Energy Audit

February 28, 2019

Plaistow Town Hall

145 Main Street
Plaistow, NH

Audit Prepared by

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE
S.E.E.D.S.
SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES
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Introduction

The purpose of an energy audit is to identify energy saving measures (ESM) in a building. Computer simulated and other energy models were developed for this building using multiple strategies and software. The models estimate predicted future energy consumption based on the local climate conditions, physical dimensions and characteristics of a building, mechanical systems, presumed lighting, equipment, and occupancy patterns, in addition to a number of other variables.

With the building modeled in existing conditions, energy savings can be estimated for improvements to the thermal envelope and other improvements. The cost of those measures can then be analyzed in terms of predicted energy saved. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures.

This audit has been prepared with the best of intentions to assist the Town make informed decisions regarding energy related improvements. It is also includes information to determine whether some measures might be eligible for weatherization rebates or lighting incentives from Unitil.

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Executive Summary

The Plaistow Town Hall was built in 1895, replacing a smaller brick Town Hall which had been built on the same site in 1831. Since Plaistow had been home to large clay deposits, leading to 19-20 brick foundries in the mid to end of the 19th century, it is quite possible the bricks for one or both buildings were made in Plaistow. The building has served multiple purposes over the past 124 years, at one time or another housing the Town's library, police station, auditorium with stage, bank, basketball court, and even had three cells as a "jail for tramps" in the 1930's. (History of Plaistow, collected for the 250th anniversary in 1999; excerpt copied on the last page of this report).

Plans for the most recent renovation were developed in 2004, which, among other things, provided elevator access to four levels, created smaller offices and storage spaces, and improved fire protection and suppression systems. The plans were reviewed as part of this study. Some of the notes and line drawings that have informed this assessment and recommendations have been included in this report.

There are four distinct areas which have been explored for energy saving opportunities: Lighting; Envelope; Occupant Habits; and System Controls. The total costs for recommended measures is estimated at $34,267. Estimated annual savings are $4,418 and 138MBTU energy, with a simple payback of 7.8 years. With approval from Unitil for Lighting Incentives, total costs would be $14,485 with a simple payback in 6.6 years.

1. **Lighting:** A proposal for a full conversion to LED lighting has been developed by Energy Management Consultants and is attached at the end of this report. Included in that proposal is the Unitil's application for lighting incentives. If approved, the project cost of $19,595 project cost would be reduced by an estimated $5,110 rebate, leaving a net project cost of $14,485. Total estimated annual savings is $3,074 for a simple payback of less than five years.

2.**Envelope:** Based on a thorough site visit with thermographic scan and the insights offered by the 2004 architect's plans, cost effective improvements include targeted air sealing and insulating above the original tin ceiling. The exterior brick walls act as an effective air barrier, though remain largely uninsulated and represent the greatest component heat loss (refer to pie chart on page 5). The inside of exterior surface temperatures can also contribute to occupant discomfort, yet insulating the walls would require complete removal of the lathe and plaster. Air leakage around windows and gaps in wainscoting are a direct source of occupant discomfort which often inspires the use of electric resistance space heaters. Targeting air sealing around windows and along gaps in wainscoting may therefore result in reduced use of costly space heaters. It should also be noted that without introducing outside air into the ducted distribution system, aggressive air sealing may create noticeable inadequate air exchange.

The estimated costs for the total envelope improvement package is $12,415 with estimated annual savings of $974 and 69.2 MMBTU worth of energy, resulting in a simple payback of 12.7 years. Since the improvements will continue to save energy from current consumption levels far longer than 13 years, the annualized Return on Investment is 2.7% per year for 25 years. Savings are based on 2019 energy prices.

3. **Occupancy.** Occupant habits and behaviors account for a certain amount of any building's energy consumption. Turning off lights when leaving a room (in the absence of occupancy controls) is an example which most people are familiar with and, in some offices, has become a cultural norm.

Unplugging (or shutting off power to a power strip) office equipment eliminates the trickle use of electricity; aka "phantom loads". This includes copiers, printers, screens, coffee makers, microwaves, projection or sound equipment, and battery chargers. In short, any device with a digital display consumes power unless its disconnected from a power source. Potential energy savings have not been included in the cost benefit analysis because it is impossible to predict human behavior. Also there are some devices which cannot be disconnected from a power source for safety or overnight functional purposes. While disconnecting individual devices overnights and weekends would result in small savings, added all up together can be significant. In this case, it would be reasonable to predict a savings of over 5400 kWh a year if *all* digital electric devices were denied of power during the 5800+ hours that the building is unoccupied. That usage is comparable to an average NH home's annual consumption.

4. **System Controls.** Thermostat settings have been programmed to follow typical occupancy patterns and are summarized on page 27 of this report. If any of the five air handlers serve areas which are unoccupied after 4:30PM on weekdays or on weekends, then re-programming winter set backs 60 degrees at those times is recommended. If implemented for the entire building, this could result in additional savings of an estimated 96 therms, or $117 a year.

Precision Temperature Control was engaged for this study to assess the control systems and offer recommendations to improve efficiency. Their one page written report can be found on page 28. Recommendations include installing a DDC (Direct Digital Control) system would allow for remote access viewing and control of individual units to further improve efficiency and replacing water value actuators with modulating motors. No costs or associate savings have been included. They also suggest ERVs for each unit with hydronic coil to provide ventilation to all spaces.

Summary of Energy Saving Measures	Cost of Measure	LG Therms Saved	LP Energy Saved MMBTU	Elec kWh Saved	Elec Energy Saved MMBTU	Annual $ Saved	Simple Payback Years
Interior Air Sealing Package	$2,257	46	4.6	1,845	6.3	$370	6.1
Ceiling Boundary	$12,415	657	65.7	1,015	3.5	$974	12.7
LED Lighting Conversion	$19,595	-	-	17,142	58.5	$3,074	6.4
	$34,267	703	70.3	20,002	68.2	$4,418	7.8

Historic Energy Use Analysis

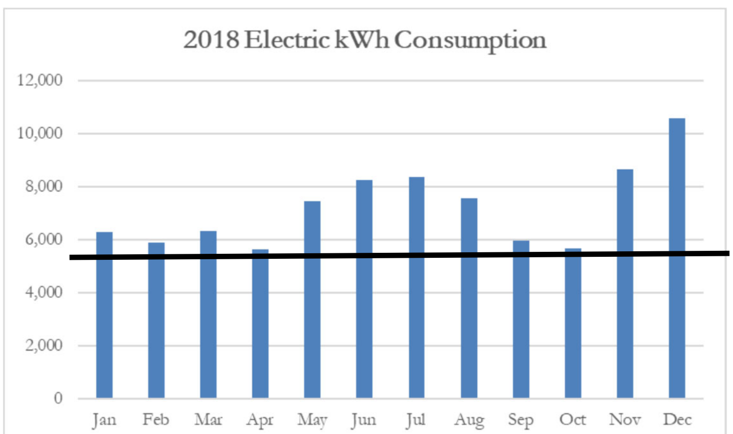
The energy analysis below is based on 2018 energy data provided for natural gas and electricity.

Energy & Unit	Units	Site MMBTUS	Source MMBTUS	Cost
Natural Gas - Therms	5,055	505.5	581.3	$6,367
Electric -kWh	86,517	295.2	982.9	$13,296
		800.7	1,564.2	$19,663
EUI KBtu/FT2	7774	103.0	201.2	$2.53

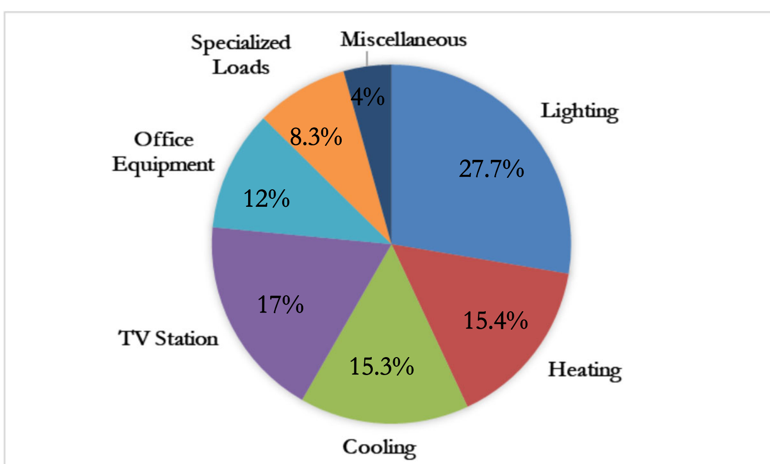
The Energy Utilization Index (EUI) offers a simple snapshot analysis of a building's energy use by looking at total amount of energy input (converted to Btu's) divided by the floor area of conditioned space. "Site Energy" refers to units of energy delivered to a site. Source energy includes transmission and total raw energy the building requires.

Based on the information provided, the Town Hall's Site EUI is 103.0 KBtu/ft2; Source Energy EUI is 201.2 KBtu/FT2. Annual energy costs—calculated in some cases from rates available—is expected to be $2.53 per sq ft in 2019 energy prices.

"Base Load" ie monthly electric loads not associated with seasonal space conditioning, is presumed to be an estimated 5000kWh.



The pie chart offers an estimated break down of kWh end uses. Specialized uses include the server and other equipment in the basement.



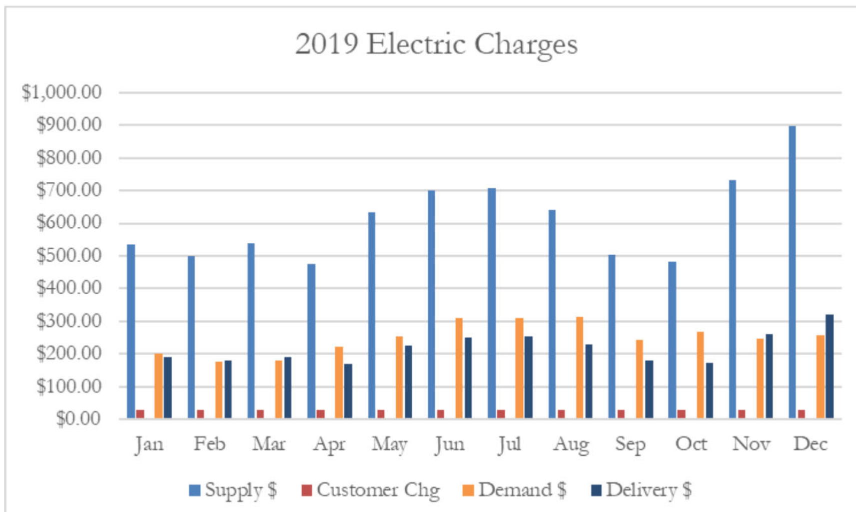
Breakdown of monthly electric charges

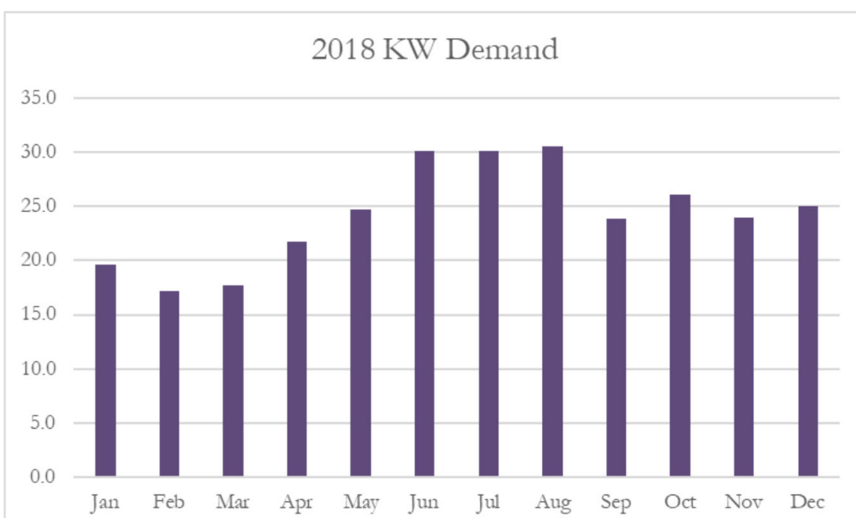
The chart to the right presents monthly charges for 2018. Unitil provides the Town with both supply and delivery services.

Demand charges reflect the cost for the Utility to be able to meet peak demand for all its customers at any time of the year. Historically in NH, peak demand has occurred in the summer (August 8th, for example) due to air conditioning loads. The monthly charge ($10.24 per KW) is based on the highest demand for each customer in that billing period, so managing loads as possible can also impact dollar savings.

For example, energy savings from converting to LED lighting will not only reduce kWh totals each month, but will also slightly reduce the peak demand for any given day—and therefore the highest KW demand for any one month.

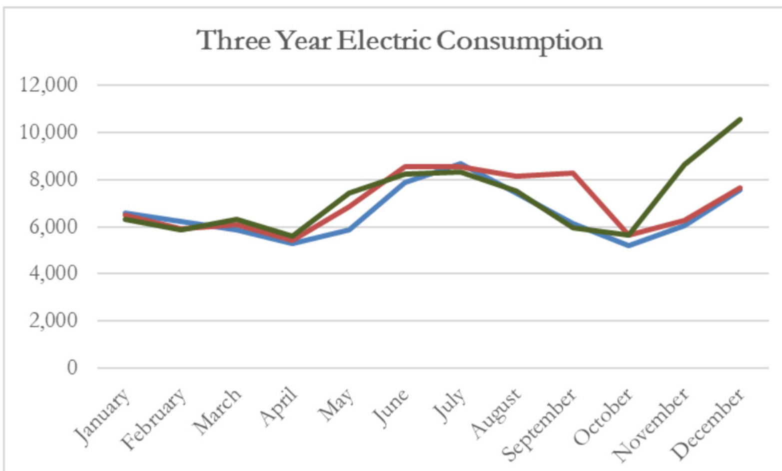
Month	Demand KW	Usage KWh	$0.0849 Supply	Monthly Charge	Total Delivery	Total Costs
Jan	19.6	6,294	$534.36	$29.02	$391.60	$954.98
Feb	17.2	5,884	$499.55	$29.02	$354.59	$883.16
Mar	17.7	6,327	$537.16	$29.02	$373.15	$939.33
Apr	21.8	5,619	$477.05	$29.02	$393.14	$899.22
May	24.7	7,451	$632.59	$29.02	$479.12	$1,140.73
Jun	30.2	8,248	$700.26	$29.02	$559.00	$1,288.28
Jul	30.2	8,348	$708.75	$29.02	$562.03	$1,299.80
Aug	30.6	7,543	$640.40	$29.02	$541.92	$1,211.34
Sep	23.9	5,940	$504.31	$29.02	$424.59	$957.92
Oct	26.1	5,663	$480.79	$29.02	$468.04	$948.83
Nov	24	8,640	$733.54	$29.02	$536.83	$1,270.37
Dec	25	10,560	$896.54	$29.02	$605.30	$1,501.85
		86,517	$7,345	$348	$5,689	$13,296

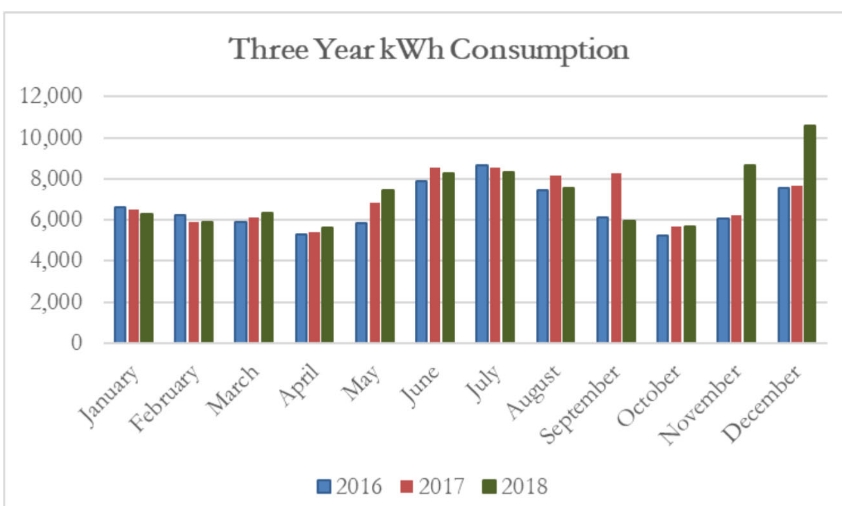




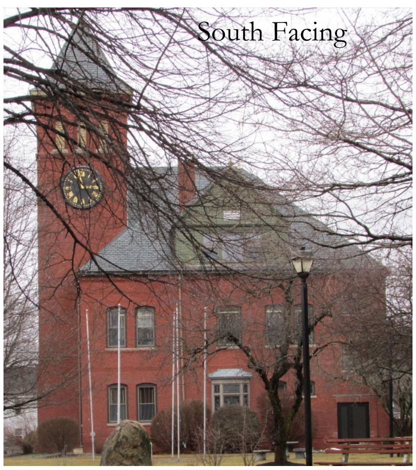
A three year history shows a nearly identical monthly pattern with a significant increase for December 2018.

Month	2016	2017	2018
January	6,606	6,512	6,294
February	6,214	5,905	5,884
March	5,887	6,094	6,327
April	5,274	5,412	5,619
May	5,871	6,861	7,451
June	7,866	8,548	8,248
July	8,670	8,554	8,348
August	7,417	8,153	7,543
September	6,124	8,278	5,940
October	5,221	5,655	5,663
November	6,066	6,255	8,640
December	7,550	7,662	10,560
Totals	78,766	83,889	86,517





West Facing



South Facing

East Facing

North

The Thermal Envelope Overview

The thermal envelope represents the assembly of materials which separate inside conditioned space with outside and unconditioned areas. Layer(s) of insulation typically define the location of the 'thermal barrier' but other materials are included in the assembly often provide important air and vapor control.

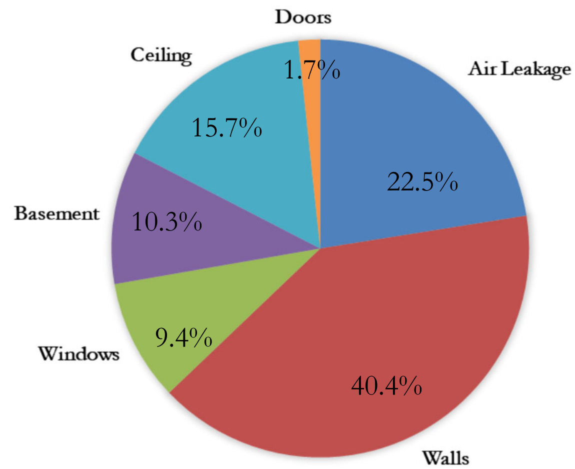
The presence, or absence, of a continuous air barrier has a significant impact on the thermal performance of the insulation—especially low density 'filter' materials like fiberglass. In reality, the air barrier is also the most important vapor control mechanism.

The pie chart shows estimated 'responsibility' for envelope heat losses. Note that air leakage isn't a single component but represents the transitions or cracks and gaps, between materials in each of the other components.

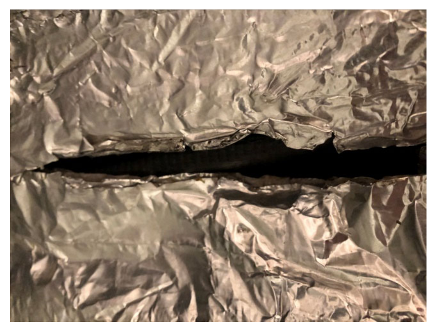
Beyond targeted air sealing, the next best opportunity involves redefining the thermal boundary above the original tin sealing—thereby 1) bringing heating system equipment into the thermal envelope and 2) replacing fiberglass with continuous air and insulation barriers at the ceiling plane.

Mechanical systems also play a role in energy consumption in the Town Hall, as in most commercial buildings. However the sheer surface area of uninsulated brick walls poses the single greatest 'heating load' component.

The five air handlers and related ductwork appears well installed and insulated, though rips and gaps are also evident and worth tape sealing.



Percentages reflect comparative conductive heat losses to the outside through the shell or thermal envelope only. Losses—or responsibility for energy consumption—from the heating and distribution equipment are not included. Windows, doors, and the ceiling plane, all share responsibility for air leakage.

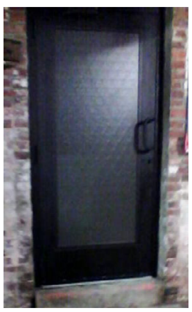


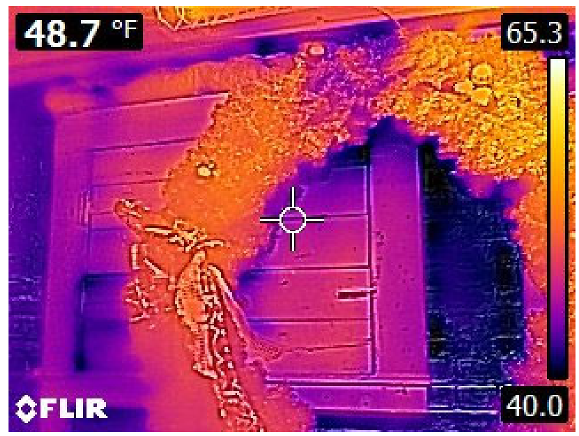
Based on the site visit, the primary upgrade to the envelope is to move the thermal barrier from above the suspended ceiling to above the tin ceiling. Suspended ceiling tiles do not stop air. Without a continuous air barrier, fiberglass batts perform poorly as insulation. The cost of establishing a floor structure for insulation above the tiles (as recommended for the library) would be far greater than moving the barrier to the original tin ceiling: a material which does stop air if all seams and transitions to other materials are air sealed. Another advantage to moving this plane is to bring the hot water pipes, air handlers, and duct work "within the thermal boundary". At that time, it may be prudent to remove the fiberglass to prevent trapping heat in the attic area above the Great Hall.

Air Sealing Package

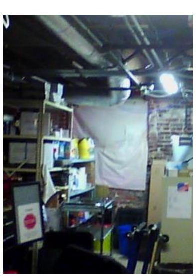
Targeted Air Sealing	Total Cost	Annual Savings	Simple Payback Years	Life of Measure	Invest-ment Gain	ROI	Annual ized ROI
Basement Windows & Door	$72						
Wainscoting	$750						
Window Weather stripping	$1,435						
Total	$2,257	$370	6.1	25	$6,993	310%	5.8%

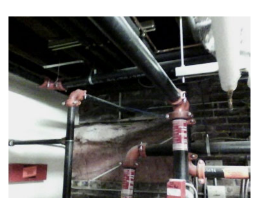
Install commercial grade weather stripping at door.



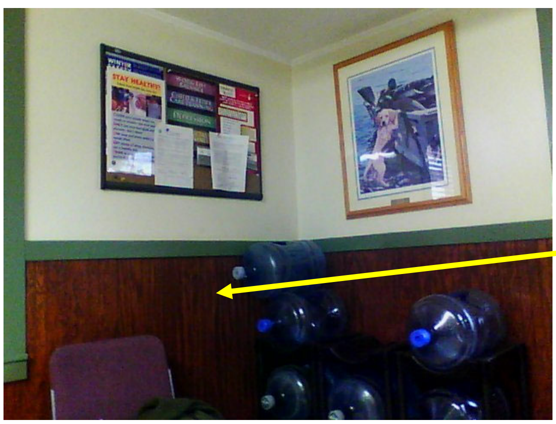


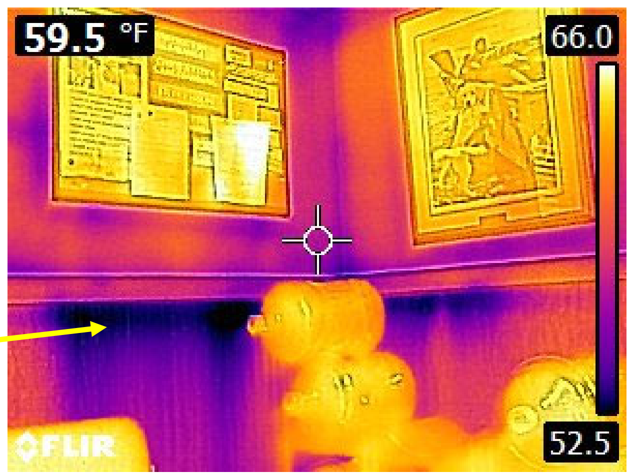
Air sealing basement windows requires installing solid materials in window openings, leaving a 1/4 to 1/2" gap around the perimeter for a silicone or foam sealant to expand and fill that gap.

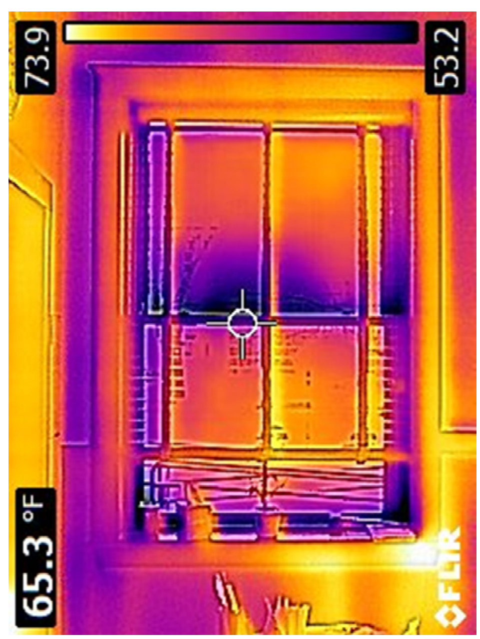




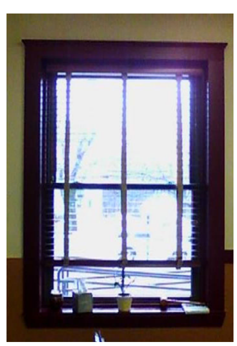
Air leakage through the edges of rough window openings and sashes account for and keeping conditioned air up near the ceiling—both causing discomfort. Coolth also 'leaks' through wainscoting and where the plaster (an air barrier) meets wood. Removing the trip and applying a bead of silicone sealant at that seam can effectively improve comfort.



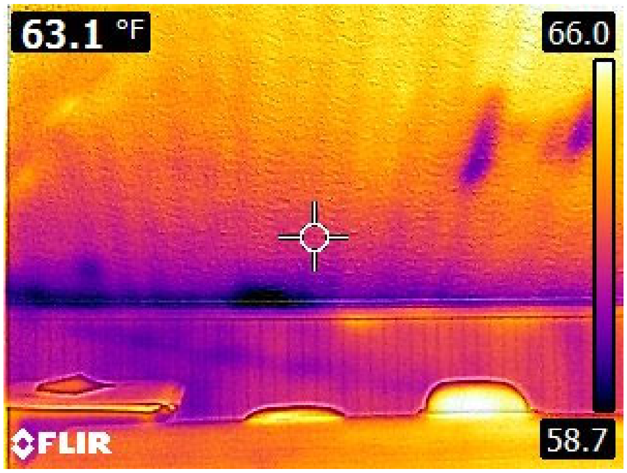


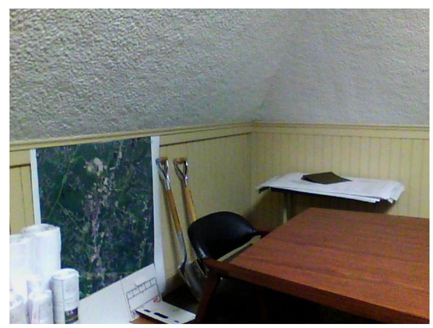


Professional weather-stripping tends to last longer than DYI projects, yet still may have to be replaced every few years depending on how often the window is opened and closed.

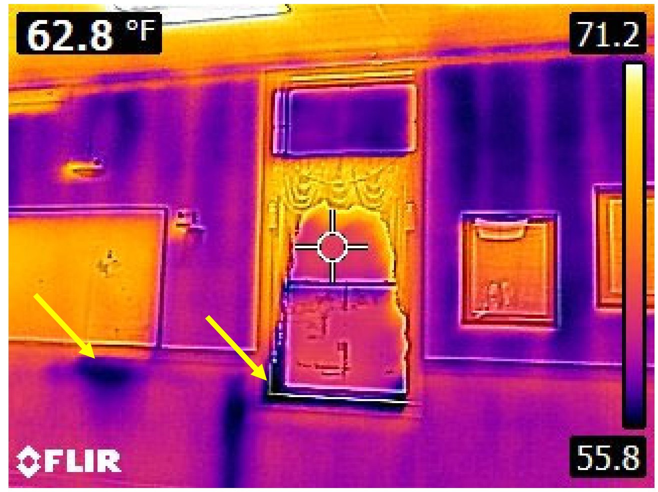


3rd Floor

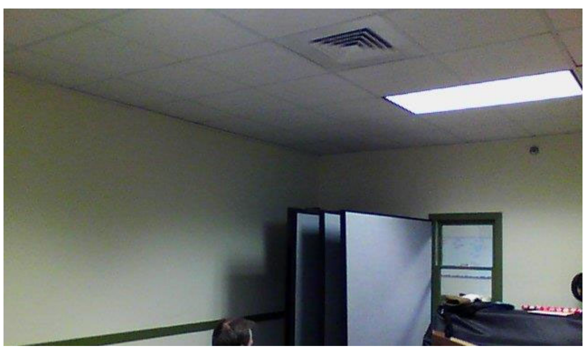




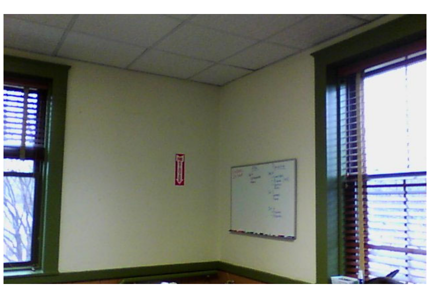
2nd Floor



Glazing and air infiltration are the main reasons why the surfaces areas of the middle office (former stage) is nearly 8 degrees warmer than the east office, with two windows.

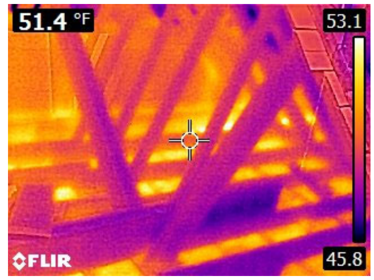


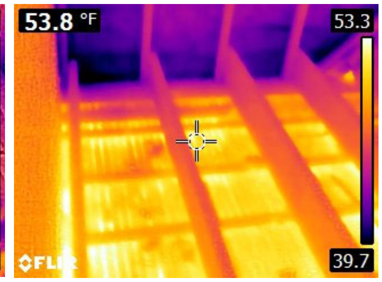
Note the surface temperature of the wall at head height when sitting is in the low 60's. A person's body heat radiates to cooler surfaces and can be a source of discomfort; hence the use of electric space heaters.



The small office below this northeast office is heated by electric resistance baseboard only, but is used so infrequently, ducting more efficient heating is not cost effective. Air sealing the window, and the window in the adjoining storage area is recommended.

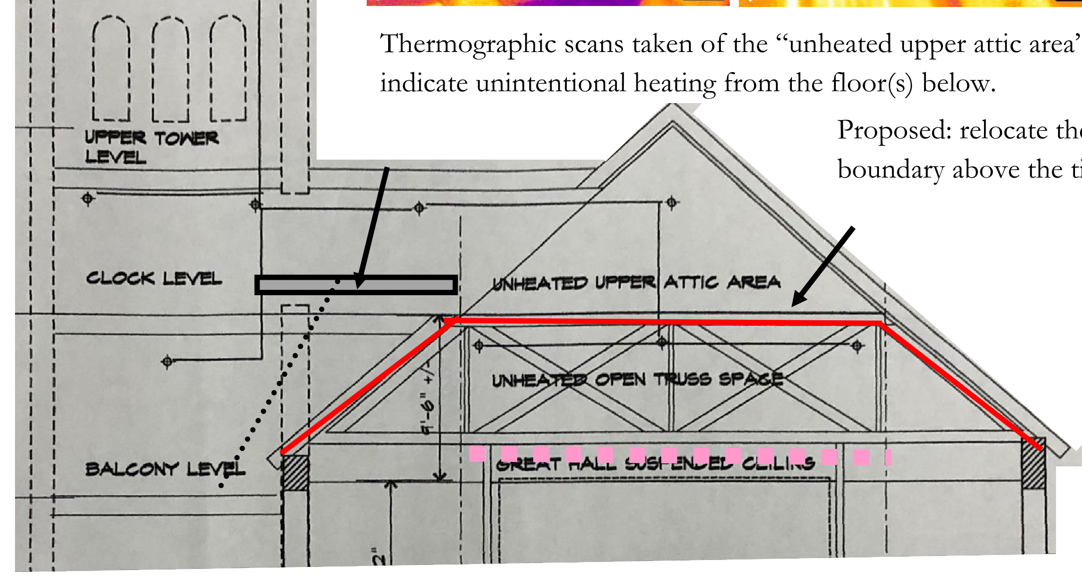
Insulating Upper Ceiling Plane





Thermographic scans taken of the "unheated upper attic area" indicate unintentional heating from the floor(s) below.

Proposed: relocate the thermal boundary above the tin ceiling.

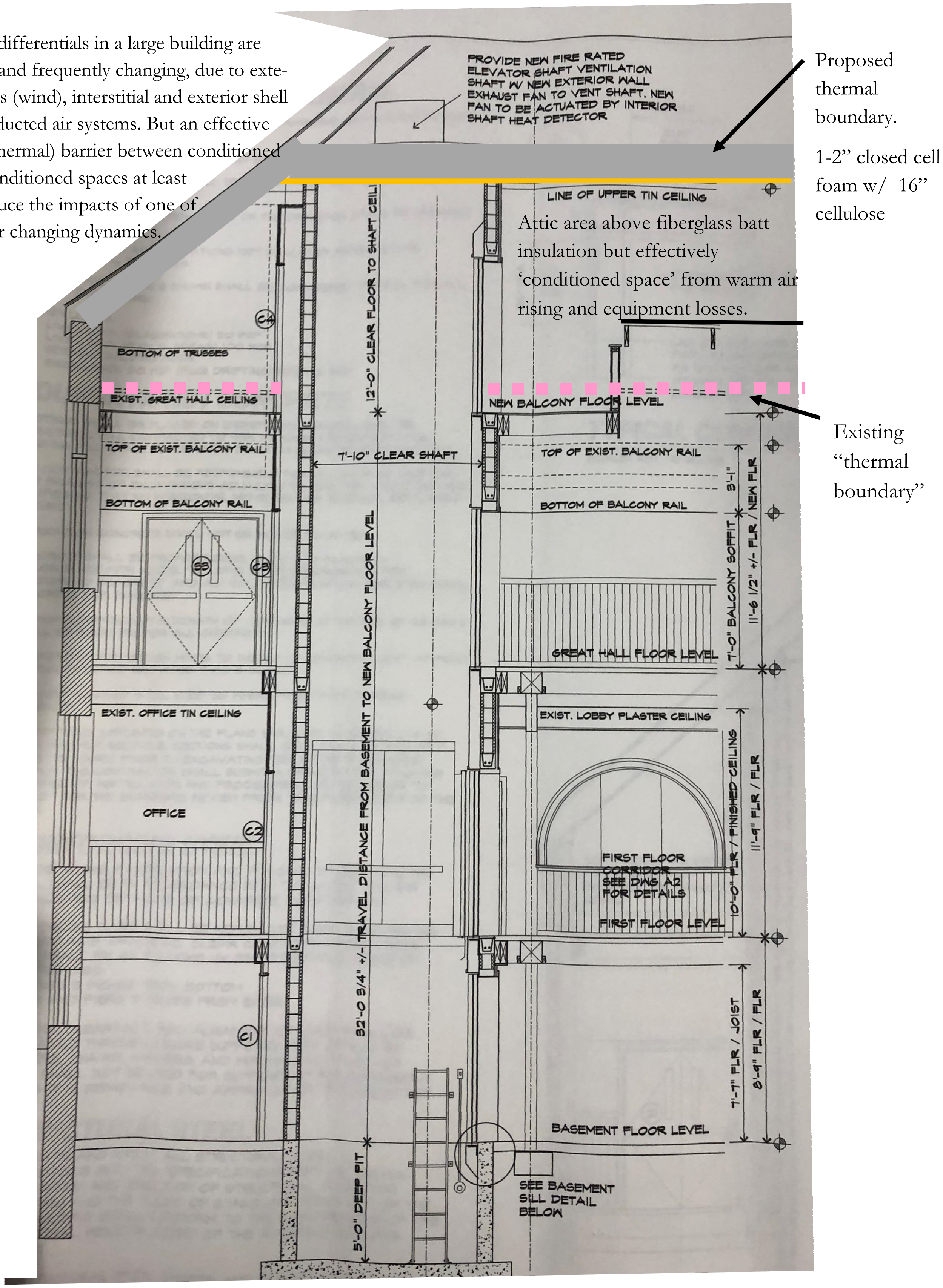


Relocated Thermal Boundary	Total Cost	Annual Savings	Simple Payback Years	Life of Measure	Invest-ment Gain	ROI	Annual ized ROI
Upper attic floor– 1" spf & 16" cellulose	$8,100						
Stage Flat—1" spf & 16" cellulose	$720						
Stage Slopes—DP cellulose	$1,400						
3rd Floor Flat- V1" spf & 16" cellulose	$720						
3rd Floor Slopes –DP cellulose	$1,125						
Clock T Floor– DP cellulose	$350						
DP= Dense Pack	$12,415	$974	12.7	25	$11,935	96.1%	2.7%

The original tin ceiling remains in tack and attached to strapping and 14" floor joists without decking. Access to this attic is through a small door off the planning room which leads into the clock tower 12 feet below the clock mechanism. A permanent wood ladder allows access to 'wind' the clock as well as to an opening 30" above the upper attic joists. Alternate access may be through dormer windows on the west side.

While not ideal access, the attic itself is in nearly original, 1895 condition. Some wiring, installed sometime after 1911, and an enclosure for the top of the elevator shaft (circa 2004) appear to be the most obvious alterations. Costs include spraying a 1-2" coat of closed foam onto lathe and plaster in order to provide monolithic support for the weight of the cellulose.

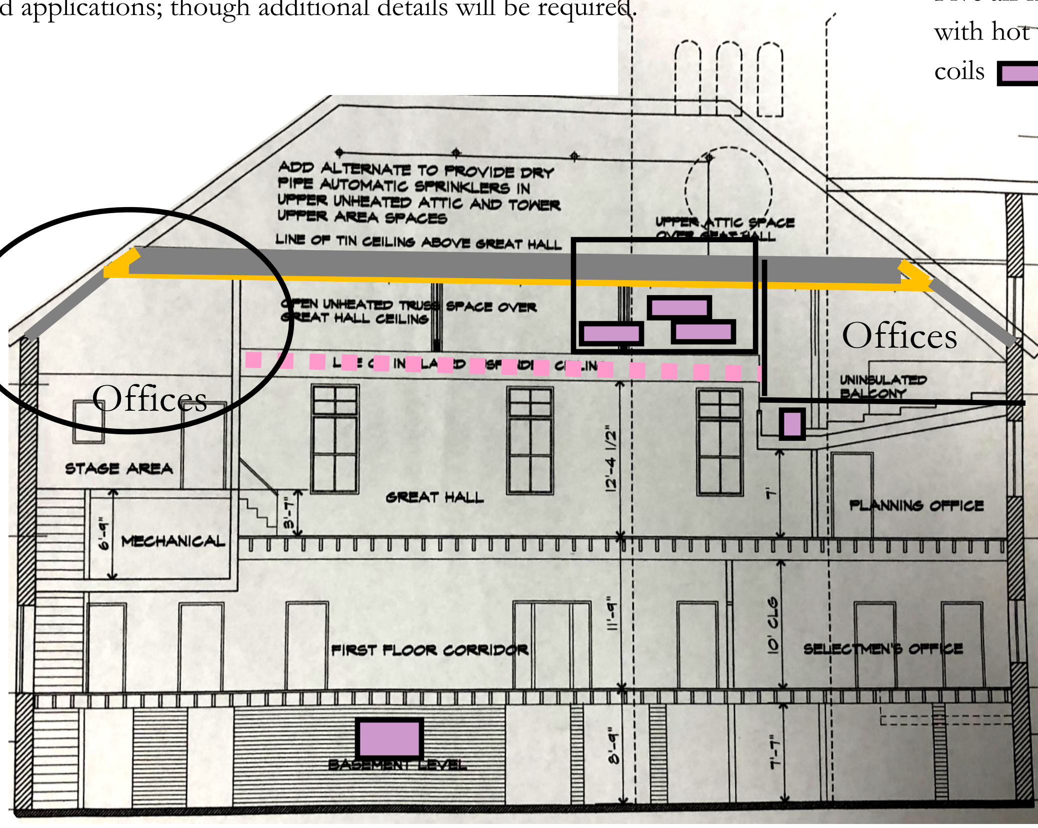
Pressure differentials in a large building are complex and frequently changing, due to exterior forces (wind), interstitial and exterior shell barriers, ducted air systems. But an effective air (and thermal) barrier between conditioned and unconditioned spaces at least helps reduce the impacts of one of these ever changing dynamics.



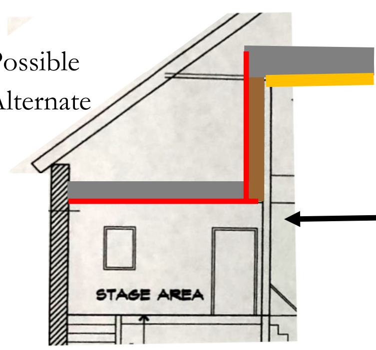
The 2004 renovations created new ceiling planes over the stage area and above what had been balcony ceiling. The plans called for the fiberglass batts and suspended ceiling tiles over the Great Hall "to remain"; presumably adding three air handlers with hydronic coils to the "unheated attic" in order to heat the newly created spaces. Visualizing - and depicting—creating a continuous air barrier with effective insulation layers is challenging! The recommendation is to contract with Rich Burns of Shakes to Shingles to specify the exact details for this measure. Cost estimates have been based on square footages and anticipated applications; though additional details will be required.

Five air handlers with hot water coils

Alternate boundary below



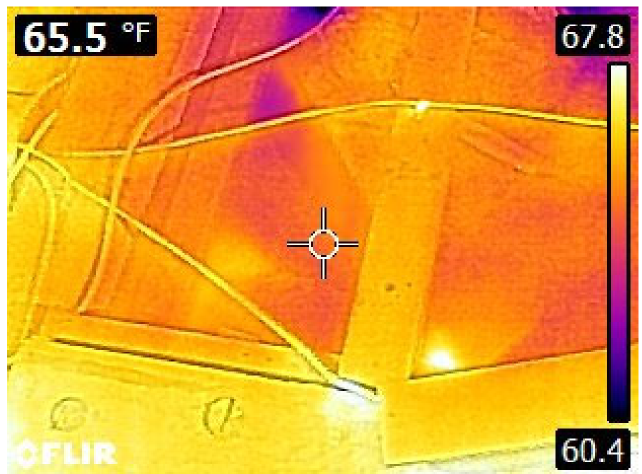
Possible Alternate

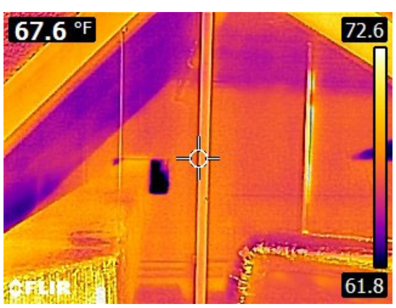


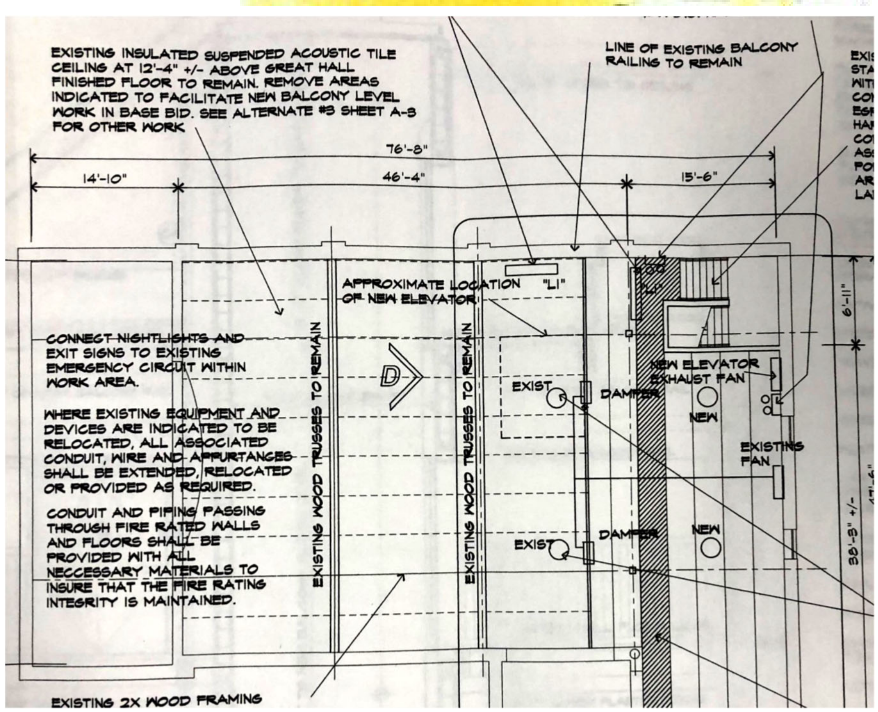
With further investigation above this ceiling plane (offices locked early) and a ceiling structure is present, it may be more cost effective to establish an effective air barrier directly above the suspended ceiling (red line) and blow in cellulose at that level, while also adding mineral wool batts and a membrane air barrier along the vertical wall.

Infra red images above the great hall ceiling with fiberglass batts.

2004 plan and notes

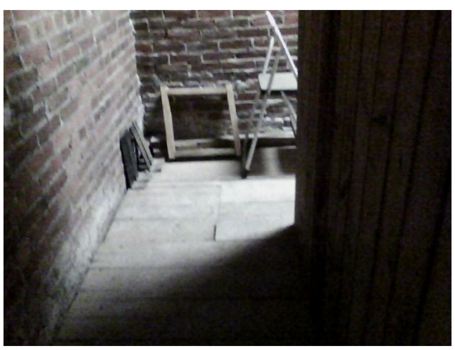


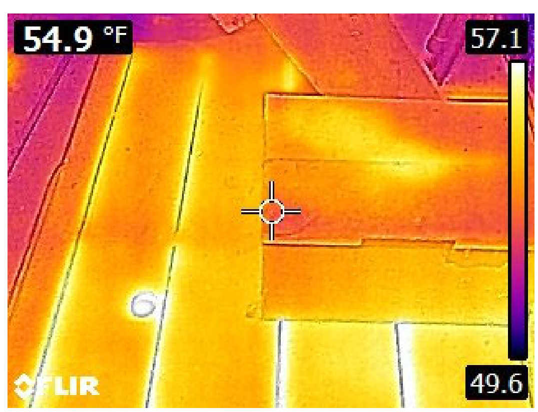




Clock tower floor—clock is in an enclosed room, inside this 3' wide exterior 'deck walk' . Lathe and plaster ceiling (with large hatch and ladder) needs patching—or sheetrock

Propose dense packing cellulose under this floor, between the approximately 14" floor joists.





This is from inside the 'mechanical attic' - ie below the tin ceiling / attic floor and above the "insulated" suspended ceiling. All slopes have tin ceilings in generally good condition, though seams have air gaps.

Proposing bringing all of this third floor level into thermal envelope

2nd floor meeting room below

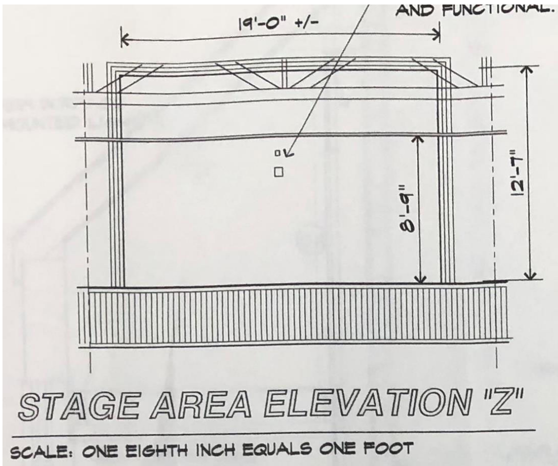
This is the ladder up to the clock tower/

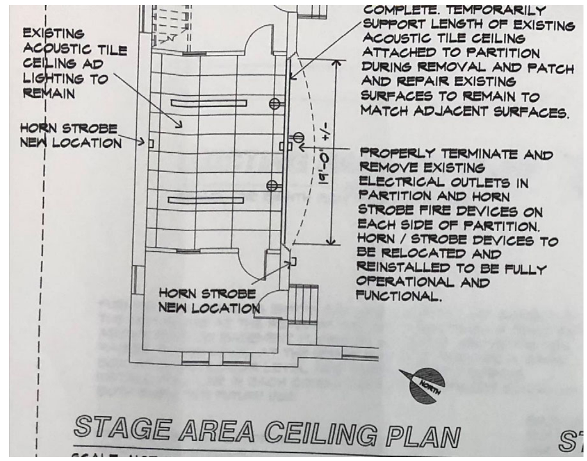
From attic looking into to clock tower floor

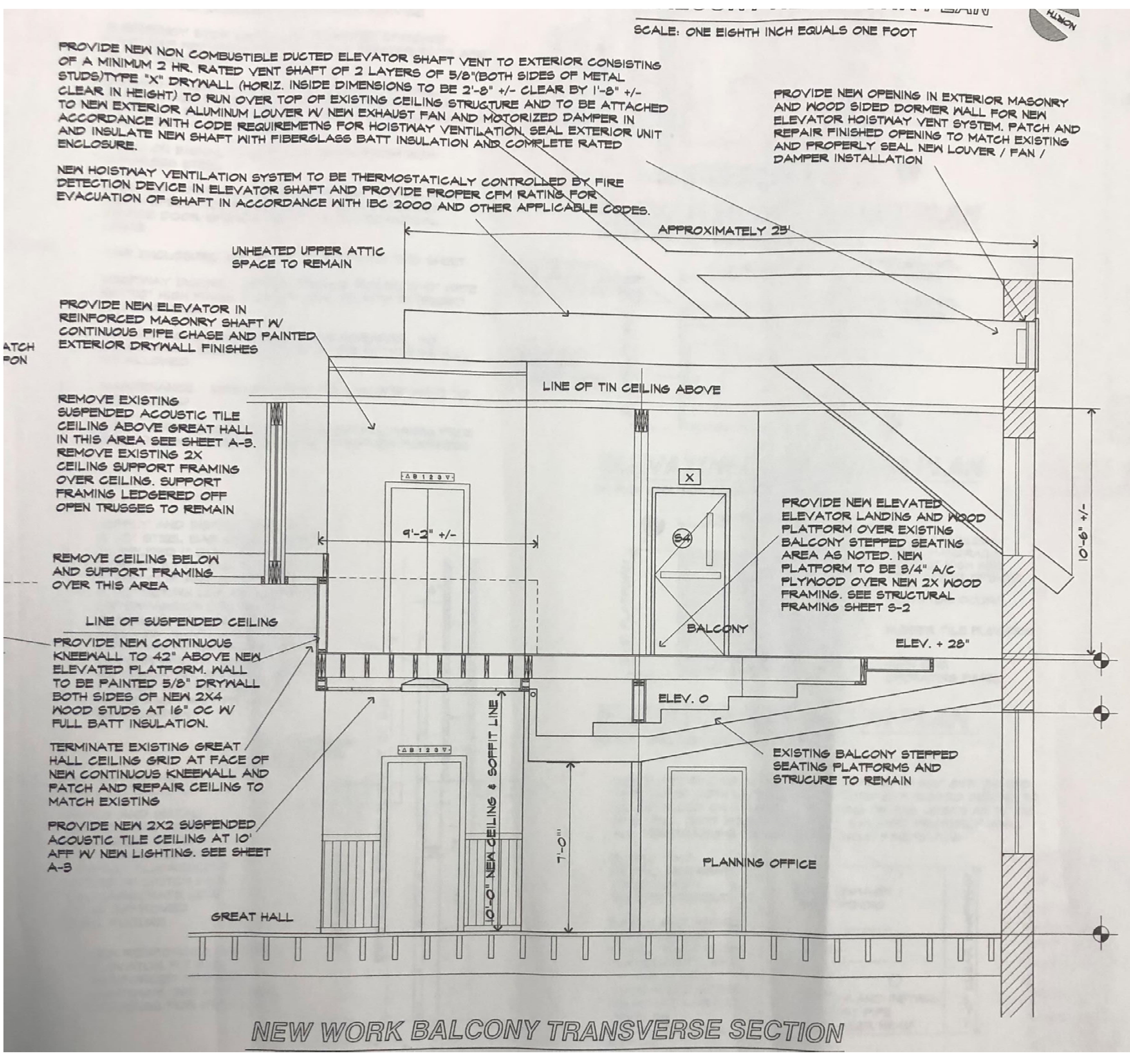
Top of enclosed elevator shaft appears effectively sealed with spackle.

From clock tower looking at the drop down.

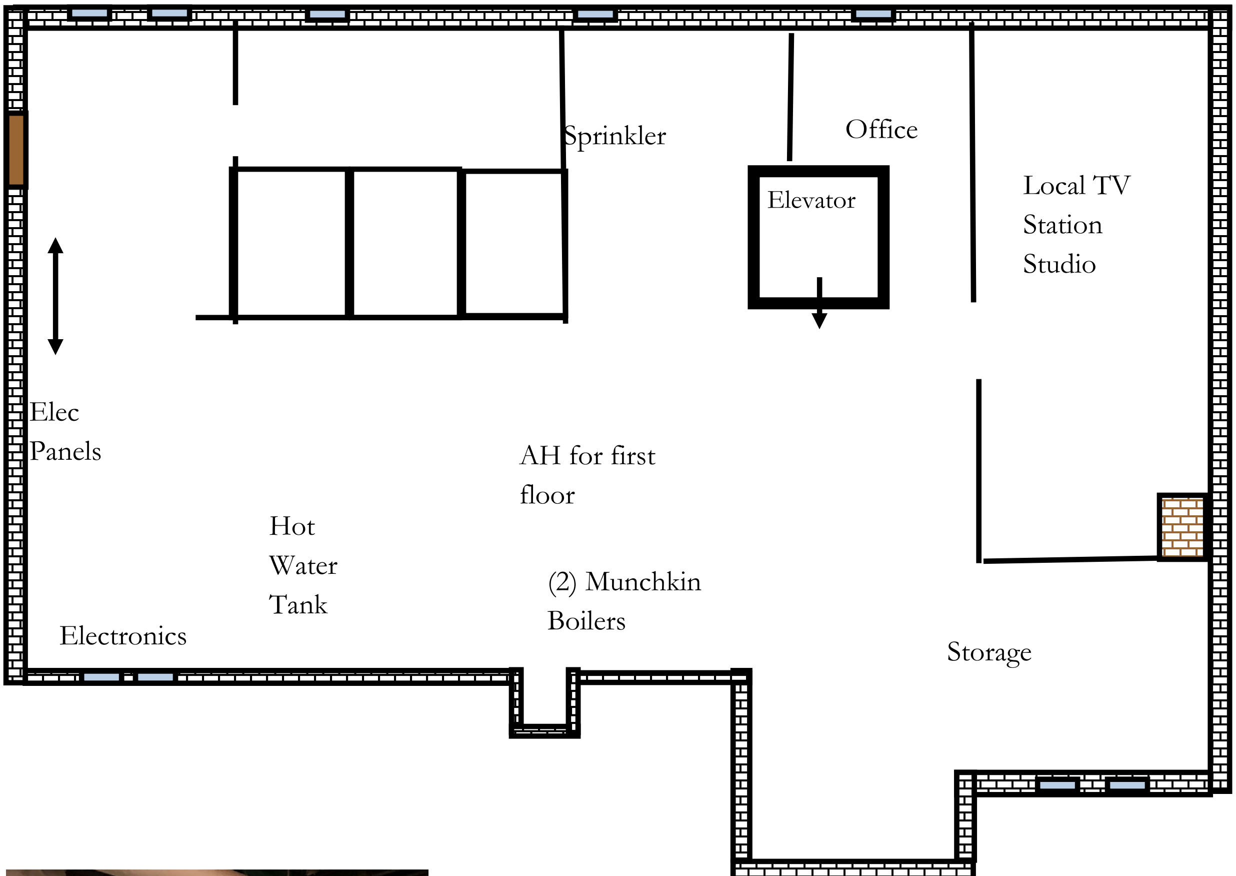
Additional drawing 'snap shots', with dimensions, for reference.

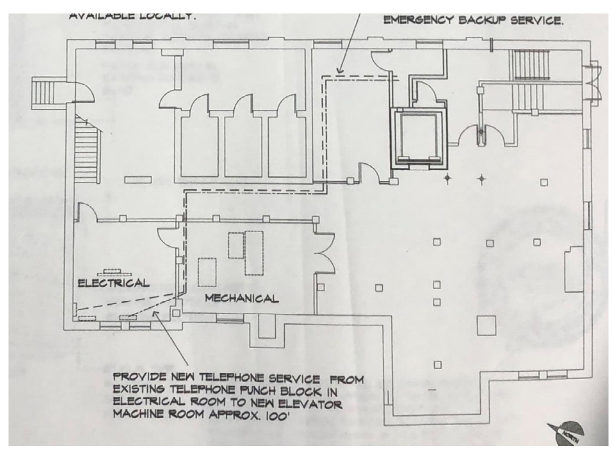




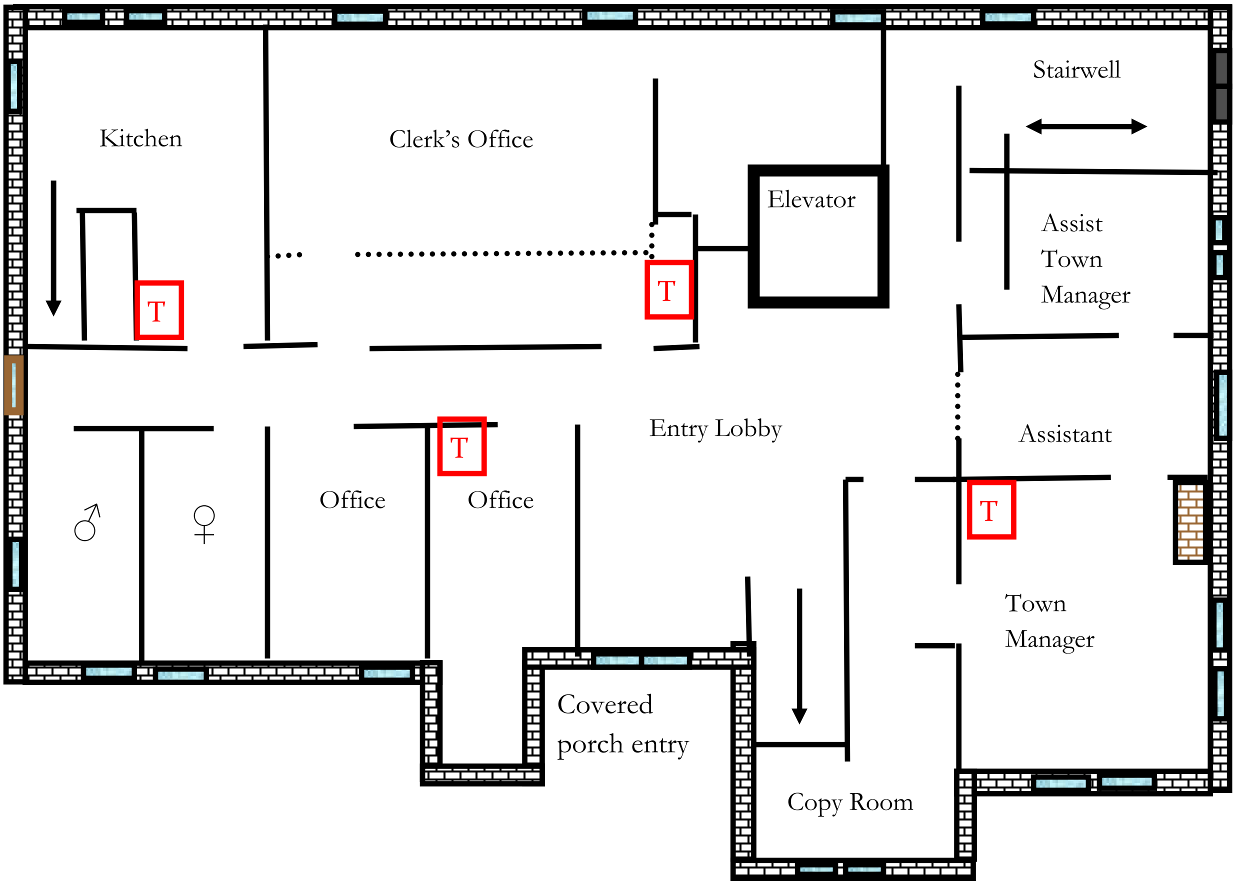


Basement

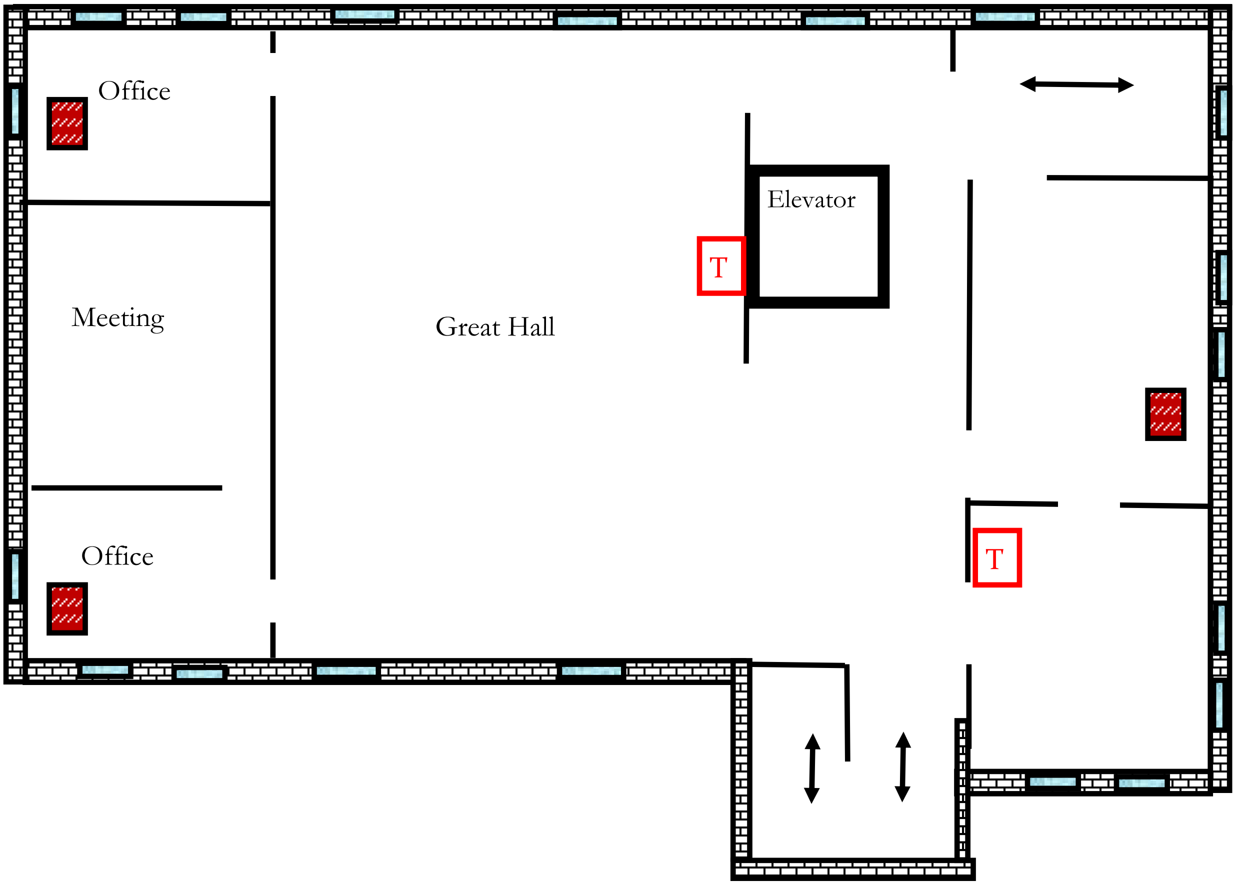

Sprinkler
Office
Elevator
Local TV
Station
Studio
Elec
Panels
AH for first
floor
Hot
Water
Tank
(2) Munchkin
Boilers
Electronics
Storage


EMERGENCY BACKUP SERVICE.
ELECTRICAL
MECHANICAL
PROVIDE NEW TELEPHONE SERVICE FROM
EXISTING TELEPHONE PUNCH BLOCK IN
ELECTRICAL ROOM TO NEW ELEVATOR
MACHINE ROOM APPROX. 100'

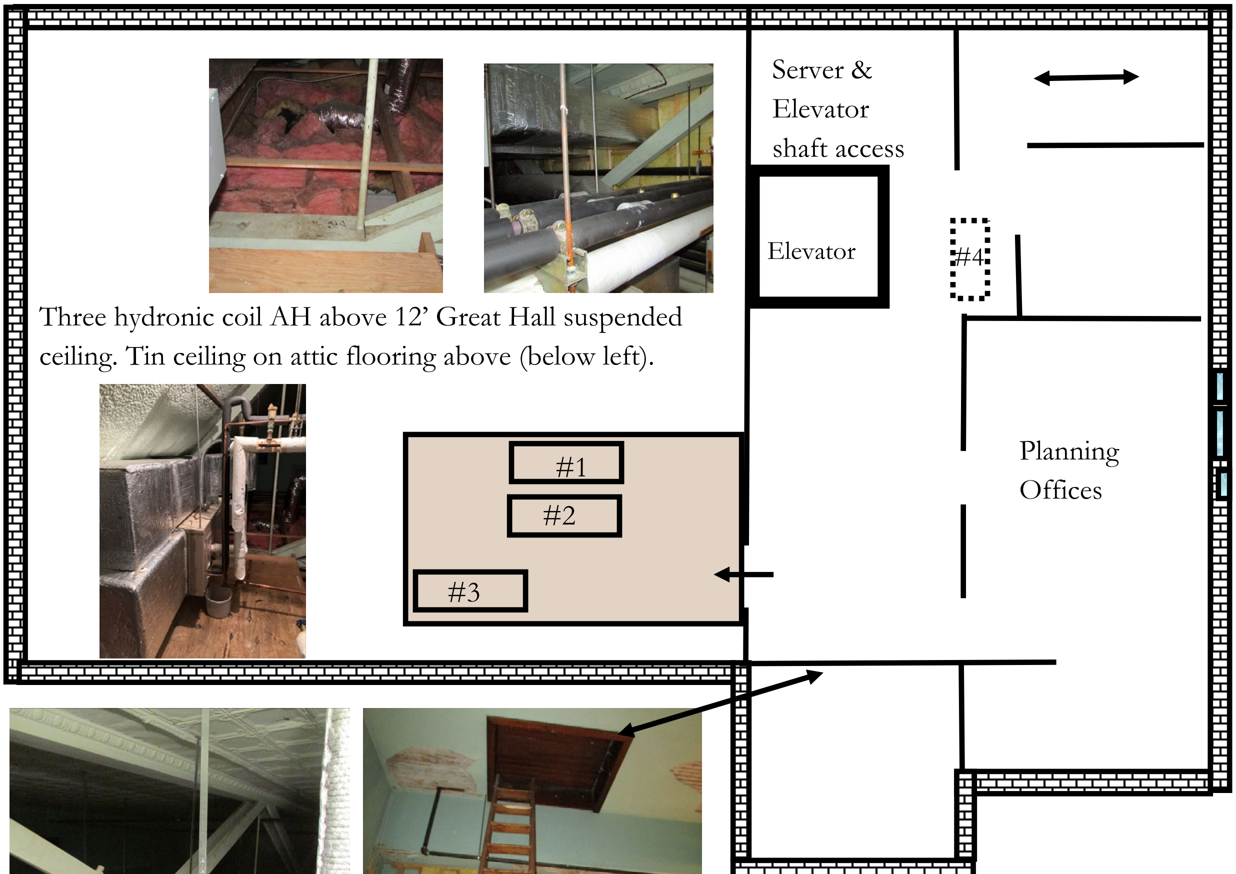
1st Floor


Kitchen
Clerk's Office
Elevator
Stairwell
Assist
Town
Manager
T
T
T
T
T
Entry Lobby
Assistant
♂
♀
Office
Office
Town
Manager
Covered
porch entry
Copy Room

2nd Floor

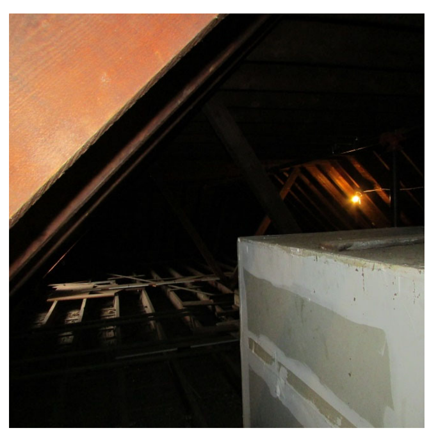


3rd Floor Air Handlers



Three hydronic coil AH above 12' Great Hall suspended ceiling. Tin ceiling on attic flooring above (below left).

Ladder leads to clock tower and from there drops down about 20" onto 14" attic floor joists. No planks to speak of, but open access to lathe, except for the sealed sheet-rock housing for air handlers which extends above the attic floor (below).



AH #1 serves the Great Hall directly below

AH #2 serves the 3rd floor

AH #3 serves the two offices on the north side second floor; stage level

AH #4 is located and accessed from a hatch in the floor, serving the south facing offices on the second floor.

AH #5 is in the basement and serves the entire first floor with 8 sub zones.

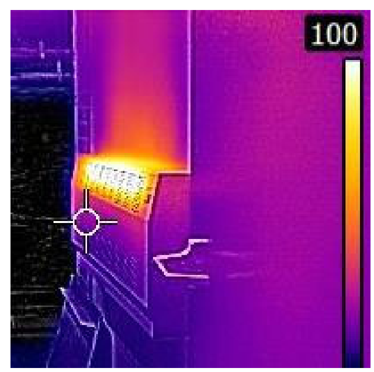
Occupant Habits and Phantom Loads

The term 'phantom' may be most appropriate because these loads have literally snuck up on us as more and more of our activities have become dependent on electronic devices. So prevalent is the use of electricity for doing most anything, is that we don't even question adding devices which need to be charged or plugged into an outlet.

"Sleep mode" or "Standby" does reduce electric consumption as compared to operating loads. However as electronic devices have become more efficient, their 'standby' losses—which offer the convenience of being 'ready for use' at all times can now and amount to 5-15% (or more, depending on how often its used) of a device's monthly consumption.

At least five water dispensers were found in the Town Hall, each plugged in to offer heated or chilled water on demand. This convenience can be a valuable time saver and 'perk' for employees with busy schedules and demands on their time. It is included here as an example of "devices" which have become so commonplace that we sometimes forget they are drawing electrical energy 24 hours a day, seven days a week and each one can cost over $105 a year in electricity. ($500 total for five). It is worth re-evaluating, from time to time, how often people actually use, or need, hot or cold water from these dispensers. Unplugging them can still offer room temperature drinking water and efficient electric kettles can make hot water for the occasional cup of tea.

Electric resistance wall and space heaters are another common heating device. The one pictured to the right is in the basement and thermostatically controlled.



Several others are in individual offices to offset drafts and the discomfort from sitting next to cold glass or plastered brick surfaces. Just like drinking water throughout the day is important to one's health (and productivity), thermal comfort is also as important as it is subjective! But its also true that electric resistance heat is the most expensive form of space heating due to the relatively few btus produced in each purchased kWh.

The last example here is depicted in the lower right hand photo. Evaluating the energy consumption and occupancy patterns of the local TV station in the basement is beyond the scope of this study. However, it is estimated that 15-20% of the electrical usage may be from the equipment in this studio.

During this walk through site visit, the lights were off and the room unoccupied—yet all of the electronic equipment was found on. The suggestion here is to evaluate the impact of disconnecting some or all of this equipment when not in use. If the only impact is that it takes minutes to warm up, then this may be the most cost effective energy saving opportunity in the entire building!

System Controls

Except for Great Hall meetings, the building is generally occupied for 45 hours a week, which suggests it is mostly unoccupied for 123 hours per week.

Numbers below indicate programmed temperature settings. Numbers in red indicate hours the building is generally occupied, though there may be some night meetings in parts of the building. Weekend occupancy is varied and infrequent.

Since the rate of conductive heat transfer depends, in part, on differences in temperature between inside and outside, lowering thermostat settings does save energy, even if it may seem that the boiler may be running more often or "harder" to bring it back up to comfort settings. In fact, boilers operate at higher efficiency when running longer, so lower settings—especially at night when its likely colder than daytime—is an effective energy conservation strategy.

The issues may be around the amount of time it takes to bring it back up to temperature, or settings are too low during extreme cold and pipes along exterior surfaces may freeze.

Overall, the schedule below looks reasonable, though it would be worth determining if all or part of the building is unoccupied after 7PM, setting back to 60 at that time would save energy. In addition, if all or parts of the building are unoccupied after 4:30 PM Tues-Fri, thermostat setbacks would be recommended.

Thermostat Schedule	5am	6am	7am	8am	9am	10am	11am	12PM	1PM	2PM	3PM	4:30PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	MID	1am	2am	3am	4am
Monday	65	65	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	65	65	65	60	60	60	60	60	60	60
Tuesday	65	65	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	71	71	65	65	65	60	60	60	60	60	60	60
Wednesday	65	65	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	71	71	65	65	65	60	60	60	60	60	60	60
Thursday	65	65	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	71	71	65	65	65	60	60	60	60	60	60	60
Friday	65	65	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*71*	71	71	65	65	65	60	60	60	60	60	60	60
Saturday	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	60	60	60	60	60	60	60
Sunday	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	60	60	60	60	60	60	60

Weekly Occupancy (from website) and Thermostat Schedule

The technician from Precision Temperature Controls, who inspected the heating and cooling system, suggested that the existing control system appears to be functioning as intended. Adding a DDC (direct digital control) would allow for remote viewing and control for each air handler through individual controllers—offering the ability for optimal setbacks. He also recommended replacing hot water valve actuators to improve efficiency. A cost benefit analysis for these recommendations is not available, but the cost could be expected to exceed $13,000.

As stated in his one page report on the next page, he also suggested installing an ERV (Energy Recovery Ventilation) for each unit to supply outside air ventilation or air exchange. Ventilation would be required by code at this time. While an excellent suggestion, spot CO2 readings in office areas taken at 1PM on the day of this Audit's site visit did not suggest a significant concern for air exchange at this time.

Precision Temperature Control INC.
AIR CONDITIONING * HEATING * REFRIGERATION SERVICE, INSTALLATION AND MAINTENANCE
SYSTEMS DESIGN AND BUILD
(603) 352-5254
Keene, NH
460 Route 101
1-800-694-8632
(603) 471-9023
Bedford, NH
Bedford, NH 03110

Plaistow Town Hall

Brian Johnson

Precision Temperature Control

2/26/19

HVAC Controls Inspection

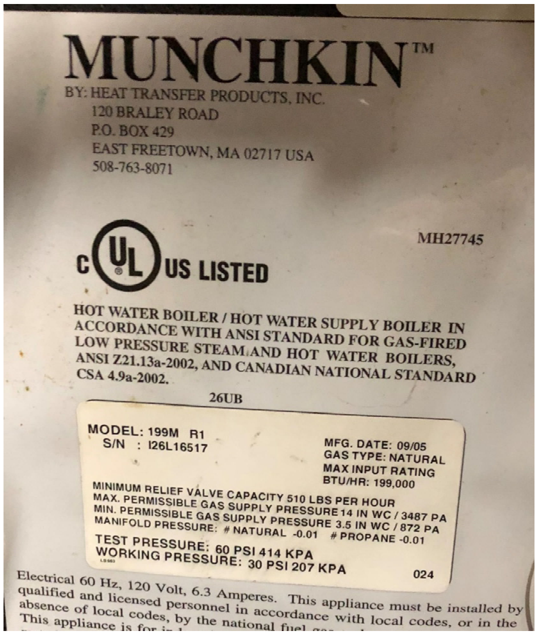
What is currently on site:

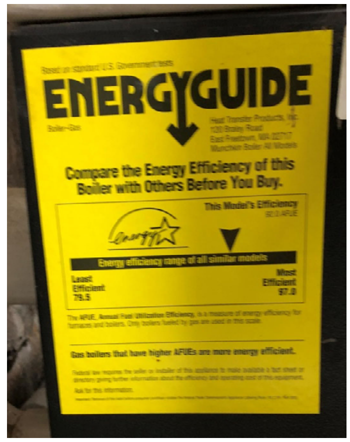
On site at 145 Main St. I observed the functioning HVAC system for the building. The heating system appeared to be operating as a lead lag system with a primary and secondary water loops. The building water loop (secondary) temperature appeared to be modulating in temperature with the use of a "Vision3" boiler controller. Based off of what the manual for this controller says, the Vision3 can modulate the loop temperature by using an Outside Air Reset program to monitor the outside air temperature and heat the secondary loop to efficient temperatures. The loop temperature will rise and drop based off of the outside temperature to use as little energy as possible to heat the building. There is also a pump control onsite, that runs two loop pumps in lead-lag. The 1st floor air handler is a basic Lennox unit with a DX air conditioning coil and a hot water coil. The hot water coil looks to be working as a on/off operation. The three-way hot water valve for the coil will either flow water to the coil or flow the water back to the coil. This is the only unit with a damper zoning system. There is also a bypass duct on the system with an electric actuator to maintain the duct pressure to a preset pressure setting. The remaining 4 units in the building appear to all work the same, except they do not incorporate any independent zoning systems. These four units are using programmable thermostats to control their operation.

What we recommend:

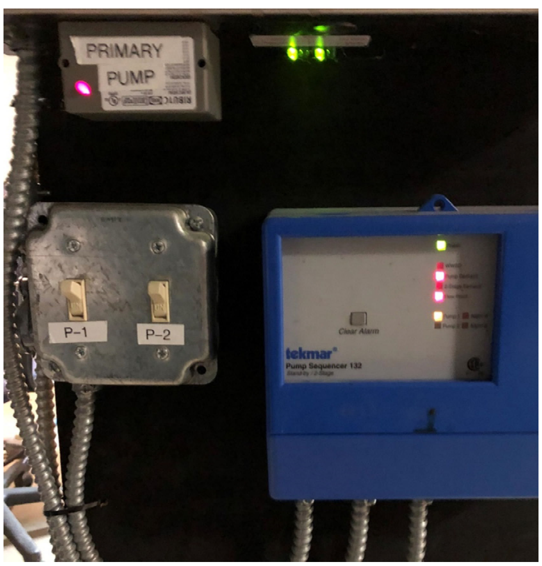
Throughout the building, I was unable to find any fresh air introduction to any of the systems. There also appears to be no exhaust fans anywhere onsite, including in the bathrooms. I do not believe building is having enough air changes per hour (ACH) in its current condition. We recommend having an ERV system installed to reach the required ACH. We can utilize the current hot water loop in the building with an additional duct coil to maintain a minimum air temperature supplying the building. This will also help in preventing any possible humidity issues the building may experience. As for the remaining controls onsite, I believe the systems are being as efficient as they can be while still being cost effective. I recommend installing individual controllers for each unit if the town would like to have a DDC system that the town can access and view remotely or locally on a computer. As well as controllers, the hot water valve actuators should be replaced with modulating motors to heat the zones more efficiently.

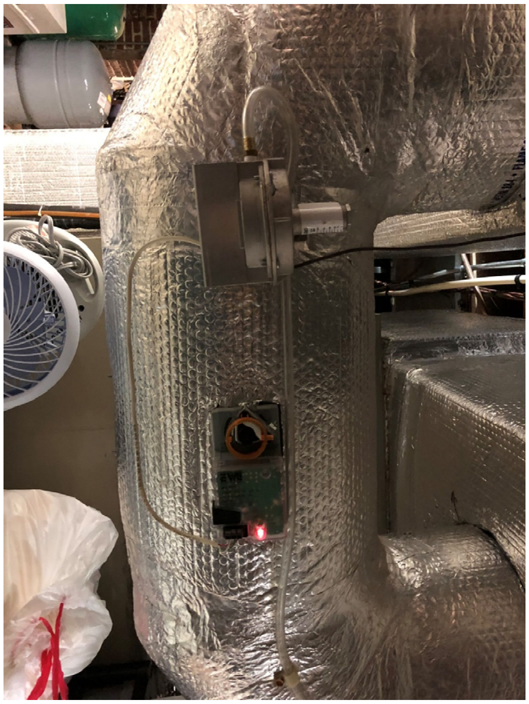
Boilers and Controls

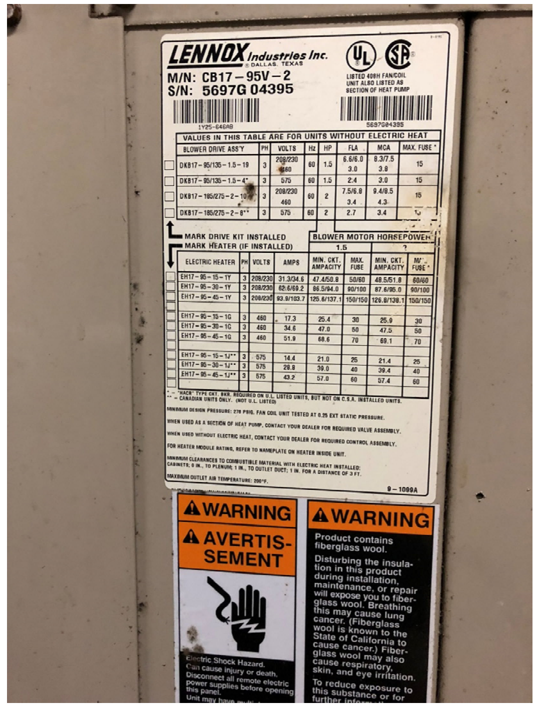




Efficiency ratings for a condensing boiler are valid when the boiler has a return temperature low enough to operate in condensing mode.






LENNOX Industries Inc.
DALLAS, TEXAS
M/N: CB17-95V-2
S/N: 5697G 04395
VALUES IN THIS TABLE ARE FOR UNITS WITHOUT ELECTRIC HEAT
MARK DRIVE KIT INSTALLED
MARK HEATER (IF INSTALLED)
BLOWER MOTOR HORSEPOWER
WARNING
AVERTIS-SEMENT
WARNING
Product contains fiberglass wool.
Disturbing the insulation in this product during installation, maintenance, or repair will expose you to fiberglass wool. Breathing this may cause lung cancer. (Fiberglass wool is known to the State of California to cause cancer.) Fiberglass wool may also cause respiratory, skin, and eye irritation.
To reduce exposure to this substance or for
Electric Shock Hazard.
Can cause injury or death.
Disconnect all remote electric power supplies before opening this panel.


OPEN
CLOSED
45 DEGREE ROTATION
DAMPACT45DEG-B
HF21KJ005
PRESS TO DISENGAGE
CLS COM OPN

Copied from the Town of Plaistow website: (This is information that was contained in the Town of Plaistow's 250th Anniversary Commemorative Book written for the anniversary celebration held in 1999. It was modified for purposes of being included in the Master Plan as the History Chapter)

The Town Hall & Pollard Park

The first Town Hall was built in 1831 on the Common (later Pollard Park) where the present building stands. Local tradition tells us that it was built with bricks produced in Plaistow by Jacob Davis, a local manufacturer. For 64 years it was the site of the annual Town Meeting, dances, social gatherings, and was used as a temporary place of worship. This was truly the town's most public space.

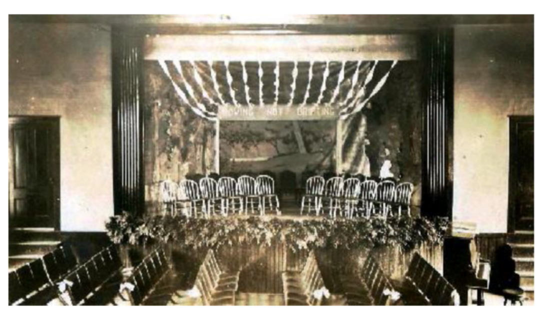
A larger Town Hall was erected in 1895 on the same site. In 1904, Arthur G. Pollard had the land-scape around the Town Hall graded and he paid for the planting of trees and shrubs. In his honor, the village green was named Pollard Park, and its vicinity was dubbed Pollard Square.

In addition to the town offices, this building housed at different times the police station and the library, and the Plaistow Cooperative Bank. There also was a kitchen and a dining room on the ground floor's north side and an auditorium with a stage and balcony upstairs, which was the site of many theatrical performances. In the 1930s young people used to play basketball here as well. The Town Hall basement contained a jail where "tramps" were held overnight.

After the library moved into a building of its own in 1977, room was made for the selectmen, the assessor, the tax collector, building inspectors, and the town clerk. Prior to this, the town clerk worked out of her or his house. Though the police, too, have moved out of the Town Hall (1986), it is where Judge Peter Hurd still presides over the Plaistow District Court, and where the clerk of the court has her office.

Being the most public space in town, the Town Hall and surrounding Pollard Park are where many monuments to Plaistow's fighting men have been erected. Statues and markers commemorate the town's veterans of the Revolution, Civil War, the two World Wars, the Korean War, the Vietnam War, and the Gulf War. Following VJ Day, a roster listing the names of Plaistow's World War II veterans was posted in the lobby.

To commemorate the Town Hall's 100th birthday, Plaistow joined together in celebration in 1995. The highlight of the day's festivities was the removal of a cornerstone containing a time capsule filled with coins, documents, and ephemera. The cornerstone now houses another time capsule, which will be opened in 2095.



June 14, 1929 Inside the Town Hall in Preparation for Pollard School Graduation

High Performance
Lighting Improvement Project
Prepared for

Town Hall

Carl Edin
February 26, 2019

February 26, 2019

Ms. Margaret Dillon
MS, BPI, LEED AP/S.E.E.D.S
Plaistow Town Hall
145 Main Street
Plaistow, NH

Re: 2019 High Performance Lighting Improvement Project

Dear Margaret,

Enclosed you will find our turnkey energy saving lighting proposal.

By implementing these cost savings measures, Plaistow Town Hall will achieve the following benefits:

- Reduced operating cost
- Reduced owning cost by removing inefficient incandescent, HID and T12 technology along with standard CFL and T8 technology.
- Utilization of high efficiency LED technology and controls.
- Standardization of lighting components
- Improved light quality and quantity
- Unitil Incentive (pending approval)

We look forward to working with you to reach your goals of lighting improvements and energy conservation. After reviewing, please contact me at (207) 767-1313 or (207) 400-4767 to answer any questions.

Sincerely,

Carl Edin
Project Developer

EMC
ENERGY MANAGEMENT CONSULTANTS INC.

PLAISTOW
NEW HAMPSHIRE
INCORPORATED 1749

Table of Contents:

Benefits of a Turnkey Lighting Upgrade

Environmental Impact

Supporting Information
    Room by Room Savings Analysis

Financial Investment
    Cost Savings Summary

Utility Document
    Unitil Incentive Application Page

Project Process Recap

Unitil

EMC
ENERGY MANAGEMENT CONSULTANTS INC.

PLAISTOW
NEW HAMPSHIRE
INCORPORATED 1749

Benefits of a Turnkey Lighting Upgrade

- Complete cost analysis: room by room survey of existing system compared to a new proposed system, providing kW and kWh savings projections

- Product specification: high efficiency equipment being specified to reduce energy and maintenance cost

- Turnkey Installlation/Project Management:
    - Providing detailed information of work to be completed
    - Overseeing of Installation with sub-contractors
    - Proper disposal of all waste-(hazardous and non-hazardous) with certificates of recycling provided
    - Weekly updates-communication with customer on progress of project completion
    - Pre and Post walkthrough's with Unitil for final approvals

- Customer benefits:
    - With the exception of scheduling, Plaistow Town Hall is able to focus on other pressing matters.
    - Cost savings will be achieved in a much quicker time frame

Warranty information

Ballast	5 years
Lamp	5 years
Fixture	5-10 years
Controls	5 years
Labor	90 days
Labor Workmanship	1 year

EMC's Assurance

As a "turnkey" Energy Service Company, (ESCo) EMC will design and project manage the installation of proven energy saving technologies as well as provide periodic follow up to assure complete customer satisfaction.

Unitil

Environmental Impact – Going Green
February 2019

The **17,849 *kWh*** saved annually by this project equates to the following positive environmental impacts:

- **2 households** is the average number of houses that can now be powered from this project. The average U.S. household consumes 11,280 kWh annually.

- **1,232 fewer gallons of oil** need to be imported, reducing our dependence on foreign oil.

- **11 tons of CO_2**
  Carbon Dioxide is considered a greenhouse gas and is a major contributor to global warming.

- **216 lbs. of SO_2**
  Sulfur Dioxide- some major health effects associated with this pollutant are: asthma, respiratory illness and aggravation of existing cardiovascular disease.

- **110 lbs. of Nox**
  Nitrogen Oxides are considered contributors to acid rain and ground level ozone (or smog).

- **7 lbs. of visible particulate**

Supporting Information

Room by Room Savings Analysis

Town of Plaistow- Town Hall

Room by Room Savings Analysis

Line	Room	EMC CM Code	Count	Hours/Week	Hours/Year	WWS Count	Control Type	Curr kW	Curr I/W	Curr Watts	Curr kWh	Prop kW	Prop I/W	Prop Watts	Prop kWh	kWh Svgs	Add'l kWh Svgs
001	LL- Elev	S2L4/LED2L4-10-L	2	168/52	8736			0.16	80.00	160.00	1397.76	0.04	20.00	40.00	349.44	1048.32	0.00
002	LL- Corr 1	RC65-R30/LED11-R30-NL	4	60/52	3120			0.26	65.00	260.00	811.20	0.04	11.00	44.00	137.28	673.92	0.00
003	LL- Sprinkler	S2L4-T8/LED2L4-10-L	1	10/52	520			0.05	53.00	53.00	27.56	0.02	20.00	20.00	10.40	17.16	0.00
004	LL- Cable Studio	RC65-R30/LED11-R30-NL	9	20/52	1040			0.59	65.00	585.00	608.40	0.10	11.00	99.00	102.96	505.44	0.00
005	LL- Back Stair	W2L4-T8/LED2L4-10-L	10	40/52	2080			0.60	60.00	600.00	1248.00	0.20	20.00	200.00	416.00	832.00	0.00
006	LL- Open Stg	W2L4-T8/LED2L4-10-L	1	40/52	2080			0.06	60.00	60.00	124.80	0.02	20.00	20.00	41.60	83.20	0.00
007	LL- Open Stg	S2L4-T8/LED2L4-10-L	4	20/52	1040			0.24	60.00	240.00	249.60	0.08	20.00	80.00	83.20	166.40	0.00
008	LL- Open Stg	WLED4-25-NF/INSTALL	1	20/52	1040			0.00	0.00	0.00	0.00	0.03	25.00	25.00	26.00	-26.00	0.00
009	LL- Open Stg	SH2L4-T8/LED2L4-10-L	25	20/52	1040			1.50	60.00	1500.00	1560.00	0.50	20.00	500.00	520.00	1040.00	0.00
010	LL- Trash	SH2L4-T8/LED2L4-10-L	3	20/52	1040			0.18	60.00	180.00	187.20	0.06	20.00	60.00	62.40	124.80	0.00
011	LL- Paint	SH2L4-T8/LED2L4-10-L	2	10/52	520			0.12	60.00	120.00	62.40	0.04	20.00	40.00	20.80	41.60	0.00
012	LL- Paint	PS26CF/LED11A-NL	3	10/52	520			0.08	28.00	84.00	43.68	0.03	11.00	33.00	17.16	26.52	0.00
013	LL- Mech Desk	S2L4-T8/LED2L4-10-L	2	40/52	2080			0.12	60.00	120.00	249.60	0.04	20.00	40.00	83.20	166.40	0.00
014	LL- Elev Equip	W2L4-T8/LED2L4-10-L	1	10/52	520			0.06	60.00	60.00	31.20	0.02	20.00	20.00	10.40	20.80	0.00
015	1FL- Main Lobby	W4L4-T8/LED4L4-10-L	1	60/52	3120			0.11	112.00	112.00	349.44	0.04	40.00	40.00	124.80	224.64	0.00
016	1FL- Main Lobby	W2L4-T8/LED2L4-10-L	3	60/52	3120			0.18	60.00	180.00	561.60	0.06	20.00	60.00	187.20	374.40	0.00
017	1FL- Main Lobby	RC2L26CF-8/RCLED13-8-NF	4	60/52	3120			0.22	56.00	224.00	698.88	0.05	13.00	52.00	162.24	536.64	0.00
018	1FL- Wait	RC2L26CF-8/RCLED13-8-NF	2	60/52	3120			0.11	56.00	112.00	349.44	0.03	13.00	26.00	81.12	268.32	0.00
019	1FL- Town Manager	T2L2U6-T8/VLED2-16-NL-KIT	6	40/52	2080	1	NLIGHT AIR	0.36	60.00	360.00	748.80	0.10	16.00	96.00	199.68	549.12	75.88
020	1FL- Reception	T2L2U6-T8/VLED2-16-NL-KIT	4	40/52	2080	2	NLIGHT AIR	0.24	60.00	240.00	499.20	0.06	16.00	64.00	133.12	366.08	50.59
021	1FL- Copy	W2L4-T8/LED2L4-10-L	2	40/52	2080			0.12	60.00	120.00	249.60	0.04	20.00	40.00	83.20	166.40	0.00
022	1FL- Selectman Admin	PM4L4-T8/LED4L4-10-L	2	40/52	2080			0.22	112.00	224.00	465.92	0.08	40.00	80.00	166.40	299.52	0.00
023	1FL- Selectman PO	PM4L4-T8/LED4L4-10-L	2	40/52	2080			0.22	112.00	224.00	465.92	0.08	40.00	80.00	166.40	299.52	0.00
024	1FL- Selectman Stg	JJ60/LED6A-NL	1	20/52	1040			0.06	60.00	60.00	62.40	0.01	6.00	6.00	6.24	56.16	0.00
025	1FL- Women	T2L4-T8/LED2L4-10-L	2	20/52	1040		E-MS	0.12	60.00	120.00	124.80	0.04	20.00	40.00	41.60	83.20	0.00
026	1FL- Men	T2L4-T8/LED2L4-10-L	2	20/52	1040		E-MS	0.12	60.00	120.00	124.80	0.04	20.00	40.00	41.60	83.20	0.00
027	1FL- Kitchen	W2L4-T8/LED2L4-10-L	4	40/52	2080			0.24	60.00	240.00	499.20	0.08	20.00	80.00	166.40	332.80	0.00
028	1FL- Cemetary Sexton	W2L4-T8/LED2L4-10-L	1	20/52	1040			0.06	60.00	60.00	62.40	0.02	20.00	20.00	20.80	41.60	0.00
029	1FL- Cemetary Sexton	S1L2/LED1L2-7-L	1	20/52	1040			0.03	32.00	32.00	33.28	0.01	7.00	7.00	7.28	26.00	0.00
030	1FL- File Stg	W2L4-T8/LED2L4-10-L	2	20/52	1040			0.12	60.00	120.00	124.80	0.04	20.00	40.00	41.60	83.20	0.00
031	1FL- Xmas Stg	S1L4-T8/LED1L4-10-L	1	5/52	260			0.03	30.00	30.00	7.80	0.01	10.00	10.00	2.60	5.20	0.00
032	1FL- Stg	S1L2/LED1L2-7-L	1	5/52	260			0.03	32.00	32.00	8.32	0.01	7.00	7.00	1.82	6.50	0.00
033	Ext- Porch Stair	CP70MH/LED13-NL	1	84/52	4368			0.10	95.00	95.00	414.96	0.01	13.00	13.00	56.78	358.18	0.00
034	Ext- Pollard Park	LED/REMAIN	1	84/52	4368			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
035	1FL- WW2 Honor	S2L3-T8/LED2L3-9-L	1	20/52	1040			0.05	47.00	47.00	48.88	0.02	18.00	18.00	18.72	30.16	0.00
036	1FL- Town Clerk	W4L4-T8/LED4L4-10-L	7	40/52	2080			0.78	112.00	784.00	1630.72	0.28	40.00	280.00	582.40	1048.32	0.00
037	1FL- Stg 104	W4L4-T8/LED4L4-10-L	1	40/52	2080			0.11	112.00	112.00	232.96	0.04	40.00	40.00	83.20	149.76	0.00
038	Main Stair	W2L4-T8/LED2L4-10-L	1	60/52	3120			0.06	60.00	60.00	187.20	0.02	20.00	20.00	62.40	124.80	0.00
039	2FL- Elev Corr	RC50-R20/LED10-R20-NL	3	60/52	3120			0.15	50.00	150.00	468.00	0.03	10.00	30.00	93.60	374.40	0.00
040	2FL- Elev Corr	P2L2U6-T8/VLED2-16-NL-KIT	4	60/52	3120		NLIGHT AIR	0.24	60.00	240.00	748.80	0.06	16.00	64.00	199.68	549.12	75.88
041	2FL- Human Services	PM4L4-8F-T8/LED4L4-10-L	3	40/52	2080			0.34	112.00	336.00	698.88	0.12	40.00	120.00	249.60	449.28	0.00

Town of Plaistow- Town Hall

Room by Room Savings Analysis

Line	Room	EMC CM Code	Count	Hours/Week	Hours/Year	WWS Count	Control Type	Curr kW	Curr I/W	Curr Watts	Curr kWh	Prop kW	Prop I/W	Prop Watts	Prop kWh	kWh Svgs	Add'l kWh Svgs
042	2FL- Health Dept.	PM4L4-8F-T8/LED4L4-10-L	1	40/52	2080			0.11	112.00	112.00	232.96	0.04	40.00	40.00	83.20	149.76	0.00
043	2FL- Finance	PM4L4-8F-T8/LED4L4-10-L	1	40/52	2080			0.11	112.00	112.00	232.96	0.04	40.00	40.00	83.20	149.76	0.00
044	2FL- Great RM	P3L4-T8/VLED4-22-NL-KIT	20	50/52	2600	2	NLIGHT AIR	1.76	88.00	1760.00	4576.00	0.44	22.00	440.00	1144.00	3432.00	434.72
045	2FL- Great RM	CH12L25C/LED12L2C-NL	1	20/52	1040			0.30	300.00	300.00	312.00	0.02	24.00	24.00	24.96	287.04	0.00
046	2FL- Planning PO	T4L4-T8/VLED4-22-NL-KIT	1	40/52	2080		NLIGHT AIR	0.11	112.00	112.00	232.96	0.02	22.00	22.00	45.76	187.20	17.39
047	2FL- Recreation PO	T4L4-T8/VLED4-22-NL-KIT	1	40/52	2080		NLIGHT AIR	0.11	112.00	112.00	232.96	0.02	22.00	22.00	45.76	187.20	17.39
048	2FL- Recreation Open	P3L4-T8/VLED4-22-NL-KIT	2	40/52	2080	1	NLIGHT AIR	0.18	88.00	176.00	366.08	0.04	22.00	44.00	91.52	274.56	34.78
049	3FL- Code Enforcement	SMT3L4-T8/LED3L4-10-L	2	40/52	2080			0.18	88.00	176.00	366.08	0.06	30.00	60.00	124.80	241.28	0.00
050	3FL- Cable PO	W2L4-T8/LED2L4-10-L	1	40/52	2080			0.06	60.00	60.00	124.80	0.02	20.00	20.00	41.60	83.20	0.00
051	3FL- Code PO 1	SMT3L4-T8/LED3L4-10-L	3	40/52	2080			0.26	88.00	264.00	549.12	0.09	30.00	90.00	187.20	361.92	0.00
052	3FL- File Stg	PS75/LED11A-NL	1	40/52	2080			0.08	75.00	75.00	156.00	0.01	11.00	11.00	22.88	133.12	0.00
053	3FL- Clock Tower	PS26CF/LED11A-NL	1	5/52	260			0.03	28.00	28.00	7.28	0.01	11.00	11.00	2.86	4.42	0.00
054	3FL- Clock Tower	S1L4/LED1L4-10-L	1	5/52	260			0.05	50.00	50.00	13.00	0.01	10.00	10.00	2.60	10.40	0.00
055	3FL- Clock Tower	W2L4-T8/LED2L4-10-L	1	5/52	260			0.06	60.00	60.00	15.60	0.02	20.00	20.00	5.20	10.40	0.00
056	3FL- Furnace	PS100/LED11A-NL	1	5/52	260			0.10	100.00	100.00	26.00	0.01	11.00	11.00	2.86	23.14	0.00
			169			**6**		**11.95**			**23912.20**	**3.46**				**17142.48**	**706.62**
												8.49					**17849.09**

Financial Investment

Cost-Savings Summary

EMC
ENERGY MANAGEMENT CONSULTANTS INC.

PLAISTOW NEW HAMPSHIRE INCORPORATED 1749

Plaistow New Hampshire- Town Hall

Cost Savings Summary

Prepared by Carl Edin

February 26, 2019

Area	Savings kW	Savings kWh	Energy Savings	Maint Savings	Total Savings	Project Cost	Estimated Unitil Incentive	Net Project Cost	Payback	ROI
Town Hall	**8**	**17,849**	$ 2,231.13	$ 843.00	$ 3,074.13	**$ 19,595.00**	**$ 5,110.00**	**$ 14,485.00**	**4.71**	**21.2%**

Notes:

1. Blended rate is $.125/kWh

2. Unitil incentive to be pre-approved

Unitil

Utility Document

Unitil Incentive Application

Commercial & Industrial Retrofit

2018 Lighting Incentive

Section A: CUSTOMER INFORMATION

Customer Name	Electric Account Number	Rate	Application Number
Facility Address	City	State	Zip Code
Service Location Identification	Email		
Mailing Address (if different from above)	City	State	Zip Code
Contact Person/Title	Telephone Number	Incorporated? (Check one.) ☐ Yes ☐ No ☐ Exempt	
Customer Signature – Upon Submission:	Incentive Payment Preference (Check one): ☐ Pay Customer ☐ Pay Contractor	If Assigning Payment to Contractor, Customer Signature Required:	

Section B: CONTRACTOR INFORMATION

Contractor Name		Contact Person/Title (Print)	Contact Person Signature	
Mailing Address		City	State	Zip Code
Email	Telephone Number	Additional Information	Incorporated? (Check one.) ☐ Yes ☐ No ☐ Exempt	

Section C: DOCUMENT APPROVALS

PRE-INSTALLATION INSPECTION

Utility Signature	Date

PRE-APPROVAL OFFER

Technical Review - Utility Signature		Date	
Utility Signature	Date	Amount of Incentive Offer ($)	Offer Valid Through:

By signing and dating below, customer accepts this Incentive offer and agrees to the Utility Terms and Conditions available from your Utility. Pursuant to a Commission order, customers also agree that the utility alone may capture all kW and kWh savings and any ISO-NE capacity payments resulting from this energy efficiency project. This agreement is contingent upon continued approval and authorization by the Commission to recover said amounts from the System Benefits Charge. The Incentive, in conjunction with all other sources of funding, cannot exceed the total project cost.

Customer Signature: Date:

POST-INSTALLATION INSPECTION

Utility Signature	Date	Total Project Cost ($)	Amount of Incentive ($)
Customer Signature	Date		

MANAGEMENT APPROVAL

Utility Signature	Date

Project Process Recap

- ○ EMC to attain electric bills
- ✓ EMC to complete site survey
- ✓ EMC to generate cost-savings proposal
- ○ Town of Plaistow to fill out Section A of Unitil Incentive Application
- ○ EMC to submit application to Unitil for incentive approval
- ○ Town of Plaistow to sign EMC & Unitil Terms and Conditions
- ○ EMC to construct project
- ○ EMC to coordinate post-utility walkthrough
- ○ EMC to provide Town of Plaistow with warranty book