ENERGY AUDIT REPORT

Prepared For:

Washington Elementary School

337 Millen Pond Road
Washington, New Hampshire

December 2011

Prepared and Submitted by

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Engineers and Consultants

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INTRODUCTION

This energy efficiency study was conducted by GDS Associates under contract to TRC in order to provide Washington Elementary School with a comprehensive energy assessment of the building located at 337 Millen Pond Road Washington, NH as a part of the New Hampshire Local Energy Audit Exchange (NH LAX). An evaluation of selected energy savings opportunities at each building are presented in this report.

The information presented in this report includes an overview of activities and findings, a description of the existing facility conditions, history of the facility energy usage, utility rate analysis, ENERGY STAR® Portfolio Manager Benchmarking assessment and energy efficiency measure recommendations. Additional energy efficiency measures that were not fully evaluated are addressed for additional considerations. This information may be used by the Washington Elementary School as a reference for prioritizing and completing energy related improvements.

All of the findings presented in this report are based on the walk-through audit of the building conducted on October 27th, 2011 and Infrared Thermal Imagining conducted on November 7th, 2011. Both site visits were conducted with Liz Sargent the Washington Elementary School Custodian, Al Krygeris from the Washington Energy Committee and Richard Beard from GDS Associates.

Historical energy data was provided by the town prior to the first site visit. These findings and recommendations are the result of what was observed during the site visits. Every effort was made for accuracy in this process but as with all equipment compilations of this type, the actual quantities, names and locations may vary slightly.

The Energy Efficiency Measures (EEMs) and associated costs and savings included in this study have been estimated based on GDS experiences, industry standards, and norms but in no way guarantee energy savings or performance. A more detailed analysis may be necessary to refine costs and savings values prior to initiating a project. In addition, incentives and grants may be available for suggested measures. These and other potential funding sources are identified and discussed in more detail in Section 5.

OVERVIEW OF ACTIVITIES AND FINDINGS

Executive Summary

The New Hampshire Local Audit Exchange (LAX) Program was developed by the NH Office of Energy and Planning as a means to provide no-cost energy audits to New Hampshire municipalities and school districts. Phase one of the LAX Program involves conducting comprehensive energy audits of municipal buildings across New Hampshire. Phase two will include analyzing the results of the audits and posting summarized information on the program website (nhlocalenergyaudits.com). The information will be grouped by building type which will allow other interested municipalities to browse the site for building types that match their own. This will allow those not directly involved in the program to familiarize similar recommendations and potential energy efficiency upgrade opportunities (as well as the associated costs and paybacks).

Energy Efficiency Measures Recommendations Summary

In the course of the site visit a number of potential energy efficiency improvement opportunities were identified, which ultimately led to the selection of four (4) EEMs analyzed in detail within this report. Other potential measures were identified, many of which have been discussed in more general terms as additional considerations. Estimated annual savings from the four measures analyzed in this report total over **$4,746** with a total installed cost of approximately **$16,806** – representing a simple payback of **3.5 years.**

Table 1 below summarizes the four targeted measures recommended for implementation at the Washington Elementary School. Each Measure is discussed in greater detail in the section, *Energy Efficiency Measures*. .

Table 1: Recommended Energy Efficiency Measures

Summary of Recommended Energy Efficiency Measures							
Energy Efficiency Measure		Installation Cost	Electricity Savings (kWh/yr)	Propane Savings (Gallons/yr)	Cost Savings ($/yr)	Total Site Energy Savings for all Fuels (MMBtu/yr)	Simple Payback (Years)
EEM:1	Air Seal Attic to Wall connection on the eave sides of the building	$6,000	2813	495	$1,404	55	4.3
EEM:2	Replace all exterior door seals	$975	0	129	$255	12	3.8
EEM:3	Retro-Commission HVAC System	$5,031	4538	766	$2,199	86	2.3
EEM:4	Upgrade Lighting controls - Occupancy Sensors	$4,800	5,922	0	$887	19	5.4
Totals		$16,806	13,273	1,390	$4,746	171	3.5

Historical Utility Consumption

Historical electric and propane billing data was received prior to the site visit. Washington Elementary School is provided electricity by Public Services of New Hampshire and propane is provided by Eastern Propane. The three year average annual energy consumption was found to be 16,333 kWh and 9.577 gallon of propane. Energy costs used in the savings analysis was the three year .

average fully blended rate of $0.150 per kWh and three year average propane cost of $1.93 per gallon. It is important to note this represents a three year average and the ongoing volatility of the price of propane may impact the estimated savings for the measures with propane savings. See Tables 2-4 and Figure 1 below for a graphical depiction of the Washington Elementary Schools energy usage

Table 2: Three Year Electric Utility Data

Electric Billing Data for Washington Elementary School								
2010-2011			2009-2010			2008-2009		
Period Ending	Electric Consumption (kWh)	Electric Cost	Period Ending	Electric Consumption (kWh)	Electric Cost	Period Ending	Electric Consumption (kWh)	Electric Cost
7/1/2011	7,960	$1,327.44	7/1/2010	8,560	$1,313.38	7/1/2009	8,640	$1,318.19
6/1/2011	8,840	$1,421.78	6/2/2010	9,200	$1,367.24	6/2/2009	11,520	$1,642.84
5/1/2011	9,160	$1,519.35	5/4/2010	12,080	$1,739.34	5/4/2009	14,520	$2,060.25
4/1/2011	13,280	$2,004.46	4/1/2010	10,840	$1,582.02	4/2/2009	13,240	$1,913.03
3/1/2011	10,880	$1,761.86	3/1/2010	11,920	$1,697.55	3/3/2009	12,640	$1,849.78
2/1/2011	12,880	$1,955.83	2/1/2010	11,960	$1,700.83	2/3/2009	542	$82.99
1/1/2011	11,760	$1,830.01	1/1/2010	8,480	$1,223.16	1/2/2009	10,280	$1,444.67
12/1/2010	7,520	$1,229.41	12/1/2009	9,800	$1,400.34	12/2/2008	11,640	$1,647.71
11/1/2010	7,240	$1,165.99	11/1/2009	8,600	$1,266.74	11/3/2008	10,400	$1,480.04
10/1/2010	7,160	$1,223.19	10/1/2009	6,240	$965.14	10/2/2008	8,760	$1,250.46
9/1/2010	5,780	$971.99	9/1/2009	6,720	$977.46	9/3/2008	9,280	$1,279.00
8/1/2010	5,680	$951.54	8/1/2009	7,600	$1,131.92	8/4/2008	8,720	$1,282.65
Totals	**108,140**	**$17,363**	**Totals**	**112,000**	**$16,365**	**Totals**	**120,182**	**$17,252**

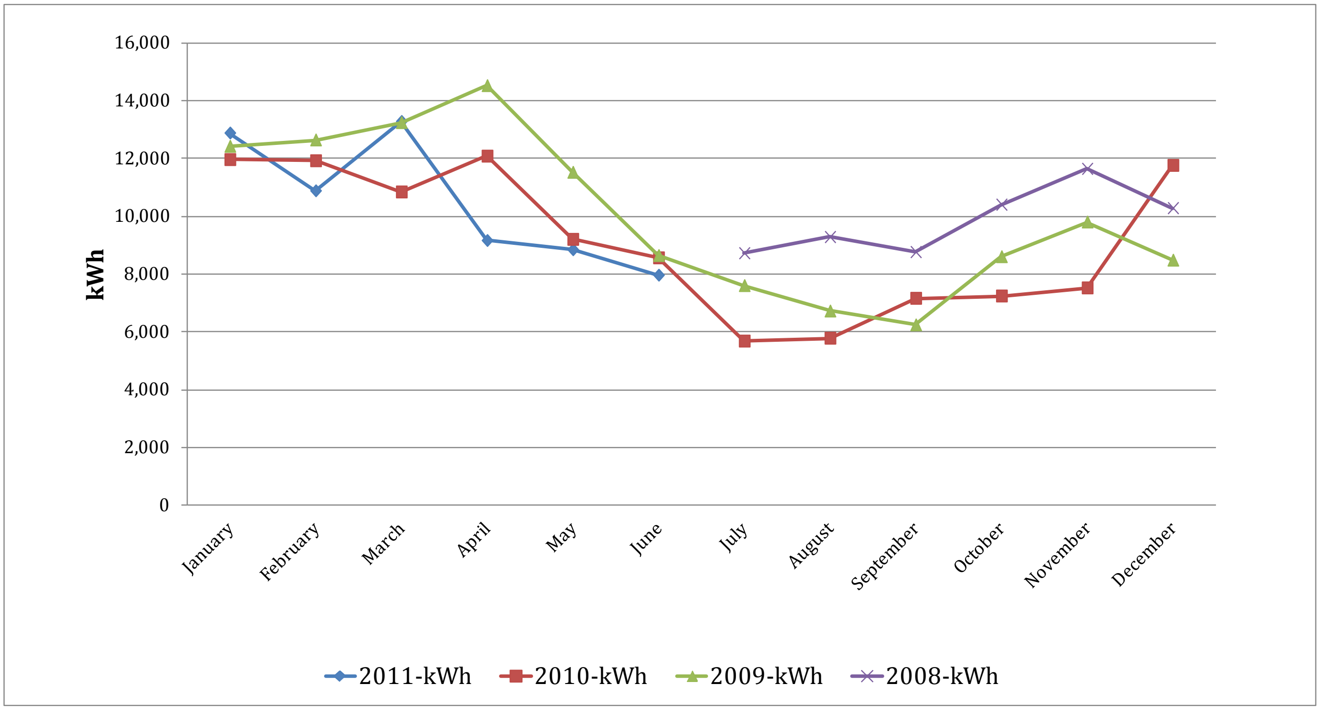
Table 3: Three Year Propane Data

Propane Billing Data for Washington Elementary School								
2010-2011			2009-2010			2008-2009		
Period Ending	Propane (Gallons)	Cost	Period Ending	Propane (Gallons)	Cost	Period Ending	Propane (Gallons)	Cost
6/30/2011	0	$0.00	6/30/2010	0	$0.00	6/30/2009	0	$0.00
5/31/2011	0	$0.00	5/31/2010	827.7	$1,150.50	5/31/2009	0	$0.00
4/30/2011	1,111.90	$2,700.26	4/30/2010	603.4	$838.70	4/30/2009	1,337.60	$3,329.29
3/31/2011	1,125.80	$2,003.92	3/31/2010	816.1	$1,134.40	3/31/2009	830.7	$2,067.61
2/28/2011	1,676.30	$2,983.81	2/28/2010	2,229.70	$3,099.30	2/28/2009	2,249.70	$5,599.50
1/31/2011	2,096.40	$3,731.59	1/31/2010	2,032.10	$2,824.60	1/31/2009	2,439.80	$6,072.66
12/31/2010	996.3	$1,773.41	12/31/2009	574.2	$798.10	12/31/2008	1,563.30	$3,891.06
11/30/2010	746	$1,327.88	11/30/2009	1,400.20	$1,946.30	11/30/2008	691.1	$1,720.15
10/31/2010	1,157.00	$2,059.46	10/31/2009	0	$0.00	10/31/2008	1,003.70	$2,498.21
9/30/2010	0	$0.00	9/30/2009	1,222.20	$3,432.10	9/30/2008	0	$0.00
8/31/2010	0	$0.00	8/31/2009	0	$0.00	8/31/2008	0	$0.00
7/31/2010	0	$0.00	7/31/2009	0	$0.00	7/31/2008	0	$0.00
Totals	**8,910**	**$16,580**	**Totals**	**9,706**	**$15,224**	**Totals**	**10,116**	**$25,178**

Table 4: Three Year Billing Summary for Washington Elementary School

2008-2011 Billing Summary for Washington Elementary School								
2010-2011			2009-2010			2008-2009		
Fuel	Usage	Cost	Fuel	Usage	Cost	Fuel	Usage	Cost
Electricity	108140 kWh	$17,363	Electricity	112000 kWh	$16,365	Electricity	120182 kWh	$17,252
Propane	8909.7 gallons	$16,580	Propane	9705.6 gallons	$15,224	Propane	10115.9 gallons	$25,178
Grand Total		**$33,943**	**Grand Total**		**$31,589**	**Grand Total**		**$42,430**

Figure 1: Three-Year Electric Consumption at the Washington Elementary School



Description of Energy Use Graphs

Based on the graphs it appears the monthly electrical energy consumption at the Washington Elementary School is consistent with the expected load profile of an elementary school in New Hampshire. The consumption peaks in the winter months when the lights are on longer and is minimized in the summer months when the school is not in full use. It is worth noting the annual energy consumption has steadily decreased the last 3 years while the use of the school has remained constant and the annual heating degree days (HDD) for August 2010 to July 2011 is nearly identical to the August 2009 to July 2010, 7,773 vs 7,122[1].

The energy reduction trend over the past three years may be the result of the current practice of manually turning off the core air handlers during the school day. According to the custodian the air handlers that serve the multipurpose room and the class rooms in the older portion of the building are manually turned off at 8:30am on school days because of the noise level those air handlers generate is disruptive to the learning environment. In the

recent past those air handlers would turn off each school day at 4pm. By manually turning off those air handlers the school is expected to see an electrical savings from not running the fans as well as a reduced heating load due to not providing ventilation to those spaces.

The Washington Elementary School is on the general rate G and is not subject to charges based on monthly demand charge.

FACILITY DETAILS

A comprehensive inspection of The Washington Elementary School was conducted to gather information on existing conditions of the major energy using/mechanical equipment and building systems. This included gathering physical information on the building, such as: HVAC equipment nameplate data, a detailed lighting inventory, and existing conditions of the thermal envelope. In addition, the site inspection allowed GDS to gain an understanding of how the facility is currently being operated and maintained.

[1] From the weather station at Hillsboro Center, NH, Hillsboro, NH (http://www.degreedays.net/#generate)

This section of the report discusses the existing conditions at the Washington Elementary School. GDS evaluated the structure, mechanical and lighting systems in the facilities to identify potential energy efficiency measures.

Washington Elementary School Description of Existing Conditions

The Washington Elementary School was originally constructed in 1992 as a 3 class room school with a multipurpose room, kitchen, main office and core area. In 2001 a major renovation project added 2 class rooms on the East side and a classroom and two conferences rooms on the west sides of the original school building to bring the school's gross floor area to 13,240 ft^2. The school day is 8:30am – 3:30pm with the Teachers and Staff on site from 7am to 5pm. The school has a staff of 15 and approximately 100 students.

Building Shell

The building is slab on grade and constructed with cement block walls with 2" of rigid foam insulation sandwiched between the block and exterior brick surface. The school has twelve (12) insulated exterior doors that have door seal gaskets in various levels of disrepair. See Figures 2 and 3 for an example of the current state of door seals at the school.

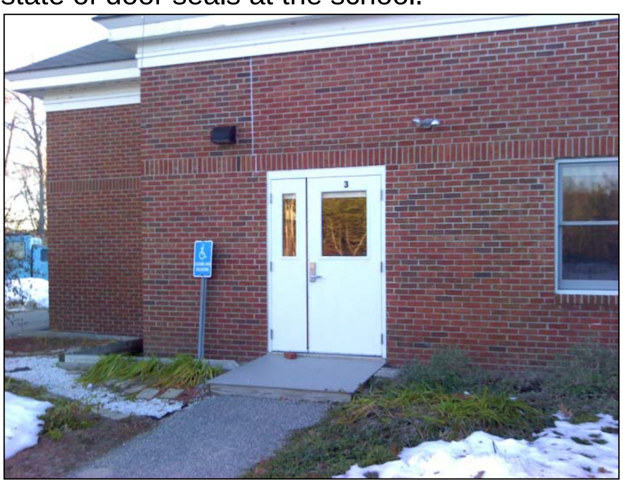


Figure 2: Typical connection between top of exterior wall and attic at eaves end of building

Figure 3: Typical connection between top of exterior wall and attic at eaves end of building

The building has a shingle roof and is vented through soffit and gable end vents. There are several attic spaces present. Most of the attic is accessible but portions are sealed off with sheet rock and are presumed to be inaccessible. Inspection of the accessible attic space and review of the original construction drawings determined the 1992 portion of the attic has 6" of blown in cellulose insulation for an insulation value of R-20. The 2001 potions of the school have two layers of R-19 insulation for an insulation value of R-38.

During the site visit it was noted approximately 300 feet of electric snow melt cabling was installed along the majority of the roof edge along the North side of the school. The school custodian stated the electric snow melt system is needed to combat the ice dams that form along the eave edge on the front (north side) of the school. It was noted ice dams also form along the back (south side) of the school but an electric snow melting system is not installed to combat the ice dams on the back of the school. See Figures 4 and 5 below for a picture and IR image of the exterior walls of the multipurpose room and the kitchen (to the right). As you can see there appears to be heat loss along the eaves. Investigation of the exterior wall from inside the kitchen found a noticeable air movement above the ceiling tiles and near the exterior wall.

Figure 4: Multipurpose Room and Kitchen wall

Figure 5: IR image of Multipurpose Room and Kitchen exterior wall

Figure 6 below is a picture of the typical connection between the top of the exterior wall and the attic at the eaves edge. It is believed there is a lack of adequate air sealing between the top of the exterior wall and the attic at the eaves is the cause of the ice dams forming.

Figure 6: Typical connection between top of exterior wall and attic at eaves end of building

The windows are double-pane with wood framing. The majority of the windows are operable double hung style windows that outwardly appear to be in good working condition. During the IR imaging of the school it was discovered the majority of the window sashes are not locked. Locking the sashes will provide a tighter seal which will reduce energy loss.

Mechanical Equipment

The Washington Elementary School is heated by two (2) propane fired cast iron Weil McLain hot water boilers (model # EG-75) that have an input of 300,000 Btu/hr and an AFUE rating of 82%. These boilers were installed in 2006 and are controlled by a Tekmar Boiler Controller Model 262 that was installed to control the original boilers.

At the time of the site visit the heating system was down for service. An interview with the service contractor, from Control Tech, discovered the Tekmar Boiler Controller is programmed to operate in characterized heating curve mode which allows the hot water supply temperature to vary between 140°F and 190°F based on outside air temperature. Review of the controllers operation manual found the characterized heating curve mode is capable of using an input from an building thermostat to enhance the controllability of the hot water heating system but the controls for hot water heating system was not functioning at the time of the site visit due to the boilers being serviced. The location of the outside air sensor was not verified but believed to be on the roof of the original structure.

During the site visit it was noted that Class Rooms 1, 2 and 3 experience overheating. These classrooms are in the original part of the school and are heated by fin tube radiation installed along the original exterior walls and controlled by wall mounted thermostats that are intended to open the hot water control valves when there is a call for heat and close the valves when space temperature set point is met. It was noted in Classrooms 1 eight (8) feet of fin tube radiation is now on an interior wall due to the 2001 classroom addition project. The control valve serving that fin tube has failed open and the maintenance staff manually adjusts that balancing valve on that fin tube based on complaints from the teacher whose desk is in front of the heater.

Figure 7: Balancing Valve used for manual control

Figure 8: Failed control valve in hallway ceiling.

Class Room 3 has sixteen (16) feet of fin tube radiation on an interior wall. Although, fin tube radiation on an interior wall is not common if controlled properly over heating should not occur. The cause for the overheating complaint in Class Rooms 2 and 3 was not identified during the site visit.

Classrooms 1, 2 and 3 are heated and ventilated by an H&V unit (HV-1) by Carrier (Model 39LA06) installed on the mezzanine above the original portion of the school. A hot water coil is used to temper the supply air to a minimum 70°F. HV-1 is controlled by a time clock that turns HV-1 on during the school hours 7am to 3:30pm. It was noted during the site visit that HV-1 is manually turned off at 8:30 am because the noise HV-1 delivers to the classrooms is too disruptive. The original intent of HV-1 is to deliver tempered fresh air to the classrooms. To compensate for not operating HV-1 when the classrooms are occupied the maintenance staff manually turns HV-1 on at 5am.

The kitchen area is heated and ventilated by an H&V unit (HV-2) by Carrier (Model 39LA03) installed on the mezzanine above the original portion of the school. A hot water coil is used to temper the supply air. It was noted during the site visit site visit that HV-2 is interlocked with the kitchen hood exhaust fan (EF-1). There were not issues reported with HV-2 or EF-1. However, three floor mounted fans are typically used to combat the excessive heat when the kitchen is in operation.

The Multipurpose Room is heated and ventilated by an H&V unit (HV-3) by Carrier (Model 39LA06) installed on the mezzanine above the original portion of the school. A hot water coil is the source of heat for HV-3. Two issues related to HV-3 were noted during the site visit. The first being the H&V unit has to be turned off during events in the multipurpose room because the noise it makes is disruptive. The second was one of the ceiling supply diffusers was not discharging air. It is believed when the ducts and supply diffusers were cleaned a few years ago the contractors disconnected the flexible supply duct from that diffuser. On a related note it was reported that snow melts on the roof on the multipurpose room in a location approximately above the disconnected supply diffuser. In other words, it appears the lost hot air from HV-3 is melting the snow on the roof.

A heat recovery unit is installed on the mezzanine above the original portion of the building. According to the original construction documents this heat recovery unit serves general building exhaust and provides tempered fresh air to HV-1 and HV-3. Due to the duct work installed in inaccessible areas of the building the actual areas served by the heat recovery unit was not confirmed. Name plate on the heat recovery unit was unable to be determined. Original construction documents specified a 600 CFM supply and exhaust unit by ZDUCT Micro-Z Model MZ1370 with a heat transfer efficiency of 75%.

The 2001 addition added two classroom on the east side of the original building and a classroom and two conference rooms on to the west side of the building. Both areas of the 2001 addition are primarily heated and ventilated by a Greenheck Energy Recovery Units (Model: ERV 361S-A-ES) with dedicated variable volume boxes with hot water coil serving each space. The hot water coils in each variable volume box is controlled by a thermostat located in the space the box serves. Private bathrooms in the 2001 addition are heated by fin tube radiation. It was noted during the site visit the 2001 addition produced no comfort complaints from the teachers and students.

Domestic Hot Water is provided to the sinks in the bathrooms and janitors closest by a coil in one of the boilers. A circulator pump controlled by a time clock serves the DHW loop.

Domestic Hot Water is provided to the kitchen sinks and dish washers by a 50 gallon indirect fired DHW tank located in the kitchen.

It was noted the kitchen DHW tank was believed to maintain a temperature between 130°F and 140°F and the DHW supply temperature at the bathroom faucets were approximately 115°F. Actual measurements were not taken because the boilers were being serviced during the site visit.

Lighting
The school underwent a lighting efficiency upgrade in 2007 that replaced all the T12 lamp fixtures to T8 lamp fixtures throughout the school with exception of the multipurpose room which has T5 lamp fixtures and the classroom bathrooms which have single lamp CFL light fixtures. All interior lighting is controlled manually. The exterior lighting system consists of metal halide wall packs and a pole mounted fixtures controlled on a time clock to turn on 30 minutes before sunset and 30 minutes after sunrise.

Appliances
The Washington Elementary School kitchen has several energy consuming appliances that contribute to the buildings electrical and propane load. Food cooking is primarily done with a propane fired 6 burner range and oven and a small commercial microwave. Two electric food warmers are used when food is served. Cold storage in the kitchen consist of a Commercial side by side refrigerator kept at 38°F, two (2) commercial vertical freezers kept below 0°F, and a reach in freezer. A milk cooler is present but was unplugged during the site visit. The kitchen also has two (2) commercial dishwashers.

Misc Plug loads
The Washington Elementary School has made a conscious effort to purchase energy efficient computers and office equipment. Inspection of the computers and office equipment found an ENERGY STAR label on all of them. In the classroom thirty-five (35) PC's with flat screen monitors were identified along with two (2) SMART Board interactive whiteboard systems. In the main office and teacher's room were two (2) PC's, a commercial copier, a 36 inch flat screen TV and a small refrigerator. Two (2) small servers and a PC operate in an IT closet.

Approximately 300 feet of electric snow melt cabling combats the ice dams that form on the roof edge along the North side of the school.

EPA Portfolio Manager Benchmarking

The Washington Elementary School Utility information was entered into the EPA's ENERGY STAR. Portfolio Manager facility tracking software to benchmark the building's energy use. Portfolio Manager accounts for a buildings climate zone and specific use. It can be used to benchmark a building's energy use over time and track energy reductions occurring from the implementation of energy efficiency measures, both physical improvements and behavioral changes. Three years of information was entered and the building's Source Energy Use Intensity for the twelve months ending September 2011 was

155 Kbtu/SF. The Portfolio Manager Score was 51. Buildings that earn a rating of 75 or higher or buildings that show a 10%, 20%, 30% or higher normalized energy use reduction may be eligible for an ENERGY STAR label or ENERGY STAR Leaders Recognition.

Table 5: Summary of Energy Performance

Summary of Energy Performance for Washington Elementary School			
Washington Elementary School		National Median for other K-12 Schools	
Energy Intensity	KBtu/SF	Energy Intensity	KBtu/SF
Source	155	Source	158
Site	90	Site	91

The ENERGY STAR Statement of Performance generated by Portfolio Manager lists the national median Source Energy Intensity of other K-12 schools at 158 Kbtu/SF, and the national median of Site Energy Intensity at 91 Kbtu/SF. Source Intensity accounts for the distribution losses that occur while the energy is being transferred to the final end use location (mostly occurring through electricity transmission), while Site Intensity only accounts for the energy used at the building

The table above indicates that the Washington Elementary School using slightly less energy than the average when compared to other K-12 Schools nationally. More energy use details can be found in The Energy Performance Statement listed in Appendix D.

ENERGY EFFICIENCY MEASURES

Table 1 in the summary section illustrates the potential energy efficiency measures that have been targeted within this report for consideration at Washington Elementary School.

These measures were identified after the site visit and discussion with representatives of the town. Energy efficiency improvement opportunities not identified in this section but merit consideration are discussed at the end of this section as additional considerations.

EEM1: Air Seal Wall to Attic connection on eave ends

During the site visit it was learned the eave end of the school suffered from ice dams. To combat the ice dams approximately 300 feet of heat cabling operates on the front side of the school, which faces North, when the snow is on the roof. Ice dams are typically caused by hot air escaping the building at the wall to roof construction joint causing the snow on the roof to melt and freeze at the eave. Investigation of the exterior wall in the kitchen, which has the heat cabling on the eave, found cold air movement. Figures 9 and 10 below show the IR image and picture of this location.

Based on conversation with the Washington Elementary School on the ice dam problems, review of the original construction documents and the IR images GDS concludes it is critical that a proper air barrier is added to mitigate the ice dam problem on the eaves end. GDS was only able to investigate a small portion of the wall to attic roof connection. GDS recommends performing further investigation of the air sealing issue to assure the proper air sealing solution is applied.

Based on previous air sealing projects GDS recommends adding a minimum of 2" of closed cell spray foam along the entire top of wall to attic connection to provide the lacking air sealing. Based on previous air sealing projects that had pre and post air sealing blower door testing performed GDS conservatively estimates the infiltration rate can be reduced by 150 CFM by air sealing the approximately 300 feet of top of wall to attic connection. Based on recent contractor pricing on similar projects GDS estimates the cost to perform the air sealing at $20 per linear foot. Although it will be an additional cost GDS strongly recommends including blower door test pre and post air sealing to accurately estimate the expected savings from this air sealing project.

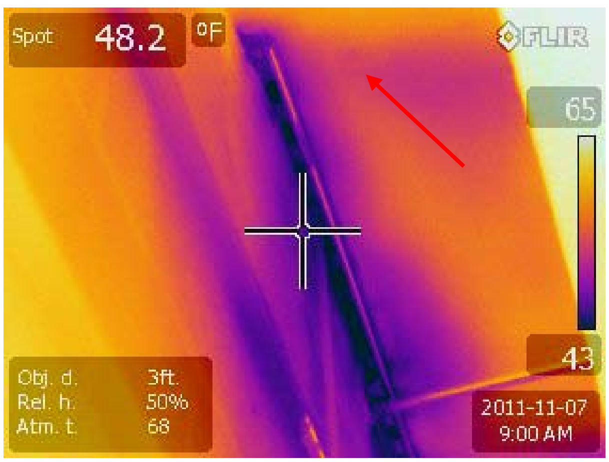


Figure 9: IR image of kitchen exterior wall above suspended ceiling that air movement was present and suffers ice dams occur

Figure 10: Picture of same kitchen exterior wall

EEM2: Replace all door seals

IR imaging of the exterior doors at the Washington Elementary School found the majority of exterior doors in need of new door seals and sweeps, see Figures 11 and 12, below. GDS recommend replacing the door seals and door sweeps on all exterior doors. GDS counted 13 failed door seal and sweeps during the site visit. Based on previous door sealing projects GDS estimates the current average leakage rate can be reduced by 3 CFM per exterior door by installing new door seals and door sweeps. Based on recent contractor pricing on similar projects GDS estimates the cost to install new door seals and sweeps at $75 per door.

Figure 11: IR image of Multipurpose Room exterior door

Figure 12: Picture of Multipurpose Room exterior door

EEM3: Retro Commission HVAC system

During the site visit the staff at the school identified several HVAC system performance issues. These issues include over heating the class rooms in the original portion of the building due to failed control valves, excessive noise in the air handlers that serve the classrooms in the original portion of the building and the multipurpose room and lack of air flow from some supply diffusers which indicates the system may be in need of re-balancing. GDS recommends Retro Commissioning (aka Existing Building Commissioning) the HVAC system. Retro Commissioning is "a process that seeks to improve how building equipment and systems function together".[2] Performing retro-commissioning of the energy management system typically provides energy savings opportunities by confirming the lighting, hot water heating and HVAC system operational schedules and set point are optimized.

It is recommended existing building commissioning (e.g. Retro-commissioning) on the HVAC system be performed at the school to identify system components that are in need of repair or replacement and rebalance the HVAC system to assure it serves the current need of the spaces it serves. This recommendation is based on a 2009 Research project by Lawrence Berkley National Lab that found virtually all retro commission projects were cost-effective with average payback of less than 2 years. GDS has professional relationships with several local commissioning providers and can provide their contact information if the school board wishes to include them in an RFP for retro-commissioning the Washington School.

EEM4: Lighting Controls upgrade

The lighting systems are controlled by manual wall switches. Although the occupants may intend to turn the lights off when the space is not occupied several studies have found adding automatic lighting controls provides attractive savings. GDS recommends adding occupancy sensors to all classrooms, bathrooms, conference rooms, the teacher's room and the main office. GDS estimated that twenty-four (24) occupancy sensors should be added to the spaces mentioned above. Some spaces, like the Multipurpose Room, would require multiple sensors, while others would only require a single sensor. However if the school determines that there are additional areas that could turn off lights automatically when no one is in the space, it is recommended to install additional sensors, as they have a 5 year or less payback normally, unless they are located in closets or storage areas in which case it is not recommended.

Green House Gas Emission Reductions

Implementation of the EEM's discussed above will result in using less energy, which in turn results in reduced emissions of greenhouse gases. Greenhouse gases are produced by the combustion of fossil fuels[3] and when emitted, reside in the atmosphere contributing to global climate change. The table below summarizes the estimated reductions of Carbon Dioxide equivalent (CO_2E). Carbon dioxide equivalent is the form in which greenhouse gases are reported in formal protocols and is an aggregation of the level of emitted carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O)) multiplied by their respective global warming potential factors[4]

Table 6: Greenhouse Gas Emission Reductions for the Washington Elementary School

Energy Efficiency Measure	CO_2 (lb/yr)	CH_4 (lb/yr)	N_20 (lb/yr)	CO_2E (lb/yr)
Measure Description				
EEM1: Air Seal Attic to Wall connection on the eave sides of the building	5,001	0.3	0.0	5,021
EEM2: Replace all exterior door seals	636	0.0	0.0	636
EEM3: Retro-Commission HVAC System	7,905	0.4	0.1	7,937
EEM4: Upgrade Lighting controls - Occupancy Sensors	5,383	0.5	0.1	5,420
	18,925	**1**	**0**	**19,015**

[2] Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions, Evan Mills, Ph.D., LBNL, Report Prepared for: CEC and PIER; July 21, 2009.

[3] Both from stationary combustion (i.e. boilers, unit heaters) and from the generation of electricity

[4] Emission and global warming potential factors are from the Climate Registry's *General Reporting Protocol* available at: http://www.theclimateregistry.org/downloads/GRP.pdf

Renewable Energy Consideration

Table 7 on the following page provides a brief discussion of the feasibility of specific renewable energy measures that may be considered for implementation at the Washington Elementary School. The table was taken from a report by AES (Acadia Engineers and Constructors) and adapted by GDS for the Washington Elementary School. For each renewable energy system a brief description of key system attributes is provided as well as a description of feasibility at the location. Further engineering analysis would be required if the Washington Elementary School wanted to pursue any of the following renewable energy considerations in the future.

Table 7: Renewable Energy Considerations

Renewable Energy System	System Description & Site Feasibility
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.
	Site Feasibility: After internal conversations it was determined that the Washington Elementary School is not a good fit for a biomass system. The lack of a dedicated maintenance person to feed the furnace and remove the ash makes this type of maintenance intensive heating system not feasible for a building that typically has very few occupants that must be ready to leave on emergency calls at immediate notice.
Geothermal Heating and 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 pumps which require electrical energy. Geothermal systems are a proven and acceptable technology in the New England region. Site constraints and building HVAC characteristics define the practicality.
	Site Feasibility: Washington Elementary School would not be a good fit for Geothermal Heating and Cooling. They do not currently cool and the cost of retorfitting the building to geothermal would outweigh the benefits.
Solar Photovoltaic System	**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. Collector arrays can be rooftop or ground mounted. For maximum efficiency there should be ample, unobstructed room on the south facing roof of the building. The two main types of solar panals are crystalline and thin film systems. Solar PV is a good fit when there is demand during the summer for electric cooling. The capital investment cost for PV systems is high (about $4,000-$5,000 installed cost per KW) but the technology is becoming increasingly more efficient thereby lowering initial costs.
	Site Feasibility: Solar PV is not recommended for the Washington Elementary School. Current electric loads are very low and they do not Air Condition during the summer. They also do not have a good Southern exposure.

Renewable Energy System	System Description & Site Feasibility
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 hot 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, especailly facilites with high daytime DHW loads.
	Site Feasibility: Based on the moderate demand for DHW at the Washington Elementary School a Solar Domestic Hot Water system is not recommended.
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 technological constraints include local variability of wind patterns and velocity. Additionally, WTGs require permitting 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.
	Site Feasibility: The site location is near the 1,500 feet above sea level threshold at which wind turbines can be sustainable but due to the residential neighbor the school is located in GDS does not recommend pursing a wind turbine at the Washington Elementary School.
Combined Heat and 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 large LPG tank must be sited. CHP systems are practical for buildings that have year round heating loads .
	Site Feasibility: The Washington Elementary School does not have a year round heating load and the facility is not well suited for a CHP system. There is low demand for both electricity and Domestic Hot Water.

Additional Considerations

A few potential energy reduction measures were identified during the site survey and in conversations with the Washington Elementary School Representatives. This section briefly discusses the additional considerations. The Washington Elementary School may choose to evaluate the potential measure in further detail.

1) **Repair and replace damaged attic insulation and air seal penetrations:**
   Inspection of the accessible portion of the attic spaces above the school found some fiberglass batt insulation in need of repair and what appears to be inadequate air sealing of all penetrations. This includes the fiberglass insulation in both the ceiling and in the kneewall that separates the mechanical room on the mezzanine from the attic. We recommend air sealing all accessible penetrations, repairing the batt insulation, and ideally adding additional insulation in the attic. The air sealing of penetrations in the ceiling should occur **prior** to repairing or adding additional insulation. Additional cellulose insulation can be blown in directly over the current fiberglass batts. Additional inches of blown in cellulose may be required in spots where fiberglass batts are missing. Typically air sealing, repairing insulation and adding additional insulation can be performed by maintenance staff or volunteers and provide an immediate payback.

Figure 13: Knee wall insulation in need of repair

Figure 14: Cellulose insulation over original portion of school.

2) **Repair and replace hot water pipe insulation:**
   Inspection of the hot water heating system identified several areas where pipe insulation was lacking. We recommend adding proper insulation to all exposed heating piping. This includes the exposed piping in above the acoustical ceiling but below the attic. Typically adding pipe insulation can be performed by maintenance staff or volunteers and provide an quck payback.

Figure 15: Lacking pipe insulation above corridor

Figure 16: Lacking pipe insulation behind boilers

3) **Replace boilers with condensing boilers:**
The installed hot water boilers are non-condensing type boilers. Condensing boilers provide superior energy efficiency over non-condensing boilers. Typically converting to condensing boiler provides a simple payback between 5-10 years. We recommend analyzing the impact of converting to a condensing boiler system after the heating system has been retro-commissioned, as described in EEM-3, and the baseline propane consumption of the building has been re-established. By doing this the expected savings can be more accurately estimated.

4) **Add instantaneous water heaters for bath rooms and kitchen:**

Instantaneous or On Demand water heaters are a greater initial expense, but because they only heat up the water when it is required and you will not need to run the boilers when the building doesn't require heat, they save money will reduce propane consumption. We suggest monitoring hot water usage to better gauge your current demand. There are on-line calculators to estimate your savings by switching to an on demand water heater. Placement and future changes to the DHW load of the building should be considered before purchasing an on demand unit. The unit must be located relatively close to the points of demand (i.e. the sink or dishwasher that will be using the hot water). Special consideration should be given to required water supply temperature if an instantaneous water heater is installed in the kitchen.

ENERGY EFFICIENCY INCENTIVES 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

Further energy efficiency program information can be found on the websites of Public Service of New Hampshire, New Hampshire Office of Energy and Planning and NH Saves:

New Hampshire Public Utilities Commission (Statewide)

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. For more information, visit http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html, or contact Kate Epsen at (603) 271-6018 or kate.epsen@puh.nh.gov.

Public Services of New Hampshire (Statewide)

Small Business Solutions

The Small Business Energy Solutions program, or "Retrofit" program, is designed for business customers with an average monthly demand of less than 200 kilowatts (kW) and operating aging and inefficient equipment. The energy efficient technologies that are available to replace your current equipment as part of this program include:

- Energy efficient fluorescent ballasts, lamps and fixtures
- Hard-wired and screw-in compact fluorescent systems
- High intensity discharge lighting systems
- Occupancy sensors
- Programmable thermostats
- Refrigeration controls, motors, and economizers.

PSNH offers two options for utilizing the rebates through this program:

1. *PSNH provides a vendor/contractor. This option includes:*
    - Payment up to a maximum of 50% of labor and material costs for installation of identified energy-efficient measures.
    - A lighting or refrigeration analysis at no cost. This analysis identifies opportunities for enhancing the energy efficiency of your business.
    - A qualified energy contractor who provides you with a written proposal outlining the recommended energy-efficient improvements. This proposal will include a detailed explanation of each energy-efficient improvement identified, a review of projected energy and cost savings, and the estimated return on your investment. The contractor will also walk you through the retrofitting process and answer any technical questions you may have. A review by PSNH to ensure that the proposed project is cost-effective and appropriate for your facility.
    - Installation of identified upgrades.
    - A post-installation inspection by PSNH to verify that the equipment was installed and is working, and that the job was done to your satisfaction.

    -
2. *Your preferred contractor performs the installation, which includes:*
    - Prescriptive installations provide you with set rebates per fixture. PSNH performs before and after inspections and reviews equipment proposals to help you maximize energy savings.
    - Custom rebates cover a percentage of your costs for energy efficiency upgrades. To qualify for rebates, custom projects must pass a benefit/cost test. For retrofit projects, the rebates cover either 35% of the installed cost, or the amount required to achieve a 1-year payback (whichever is less).

For more information on this program, visit http://www.psnh.com/SaveEnergyMoney/For-Business/Small-Business-Energy-Solutions.aspx, or call 800-662-7764.

The Municipal Smart Start Program

The Municipal 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-Business/Municipal-Smart-Start-Program.aspx, or contact Catalina Celentano,

PSNH's Seacost Program Representative at celencj@nu.com.

METHODOLOGY FOR ESTIMATING SAVINGS AND COSTS

In order to estimate the savings and costs associated with these energy efficiency measures, GDS relied on standard engineering calculations and equipment manufacturer's published information and energy modeling. Cost estimates were derived using information gathered from previous projects that involved similar energy efficient equipment, HVAC contractors, budget estimates and quotes from manufacturers and their websites.

Savings estimates were developed using standard engineering calculations which were then calibrated, as appropriate, to the historical utility data. For heating, lighting, electrical and miscellaneous measures calculations were developed based on site conditions found during the walk-through. The utility costs for 2011 are based on the three year average price paid for electricity on a per kWh basis and for propane on a per gallon basis with those prices broken out as follows: electrical cost was $0.150 per kWh[5]; current propane cost is $1.93[6] per gallon. GDS uses current prices in its savings calculations to be conservative.

While the overall payback value of 3.5 years provides a reasonably accurate reflection of the potential for cost savings by implementing the four measures, there could be changes to this value in the event that costs and savings data become more refined. A more detailed analysis might be necessary before installing these measures or entering into a contract. All paybacks were based on operational assumptions and information presented at our site visits on October 27th, 2011 and email exchanges with the site contact.

[5] $0.150/kWh was calculated as the average over the past three years of billing data given to GDS during the site visit as a combination of all electric costs

[6] $1.93 per gallon was calculated as the average over the past three years of propane billing data given to GDS during the site visit

Appendix A
Photographs



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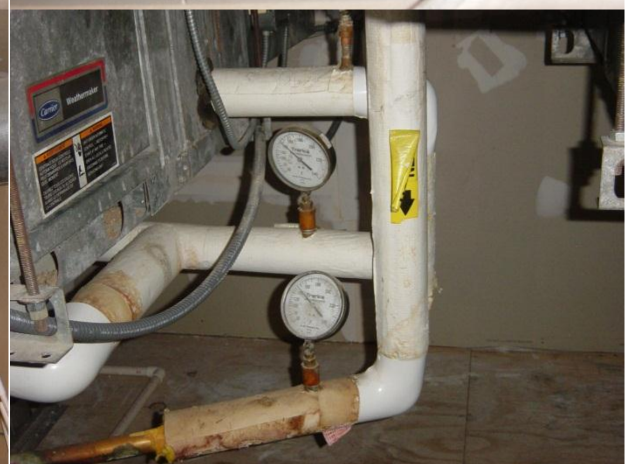


EXIT

Appendix B
Infrared Images


Spot ~ 29.3 °F
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-40
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Rel. h. 50%
Atm. t. 68
2011-11-07
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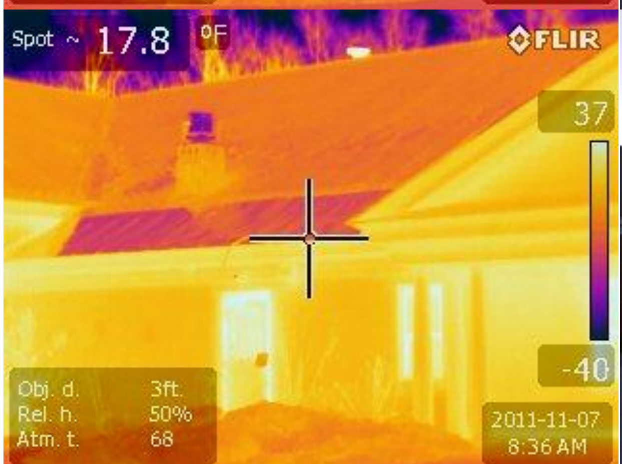
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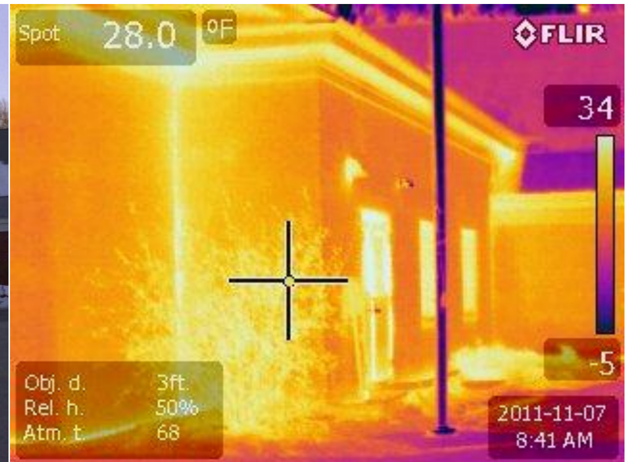
FLIR
37
-40
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
8:36 AM


Spot 35.8 °F
FLIR
38
23
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
8:40 AM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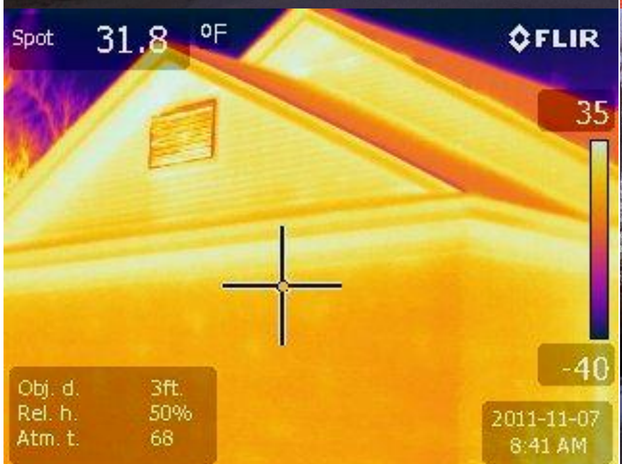
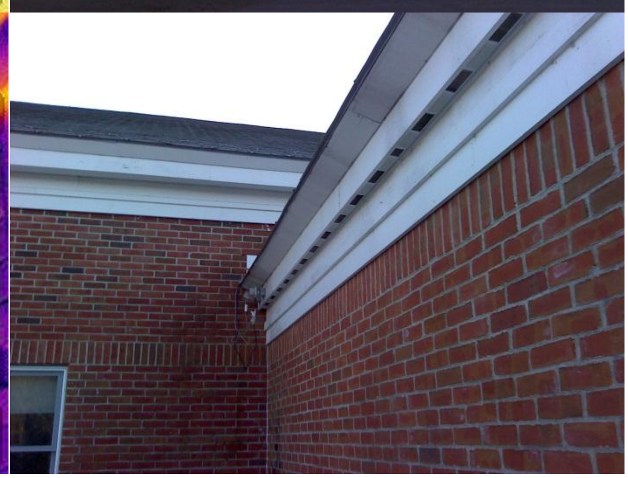
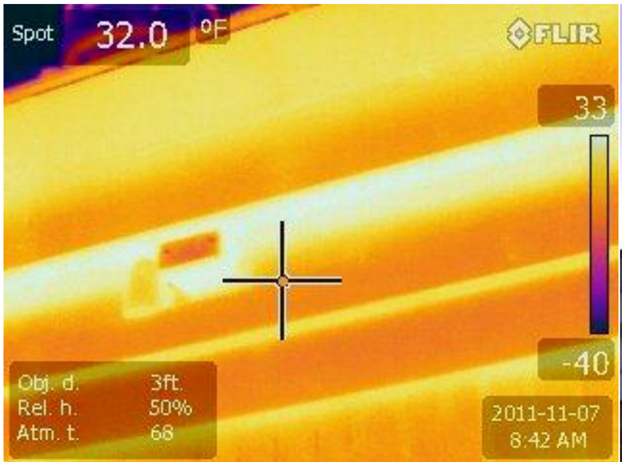
FLIR
34
-5
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
8:41 AM


Spot 31.8 °F
FLIR
35
-40
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
8:41 AM


Spot 30.7 °F
FLIR
33
25
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
8:42 AM

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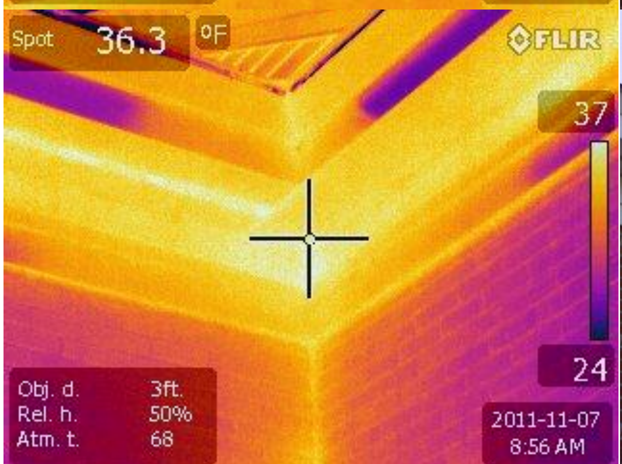
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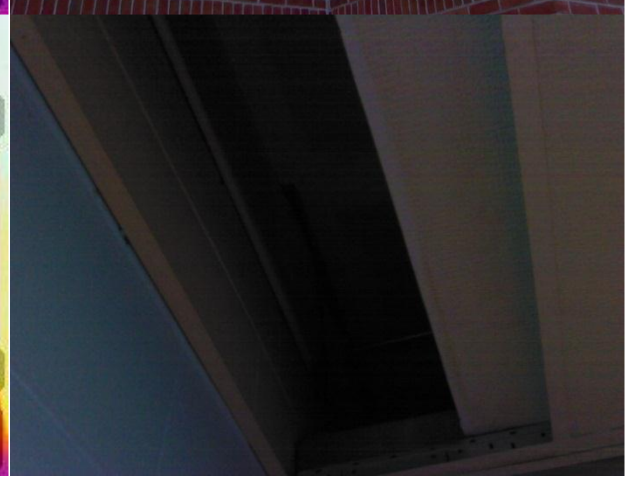


Spot 58.6 °F
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58
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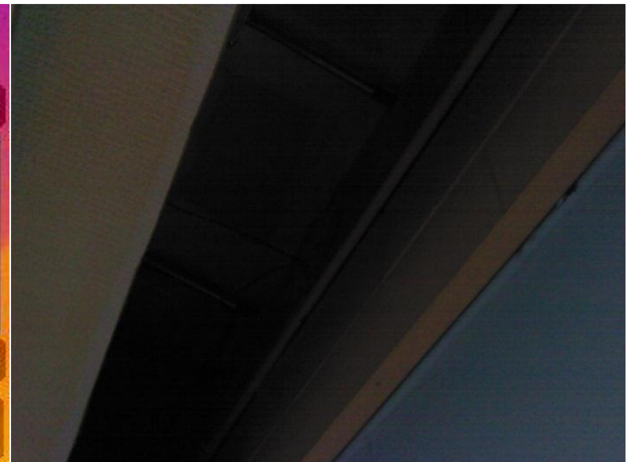


Spot 51.6 °F
FLIR
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Atm. t. 68
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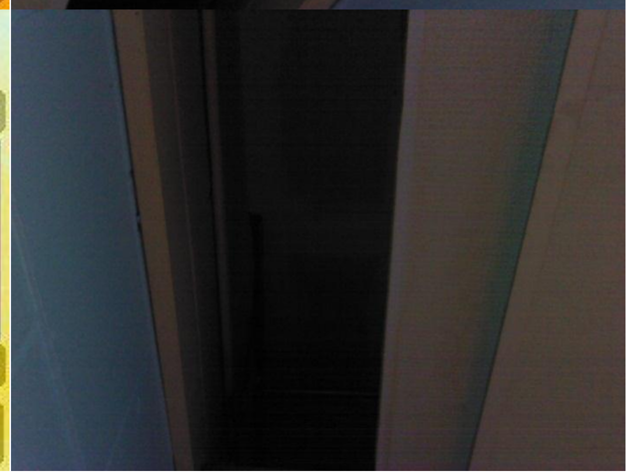

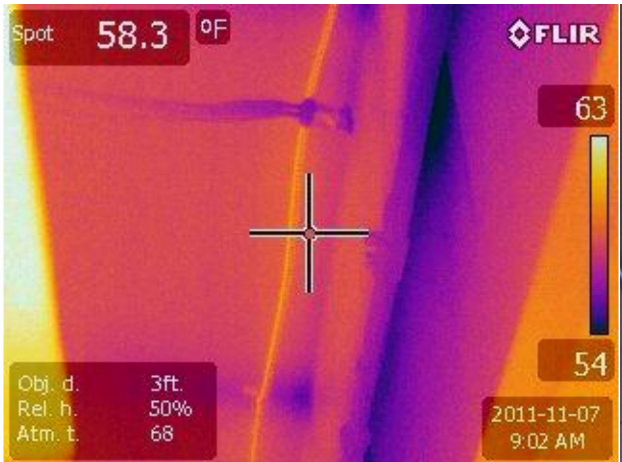
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FLIR
63
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2011-11-07
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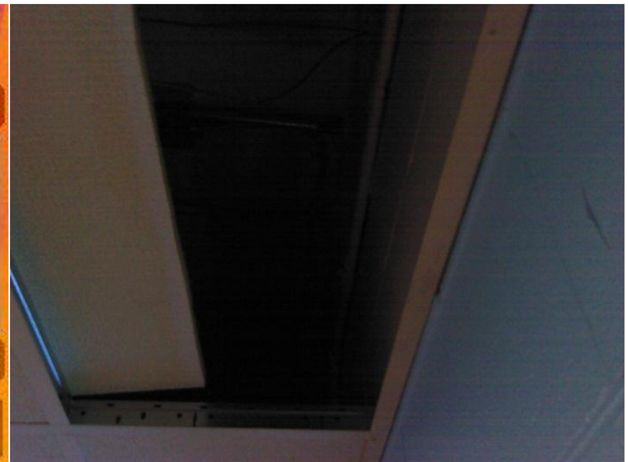


Spot 52.3 °F
FLIR
58
42
Obj. d. 3ft.
Rel. h. 50%
Atm. t. 68
2011-11-07
9:03 AM


Appendix C
Lighting Inventory

Washington Elementary School

Lighting Inventory						
Location	**Fixture Description**	**# of Fixs.**	**W/Fix. (Def.)**	**Controls**	**Oper. Hrs (Def.)**	**Act. Oper. Hrs. (if diff)**
Main Office	Fluorescent, three lamp, four foot, T8	4	83	Manual Switch	7am to 5pm	10
Conference Room 1	Fluorescent, three lamp, four foot, T8	4	83	Manual Switch	8am to 4pm	8
Conference Room 2	Fluorescent, three lamp, four foot, T8	4	83	Manual Switch	8am to 4pm	8
Kindergarten	Fluorescent, three lamp, four foot, T8	15	83	Manual Switch	8am to 4pm	8
Kindergarten - Bathroom	CFL, 23 W (estimated)	1	23	Manual Switch	8am to 4pm	8
Class 1	Fluorescent, three lamp, four foot, T8	9	83	Manual Switch	8am to 4pm	8
Class 1 - Pvt Room	Fluorescent, three lamp, four foot, T8	2	83	Manual Switch	8am to 4pm	8
Class 1 - Bathroom	CFL, 23 W (estimated)	1	23	Manual Switch	8am to 4pm	8
Class 2	Fluorescent, three lamp, four foot, T8	9	83	Manual Switch	8am to 4pm	8
Class 2 - Pvt Room	Fluorescent, three lamp, four foot, T8	2	83	Manual Switch	8am to 4pm	8
Class 2 - Bathroom	CFL, 23 W (estimated)	1	23	Manual Switch	8am to 4pm	8
Class 3	Fluorescent, three lamp, four foot, T8	9	83	Manual Switch	8am to 4pm	8
Class 4	Fluorescent, three lamp, four foot, T8	9	83	Manual Switch	8am to 4pm	8
Class 4 - Pvt Room	Fluorescent, three lamp, four foot, T8	3	83	Manual Switch	8am to 4pm	8
Class 4 - Bathroom	CFL, 23 W (estimated)	1	23	Manual Switch	8am to 4pm	8
Class 5	Fluorescent, three lamp, four foot, T8	9	83	Manual Switch	8am to 4pm	8
Class 5 - Pvt Room	Fluorescent, three lamp, four foot, T8	3	83	Manual Switch	8am to 4pm	8
Class 5 - Bathroom	CFL, 23 W (estimated)	1	23	Manual Switch	8am to 4pm	8
Boys Bathroom	Fluorescent, two lamp, four foot, T8	1	56	Manual Switch	8am to 4pm	8
Girls Bathroom	Fluorescent, two lamp, four foot, T8	1	56	Manual Switch	8am to 4pm	8
Multipurpose Room	Fluorescent, three lamp, four foot, T5	20	83	Manual Switch	8am to 4pm	8
Kitchen	Fluorescent, three lamp, four foot, T8	5	83	Manual Switch	9am to 3pm	6
Teachers Room	Fluorescent, three lamp, four foot, T8	3	83	Manual Switch	7am to 5pm	10
Corridors	Fluorescent, two lamp, four foot, T8	12	56	Manual Switch	7am to 5pm	10

Washington Elementary School

EEM4: Lighting Controls - Occupancy Sensors

Location	Weekly Hours of Use	Annual Hours of Use	Total # of Fixtures	# of Sensors Needed	Lamp Type to be Controlled (Sensor Type)	Annual kWh	Annual Cost	Sensor Labor Cost	Sensor Materials Cost	Total Cost	Savings Factor	Annual kWh Savings	Annual Cost Savings	Simple Payback
Main Office	50	2,500	4	0	Fluorescent, three lamp, four foot, T8	830	$124	$0	$0	$0	0%	0	$0	**N/A**
Conference Room 1	40	1,520	4	1	Fluorescent, three lamp, four foot, T8	505	$76	$100	$100	$200	35%	177	$26	**7.6**
Conference Room 2	40	1,520	4	1	Fluorescent, three lamp, four foot, T8	505	$76	$100	$100	$200	35%	177	$26	**7.6**
Kindergarten	40	1,520	15	1	Fluorescent, three lamp, four foot, T8	1,892	$283	$100	$100	$200	40%	757	$113	**1.8**
Kindergarten - Bathroom	40	1,520	1	1	CFL, 23 W (estimated)	35	$5	$100	$100	$200	40%	14	$2	**95.5**
Class 1	40	1,520	9	1	Fluorescent, three lamp, four foot, T8	1,135	$170	$100	$100	$200	40%	454	$68	**2.9**
Class 1 - Pvt Room	40	1,520	2	1	Fluorescent, three lamp, four foot, T8	252	$38	$100	$100	$200	40%	101	$15	**13.2**
Class 1 - Bathroom	40	1,520	1	1	CFL, 23 W (estimated)	35	$5	$100	$100	$200	40%	14	$2	**95.5**
Class 2	40	1,520	9	1	Fluorescent, three lamp, four foot, T8	1,135	$170	$100	$100	$200	40%	454	$68	**2.9**
Class 2 - Pvt Room	40	1,520	2	1	Fluorescent, three lamp, four foot, T8	252	$38	$100	$100	$200	40%	101	$15	**13.2**
Class 2 - Bathroom	40	1,520	1	1	CFL, 23 W (estimated)	35	$5	$100	$100	$200	40%	14	$2	**95.5**
Class 3	40	1,520	9	1	Fluorescent, three lamp, four foot, T8	1,135	$170	$100	$100	$200	40%	454	$68	**2.9**
Class 4	40	1,520	9	1	Fluorescent, three lamp, four foot, T8	1,135	$170	$100	$100	$200	40%	454	$68	**2.9**
Class 4 - Pvt Room	40	1,520	3	1	Fluorescent, three lamp, four foot, T8	378	$57	$100	$100	$200	40%	151	$23	**8.8**
Class 4 - Bathroom	40	1,520	1	1	CFL, 23 W (estimated)	35	$5	$100	$100	$200	40%	14	$2	**95.5**
Class 5	40	1,520	9	1	Fluorescent, three lamp, four foot, T8	1,135	$170	$100	$100	$200	40%	454	$68	**2.9**
Class 5 - Pvt Room	40	1,520	3	1	Fluorescent, three lamp, four foot, T8	378	$57	$100	$100	$200	40%	151	$23	**8.8**
Class 5 - Bathroom	40	1,520	1	1	CFL, 23 W (estimated)	35	$5	$100	$100	$200	40%	14	$2	**95.5**
Boys Bathroom	40	1,520	1	1	Fluorescent, two lamp, four foot, T8	85	$13	$100	$100	$200	40%	34	$5	**39.2**
Girls Bathroom	40	1,520	1	1	Fluorescent, two lamp, four foot, T8	85	$13	$100	$100	$200	40%	34	$5	**39.2**
Multipurpose Room	40	1,520	20	4	Fluorescent, three lamp, four foot, T5	2,523	$378	$400	$400	$800	40%	1009	$151	**5.3**
Kitchen	30	1,140	5	0	Fluorescent, three lamp, four foot, T8	473	$71	$0	$0	$0	40%	189	$28	**0.0**
Teachers Room	50	1,900	3	1	Fluorescent, three lamp, four foot, T8	473	$71	$100	$100	$200	40%	189	$28	**7.1**
Corridors	50	1,900	12	0	Fluorescent, two lamp, four foot, T8	1,277	$191	$0	$0	$0	40%	511	$77	**0.0**
									Totals	**$4,800**		**5,922**	**$887**	**5.4**

Appendix D
ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Washington Elementary School

Building ID: 2427452
For 12-month Period Ending: June 30, 2011[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: December 05, 2011

Facility
Washington Elementary School
337 Millen Pond Road
Washington, NH 03280

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1997
Gross Floor Area (ft^2): 13,240

Energy Performance Rating[2] (1-100) 51

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	369,042
Propane (kBtu)	816,553
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	1,185,595

Energy Intensity[5]	
Site (kBtu/ft^2/yr)	90
Source (kBtu/ft^2/yr)	155

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	93

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

National Median Comparison	
National Median Site EUI	91
National Median Source EUI	158
% 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[6] **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.

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
Washington Elementary School
337 Millen Pond Road
Washington, NH 03280

Facility Owner
N/A

Primary Contact for this Facility
N/A

General Information

Washington Elementary School	
Gross Floor Area Excluding Parking: (ft^2)	13,240
Year Built	1997
For 12-month Evaluation Period Ending Date:	June 30, 2011

Facility Space Use Summary

K-12 School	
Space Type	K-12 School
Gross Floor Area(ft^2)	13,240
Open Weekends?	No
Number of PCs	40
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	Yes
Percent Cooled	20
Percent Heated	100
Months[o]	8
High School?	No
School District[o]	Washington

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 06/30/2011)	**Baseline** (Ending Date 12/31/2010)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	51	47	75	N/A	50
Energy Intensity					
Site (kBtu/ft²)	90	93	71	N/A	91
Source (kBtu/ft²)	155	160	123	N/A	158
Energy Cost					
$/year	$ 33,942.71	$ 30,961.16	$ 26,922.96	N/A	$ 34,431.67
$/ft²/year	$ 2.56	$ 2.34	$ 2.03	N/A	$ 2.60
Greenhouse Gas Emissions					
$MtCO_2e$/year	93	96	74	N/A	94
$kgCO_2e/ft^2$/year	7	7	6	N/A	7

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.

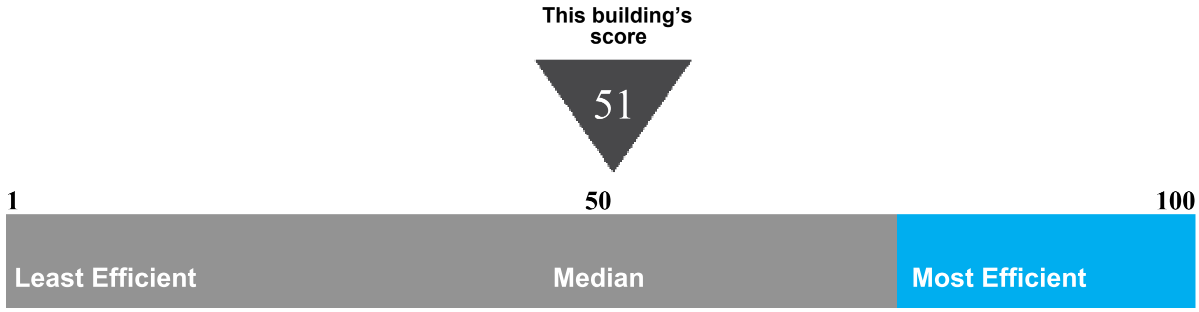
Statement of Energy Performance

2011

Washington Elementary School
337 Millen Pond Road
Washington, NH 03280

Portfolio Manager Building ID: 2427452

The energy use of this building has been measured and compared to other similar buildings using the Environmental Protection Agency's (EPA's) Energy Performance Scale of 1–100, with 1 being the least energy efficient and 100 the most energy efficient. For more information, visit energystar.gov/benchmark.



This building uses 155 kBtu per square foot per year.*

*Based on source energy intensity for the 12 month period ending June 2011

Buildings with a score of 75 or higher may qualify for EPA's ENERGY STAR.

I certify that the information contained within this statement is accurate and in accordance with U.S. Environmental Protection Agency's measurement standards, found at energystar.gov

Date of certification

EPA United States Environmental Protection Agency

Date Generated: 12/05/2011

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	Washington 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	337 Millen Pond Road, Washington, NH 03280	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 (general medical and surgical)) nor can they be submitted as representing only a portion of a building		☐

K-12 School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	13,240 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	40	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	0	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	20 %	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	8(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 Consumption

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

Fuel Type: Electricity

Meter: Electricity (kWh (thousand Watt-hours))
Space(s): K-12 School
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
05/02/2011	06/01/2011	8,840.00
04/02/2011	05/01/2011	9,160.00
03/02/2011	04/01/2011	13,280.00
02/02/2011	03/01/2011	10,880.00
01/02/2011	02/01/2011	12,880.00
12/02/2010	01/01/2011	11,760.00
11/02/2010	12/01/2010	7,520.00
10/02/2010	11/01/2010	7,240.00
09/02/2010	10/01/2010	7,160.00
08/02/2010	09/01/2010	5,780.00
07/02/2010	08/01/2010	5,680.00
Electricity Consumption (kWh (thousand Watt-hours))		**100,180.00**
Electricity Consumption (kBtu (thousand Btu))		**341,814.16**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**341,814.16**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Propane

Meter: Heat (Gallons)
Space(s): K-12 School

Start Date	End Date	Energy Use (Gallons)
06/01/2011	06/30/2011	0.00
05/01/2011	05/31/2011	0.00
04/01/2011	04/30/2011	1,111.90
03/01/2011	03/31/2011	1,125.80
02/01/2011	02/28/2011	1,676.30
01/01/2011	01/31/2011	2,096.40
12/01/2010	12/31/2010	996.30
11/01/2010	11/30/2010	746.00
10/01/2010	10/31/2010	1,157.00
09/01/2010	09/30/2010	0.00
08/01/2010	08/31/2010	0.00

07/01/2010	07/31/2010	0.00
Heat Consumption (Gallons)		**8,909.70**
Heat Consumption (kBtu (thousand Btu))		**816,552.62**
Total Propane Consumption (kBtu (thousand Btu))		**816,552.62**
Is this the total Propane consumption at this building including all Propane 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.