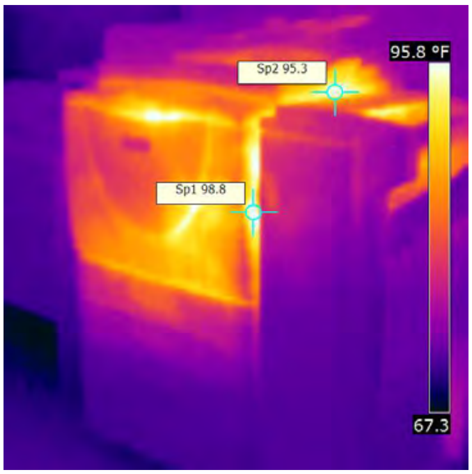


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:57:15 PM
Image Name	IR_1841.jpg
Emissivity	0.96
Reflected apparent temperature	96.0 °F
Object Distance	5.0 ft

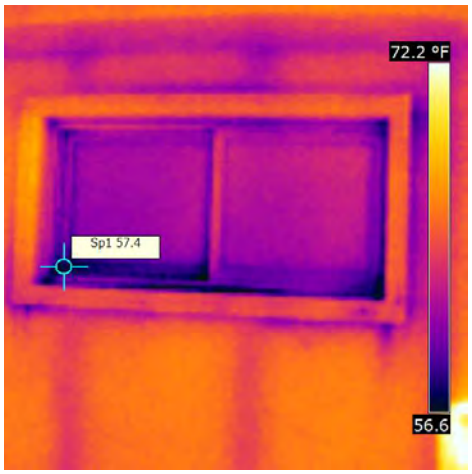
Text Comments

Description

Photocopier produces thermal energy and consumes high amounts of electricty, even in standby mode. Recommend putting copiers on a time clock to power down when building is unoccupied. Refer to EEM T1-7 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



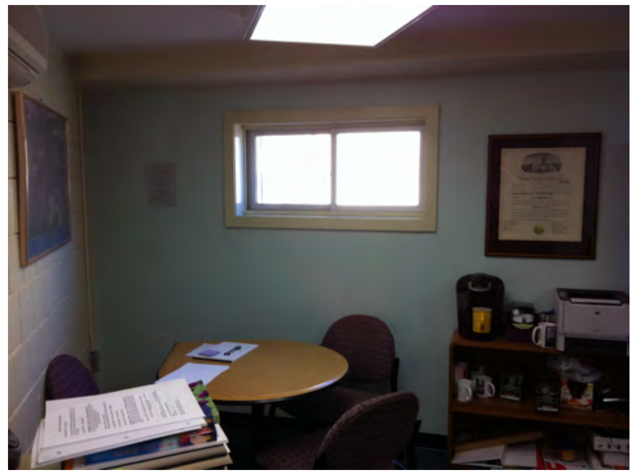


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/19/2011 2:57:50 PM
Image Name	IR_1842.jpg
Emissivity	0.96
Reflected apparent temperature	57.0 °F
Object Distance	6.0 ft

Text Comments

Description

IR of window reveals thermal transfer around window frame. Studs are also visible in the wall indicating poor insulation. Recommend air-sealing all windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

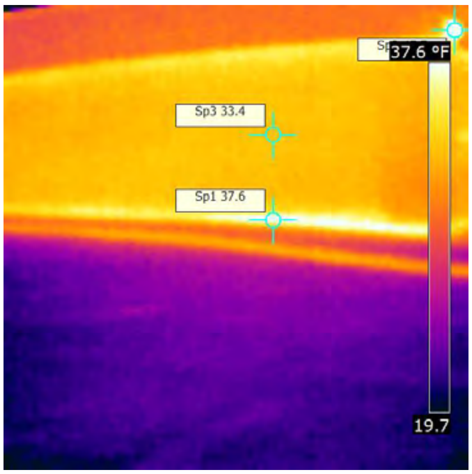


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:56:14 AM
Image Name	IR_1843.jpg
Emissivity	0.96
Reflected apparent temperature	36.0 °F
Object Distance	15.0 ft

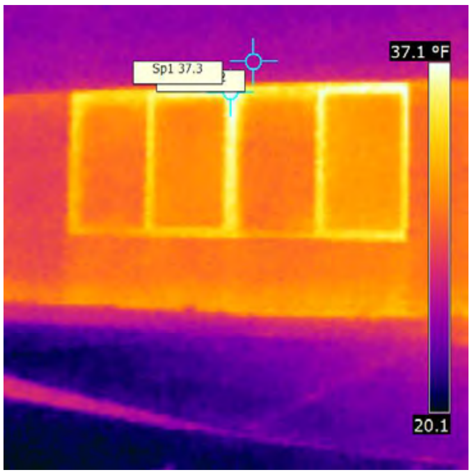
Text Comments

Description

Exterior IR reveals thermal transfer through concrete foundation as well as thermal energy from light fixture (upper right). Recommend replacing light with LED unit (EEM T2-5). Insulating walls may not be cost effective.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



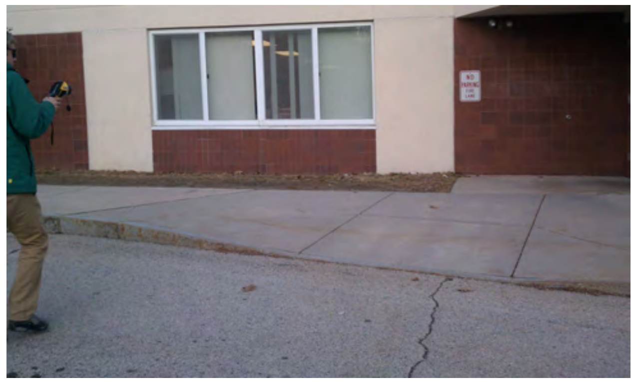


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:57:09 AM
Image Name	IR_1845.jpg
Emissivity	0.96
Reflected apparent temperature	36.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of building exterior reveals thermal transfer through window frames as well as different thermal properties through different exterior fascades. Recommend air-sealing windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

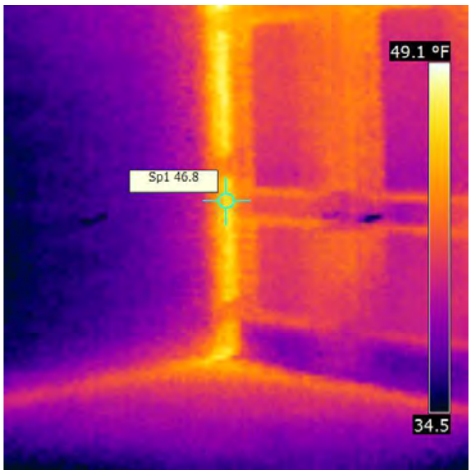


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:57:18 AM
Image Name	IR_1846.jpg
Emissivity	0.96
Reflected apparent temperature	46.0 °F
Object Distance	7.0 ft

Text Comments

Description

Side entrance IR reveals thermal transfer through seal between doorway and wall. Recommend air-sealing exterior doors and windows. Refer to EEM T1-5 for cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

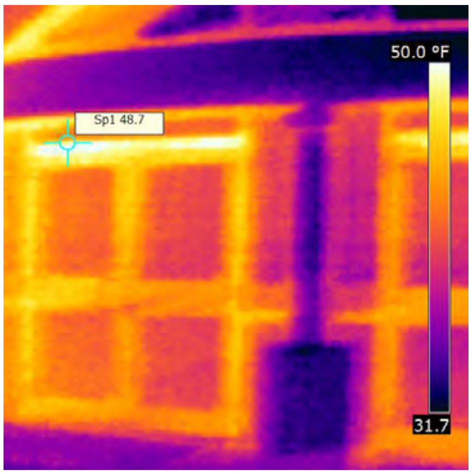


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:57:55 AM
Image Name	IR_1848.jpg
Emissivity	0.96
Reflected apparent temperature	48.0 °F
Object Distance	7.0 ft

Text Comments

Description

Front door IR reveals thermal transfer through top of door frame. Recommend air-sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

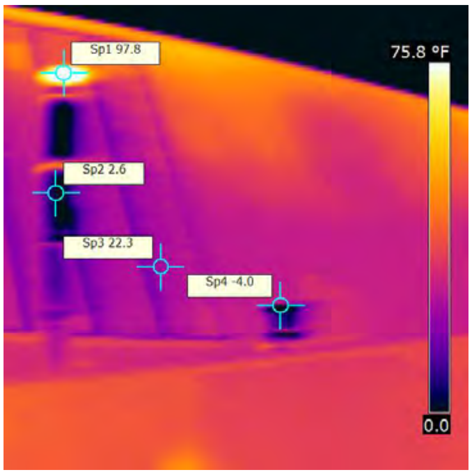


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:58:43 AM
Image Name	IR_1853.jpg
Emissivity	0.96
Reflected apparent temperature	0.0 °F
Object Distance	15.0 ft

Text Comments

Description

Roof IR reveals cold roof and cold metal exhaust pipes but high temperature of exaust. Recommend repairing makeup air damper in the boiler room to limit this exhaust. Refer to EEM T1-4 for associated cost and savings.

Inspection Report

Report Date	5/25/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

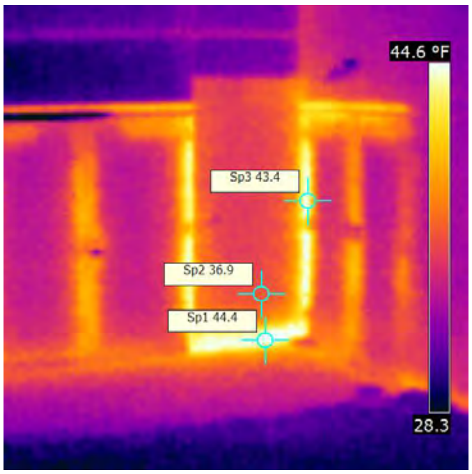


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:59:44 AM
Image Name	IR_1857.jpg
Emissivity	0.96
Reflected apparent temperature	42.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR at the side doors to the building reveal thermal transfer around doors as well as transfer through concrete at bottom. Recommend air-sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

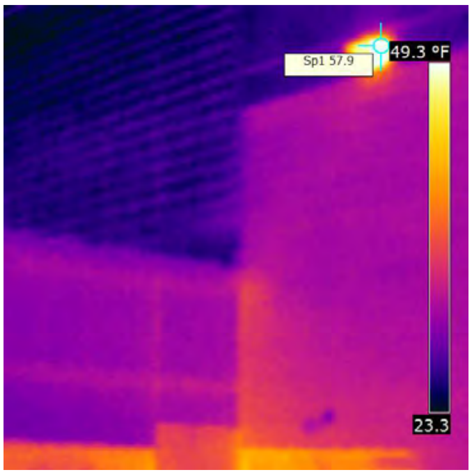


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 8:59:54 AM
Image Name	IR_1858.jpg
Emissivity	0.96
Reflected apparent temperature	57.0 °F
Object Distance	15.0 ft

Text Comments

Description

Exterior light was not illuminated during picture however it revealed to still emit thermal energy. Recommend replacing with an LED unit. Refer to EEM T2-5 for associated cost and savings.

Inspection Report

Report Date	5/25/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Upper Elementary School
Address	90 Main Street, Newmarket, NH 03857	Site Address	12 Drury Lane, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

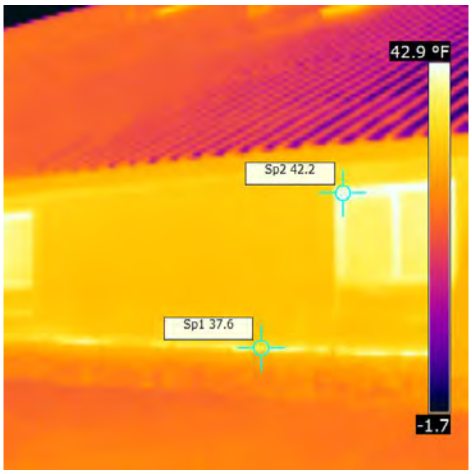


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/20/2011 9:01:53 AM
Image Name	IR_1865.jpg
Emissivity	0.96
Reflected apparent temperature	36.0 °F
Object Distance	12.0 ft

Text Comments

Description

Rear of building IR reveals thermal transfer through window frame and through concrete foundation. Recommend air-sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

APPENDIX C

Indoor Metering Data

INDOOR METERING DATA

Facility:	Location:	Date:	Outdoor:
HUES	Hollis, NH	12/19/2011	Temp= 42 RH= 25 CO2= 325

Location /Use Description	Time	Occupied	Air Quality		
			Temp (°F)	RH (%)	CO2 (ppm)
307	1135	N	68.1	24.8	1,746
4th grade southeast corridor	1140	N	69	20.6	1,419
305	1140	N	69	21	1,300
303	1145	N	70.3	19.9	1,390
302	1150	N	71.2	18.5	1,527
301	1155	Y	73.7	16.9	1,166
Gym 2nd fl	1200	N	69.6	15.2	632
Vestibule off gym	1210	N	69	14.3	680
201	1210	N	69.2	19.1	1,418
203 art	1220	Y	67.1	17.8	907
205 media	1225	Y	68.3	12.9	560
Teachers lounge	1227	Y	71.4	13	724
208	1230	Y	71.6	14.6	911
209	1230	Y	75.5	14	791
123	1241	N	73.9	17.8	1,212
109	1245	N	73.2	14.1	750
108	1247	N	71	13.8	576
114	1248	Y	73.9	16.1	828
112	1300	N	75.3	17.6	1,310
105	1301	N	72.8	12	575
102	1304	Y	72.8	15.4	693
103	1307	Y	72.6	16.1	704
Music	1338	Y	70.8	14.2	694
Nurse	1356	Y	75.5	15.7	997
Main office	1358	Y	74.6	16	1,010
Principal	1400	Y	76.4	18.2	1,076
Averages:			**71.8**	**16.5**	**984**

Location	Lighting Density (FC)	Recommended Density (FC) [1]
307	54.2	30
4th grade southeast corridor	33.2	10
305	50.3	30
303	50.4	30
302	72.5	30
301	69.6	30
Gym 2nd fl	40	75
Vestibule off gym	27.4	10
201	48.2	30
203 art	50.6	50
205 media	41.8	30
Teachers lounge	42.5	30
208	69	30
209	65.1	30
123	108.7	30
2nd fl hall	43.8	10
109	67.4	30
108	41.1	30
114	54	30
112	52.7	30
105	41.1	30
102	54.4	30
103	51.8	30
Nurse	49.8	30
1st fl hall	42.8	10
Main office	45	30
Principal	28	30

(1) Based upon IESNA standards and AEC recommendations.

APPENDIX D

Lighting Fixture Inventory

LIGHTING FIXTURE INVENTORY

Facility:	Location:	Date:
HUES	Hollis, NH	12/19/2011

Location /Use Description	Fixture	Watts/fixture	Qty	Controls	Total watts	Est. Hr/Wk	Est. KWH Consumption/Yr
Exit	Led	5	52	Always on	260	168	2,271
Main office	Cfl	16	3	Switch	48	50	96
Exterior	Cfl	20	15	Switch	300	61	952
304 storage	T8	30	3	Occ	90	0.5	2
Elecrtical	T8	30	2	Switch	60	0.5	1
Electrical	T8	30	2	Switch	60	0.5	1
Electrical	T8	30	1	Switch	30	0.5	1
Electrical	T8	30	2	Switch	60	0.5	1
Elevator machine	T8	30	2	Switch	60	0.5	1
Gym fire room	T8	30	4	Switch	120	0.5	2
Mechanical	T8	30	2	Switch	60	0.5	1
104 storage	T8	30	4	Switch	120	1	5
Boiler	T8	30	2	Switch	60	1	2
Custodial	T8	30	4	Switch	120	1	5
Custodial storage	T8	30	2	Switch	60	1	2
Custodian	T8	30	2	Switch	60	1	2
Storage	T8	30	2	Switch	60	1	2
Storage	T8	30	3	Switch	90	1	4
Boys bathroom	T8	30	3	Occ	90	3	11
Girls bathroom	T8	30	4	Occ	120	3	14
Boys bathroom	T8	30	4	Switch	120	5	24
Boys room	T8	30	2	Switch	60	5	12
Girls bathroom	T8	30	4	Switch	120	5	24
Girls room	T8	30	2	Switch	60	5	12
111	T8	30	2	Switch	60	35	84
Music room	T8	30	6	Switch	180	35	252
NE stairs	T8	30	3	Switch	90	50	180
Art storage	T8	60	2	Switch	120	0.5	2
Music storage	T8	60	2	Motion	120	0.5	2
Records	T8	60	1	Switch	60	0.5	1
4th fl custodial	T8	60	5	Switch	300	1	12
Cafeteria stage	T8	60	9	Switch	540	1	22
Custodial	T8u	60	1	Switch	60	1	2
Custodian	T8	60	1	Switch	60	1	2
118	T8	60	2	Occ	120	2	10
Boys room	T8	60	3	Motion/switch	180	2	14
Girls room	T8	60	3	Motion/switch	180	2	14
Staff rest	T8	60	1	Occ	60	2	5
Boys bath	T8	60	2	Occupancy	120	3	14
Boys bath	T8	60	2	Occupancy	120	3	14
Conference	T8	60	6	Switch	360	5	72
Girls bath	T8	60	2	Occupancy	120	3	14

Girls bath	T8	60	2	Occupancy	120	3	14
Restroom	T8	60	1	Switch	60	5	12
Restroom	T8	60	1	Switch	60	5	12
Restroom	T8u	60	1	Switch	60	5	12
Staff bath	T8	60	1	Occupancy	60	3	7
Staff bath	T8	60	1	Occupancy	60	3	7
Volunteers	T8	60	4	Switch	240	5	48
Boys locker	T8	60	6	Motion/switch	360	8	115
Girls locker	T8	60	6	Motion/switch	360	8	115
Special ed secretary	T8	60	1	Switch	60	35	84
Kitchen	T8	60	13	Switch	780	30	936
116	T8	60	3	Motion/switch	180	35	252
117	T8	60	2	Switch	120	35	168
119	T8	60	3	Motion/switch	180	35	252
120	T8	60	2	Occ	120	35	168
121	T8	60	2	Occ	120	35	168
122	T8	60	10	Motion/switch	600	35	840
203 art	T8	60	13	Motion/switch	780	35	1,092
206 laminating	T8	60	2	Switch	120	35	168
Music room	T8	60	16	Switch	960	35	1,344
Music room	T8	60	8	Switch	480	35	672
Nurse	T8	60	7	Switch	420	40	672
PE office	T8	60	2	Occ	120	35	168
Principal	T8	60	5	Switch	300	40	480
Teacher/aid workroom	T8	60	8	Switch	480	35	672
205 media/Library	T8	60	20	Motion/switch	1200	40	1,920
Assistant principal	T8	60	3	Switch	180	40	288
Guidance	T8	60	3	Switch	180	40	288
2nd fl hall EW	T8	60	31	Switch	1860	50	3,720
4th fl hall	T8	60	5	Switch	300	50	600
Bottom fl hall EW	T8	60	35	Switch	2100	50	4,200
Bottom fl hall ns	T8	60	5	Switch	300	50	600
Entrance hall	T8	60	11	Switch	660	50	1,320
Entrance vestibule	T8	60	3	Switch	180	50	360
First fl hall ew	T8	60	14	Switch	840	50	1,680
First fl hall ns	T8	60	8	Switch	480	50	960
Gym vestibule	T8	60	4	Switch	240	50	480
Main office	T8	60	17	Switch	1020	50	2,040
Middle stairs 1-2	T8	60	4	Switch	240	50	480
NE bottom fl vestibule	T8	60	1	Switch	60	50	120
NE stairs	T8	60	2	Switch	120	50	240
Nurse hall	T8	60	3	Switch	180	50	360
South side entrance	T8	60	1	Switch	60	50	120
Stairs off main entrance	T8	60	4	Switch	240	50	480
Stairs off music room	T8	60	4	Switch	240	50	480
Stairs off nurse	T8	60	4	Switch	240	50	480

West vestibule bottom fl	T8	60	1	Switch	60	50	120
Cafeteria	HPS	70	9	Switch	630	40	1,008
Library storage	T8	90	10	Motion/switch	900	0.5	18
101	T8	90	15	Motion/switch	1350	35	1,890
102	T8	90	15	Motion/switch	1350	35	1,890
103	T8	90	15	Motion/switch	1350	35	1,890
104	T8	90	9	Motion/switch	810	35	1,134
105	T8	90	15	Motion/switch	1350	35	1,890
106	T8	90	15	Motion/switch	1350	35	1,890
107	T8	90	9	Motion/switch	810	35	1,134
108	T8	90	12	Motion/switch	1080	35	1,512
109	T8	90	15	Motion/switch	1350	35	1,890
110	T8	90	5	Motion/switch	450	35	630
112	T8	90	6	Motion/switch	540	35	756
114	T8	90	16	Motion/switch	1440	35	2,016
115	T8	90	20	Motion/switch	1800	35	2,520
123	T8	90	15	Motion/switch	1350	35	1,890
201	T8	90	15	Motion/switch	1350	35	1,890
202	T8	90	15	Motion/switch	1350	35	1,890
206 media workroom	T8	90	6	Motion/switch	540	40	864
207 staff	T8	90	12	Motion/switch	1080	35	1,512
208	T8	90	15	Motion/switch	1350	35	1,890
209	T8	90	15	Motion/switch	1350	35	1,890
301	T8	90	12	Switch	1080	35	1,512
302	T8	90	15	Switch	1350	35	1,890
303	T8	90	15	Switch	1350	35	1,890
305	T8	90	15	Switch	1350	35	1,890
306	T8	90	15	Switch	1350	35	1,890
307	T8	90	15	Switch	1350	35	1,890
Cafeteria stage	Inc	100	24	Switch	2400	1	96
Gymnasium	T8	120	24	Switch	2880	40	4,608
Cafeteria	T8	120	18	Motion	2160	40	3,456
Cafeteria stage	Inc	125	3	Switch	375	1	15
Exterior	Pole	150	3	Switch	450	61	1,427
Exterior	Wallpack	150	14	Switch	2100	61	6,661
Totals:			**934**		**66,443**		**95,103**

APPENDIX E

Mechanical Equipment Inventory

BOILER DATA SHEET

Facility:		Location:				Date:
HUES		Hollis, NH				12/19/2011
Location /Use Description	**Manufacturer**	**Model Number**	**Qty**	**Year**	**Capacity (mbh)**	**Thermal Efficiency**
Boiler Room/Boiler No. 1-4	Weil-McLain	P-WTGO-6	4	1997	212	86.8%
Boiler Room/Boiler No. 5-10	Hydro-Therm	2310A	6	1980	1,818	86.7%

ELECTRIC WATER HEATER

Facility:						Location:			Date:
Hues						Hollis NH			12/27/2011
Name	**Location**	**Qty.**	**Watts/element**	**V**	**Phase**	**Capacity (gal)**	**Manufacturer**	**Model**	**Est. kWh/yr**
State Select	Multi-purpose mech. rm.	1	5,000	480	3	119	State Select	S8612054IFEB	10,400
Ruud	Second Floor Mech RM	2	6,000	480	1	85	Ruud Commercial	ES85-6-G	24,960
Total		3				289			35,360

PUMPS DATA SHEET

Facility:		Location:				Date:		
Hues		Hollis NH				12/27/2011		
Location /Use Description	**Manufacturer**	**Model Number**	**RPM**	**Amps**	**HP**	**Volt**	**Phase**	**Est. kWh/yr**
Mec. Closet / CP-1 Circulating pump	Emerson	S55JXDYE-2681	1725	5.7	1/4	115	1	3,146
Mec. Closet / CP-2 Circulating pump	Marathon	5K46MN4126	1725	3.6	1	230	3	11,923
Pump House / Water Distribution	Aquavar			8	5	480	3	46,488
Pump House / Water Distribution	Aquavar			11	7	480	3	65,083
Septic System pump 1	Hydromatic	SK75/100			1	460	3	3,576
Septic System pump 2	Hydromatic	SK75/100			1	460	3	3,576
Boiler Room / Heat pump 1					5	480	3	18,774
Boiler Room / Heat pump 2					5	480	3	18,774
Total					**25 1/4**			**171,341**

FAN DATA SHEET

Facility:		Location:				Date:		
Hues		Hollis NH				12/27/2011		
Location /Use Description	**Manufacturer**	**Model Number**	**Qty**	**CFM**	**HP**	**Volt**	**Phase**	**Est. kWh/yr**
Gym exhaust	Greenheck	GB 180 10	4	3500	1	480	3	7,450
Gym storage	Greenheck	GB 180 7	1	2640	3/4	480	3	1,397
lavatory 2 and 3	Greenheck	GB 80 4	2	450	1/4	120	1	931
lavatory 334	Greenheck	GB 70 4	1	150	1/4	120	1	466
Kitchen hood	Greenheck	Cube 200 20	1	4800	2	480	3	3,725
Corridor main floor	Greenheck	GB 180 15	1	4320	1 1/2	480	3	2,794
Fire pump room	Greenheck	GB 180 7	1	3700	3/4	480	3	1,397
401 (inline)	Greenheck	BSQ 140 5	1	1600	1/2	480	3	931
Corridor exhaust	Greenheck	BSQ 160 7	1	2500	3/4	480	3	1,397
Lavatory exhaust	Greenheck	GB 70 4	1	100	1/4	120	1	466
Cafeteria exhaust	Greenheck	GB 180 10	1	3515	1	480	3	1,863
Electrical Room exhaust	Greenheck	BSQ 90 4	2	500	1/4	120	1	931
Total			**17**	**27,775**	**9**			**23,747**

MECHANICAL EQUIPMENT INVENTORY

Facility:		Location:	Date:	
Hues		Hollis, NH	12/27/2011	
Location /Use Description	**Qty**	**Affiliated System**	**Est. kWh/yr**	**Notes**
Walk in fridge	1	Refrigeration	14,150	
307 unit ventilator	1	Heat, Vent	4,649	
306 unit ventilator	2	Heat, Vent	9,298	
305 unit vent	1	Heat, Vent	4,649	
303 unit heater	2	Heat	397	
391 unit heater	2	Heat	397	
209 unit heater	1	Heat	199	
208 unit heater	2	Heat	397	
boiler room unit heater	1	Heat	298	
sprinkler room unit heater	1	Heat	199	
Munters	1	AC, Heat, Vent	105,223	R410, vfd
Outdoor Carrier AC unit	1	AC	5,304	R-22
Outdoor Mitsubishi AC unit	1	AC	5,479	R410
Outdoor Roof AC unit	1	AC	8,219	
Gymnasium AHU	1	Heat, Vent	17,880	
Loft AHU	1	Heat, Vent	21,307	
Boiler Room / Tank Monitoring System	2	Heat	841	
Electric Heater in Pump House	1	Heat	10,000	
Boiler Room / Burners	10	Boilers	6,555	
Total	**33**		**215,440**	

APPENDIX F

Plug Load Inventory

PLUG LOAD INVENTORY

Facility:		Location:			Date:		
Hues		Hollis, NH			12/27/2011		
Location /Use Descrip	**Unit**	**Watts/fixture**	**Qty**	**Total watts**	**Est. Hr/Wk**	**Est. kWh/Yr**	**Notes**
Admin main office	Cd player	25	1	25	5	5	
Assistance principal	Coffee maker	1,200	1	1,200	2	96	
207	Coffee maker	1,200	1	1,200	3	144	
Nurse	Computer	85	1	85	50	170	
Guidance	Computer	85	1	85	50	170	
Music	Computer	85	1	85	50	170	
307	Computer	85	5	425	50	850	
303	Computer	85	4	340	50	680	All on over vacation
302	Computer	85	4	340	50	680	
301	Computer	85	4	340	50	680	
Loft tech	Computer	85	8	680	50	1,360	
209	Computer	85	5	425	50	850	
208	Computer	85	4	340	50	680	
201	Computer	85	4	340	50	680	
103	Computer	85	4	340	50	680	
104	Computer	85	5	425	50	850	
102	Computer	85	4	340	50	680	
110	Computer	85	1	85	50	170	
105	Computer	85	3	255	50	510	
106	Computer	85	1	85	50	170	
114	Computer	85	24	2,040	50	4,080	
108	Computer	85	4	340	50	680	
109	Computer	85	5	425	50	850	
119	Computer	85	1	85	50	170	
123	Computer	85	4	340	50	680	
120	Computer	85	1	85	50	170	
121	Computer	85	3	255	50	510	
Admin main office	Computer	85	2	170	50	340	
Assistance principal	Computer	85	1	85	50	170	
306	Computer	85	5	425	50	850	
305	Computer	85	4	340	50	680	
Loft confrene	Computer	85	1	85	50	170	
207	Computer	85	1	85	50	170	
206	Computer	85	1	85	50	170	
205	Computer	85	6	510	50	1,020	
202	Computer	85	4	340	50	680	
112	Computer	85	19	1,615	50	3,230	
Admin main office	Copier	1,440	1	1,440	10	576	
206	Copier	1,440	2	2,880	10	1,152	
117	Copier	1,440	1	1,440	10	576	
115	Cow	600	1	600	50	1,200	
Guidance	Deskjet	35	1	35	3	4	

Admin main office	Deskjet	35	1	35	3	4	
Kitchen	Electric oven	1,800	4	7,200	15	4,320	
Kitchen	Electric stove	1,800	1	1,800	15	1,080	
Admin main office	Fan	15	1	15	15	9	Warm weather use
Guidance	Fan	15	2	30	15	18	Warm weather use
Music	Fan	15	1	15	15	9	Warm weather use
Cafeteria	Fan	15	2	30	15	18	Warm weather use
305	fan	15	1	15	15	9	Warm weather use
303	Fan	15	1	15	15	9	Warm weather use
302	Fan	15	2	30	15	18	Warm weather use
301	Fan	15	2	30	15	18	Warm weather use
Loft	Fan	15	1	15	15	9	Warm weather use
208	Fan	15	1	15	15	9	Warm weather use
205	Fan	15	1	15	15	9	Warm weather use
203	Fan	15	1	15	15	9	Warm weather use
202	Fan	15	1	15	15	9	Warm weather use
201	Fan	15	1	15	15	9	Warm weather use
104	Fan	15	1	15	15	9	Warm weather use
101	Fan	15	2	30	15	18	Warm weather use
110	Fan	15	1	15	15	9	Warm weather use
105	Fan	15	1	15	15	9	Warm weather use
106	Fan	15	1	15	15	9	Warm weather use
107	Fan	15	1	15	15	9	Warm weather use
109	Fan	15	1	15	15	9	Warm weather use
117	Fan	15	1	15	15	9	Warm weather use
116	Fan	15	1	15	15	9	Warm weather use
121	Fan	15	1	15	15	9	Warm weather use
307	Fan	15	1	15	15	9	Warm weather use
306	Fan	15	1	15	15	9	Warm weather use
207	Fan	15	1	15	15	9	Warm weather use
102	Fan	15	1	15	15	9	Warm weather use
108	Fan	15	1	15	15	9	Warm weather use
Admin main office	Fax	150	1	150	1	6	
Kitchen	Ice cream	480	1	600	60	1,440	
203	Kiln	12,000	1	12,000	0.25	120	
Admin main office	Laminator	600	1	600	0.5	12	
206	Laminator	600	1	600	0.5	12	
Nurse	Lamp	75	1	75	40	120	
Assistance principal	Laptop	40	1	40	40	64	
Principal	Laptop	40	1	40	40	64	
Music	Laptop	40	1	40	40	64	
305	Laptop	40	1	40	40	64	
303	Laptop	40	1	40	40	64	
302	Laptop	40	1	40	40	64	
301	Laptop	40	1	40	40	64	
301	Laptop	40	1	40	40	64	

208	Laptop	40	1	40	40	64
203	Laptop	40	1	40	40	64
Pe office	Laptop	40	1	40	40	64
202	Laptop	40	1	40	40	64
105	Laptop	40	2	80	40	128
106	Laptop	30	2	60	40	96
112	Laptop	30	4	120	40	192
108	Laptop	30	1	30	40	48
109	Laptop	30	1	30	40	48
118	Laptop	30	1	30	40	48
123	Laptop	30	1	30	40	48
121	Laptop	30	1	30	40	48
121	Laptop	30	1	30	40	48
Sped	laptop	30	1	30	40	48
304	Laser jet	500	1	500	3	60
302	Laser jet	500	1	500	3	60
205	Laser jet	500	2	1,000	3	120
103	Laser jet	500	1	500	3	60
102	Laser jet	500	1	500	3	60
114	Laser jet	500	2	1,000	3	120
109	Laser jet	500	1	500	3	60
Nurse	Laser jet	500	1	500	3	60
306	Laser jet	500	1	500	3	60
305	Laser jet	500	1	500	3	60
120	Laser jet	500	1	500	3	60
Loft tech	Lcd	30	4	120	50	240
209	Lcd	30	5	150	50	300
Guidance	LCD	30	1	30	50	60
307	LCD	30	5	150	50	300
306	LCD	30	5	150	50	300
305	LCD	30	4	120	50	240
303	LCD	30	5	150	50	300
302	LCD	30	4	120	50	240
301	LCD	30	4	120	50	240
Loft confrene	LCD	30	1	30	50	60
208	LCD	30	4	120	50	240
206	LCD	30	1	30	50	60
205	LCD	30	6	180	50	360
202	LCD	30	4	120	50	240
201	LCD	30	4	120	50	240
103	LCD	30	4	120	50	240
104	LCD	30	5	150	50	300
102	LCD	30	4	120	50	240
110	LCD	30	1	30	50	60
105	LCD	30	3	90	50	180
106	LCD	30	1	30	50	60

112	LCD	30	19	570	50	1,140
114	LCD	30	24	720	50	1,440
108	LCD	30	4	120	50	240
109	LCD	30	5	150	50	300
119	LCD	30	1	30	50	60
123	LCD	30	4	120	50	240
120	LCD	30	1	30	50	60
121	LCD	30	3	90	50	180
Admin main office	Microwave	1,100	1	1,100	2	88
302	Microwave	1,100	1	1,100	2	88
209	Microwave	1,100	1	1,100	2	88
205	Microwave	1,100	1	1,100	2	88
201	Microwave	1,100	1	1,100	2	88
103	Microwave	1,100	1	1,100	2	88
105	Microwave	1,100	1	1,100	2	88
106	Microwave	1,100	1	1,100	2	88
107	Microwave	1,100	1	1,100	2	88
120	Microwave	1,100	1	1,100	2	88
121	Microwave	1,100	1	1,100	2	88
Kitchen	Microwave	1,100	1	1,100	2	88
307	Microwave	1,100	1	1,100	2	88
305	Microwave	1,100	1	1,100	2	88
207	Microwave	1,100	2	2,200	2	176
109	Microwave	1,100	1	1,100	2	88
Kitchen	Milk chest	600	1	600	80	2,496
Admin main office	Mini fridge	300	2	600	60	1,872
Principal	Mini fridge	300	1	300	60	936
Nurse	Mini fridge	300	1	300	60	936
307	Mini fridge	300	1	300	60	936
302	Mini fridge	300	1	300	60	936
209	Mini fridge	300	1	300	60	936
208	Mini fridge	300	1	300	60	936
205	Mini fridge	300	1	300	60	936
201	Mini fridge	300	1	300	60	936
105	Mini fridge	300	1	300	60	936
107	Mini fridge	300	1	300	60	936
109	Mini fridge	300	1	300	60	936
Assistance principal	Mini fridge	300	1	300	60	936
106	Mini fridge	300	1	300	60	936
Kitchen	Mixer	250	1	250	2	20
Admin main office	Monitor	15	2	30	40	48
Assistance principal	Monitor	15	1	15	40	24
Nurse	Monitor	15	1	15	40	24
Admin main office	Old laser jet	600	1	600	3	72
201	Projcetor	240	1	240	10	96
302	Projector	240	1	240	10	96

301	Projector	240	1	240	10	96	
202	Projector	240	1	240	10	96	
102	Projector	240	1	240	10	96	
107	Projector	240	1	240	10	96	
114	Projector	240	1	240	10	96	
307	Projector	240	1	240	10	96	
303	Projector	240	1	240	10	96	
209	Projector	240	1	240	10	96	
208	Projector	240	1	240	10	96	
205	Projector	240	1	240	10	96	
115	Projector	240	1	240	10	96	
108	Projector	240	1	240	10	96	
Nurse	Radio	20	1	20	5	4	
302	radio	20	1	20	5	4	
105	Radio	20	1	20	5	4	
Music	Radio	20	3	60	15	36	
Kitchen	Slicer	92	1	92	2	7	
120	Space heater	1,500	1	1,500	15	900	Cold weather use
Kitchen	Steamer	1,200	1	1,200	15	720	
Music	Tv	165	1	165	3	20	
306	Tv	165	1	165	3	20	
304	Tv	165	1	165	3	20	
301	Tv	165	1	165	3	20	
205	Tv	165	1	165	3	20	
101	Tv	165	2	330	3	40	
115	Tv	165	1	165	3	20	
Music	VCR	25	1	25	3	3	
306	VCR	25	1	25	3	3	
Lobby	Vending machine	600	1	600	60	1,440	
207	Vending machine	600	1	600	60	1,440	
Kitchen	Warming trays	240	4	960	20	768	
Admin main office	Water cooler	660	1	660	10	264	
East all	Water fountain	350	2	700	60	1,680	
First floor	Water fountain	350	3	1,050	60	2,520	
Lobby	Water fountain	350	1	350	60	840	
Gym	Water fountain	350	2	700	60	1,680	
2nd floor corridor	Water fountain	350	2	700	60	1,680	
Totals:			**465**	**94,917**		**79,999**	

APPENDIX G

ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Hollis Upper Elementary School

Building ID: 1746619
For 12-month Period Ending: January 31, 2012[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 20, 2012

Facility
Hollis Upper Elementary School
12 Drury Ln
Hollis, NH 03049

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1980
Gross Floor Area (ft²): 96,258

Energy Performance Rating[2] (1-100) 49

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,142,054
Fuel Oil (No. 2) (kBtu)	2,906,786
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	5,048,840

Energy Intensity[4]	
Site (kBtu/ft²/yr)	52
Source (kBtu/ft²/yr)	105

Emissions (based on site energy use)	
Greenhouse Gas Emissions (MtCO$_2$e/year)	451

Electric Distribution Utility
Public Service Co of New Hampshire [Northeast Utilities]

National Median Comparison	
National Median Site EUI	52
National Median Source EUI	104
% Difference from National Median Source EUI	1%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist
for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) or a Registered Architect (RA) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE or RA in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Hollis Upper Elementary School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	12 Drury Ln, Hollis, NH 03049	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of a hospital, k-12 school, hotel and senior care facility) nor can they be submitted as representing only a portion of a building.		☐

Hollis Upper Elementary School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	96,258 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	50	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	2	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	Yes	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	10 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	9(Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	No	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		☐

ENERGY STAR® Data Checklist
for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: Public Service Co of New Hampshire [Northeast Utilities]

Fuel Type: Electricity		
Meter: HUES-ELEC (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
01/01/2012	01/31/2012	43,400.00
12/01/2011	12/31/2011	40,600.00
11/01/2011	11/30/2011	48,400.00
10/01/2011	10/31/2011	58,600.00
09/01/2011	09/30/2011	42,600.00
08/01/2011	08/31/2011	34,400.00
07/01/2011	07/31/2011	47,800.00
06/01/2011	06/30/2011	62,000.00
05/01/2011	05/31/2011	58,800.00
04/01/2011	04/30/2011	64,000.00
03/01/2011	03/31/2011	59,600.00
02/01/2011	02/28/2011	67,600.00
HUES-ELEC Consumption (kWh (thousand Watt-hours))		**627,800.00**
HUES-ELEC Consumption (kBtu (thousand Btu))		**2,142,053.60**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**2,142,053.60**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Fuel Oil (No. 2)		
Meter: HUES-OIL (Gallons) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (Gallons)**
01/01/2012	01/31/2012	4,174.80
12/01/2011	12/31/2011	0.00
11/01/2011	11/30/2011	3,178.00
10/01/2011	10/31/2011	0.00
09/01/2011	09/30/2011	0.00
08/01/2011	08/31/2011	0.00
07/01/2011	07/31/2011	0.00
06/01/2011	06/30/2011	0.00
05/01/2011	05/31/2011	3,001.70
04/01/2011	04/30/2011	0.00

03/01/2011	03/31/2011	7,596.00
02/01/2011	02/28/2011	3,008.30
HUES-OIL Consumption (Gallons)		**20,958.80**
HUES-OIL Consumption (kBtu (thousand Btu))		**2,906,786.45**
Total Fuel Oil (No. 2) Consumption (kBtu (thousand Btu))		**2,906,786.45**
Is this the total Fuel Oil (No. 2) consumption at this building including all Fuel Oil (No. 2) meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same PE or RA that signed and stamped the SEP.)

Name: ____ Date: _____________

Signature: ______________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Hollis Upper Elementary School
12 Drury Ln
Hollis, NH 03049

Facility Owner
N/A

Primary Contact for this Facility
N/A

General Information

Hollis Upper Elementary School	
Gross Floor Area Excluding Parking: (ft²)	96,258
Year Built	1980
For 12-month Evaluation Period Ending Date:	January 31, 2012

Facility Space Use Summary

Hollis Upper Elementary School	
Space Type	K-12 School
Gross Floor Area (ft²)	96,258
Open Weekends?	No
Number of PCs	50
Number of walk-in refrigeration/freezer units	2
Presence of cooking facilities	Yes
Percent Cooled	10
Percent Heated	100
Months o	9
High School?	No
School District o	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 01/31/2012)	**Baseline** (Ending Date 04/30/2008)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	49	59	75	N/A	50
Energy Intensity					
Site (kBtu/ft²)	52	46	41	N/A	52
Source (kBtu/ft²)	105	96	81	N/A	104
Energy Cost					
$/year	$ 157,940.70	$ 121,012.15	$ 122,468.03	N/A	$ 156,615.74
$/ft²/year	$ 1.64	$ 1.26	$ 1.27	N/A	$ 1.63
Greenhouse Gas Emissions					
$MtCO_2e$/year	451	403	350	N/A	447
$kgCO_2e$/ft²/year	5	4	4	N/A	5

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Median column presents energy performance data your building would have if your building had a median rating of 50.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

APPENDIX H

Renewable Energies Screening Worksheets

RENEWABLE ENERGY SCREENING SUMMARY

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

RE Technology	Score (out of 70 pts.)	Grade	Notes/Comments
Roof Photovoltaic	57.5	82%	Medium system 10kw-30kw.
Biomass Heating	56.0	80%	Pellet feed system recommended.
Geothermal Heating/Cooling	55.5	79%	Closed-loop GSHP system.
Solar DHW	54.5	78%	DHW demand should be confirmed.
Wind Turbine Generator	52.5	75%	Permit requirements are height dependent.
Ground Photovoltaic	52.0	74%	Small system 5w-10kw.
Solar Thermal	48.0	69%	Medium-temperature system.
Combined Heat & Power	44.5	64%	75kW system.

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Roof-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3.5	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	5	High grid electrical demand.
5	Facility/systems conditions	5	Ample amount of south facing roof space.
6	Facility/systems compatibility	5	Roof is pitched and is in good condition.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	School not visible from abutting properties.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	3.5	Increased roof maintenance and panel replacement.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	5	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy in NH has lower than average CO2 emissions.
14	Public awareness/education	4.5	Moderate public use facility. South facing roof along parking lot making highly visible.
	Total Score:	**57.5**	
	Total Possible Score:	**70**	
	Grade:	**82%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Biomass Heating Systems (wood, chips, pellets)**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology. Some woodchip and pellet feed units are newer technology.
2	Expected service life/durability	4	Expected service life is 20 yrs.
3	Geographical considerations	3	Limited fuel in Southern NH.
4	Energy demand	5	Heating energy is high in the building.
5	Facility/systems conditions	4	Woodchips/pellets could be stored in rear or side of building.
6	Facility/systems compatibility	4	Woodchips/pellets could be stored in rear or side of building.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	4	Systems are located inside building. Wood or chip feedstock located outside could be a concern.
9	Capital investment	4.5	Low capital cost.
10	O&M requirements	3.5	Wood and woodchip units require constant attending and feedstock must be sourced. Pellet systems with hoppers are less intensive and feedstock is commercially available.
11	Financial incentives	2.5	Limited incentives.
12	Owner initiatives	5	Owner is highly interested biomass heating.
13	CO2e emissions	3.5	Biomass does emit CO2 but the net reduction from the oil system will be significant.
14	Public awareness/education	4	Moderate public use. Information could be displayed in the building so users are aware of biomass heating system.
	Total Score:	**56**	
	Total Possible Score:	**70**	
	Grade:	**80%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Geothermal Heating & Cooling**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	Well demonstrated technology but does require engineering design.
2	Expected service life/durability	4.5	Well field and loop system has +50 year service life. Equipment has +20 yr service life.
3	Geographical considerations	4.5	Abundant geothermal energy reserves.
4	Energy demand	4.5	Heating and cooling energy consumption is relatively high.
5	Facility/systems conditions	3	Existing system is functioning.
6	Facility/systems compatibility	3	Building system is old but a heat pump can be installed.
7	Permitting constraints	5	No special permitting required for a closed-loop system (open-loop would require state permit and is not recommended).
8	Abutter concerns	5	Abutters with water supply wells can be sensitive to geothermal wells but a closed-loop system will have no impact.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	4.5	Very low O&M except routine equipment maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	The building currently uses a high amount of oil.
14	Public awareness/education	3.5	Moderate public use. Information could be displayed in the building so users are aware of geothermal system.
	Total Score:	**55.5**	
	Total Possible Score:	**70**	
	Grade:	**79%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Solar Domestic Hot Water**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology although system design and function can vary.
2	Expected service life/durability	3	Expected service life of heating panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	4.5	Expected DHW demand is low.
5	Facility/systems conditions	4.5	System could utilize the existing electric hot water tanks.
6	Facility/systems compatibility	4.5	System could utilize the existing electric hot water tanks.
7	Permitting constraints	5	No special permitting required.
8	Abutter concerns	5	Low visibility/impact.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	4	Panel replacement and normal DHW system maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	3.5	Moderate reduction of oil use based on DHW demand.
14	Public awareness/education	4	Moderate public use.
	Total Score:	**54.5**	
	Total Possible Score:	**70**	
	Grade:	**78%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility: Hollis Upper Elementary School
Location: Hollis, NH
Gross Area (sf): 96,258
Date: 2/24/2012
Use Category: K-12 School
EUI (kBtu/sf/yr): 105
Heating Fuel(s): Oil (No. 2)
PM Grade: 49
Heating System(s): Hydronic
Cooling System(s): Limited (DX Coils)

Technology: **Wind Turbine Generator**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	A well demonstrated technology but proper site selection is critical.
2	Expected service life/durability	3.5	Some turbine units have proven unreliable (design flaws). Selection of a reputable manufacturer is critical.
3	Geographical considerations	3	Limited wind energy but a feasibility study is required.
4	Energy demand	5	Electric energy consumption is high.
5	Facility/systems conditions	4	Fairly modern systems.
6	Facility/systems compatibility	4	Fairly modern systems
7	Permitting constraints	3	Special permits are required depending on the height of the pole-mounted turbine. Roof-mounted turbines may be practical however they provide less energy.
8	Abutter concerns	2.5	Pole-mounted turbines have a large visual impact.
9	Capital investment	3.5	Moderate capital cost.
10	O&M requirements	3.5	Routine maintenance required. Units are subject to damage from elements.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility.
	Total Score:	**52.5**	
	Total Possible Score:	**70**	
	Grade:	**75%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Ground-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	5	High grid electrical demand.
5	Facility/systems conditions	4	Older facility and systems.
6	Facility/systems compatibility	2.5	Limited south-facing land space currently available. Expansion possible.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	School not visible from abutting properties.
9	Capital investment	3	High capital cost.
10	O&M requirements	3.5	Vegetative cutting and panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	4	Moderate public use. South facing land abutting parking lot.
	Total Score:	**52**	
	Total Possible Score:	**70**	
	Grade:	**74%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Solar Thermal HVAC**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	3.5	Well demonstrated technology but supply limited. More efficient than regular PV.
2	Expected service life/durability	4	Expected service life of system is 20 years.
3	Geographical considerations	3	Limited solar availability in New England.
4	Energy demand	4	Heating and cooling relatively high.
5	Facility/systems conditions	2.5	Existing mechanical system is limited.
6	Facility/systems compatibility	3	Considerable space required but could be made available. Plumbing complex to protect against freezing.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	School not visible from abutting properties.
9	Capital investment	2	High capital cost.
10	O&M requirements	3	Vegetative cutting for ground mount, roof maintenance for roof mount, panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility depending on placement.
	Total Score:	**48**	
	Total Possible Score:	**70**	
	Grade:	**69%**	

RENEWABLE ENERGY SCREENING WORKSHEET

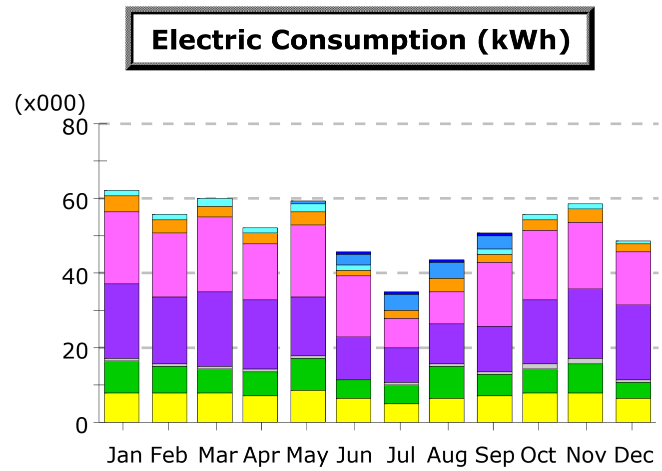
Building/Facility:	Hollis Upper Elementary School	Location:	Hollis, NH
Gross Area (sf):	96,258	Date:	2/24/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	105
Heating Fuel(s):	Oil (No. 2)	PM Grade:	49
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

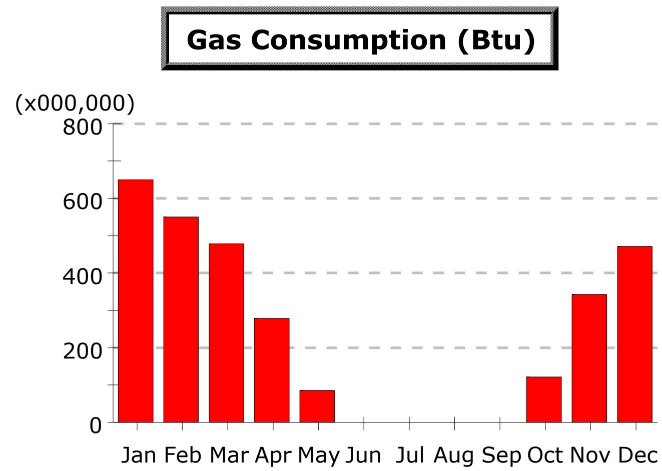
Technology: **Combined Heat & Power System**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Smaller CHP units are relatively new technology. Larger units (+75kW) are more reliable.
2	Expected service life/durability	3.5	Expected service life for a small CHP unit is 10 yrs. Large CHPs have a 20 yr. service life.
3	Geographical considerations	3	NH has a low electrical energy cost.
4	Energy demand	4.5	Electric energy consumption is high.
5	Facility/systems conditions	2.5	Older building.
6	Facility/systems compatibility	1	No renewables currently on site.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	5	Modern CHPs are relatively quiet and would be inside of the building.
9	Capital investment	2	High capital cost.
10	O&M requirements	2	Frequent maintenance required. Large system manufacturers require that they complete maintenance for warranty validation.
11	Financial incentives	2	Limited incentives.
12	Owner initiatives	4	Owner is open to renewable options
13	CO_2e emissions	1	CHPs consume a large amount of fuel and emissions relative to the re-used energy.
14	Public awareness/education	4	Moderate public use. Information could be displayed in the building so users are aware of CHP system. However CHP is not entirely renewable.
	Total Score:	**44.5**	
	Total Possible Score:	**70**	
	Grade:	**64%**	

APPENDIX I

eQUEST® Energy Efficiency Measure Modeling





Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	0.17	0.51	0.80	0.77	0.59	-	-	-	2.84
Heat Reject.	-	-	-	-	0.94	2.87	4.43	4.32	3.38	-	-	-	15.94
Refrigeration	1.51	1.36	1.58	1.21	1.66	1.21	0.02	0.02	1.43	1.58	1.51	1.06	14.15
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	3.79	3.67	3.31	3.06	3.84	2.04	2.04	3.31	2.19	2.66	3.31	2.11	35.32
Vent. Fans	19.80	17.46	19.76	14.84	19.48	15.82	7.52	8.98	17.60	18.55	18.20	14.57	192.58
Pumps & Aux.	19.90	17.85	19.84	18.78	15.57	11.50	9.89	10.23	11.73	17.42	18.83	19.59	191.14
Ext. Usage	0.91	0.70	0.77	0.75	0.53	0.52	0.53	0.87	0.84	0.87	0.88	0.91	9.09
Misc. Equip.	7.90	7.43	6.64	6.27	8.53	4.70	5.07	8.84	5.65	6.64	7.84	4.44	79.95
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	8.21	7.52	7.87	7.04	8.68	6.47	4.80	6.19	7.17	7.86	8.10	6.23	86.16
Total	62.01	55.98	59.78	51.96	59.40	45.64	35.10	43.53	50.59	55.58	58.68	48.92	627.18

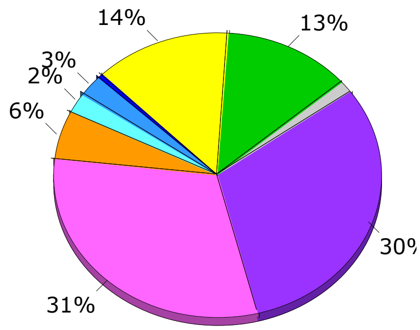
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	647.9	551.0	480.1	278.6	84.1	1.4	-	-	1.7	121.0	342.7	472.1	2,980.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	647.9	551.0	480.1	278.6	84.1	1.4	-	-	1.7	121.0	342.7	472.1	2,980.5

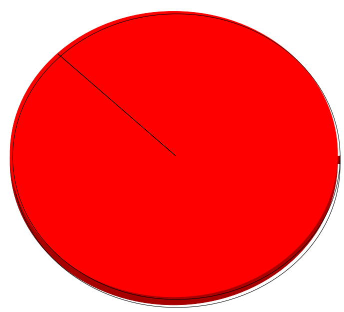
Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	2.84	-	-	-
Heat Reject.	15.94	-	-	-
Refrigeration	14.15	-	-	-
Space Heat	-	2,980.5	-	-
HP Supp.	-	-	-	-
Hot Water	35.32	-	-	-
Vent. Fans	192.58	-	-	-
Pumps & Aux.	191.14	-	-	-
Ext. Usage	9.09	-	-	-
Misc. Equip.	79.95	-	-	-
Task Lights	-	-	-	-
Area Lights	86.16	-	-	-
Total	627.18	2,980.5	-	-

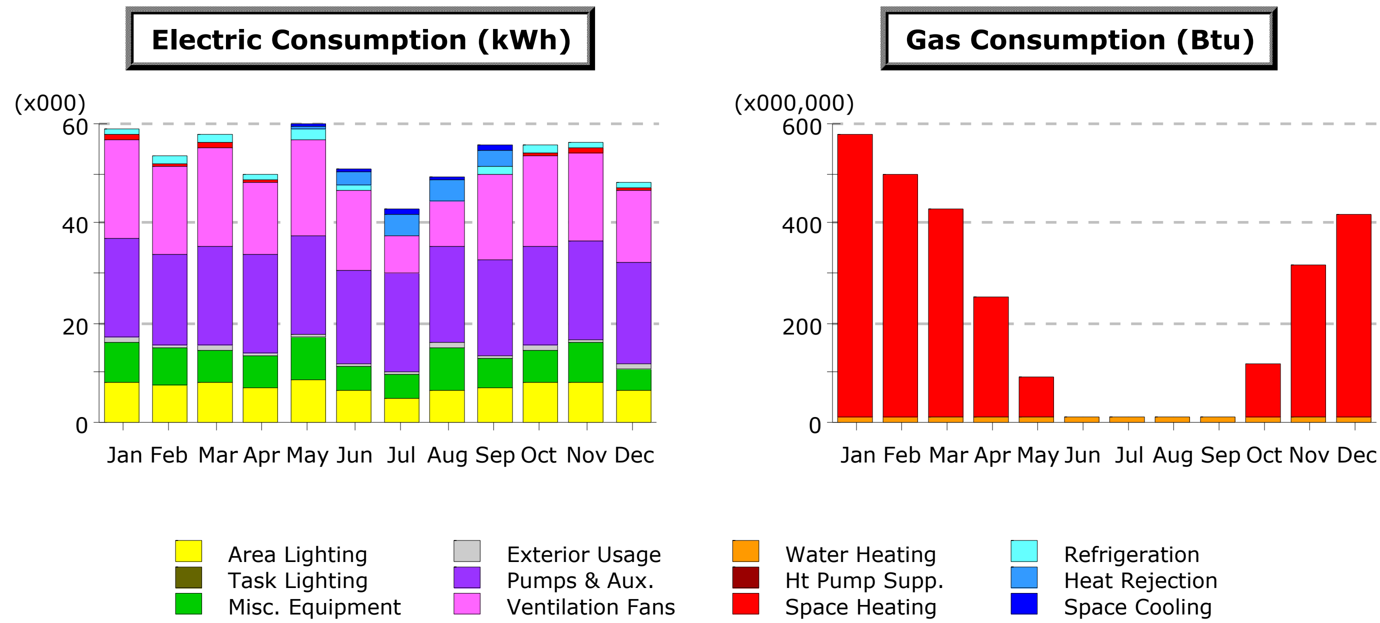
Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling



Electricity



Natural Gas



Electric Consumption (kWh x000)

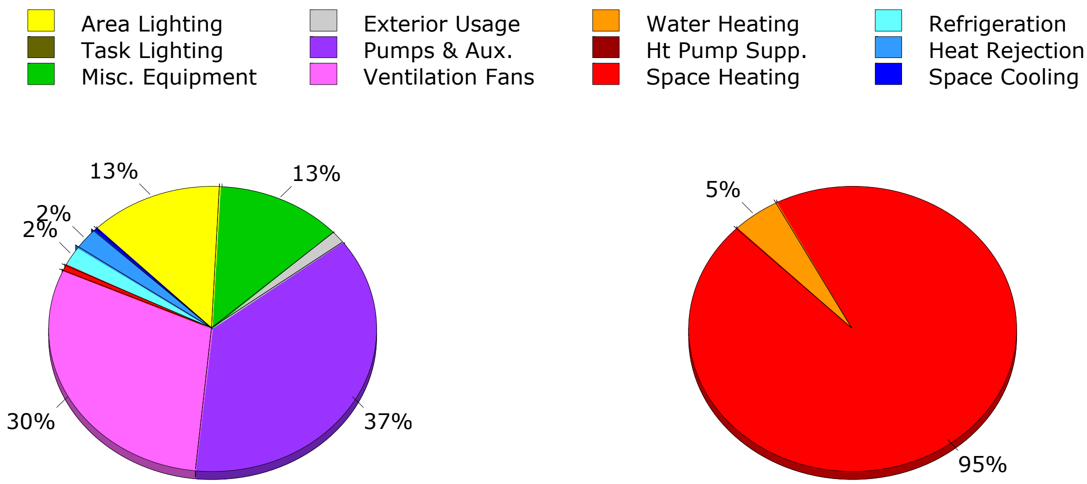
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	0.17	0.51	0.80	0.77	0.59	-	-	-	2.84
Heat Reject.	-	-	-	-	0.94	2.87	4.43	4.32	3.38	-	-	-	15.94
Refrigeration	1.51	1.36	1.58	1.21	1.66	1.21	0.02	0.02	1.43	1.58	1.51	1.06	14.15
Space Heat	0.94	0.81	0.82	0.59	0.18	0.00	-	-	0.01	0.26	0.62	0.83	5.07
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	19.80	17.46	19.76	14.58	19.47	15.86	7.52	8.98	17.60	18.55	18.05	14.56	192.19
Pumps & Aux.	19.93	18.09	20.30	19.45	19.61	18.81	19.44	19.44	18.82	19.72	19.47	20.31	233.39
Ext. Usage	0.91	0.70	0.77	0.75	0.53	0.52	0.53	0.87	0.84	0.87	0.88	0.91	9.09
Misc. Equip.	7.90	7.43	6.64	6.27	8.53	4.70	5.07	8.84	5.65	6.64	7.84	4.44	79.95
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	8.21	7.52	7.87	7.04	8.68	6.47	4.80	6.19	7.17	7.86	8.10	6.23	86.16
Total	59.20	53.36	57.75	49.90	59.77	50.96	42.61	49.43	55.49	55.49	56.48	48.34	638.77

Gas Consumption (Btu x000,000)

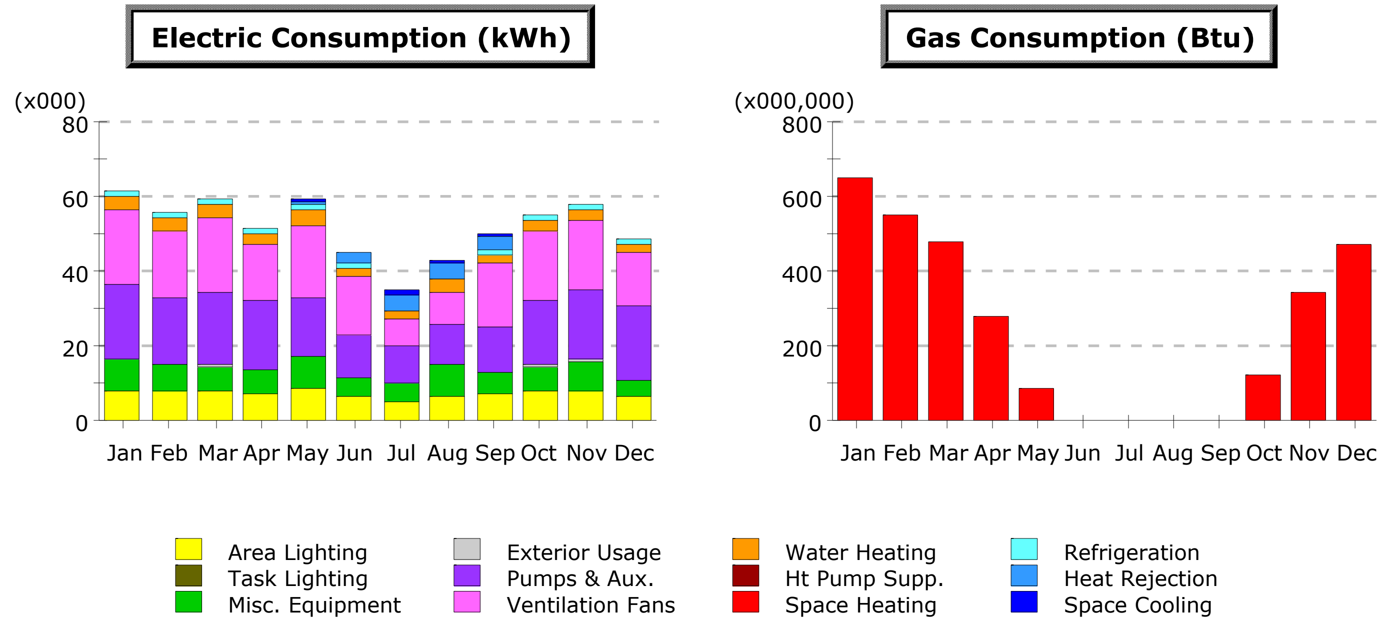
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	568.6	484.4	417.6	240.9	76.4	1.2	-	-	1.5	106.5	302.6	408.7	2,608.3
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	12.6	11.7	12.0	11.4	12.6	10.1	10.4	12.0	10.3	11.2	11.7	10.5	136.6
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	581.2	496.1	429.5	252.3	89.0	11.3	10.4	12.0	11.8	117.7	314.3	419.1	2,744.8

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	2.84	-	-	-
Heat Reject.	15.94	-	-	-
Refrigeration	14.15	-	-	-
Space Heat	5.07	2,608.3	-	-
HP Supp.	-	-	-	-
Hot Water	-	136.6	-	-
Vent. Fans	192.19	-	-	-
Pumps & Aux.	233.39	-	-	-
Ext. Usage	9.09	-	-	-
Misc. Equip.	79.95	-	-	-
Task Lights	-	-	-	-
Area Lights	86.16	-	-	-
Total	638.77	2,744.8	-	-



Electricity **Natural Gas**



Electric Consumption (kWh x000)

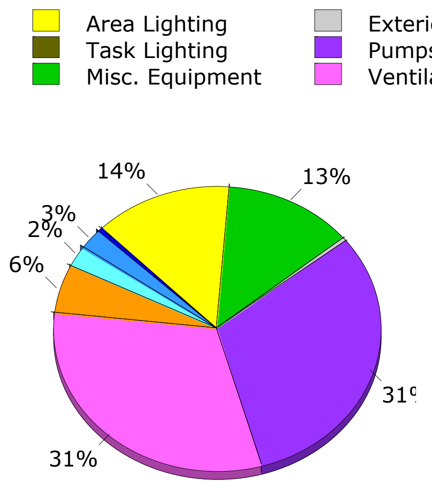
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	0.17	0.51	0.80	0.77	0.59	-	-	-	2.84
Heat Reject.	-	-	-	-	0.94	2.87	4.43	4.32	3.38	-	-	-	15.94
Refrigeration	1.51	1.36	1.58	1.21	1.66	1.21	0.02	0.02	1.43	1.58	1.51	1.06	14.15
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	3.79	3.67	3.31	3.06	3.84	2.04	2.04	3.31	2.19	2.66	3.31	2.11	35.32
Vent. Fans	19.80	17.46	19.76	14.84	19.48	15.82	7.52	8.98	17.60	18.55	18.20	14.57	192.58
Pumps & Aux.	19.90	17.85	19.84	18.78	15.57	11.50	9.89	10.23	11.73	17.42	18.83	19.59	191.14
Ext. Usage	0.27	0.21	0.23	0.22	0.16	0.15	0.16	0.26	0.25	0.26	0.26	0.27	2.71
Misc. Equip.	7.90	7.43	6.64	6.27	8.53	4.70	5.07	8.84	5.65	6.64	7.84	4.44	79.95
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	8.21	7.52	7.87	7.04	8.68	6.47	4.80	6.19	7.17	7.86	8.10	6.23	86.16
Total	61.37	55.49	59.24	51.43	59.02	45.28	34.72	42.92	50.00	54.97	58.06	48.28	620.80

Gas Consumption (Btu x000,000)

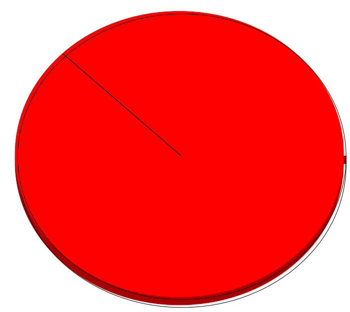
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	647.9	551.0	480.1	278.6	84.1	1.4	-	-	1.7	121.0	342.7	472.1	2,980.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	647.9	551.0	480.1	278.6	84.1	1.4	-	-	1.7	121.0	342.7	472.1	2,980.5

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	2.84	-	-	-
Heat Reject.	15.94	-	-	-
Refrigeration	14.15	-	-	-
Space Heat	-	2,980.5	-	-
HP Supp.	-	-	-	-
Hot Water	35.32	-	-	-
Vent. Fans	192.58	-	-	-
Pumps & Aux.	191.14	-	-	-
Ext. Usage	2.71	-	-	-
Misc. Equip.	79.95	-	-	-
Task Lights	-	-	-	-
Area Lights	86.16	-	-	-
Total	620.80	2,980.5	-	-



Electricity



Natural Gas

APPENDIX J

Cost Estimates

BUDGETARY COST ESTIMATE

Facility: **Hollis Upper Elementary School**

Date: **2/29/2012**

EEM	Design + Engineering	Installed Cost				Construction Management	Contingency (15%)	Total Investment
		Pricing Unit	Price	Qty	Subtotal			
Replace walk-in freezer condenser units with high efficiency units with economizers.	$ 630	EA	$ 1,830	1	**$ 1,830**	$ 183	$ 396	**$ 3,039**
Replace exterior metal halide wallpack fixtures with LED units (14).	$ -	EA	$ 450	14	**$ 6,300**	$ 630	$ 1,040	**$ 7,970**
Replace all electrical transformers older than 15 years with high efficiency units.	$ 850	EA	$ 8,000	5	**$ 40,000**	$ 4,000	$ 6,728	**$ 51,578**
Install air exchange ventilators with ERUs and demand controls (integrate with DDC) for 2nd and 3rd floor spaces. Ventilation rates and system capacity should comply with ASHRAE 90.1. Assume 3 ERV units.	$ 18,300	EA	$ 26,000	3	**$ 78,000**	$ 7,800	$ 15,615	**$ 119,715**
Consolidate existing oil-fired boiler units with two (2) new high efficiency units. Re-line flue. Connect the new system into the existing DDC system. Install VFD controls on main circulation pumps.	$ 10,800	EA	$ 83,000	2	**$ 166,000**	$ 16,600	$ 29,010	**$ 222,410**