Building Performance Evaluation and Sustainability Assessment

Rye Town Hall

Rye, New Hampshire

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Prepared for:

Town of Rye
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Acronyms and Abbreviations

ADA	American Disabilities Act
AFUE	Annual Fuel Utilization Efficiency
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
AT/FP	Antiterrorism / Force Protection
BTU	British Thermal Unit
cf	Cubic Feet
CFM	Cubic Feet per Minute
CIP	Cast-In-Place
CMU	Concrete Masonry Unit
DoE	United States Department of Energy
EB	Existing Building
EER	Energy Efficiency Rating
EPA	United States Environmental Protection Agency
GWP	Global Warming Potential
HVAC	Heating, Ventilation, and Air-Conditioning
IBC	International Building Codes
IBCC	International Building Code Council
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IESNA	Illuminating Engineering Society of America
IR	Infra-Red
LEED	Leadership in Energy and Environmental Design
LPG	Liquefied Propane Gas

MEP	Mechanical, Electrical, and Plumbing
M&V	Measurement and Verification
MASB	Minimum Antiterrorism Standards for Buildings
MERV	Minimum Efficiency Rating Value
NC	New Construction
NEC	National Electrical Code
NFPA	National Fire Protection Association
NG	Natural Gas
ODP	Ozone Depletion Potential
PESA	Performance Evaluation and Sustainability Assessment
psi	Pounds per Square Inch
SEER	Seasonal Energy Efficiency Rating
sf	Square Feet
UFC	Unified Facilities Criteria
USGBC	United States Green Building Council
UST	Underground Storage Tank
VRFZ	Variable Refrigerant Flow Zone
VAV	Variable Air Volume
WBDG	Whole Building Design Guide

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1.0 INTRODUCTION

Forward

Buildings constructed prior to 2003 likely do not comply with current energy efficiency standards for new buildings. In 2003, the *International Energy Conservation Code* (IECC) was developed and adopted by most state and municipal building regulators. The IECC was revised in 2009 which defines new standards including more efficient mechanical equipment and thermal performance of building envelopes.

Through diligent evaluation and enhancement of existing buildings and systems, overall building performance and sustainability can be improved substantially. Enhancements to the building will result in reduced consumption of non-renewable energy resources, improved occupant comfort, and reduced impacts to land, water, and air resources.

Purpose

Under an existing contract with the Town of Rye to perform Comprehensive Energy Audits, anix completed a building Performance Evaluation and Sustainability Assessment (PESA) of the Town Hall Building.

The primary objectives of this task are: 1) to evaluate the overall building performance as defined by energy consumption and building integrity; 2) to assess the overall sustainability of the building components and infrastructure; and, 3) provide recommendations that improve building performance and occupant comfort. Consistent with these objectives, the following general scope of this PESA includes: reviewing historical records and existing building drawings provided by the Town of Rye; visual inspection of the building components and systems and photographic documentation (Exhibit A); a thermal imaging survey of the building envelope (Exhibit B); indoor air quality measurements (Exhibits C-F); and, evaluation and assessment of the building components and systems within the context of current building codes and industry standards.

Between June 4th and 9th, 2009 anix completed a comprehensive inspection of the Town Hall facility. Results of this inspection and all information obtained are presented herein. This report also presents pertinent information gathered from a historical records review. Based upon the evaluation, recommendations are provided for consideration. A red flag ( ) symbol included the text body denotes a recommended action; these actions are tabulated in Section 6.0.

Relevant Codes and Standards

The following current building codes and industry standards are applicable to building performance and sustainability. Although determining total compliance with each code and standard is beyond the scope of this PESA, these serve as general guidelines for this building evaluation and assessment.

Table 1.1 – Relevant Codes and Standards

Current Code / Standard	Issuing Agency	Applicability
International Building Codes (IBC), 2006	International Building Code Council (IBCC)	Standards for building construction practices
International Energy Conservation Code (IECC), 2006	International Building Code Council (IBCC)	DoE recognized standard energy code
NFPA Standard 70, National Electrical Code (NES), 2008	National Fire Protection Association (NFPA)	Standards for electrical and life safety practices
NFPA Standard 101, Life Safety Code, 2009	National Fire Protection Association (NFPA)	Industry standard for life safety codes
NFPA Standard 5000, Building Construction and Safety Code, 2009	National Fire Protection Association (NFPA)	Industry standard for fire prevention requirements for new construction
American Disabilities Act (ADA), Title III (CFR 28 Part 36), 1994	U.S. Department of Justice (DoJ)	Building code requirements to accommodate disabled persons
ANSI/ASHRAE/IESNA Standard 90.1, 2007	American Society of Heating, Refrigerating and Air-Conditioning Engineers	DoE and USGBC recognized standard for mechanical and electrical systems
ANSI/ASHRAE Standard 62.1, 2007	American Society of Heating, Refrigerating and Air-Conditioning Engineers	DoE and USGBC recognized standard for ventilation systems
Energy Code for New Federal, Commercial and Multi-Family High-Rise Residential Buildings, 10CFR434.401, 2002	U.S. Department of Energy (DoE)	Older energy code for federal buildings (*currently under revision consistent with other referenced standards*)
ENERGY STAR® Guidelines for Energy Management, Buildings and Plants	U.S. Environmental Protection Agency (EPA)	Energy management program that defines processes to increase energy efficiency of commercial buildings
LEED® Reference Standard for New Construction and Major Renovation, v. 2.2, 2007	U.S. Green Building Council (USGBC)	Defines energy performance and sustainability standards required for LEED® certification of commercial buildings

Records Review

As part of the Town Hall evaluation, available historical documents were reviewed to gain a better understanding of the building systems and components. The following documents were provided by Town of Rye personnel and reviewed as part of this evaluation:

- Design Drawings for: *Alterations and Renovations to Rye Town Hall*, Philip S. Tambling Architect, August 2nd, 1974.
- Design Drawings for: *Alterations and Renovations to Rye Town Hall*, Philip S. Tambling Architect, September 26th, 1974.
- *Specifications for Alterations and Additions to Town Hall*, Philip S. Tambling Architect and Test, Abbott & Dickson Mechanical and Electrical Engineers, September 26th, 1974.
- *Composite Sketch of Town Owned Lands*, John W. Durgin Associates, April 15th, 1980.
- *Rye Town Hall Floor Plans*, Lee Blaisdell, September 10th, 1997.
- *PlanNH Charrette Application*, Earl Rinker, February 8th, 2001.
- *Specifications for Town Hall Improvements*, Town of Rye, July 11th, 2002.

Building Description and History

Rye Town Hall c. 1873

The Rye Town Hall is located at 10 Central Road in the center of Rye within the defined historic district. It is composed of three adjoined buildings including the original historic structure (c. 1846) and two building additions to the rear (c. 1890 and 1980). The building and associated infrastructure, including parking, are sited on Town owned land within the historic section of the Rye Town center. The Town Hall complex is located within the northwest corner of a large town owned parcel consisting of nearly 200 acres of contiguous land (Figure 1). Abutting the Town Hall to the northeast is the Rye Congregational Christian Church and Central Road defines the western property limit. The Town cemetery abuts the complex to the south and private residentially developed properties lie beyond. Access to the Town Hall is gained from a driveway off of Central Road which leads into a parking area.

The Town Hall building is orientated approximately ten degrees counter-clockwise from the north-south axis with the building front facing due west. The original building was constructed as a church and is a two-story colonial structure with a gable roof and a belfry at the front. A two-story hip roof addition (c. 1890) was added to the rear of the original structure to accommodate a stage on the second floor and office space below. A second two-story addition (c. 1980) extends from rear of the original addition and has a hip roof and first and second story access. Space below this addition provides records storage for the Town Hall.

Center of Rye (looking north on Central Road) c. 1903

According to accounts by Langdon D. Parsons (*History of the Town of Rye, 1903*), sometime in the early 1870's the Rye meeting house was demolished after a warrant for the appropriation of funds for "fitting up" the old meeting house into a new Town Hall building was dissapproved by voters. Town meetings were then held in the vestry of the

Congregational Church. In 1872 the prolific Pastor Barber and his wife left the Rye Methodist Church and moved to Newton, Massachusetts after Mr. Barber became ill. Shortly thereafter, the church dissolved and the Town initiated negotiations to purchase the church building and land. In 1873, the Town purchased the church building and land for the sum of $1,000. An additional $3,000 was spent retofitting the front and interior to "fit the purpose intended". The building was dedicated as the new Rye Town Hall on November 19th, 1873. In 1890, the town voted to add a fourteen-foot addition to the rear for the cost of $400. Langdon notes that the Town Hall building "has proved to be a rather expensive building, as repairs have frequently been required, and will continue to be required as long as it remains on its present foundation".

In 1974 the building was renovated and the lower portion of the rearmost addition was closed-in to provide additional office space. The building interior was renovated again in 2002 including reconfiguring lower and upper office spaces and adding a kitchen and lavatory to the second floor. Other Town records discuss the need for additional building improvements to better serve functional needs of the Town and to improve occupant comfort. In 2001, the acting Town Administrator applied for a PlanNH Charrette but it is unclear if a Charrette was ever completed for the Town.

Space Configuration and Use

The net conditioned area of the Town Hall building is approximately 5,642 square feet including all first and second spaces and the storage room located on the third floor. This area does not account for the unfinished attic spaces. Primary designated use spaces within the Town Hall include public assembly areas and office spaces for Town employees (open and private). Table 1.2 presents the estimated area based on the designated use for the Town Hall. Figures 2 and 3 present a building floor plan and use designation map of the Town Hall for the lower and upper floors respectively.

Table 1.2 – Gross Floor Area by Use

Use Designation	Net Conditioned Area (sf)	% Gross Area
Assembly	876	15.5
Dining / Food Prep	249	4.4
Lavatory	97	1.5
Mechanical / Utility	159	2.8
Office – Open	1,795	31.8
Office – Private	646	11.4
Passage	1,035	18.3
Storage / Warehouse	733	13.0
Vestibule / Entry	54	1.0
TOTAL:	5,642	100%

The current building configuration and space use does not appear to support the needs of the Town Hall users. More than 18% of the building is designated for passage suggesting inefficient layout and configuration – in general, passage space in office buildings should represent 5% to 10% of total conditioned area. Other concerns include corridors within office space such as the recreation office, the Town Engineer Office, and the office in the southwest stairwell. Although storage space represents a sizeable portion of the building area, the storage spaces are not easily accessible and are not efficiently organized resulting in less usable storage space. Respective areas for office and assembly space are 43% and 16% of the net conditioned area representing a total primary space allocation of 59%. Primary spaces should represent at least 75% of the total conditioned space to provide the most efficient utilization of space.

Other observations made during the building inspections included a lack of office privacy in the second floor open office area where partial walls (8-feet) and a tin ceiling limit private conservations and increase noise distraction. Because there are no designated office equipment areas, photocopiers, printers, file cabinets, and other equipment are kept in open office areas and corridors. Aside from the kitchen areas which are constrained, there are no common that promote social interaction among building occupants.

It is recommended that a space planning study be completed to define the functional needs for existing and potential future Town operations.

2.0 BUILDING SYSTEMS PERFORMANCE EVALUATION

Envelope Integrity and Performance

The building envelope and performance of the Town Hall was evaluated based on a visual inspection and thermal imaging survey of all building systems and components. Representative photographs are presented in Exhibit A and the thermal survey report is presented as Exhibit B.

Foundation

Inspection of the original building foundation along the south perimeter identified a granite stone, brick and mortar perimeter wall that extends approximately sixteen-inches from a concrete footing or slab and supports a timber sill plate. It appears as though several repairs have been made to the foundation wall over time. The front (west) and north perimeter of the original building foundation consists of a concrete wall extending below grade. It is presumed that the exposed concrete slab evident along the south perimeter is a continuous monolithic structure that extends beneath the entire building. Investigation of the south perimeter stone and mortar wall revealed several deteriorated sections where cracked and spalled mortar have created gaps (Photographs 156-157, 164-172, 236-243). Bearing on the perimeter stone wall could not be determined, however, it does appear that the concrete slab and any subgrade footings provide primary bearing support for the building.

Inspection of the interior section of the wall identified the interior wallboards located sixteen-inches from the outer edge of the exterior wall (Photographs 236 to 239). It is presumed that the stone wall is eight-inches wide and the timber wall stud is eight-inches thick. The wood sill plate resting on the stone wall is deteriorated and in very poor condition due to moisture damage. Although, the sill plate does not appear to have substantial vertical loading, further investigation of the interior wall to determine load distribution should be performed.

Because the connection between the structural timber framing members to the original building foundation could not be determined, a more rigorous inspection of the structural foundation connection is recommended. As part of this investigation the condition of all timber members should be assessed. Additionally, the foundation system could not be verified and further investigation is warranted to determine the foundation type, dimensions, and configuration (i.e., continuous slab, continuous perimeter footing, column footings). It is noteworthy to recall Langdon Parsons comment in his Town of Rye historical account in 1903 whereby he states that the building requires frequent repairs and he implies that the foundation was poorly constructed.

Foundations for the two additions were also inspected and no significant deficiencies were noted. The exposed portion of the older foundation wall is composed of brick and mortar and the footing for the wall could not be verified. Records suggest that the brick wall was repaired as part of the 1974 renovation project. Foundation walls for the newer addition consist of concrete walls presumably supported by a continuous shallow footing wall (based on construction date). Although no significant foundation issues were noted, it is recommended that they be further investigated as part of the original building foundation evaluation.

Floors

The basement concrete slab-on-grade (SOG) floor was visually inspected in the mechanical rooms and no indications of settlement or other defects were observed. The remainder of the floor is covered with carpeting and floor tiles –visual inspection did not reveal any indications of floor deficiencies. Floors for the second or upper floor areas are supported by a timber framed joist system which appears to be in satisfactory condition. No intermediate columns were noted and based on the original building use (church), the floor joists are presumed to be supported by timber girders spanning the entire building width.

Structural Members

The Town Hall building is supported by hand-hewn pine timbers with pinned mortise and tenon connections (Photographs 62-67). Pins consist of wooden dowels approximately one-inch in diameter. Many of the dowels have loosened due to normal moisture expansion and shrinkage and are partially connected (Photographs 64, 66, 67, and 96). The roof is supported by simple king trusses with lateral bracing (Photographs 57-60).

Overall condition of the timber structural system is good – minor recommended improvements include repairing the wooden dowel pins which can be achieved by several methods. To preserve the historic integrity of the building, the existing dowels should be re-inserted and steel lag bolts added to provide additional connection strength. Another option includes replacing the existing dowels with new hardwood dowels (oak).

Walls

Although wall sections of the original building could not be verified, they are presumed based on construction methods consistent with the period and observations and images created by the infrared camera including framing methods of exposed members in the attic. The original building is a timber-framed structure with clear-span truss supports in the attic. Therefore, the perimeter walls entirely support the building with a system of timber beams, columns, and angled bracing supports. The IR thermal images reveal the timber framing including vertical columns, wall studs, horizontal beams and angled bracing timbers (IR Report pp. 16, 35-42, 59, 70, 73-75, 86). The images also identify a lower sill wall consisting of a perimeter beam supported by a conventional timber framed stud wall (2-inch by 8-inch studs at 16 or 24-inch O.C.). It is presumed that this lower wall was constructed to support a sill beam and uniformly distribute the point loads from the larger timber members to the foundation system.

The exterior walls are clad with cedar clapboard and interior walls are covered with plaster. Some of the interior walls area also covered with wainscoting, beadboard (e.g., stairwells), and paneling (e.g., public meeting room). Some of the loose-fill fiberglass insulation on the attic floor has fallen into the open wall cavities, however no other wall insulation was observed during inspection. In a building of such age it would not be uncommon for discrete sections of walls to have been insulated at some time due to drafts or frozen pipes.

The addition walls are conventionally framed with 2 by 4-inch timber studs spaced at sixteen-inches on center (Photographs 89, 90, 93, 94). With the exception of the first-floor walls on the newer addition, insulation was not observed in the wall cavities. Interior wall finishes include plaster and wood beadboard.

Table 2.1 – Perimeter Wall Sections

Location	Wall Section	Cavity Insulation
Original Structure – Upper	Cedar clapboard, ¾" wood plank sheathing, +10" timber frame cavity, ¾" wood plank sheathing, 5/8" plaster.	None
Original Structure – Lower	Cedar clapboard, ¾" wood plank sheathing, 16" timber frame cavity, ¾" wood plank sheathing, 5/8" plaster.	None
Older Addition	Cedar clapboard, ¾" wood plank sheathing, 4" timber frame cavity, ¾" wood plank sheathing, 5/8" plaster.	None
Newer Addition	Cedar clapboard, ¾" wood plank sheathing, 4" timber frame cavity, ¾" wood plank sheathing, ½" wood beadboard.	None

Legend: GWB = Gypsum Wall Board, EPS = Extruded Polystyrene, FGB = Fiberglass Batt

No structural deficiencies were noted in the original building or additions and all walls appeared to be plumb and sound. A wall penetration was observed in the south wall of the third floor records storage room – it is recommended that this be sealed (Photograph 98).

The most notable observation is the lack of insulation in the wall cavities – this is discussed in greater detail in the Thermal Envelope section of this report (Section 4.0).

Ceilings

Ceiling materials and finishes in the original Town Hall vary throughout the building. A suspended acoustical ceiling covers most of the first floor area except the public meeting room where an older tile ceiling remains (Photograph 107). The space above the suspended ceiling is used as a chase for ductwork and electrical and communications wiring (Photographs 134, 122, 123, 230). The ceiling in the rear records storage area is covered with gypsum wall board (Photograph 125). Is appears that the original ceiling on the first floor consisted of wooden beadboard (Photograph 122).

Ceilings in the stairwells are composed of wooden lathe and plaster. Water damage was noted in the northwest stairwell ceiling (Photograph 100). No evidence of recent wetting was observed and this damage is presumed to be a result of artifact roof leakage. It is recommended that the plaster ceiling and adjacent walls be repaired.

Second floor ceilings consist of wooden beadboard, plaster, acoustical drop ceilings, and a decorative tin tray ceiling. The tin tray ceiling adorns the main portion of the second floor and is considered to be architecturally significant to the structure. Wooden beadboard covers the office areas in the front stairwells and the rear addition area. Plaster ceilings are located in the stairwells and an acoustical drop-ceiling is located in the Town Administrators office.

Attic

The attic space above the second floor was inspected for insulation, ventilation, and overall condition of exposed structural members. The floor is covered with loose-fill fiberglass insulation placed directly on the plaster and wood lathe ceiling and there is no moisture barrier (Photographs 56, 58, 60). Because the ceiling is slightly curved toward the walls, some of the uncontained insulation has sloughed into the wall cavities (Photographs 244-249).

No attic ventilation was noted during the inspection and as evidenced by the IR thermal images (IR Report pp. 24-29) there is a significant heat load from the roof. A lack of ventilation increases heat loads to the building through ceiling penetrations, wall cavities, and insulation breaks in the attic floor and increase the potential for moisture damage of building materials. Installation of thermostatically controlled fans in recommended in the main attic and the addition attic space

A bat was identified nesting in the joints of a timber frame connection (Photograph 67) and rodent droppings were observed in the attic (Photograph 61). Although no indication of pest damage was noted, it is recommended that a pest professional inspect the building to ensure that it is not infested with other rodents including mice and squirrels .

Roof

The Town Hall roof was inspected to determine composition and existing condition. The roof consists of an asphalt shingle roof over the original wood plank roof sheathing. Some sections of the sheathing planks have been replaced due to cracking (presumably from foot traffic during roof work). No insulation board exists on the roof and edge flashing is inadequate as it does not extend beyond the roof edge thereby causing water to drip onto the wooden eave molding and fascia. Visual inspection of the roof shingles revealed indications of pending failure including cracked and warped shingles.

It is recommended that the roof system be entirely replaced within the next 2-years . Replacement should include removing the existing roof shingles, covering the entire roof with exterior rated plywood sheathing (over existing plank sheathing), installing a bituminous self-adhering waterproofing film on the entire roof, installing new curb flashing on penetrations, installing new drip edge flashing that extends over the fascia wood molding, and installing new asphalt shingles with a minimum rating of 30-years. Replacement of the roof system should also consider replacement of the fascia boards and moldings as recommended later in this report.

Much of the gutter system has been removed from the building most likely due to deteriorated fascia boards that do not hold the gutter nails. The remaining gutter sections are not properly affixed to the fascia and water is able to drain behind the gutter and onto fascia boards and moldings (Photograph 257). This can be especially problematic during freeze-thaw conditions when water can backup beneath the edge flashing and create moisture infiltration into the roof eaves. Therefore, removal of the remaining gutter sections is recommended .

Belfry

The belfry is considered a historically significant component of the Town Hall building and was inspected as part of the roof evaluation. No significant deficiencies were noted in the belfry and with the exception of some relatively minor moisture damage to a timber beam (Photographs 78 and79), the belfry structure is in good condition. A significant amount of debris has accumulated on the belfry floor presumably due to bird nesting (Photograph 77). It is recommended that the debris be removed to prevent moisture accumulation and to deter future bird and rodent nesting. Other recommendations include sealing the belfry louvers and other gaps to prevent rain and bird intrusion.

Windows and Glazing

Inspection of the existing window units included visual inspection and a survey with an infra-red (IR) camera. The windows in the original structure are double-hung units with intact sash cords and weights. These original windows are low-efficiency single-pane units but are considered to be historically significant to the structure. The window sashes, glazing, and grilles are in relatively good condition and storm window units are installed on the window exteriors. Table 2.2 presents a window schedule for the Town Hall.

As an alternative to replacing the units with high-efficiency windows, these historic windows can be preserved and retrofitted to improve thermal performance. Retrofitting of the units includes removing the original sash cord and weights, re-glazing of the panes, and filling the weight cavities with expanding insulation such as polyurethane foam. It is also recommended that the windows be permanently sealed to minimize air infiltration by caulking the interior and exterior frame using polyurethane caulking.

Table 2.2 – Window Schedule

Unit No.	Location	Window Type	Operable/ Fixed	Window Construction	Notes
1	Addition	Double-hung	O	Wood and vinyl framed, double-pane glazing with ½" air-break and metal spacer.	Low-efficiency units. Several units have gaps between sash and frame due to poor installation.
2	Original Structure	Double-hung, true divided lights	O	Wood frame, sash, and grilles. Single-pane glass. Sash cord and weight operation.	Very low-efficiency units. Original historic windows in operable condition.
3	Addition	Undivided lights and storefront assemblies	F	Aluminum frame, double-pane glazing with ½" air-break and metal spacer.	Low-efficiency units. Some caulking is separating from glazing.

To provide fresh-air ventilation during transitional seasons (spring and fall), one of south facing windows and one of the north facing windows (on each floor) could be left in operating condition. Another option is to add operable transom awning windows to replace the function of the original windows (this option should consider the historical architecture of the building). Windows in the newer addition are not considered historically significant and are low performing units. Therefore, replacement of these units with high-efficiency windows is recommended.

The roof overhang is limited and does not provide shading of the upper windows. Deciduous trees on the north side of the Town Hall provide some shading thereby reducing solar heat loading during cooling periods. Interior horizontal shades are located on the original double-hung windows helping to reduce solar heat gain during summer months. However, not all of the south-facing windows have shades including the unit in the older addition (Photograph 19). It is recommended that exterior shades or interior UV reflective shades be installed on all south facing windows and that they are lowered during cooling periods to reduce solar heat gain. A less immediate option is to plant deciduous trees on the south face lawn area to provide natural shading. Even in transitional seasons, the solar heat gain from the south-facing windows is evident based on the infrared imaging (IR Report pp. 7 and 15). Table 2.3 presents the window area for each building face relative to the respective exterior wall area.

Table 2.3 – Windows Area and Orientation

Face	Exterior Wall Area (sf)	Window Area (sf)	% of Window to Wall
North	1,912	141	7.4
South	1,912	228	11.9
East	1,140	39	2.0
West	1,140	79	6.9
Totals:	6,104	487	8.0

Doors

Similar to the windows, inspection of the existing entry doors units included checking door operation, visual inspection of door integrity, and a survey with an IR camera. There are a total of five entry doors for the Town Hall including the entry on the west face which is composed of the original wood panel double-doors for the main church entry.

The original double-entry doors on the west face are no longer used and public entry to the Town Hall is provided by the south entry vestibule on the first floor. Secondary egress for Town employees is provided on the rear/east side of the building with first and second floor entries. As observed during the field inspections, the second floor entry is also used by Town employees and occasionally used by the public to access the Recreation Office and other second floor offices. The first floor east entry appears to have limited use and functions primarily as a secondary egress for employees. Table 2.4 presents a schedule of all entry doors for the Town Hall.

Table 2.4 – Entry Door Schedule

Perimeter Wall	Location	Door Type	Glazing	Function
S	1ST floor	Wood panel	Top	Main entry for public. Vestibule entry with air-lock with overhang.
E	1st floor	Wood panel	None	Secondary egress for first floor. Limited use.
	2nd floor	Wood panel	Top	Recreation office entry and secondary egress to second floor functions.
W	1st floor	Wood panel (double)	None	Original double entry door. No current function.

The existing wood panel doors are very low efficiency units providing substantial thermal transfer between the interior and exterior environments. Inspection of the doors revealed air gaps on all of the entry doors (Photographs 104, 108, and 231). All doors should be sealed/weatherproofed to reduce air leakage and improve thermal performance – the front/west double doors should be sealed if it is not required for access and egress (review with Rye Fire Department).

Exterior Trim

Exterior trim for the Town Hall includes door and window molding, watermark trim, corner molding, and fascia molding. Much of the trim/moldings are deteriorated as a result of moisture damage (Photographs 149, 157, 162, 163, 168, 171, 172, 180, 182, 250-257). Some of the trim moldings are deteriorated beyond repair and require replacement. Because the moldings are historical significant to the building, replacement of such should consider replication of the original moldings.

Other molding sections require routine maintenance including scraping, sanding, priming, and repainting to provide protection against the elements. Addressing the issues noted in the roofing section will also help to preserve the existing trim and mitigate future damage of such.

Mechanical Systems

Heating

Heating is provided to the Town Hall from an oil-fired hot water boiler supplying a packaged air-handler with heating coils. The boiler unit is a Weil-McLain Model No. 578, Series 1 with a rated gross output of 521,000 BTU/hr (Photographs 114-116). The unit is passively vented into the existing chimney and combustion air is provided by a horizontal passive wall duct with louvers (Photographs 117-118). There are two zone pumps presumably for the first and second floors (Photograph 119). The boiler is estimated to be more than fifteen years old and according to occupant accounts, it requires frequent repair (Photograph 121). A published efficiency rating was not available and the estimated AFUE is 75% based on unit age and condition. The packaged air handler unit is a First Co., Model 940-2 CU rated at a maximum output of 91,000 BTU's at a hot water coil temperature of 140°F (Photographs 131-133). Heat for the second floor recreation office space and the Town Administrator office is provided by a series of electric baseboard heating units.

Oil is supplied to the boiler from an underground fuel storage tank buried on the north side of the building (Photograph 150). The size and condition of the tank are unknown and inspection of the tank should be completed to ensure that it is in good operating condition. Ideally, the underground tank would be removed and replaced with an alternate fuel source for heating. If the Town expects to continue using oil, then the buried tank should be replaced with an above-ground tank complying with NFPA code.

Because the older oil-fired boiler is expected to have a low operating efficiency, replacement of the unit would result in substantial cost savings due to reduced fuel consumption. A new alternative fuel unit (gas or electric) would also have reduced maintenance and repair costs compared to oil units. Additional benefits include reduced air emissions.

Hot air from the air-handler unit is distributed via ductwork and ceiling and wall mounted diffusers. Ductwork for the lower level is routed through the suspended ceiling. Ductwork for the upper level is routed vertically to perimeter walls and diffusers. Ductwork observed in the first floor ceiling chase is insulated with wrapped fiberglass having a rated thermal value of R-2. If the supply ductwork is expected to continue servicing the building, additional insulation is recommended to prevent heat loss from the ductwork into the unconditioned ceiling chase and walls.

On June 3rd, 2009, a temperature survey of the Town Hall conditioned spaces was completed. Ambient conditions included an outdoor temperature of 65°F, relative humidity of 60%, and clear skies. The overnight low temperature was approximately 52°F and the heating system did operate during the overnight hours. All recorded temperatures in the conditioned areas of the Town Hall exceeded recommended setpoint temperatures (67-69°F) and ranged from 73°F to 82°F with an average reading of 77°F. Highest temperatures were recorded in the second floor recreation office, Town Administrator Office, and the first floor Planning Office. The lowest temperatures were recorded in the first floor offices east of the meeting room. The deviation in temperature suggests that heating distribution throughout the conditioned spaces is not balanced – this is consistent with information provided by occupants throughout the building. Additionally, portable space heating units were observed in some office areas which are indicative of an inefficient heating distribution system.

Because the building wall cavities are not insulated and the air leakage rate is high, a substantial amount of heat is lost through the building envelope thereby diminishing the heating capacity of the system. It is estimated that 20% to 30% of generated heat is lost to unconditioned spaces and through the building envelope.

Cooling

Cooling is supplied to the Town Hall building from the packaged DX air handler unit, a bank of split air-cooled DX units located at the north side of the building (Photographs 151-152), and a window unit in the Recreation Office area (Photograph 12). Table 2.5 presents a schedule of the air-conditioner units.

Table 2.5 – Air-Conditioner Condensing Unit Rated Specifications(1)

Unit	Refrigerant	Capacity (BTU/hr)	SEER Rating	Notes
Sanyo C2422-01	R-22	22,800	10	Supplies the second floor open office area.
Sanyo C2422-02	R-22	22,800	10	Supplies the second floor open office area.
Sanyo C2422-03	R-22	22,800	10	Supplies the second floor open office area.
Sanyo C2422-04	R-22	22,800	10	Supplies the second floor open office area.
American Standard Allegiance 10	R-22	10,000 (1)	10	Assumed to supply the packaged air handling unit.
Sanyo 06	R-22	7,000 (1)	10	Assumed to supply the Town Administrator office.
Recreation Office Window Unit	R-22 (1)	4,000 (1)	10	Recreation office window unit – does not appear to be sufficient for the space.

(1) Assumed values based on industry standards.

The air conditioner units are low-efficiency units compared to available technology and as of January 2006, all air conditioning units sold in the U.S. are mandated to have a minimum SEER of 13 or greater. All of the existing units are rated at 10 or less while high-efficiency air conditioner units can achieve SEER ratings in excess of 20. As example, a SEER 20 unit would provide an equivalent amount of cooling capacity while using 50% less energy than the existing SEER 10 units. The existing condensing units contain R-22 refrigerant which has a relatively high ozone depletion potential (ODP) and global warming potential (GWP) compared to currently available refrigerants.

The current cooling system configuration is very inefficient with seven independent units supplying the building. Because compressors use the most energy when they are in startup mode, the more units that are cycling exponentially increases total electrical usage. Replacing these units with a single high-efficiency unit would provide a substantial reduction in electrical energy consumption. Ideally, the existing cooling system would be replaced concurrent with the heating system (refer to Section 4.0).

Humidity Control

Measured relative humidity (RH) levels in the Town Hall indicate that humidity is within the recommended range per ASHRAE (25% to 60%). On June 3rd the ambient humidity was 60% and the recorded levels in the conditioned spaces of the Town Hall varied from 30% to 40% with an average value of 36% (Figure 4 and Exhibit E). It should be noted that the humidity measurements represent a single-point in time and that humidity will change based on meteorological conditions, building loading, and HVAC system operation. RH levels should be routinely measured and following any HVAC system modifications or improvements, ideally during peak heating and cooling periods.

Proper humidity control is important in older buildings to prevent moisture accumulation and to ensure occupant comfort. Currently there are no humidification systems in the Town Hall. It is recommended that a humidification system be integrated into the design of a new heating and cooling system for the building.

Ventilation

On June 3rd, carbon dioxide (CO^{2}) concentrations were measured in the Town Hall conditioned spaces. The EPA recommended threshold for CO^{2} is 1,000 parts per million (ppm) and of thirteen measurements throughout the lower and upper level occupied areas, concentrations ranged from 525 ppm to 973 ppm with an average concentration of 764 ppm (Exhibits C and D). The elevated concentrations were measured at the vaulted ceiling in the second floor open office Based on these results, design of a new ventilation system is recommended – this should be considered as part of a new HVAC system design. It is noted that the data represents a single point in time and concentrations will vary based on atmospheric conditions, HVAC system operation, and occupant loading. Ideally, several measurements will be taken during peak heating and cooling periods.

Outdoor combustion air is supplied to the boiler unit via a square wall vent with louvers – it is recommended that the passive vent be replaced with a pressure actuated damper. Fresh air for the air handler unit is supplied from a window mounted passive vent measuring approximately 10-inches by 1-inches (Photograph 130). This small vent does not provide an adequate supply of outdoor for the HVAC system and the air handling unit obtains a large volume of make-up air from the building interior thus lowering indoor air quality during heating and cooling operation. It is recommended that a new air supply system is designed based on the building space and HVAC demand – ideally this would be integrated with a new HVAC system. As part of a new air supply design, heat recovery units are recommended to condition/heat the outdoor air prior to entering the furnace thereby improving system efficiency. Fresh-air is also supplied to the building through the operating double-hung windows. Two ceiling fans are located in the second floor open office area to help circulate air in the vaulted ceiling area.

Exhaust ventilation is limited to ceiling fans located in the lavatories. No exhaust fans are located in the attic and based on the heat loading from the roof, installation of fan units is recommended in the main attic area and in the rear addition attic. The fans should be thermostatically controlled with setpoints of 85°F. It is also recommended that all lavatory exhaust fans be connected to the light switches to ensure operation during occupancy.

Electrical Systems

Supply and Distribution

Electric is supplied to the Town Hall via overhead transmission lines connecting to the southeast corner of the original building (Photograph 176). The main 200-amp circuit panel is located in the second floor corridor of the older addition (Photograph 191) and a newer panel is located in the Recreation Office closet (Photograph 1). The metered usage on the date of inspection was 0.88 kW/h (Photograph 174) when no HVAC equipment was operating including the air-conditioning units. Assuming that the usage was for lighting and plug loads only, it represents approximately 40% of the peak building load at 80 amps (110v). Peak load condition assumes that all air-conditioning units and the air-handler are operating simultaneously during the hottest periods (July-August). The four large Sanyo units use 2.4 kW/h each or a total of 9.6 kW/h plus an additional load 6 kW/h for the smaller A/C units and window unit. Table 2.6 presents the estimated peak electrical load condition.

Table 2.6 – Estimated Peak Electrical Load

Load	Voltage	Usage (kW/h)	Amperage	Notes
Base lighting and plug loads	110	0.88	80	Based on meter reading w/ no HVAC loads
Air-conditioning units	220	15.60	71	Based on mfr. specifications
Air-handling unit	110	1.32	12	Based on mfr. specifications
	Totals	17	163	

Based on the estimated peak load of 163 amps, the existing 200-amp service provides little additional capacity for large office equipment such as photocopiers and additional plug loads that may be added. It is recommended that the service be increased to at least 300-amps part of any major building renovation.

Several electrical issues were noted during the inspection including potentially overloaded circuits, improperly routed wiring, and overloaded outlets. Inspection of the main circuit panel with the infrared camera revealed “hot” and potentially overloaded circuits and wiring (IR Report pp. 11-13) – this should be investigated further by a licensed electrician. Outlets in the second floor corridor were taped and posted to prevent usage due to tripping circuit breakers (Photographs 200-202). The measured amperage on one of the outlets was 1.26 amps indicating that the circuit is not overloaded which implies either a faulty breaker or faulty wiring – this should be investigated further by a licensed electrician.

Because there is an insufficient number of outlets in the building, extension cords are being used which creates a fire hazard and potentially overloaded outlets (Photograph 113). Additional outlets are necessary in many office spaces – as a temporary measure the ungrounded extension cords should be replaced with common surge protection units. The outlet beneath the first floor sink is not GFCI protected and it is recommended that a GFCI outlet be installed to comply with code requirements.

Some unshielded wiring is haphazardly routed in chase areas including the first floor drop ceiling and the space below the second floor stage (Photographs 13, 24, 122, 134, 135, and 230). Poorly routed and unsupported wiring is a concern as it is vulnerable to damage (e.g., beneath the stage), and tracing of wiring is difficult due to intertwined wiring and old disconnected wiring. Exposed unshielded wiring was identified on the second floor corridor walls (Photograph 25) – it is recommended that the wiring be shielded or placed within a chase where it would not be exposed. As part of any new electrical work, all old abandoned wiring should be entirely removed and new wiring should be properly routed and supported. Renovation plans for the Town Hall building should include designing and installing an entirely new electrical supply and distribution system.

Lighting

Lighting fixtures in the Town Hall vary throughout the building. Building fixtures include ceiling mounted fluorescent fixtures, incandescent fixtures, track-lights, and chandeliers. Desk lamps are also used for task lighting in several offices.

Table 2.7 – Lighting Fixtures Schedule

Floor	Location	Fixture Type
1	Corridors	4' Surface-mounted Fluorescent
1	Public Meeting Room	4' Surface-mounted Fluorescent
1	Town Clerk Offices	4' Surface-mounted Fluorescent
1	Building Inspectors Office	4' Surface-mounted Fluorescent & 2'x2' recessed Fluorescent
1	Rear Records Storage	4' Surface-mounted Fluorescent
1	Lavatories	Incandescent fan/light unit
1	Mechanical Rooms	Incandescent
2	Lavatory	Incandescent fan/light unit
2	Office Areas	Incandescent 4" track lights
2	Vaulted Open Area	Chandeliers (4) w/ fluorescent bulbs (10 ea.)
2	Town Administrator Office	2'x2' Fluorescent
2	Recreation Office	4' Fluorescent

Minimum recommendations for lighting fixtures in the Town Hall include replacing or retrofitting fluorescent fixtures with low-wattage ballasts and bulbs (note that PSNH offers a lighting retrofit program). And, all incandescent bulbs should be replaced with compact fluorescent light bulbs (CFLs). More costly recommendations include replacing the lighting system with a more efficient lighting configuration and fixtures. The current configuration in the open office area does not provide adequate lighting density during sundown conditions and a more efficient configuration would reduce energy consumption and improve occupant comfort.

Appliances

Electrical appliances in the Town Hall building include refrigerators, microwaves, toasters, coffee-makers, and a cooktop unit in the second floor kitchen (Photographs 48, 49, and 138). None of the appliances are EnergyStar® rated and the second floor kitchen refrigerator is a very inefficient older unit. Measured amperage on the refrigerator was 1.06-amps which is more than twice the consumption of a new equivalently sized EnergyStar® rated refrigerator. Additionally, this unit creates a substantial heat load (IR Report p. 19) to the conditioned space and during cooling periods it increases the cooling demand thereby consuming additional energy. Based on predicted energy savings, replacement of this refrigerator with an EnergyStar® unit would provide a return on investment within five years. Future replacement of all other appliances should consider EnergyStar® rated units.

Mechanical Equipment

Major electrically controlled mechanical equipment includes the air handler fan and the domestic hot water heater. Replacement of the air handler unit should be completed as part of a new HVAC system design and installation. The domestic hot water is an instant-on unit and is relatively efficient.

Electronics

Notable electronic equipment for the Town Hall includes computer systems, printers, and photocopier machines. Often referred to "phantom loads" these electronics can be a significant source of electrical consumption. As evidenced by the thermal camera images (IR Report pp. 17-18), these electronics also contribute to heat load within the building during cooling periods.

Recommendations to help reduce phantom loads include powering off all office equipment at the end of each day (computers, photocopier, and printers) and removing chargers from outlets when not in use. By plugging all equipment into a surge protected multi-outlet, multiple equipment can be powered on and off using a single switch.

Plumbing Systems

Water Supply and Distribution

Water for the Town Hall is supplied from a public distribution system managed by a State regulated utility company (Aquarion Water). No distribution system issues were noted and supply pressures are adequate for the current uses. The age of the main supply pipe could not be verified – it is recommended that Town records be reviewed to determine the age of the supply pipe. If the supply pipe is more than 30 years old then complete replacement should be considered.

Domestic Hot Water

Domestic hot water is provided by a small tank unit beneath the first floor sink (Photograph 139). The unit is relatively new (Dec. 2006) and is a relatively efficient unit. As evidenced by the IR thermal imaging (IR Report p. 62), there is no insulation on the hot water piping resulting in heat loss to conditioned spaces and wall cavities (IR Report p. 57 and 58). Installation of piping insulation to the hot water piping is recommended.

Fixtures

Plumbing fixtures in the Town Hall building include kitchen sinks, lavatory sinks, and toilets (Photographs 49, 52, 53, 102, 103, and 138). Table 2.8 presents a summary of the interior fixtures and estimated maximum flow rates.

Table 2.8 – Interior Plumbing Fixtures

Room and Description	Fixture Type	Qty.	Est. Max. Flow Rate (gpm/gpf)
1st Floor Kitchen	Kitchen Sink Faucet	1	2.0
2nd Floor Kitchen	Kitchen Sink Faucet	1	3.0
1st Floor Women's Lavatory	Sink Faucets	1	1.5
	Toilets	1	1.8
1st Floor Men's Lavatory	Sink Faucet	1	1.5
	Toilets	1	1.8
2nd Floor Lavatory	Sink Faucet	1	1.5
	Toilet	1	1.6

All fixtures were in good working condition and no deficiencies were noted. Assuming the Town Hall water consumption is 150 gallons per day (gpd) with a total annual water consumption of 54,750 gallons. Current water consumption rates by Aquarian Water are $4.380 per 1,000 gallons. Replacing or retrofitting toilets and sinks with low-flow fixtures would reduce total consumption by at least 30%. As presented in Table 2.9, this would provide a net annual savings of $72.

Table 2.9 – Potential Water Consumption Savings

Annual Consumption (gallons x 1000)	Annual Cost	Predicted Consumption (gallons x 1000)	Annual Cost	Predicted Annual Cost Savings
54.750	$240	38.325	$168	$72

While the potential cost savings are nominal, water rates are expected to increase by a percentage higher than the standard inflation rate thereby providing additional future cost savings. In addition to reduced water consumption, conservation measures will also reduce sanitary loads to the septic system thereby increasing the service life of the system.

Specific measures to reduce water consumption include installing low-flow aerators on all sink faucets, installing low-flow toilets (1.2 gallons per flush or less), and installing motion-sensitive faucets. Installing local tankless hot water heating units beneath each sink will also reduce water consumption by providing instant hot water at the tap.

Sanitary Systems

All sanitary wastes drain to an on-site septic system. Plans and design information for the system were not available. Annual or bi-annual cleaning and inspection of the system is recommended to ensure proper operation.

Hazardous Building Materials

Completion of a detailed building materials hazardous survey is beyond the scope of this evaluation, however, the following information is provided based on the building age and observations noted during the inspection. This is not intended to be a comprehensive listing and is provided as anecdotal information only.

Asbestos Containing Materials

Some common asbestos containing materials (ACMs) used in building construction prior to the mid-1970s include:

- Pipe insulation
- Refractory masonry
- Asphaltic roofing
- Flooring tiles
- Mastics and adhesives
- Window glazing compound
- Wall plaster
- Siding (transite)
- Piping (transite)

Potential ACMs in the Town Hall building include the 9-inch square floor tiles on the first floor, brick and stone mortar, wall plaster, window glazing compound, piping insulation concealed in the existing walls, exterior buried piping insulation (heating oil supply), and exterior buried drainage piping (transite).

The suspect floor tiles are exposed in the first floor public meeting room (Photograph 106) and in the two mechanical rooms (Photographs 129 and 229). Tiles in the meeting room are in good condition and do not pose an immediate hazard. The tiles in the mechanical rooms however are in poor condition and may pose a hazard resulting from suspension and inhalation of broken tile fragments – removal of these tiles by a licensed asbestos abatement contractor is recommended.

As a best management practice, it is recommended that all suspect ACMs be tested for asbestos prior to disturbing or removing/demolishing.

Lead Paint

Based on the age of the Town Hall, it should be assumed that all original painted surfaces are covered with lead-based paints and/or primers. Suspect items include equipment, piping, walls, doors and moldings, windows moldings, and all exterior trim. Peeling and subsequent air suspension of lead containing particles presents the greatest hazard to building occupants (inhalation hazard). Some peeling of painted interior and exterior surfaces was apparent during the inspection, notably in the northwest stairwell (Photograph 206). Other activities that could create a hazard include sanding, grinding, and welding of lead painted surfaces. It is recommended that primed and painted surfaces in the original building be tested for lead prior to disturbing or disposing of such.

Mercury

Mercury containing devices in the Town Hall building include fluorescent light bulbs and thermostats. Used bulbs should be segregated for proper disposal/recycling. There are several old thermostats that are expected to have mercury containing switches (Photographs 209, 215, and 216) – these units should be properly handled and disposed of as mercury wastes.

PCBs

Many older fluorescent lighting ballasts were manufactured with PCB containing capacitors. All of the older fluorescent units (pre-1980) should be suspected to contain PCB capacitors. Removal of the fixture housing will reveal the capacitors and unless they are clearly marked "DOES NOT CONTAIN PCBs", then it should be presumed that the capacitors do contain PCBs.

Petroleum Impacted Soils

Considering the age of the building and use of heating fuel-oil, the soils in the vicinity of the oil storage tank and supply piping may be impacted with petroleum compounds including volatile and semi-volatile organic compounds. Intrusive work near the tank, or future abandonment of the tank should include a visual survey to identify soils staining that may be indicative of petroleum contamination as defined by NHDES Standards.

3.0 BUILDING CODE COMPLIANCE

Although establishing compliance with current building code and regulatory requirements including the *International Building Code* (IBC) standards and the *American Disabilities Act* (ADA) is not the objective of this evaluation, following are some observations that may warrant further evaluation as part of planned building maintenance and alterations. Planned building renovations should also consider compliance with current and applicable building code standards, particularly the *International Existing Building Code* (IEBC, 2009) and all referenced standards.

Building Systems

Insulation

The current building envelope insulation does not comply with current *International Energy and Conservation Code, 2009* (IECC, 2009) standards. Potential improvements to the thermal envelope are discussed further in Section 2.0.

Mechanical

Notable mechanical code compliance issues include:

- No duct smoke detection/alarm units on the air handling unit.

Installation of duct smoke detectors on the air handler is recommended and design of a new HVAC system should include such.

Electrical

The existing electrical distribution was evaluated based on current *National Electrical Cod*e (NEC, 2008) standards. Specific items noted during inspection that warrant further evaluation include:

- Potentially overloaded circuits.
- Improperly routed wiring above ceilings and inside walls.
- Exposed unshielded wiring in second floor corridor.
- No GFCI protection on the outlet beneath the first floor kitchen sink.

- Inadequate number of outlets in office spaces.

Plumbing
No plumbing code compliance issues were noted during the inspection.

Sanitary
The on-site septic discharge system (i.e., tanks and distribution field) is located on the north side of the building and was not inspected as part of this evaluation. It is recommended that the system be cleaned and inspected annually. Indications of a failed distribution system were not observed during the site inspection. Major building renovations should consider the design and installation of a new septic system consistent with current NHDES standards.

Life Safety
Inspection of the stairway and space beneath the old stage revealed a substantial amount of paper and wood debris (Photographs 21-24). Because this space is not equipped with smoke or heat detection units, it presents a fire hazard and all debris should be removed from the space.

Heat and smoke alarms are installed in all conditioned spaces and the attic. As noted in the Mechanical Section, duct smoke detection should be added to the air handler unit. It is presumed that all fire detection and alarms are routinely tested by the Rye Fire Department.

The Town Hall building does not contain any fire suppression systems. Based on the construction methods, materials, and building age, installation of fire suppression system is highly recommended. The building is timber framed with balloon style perimeter walls creating an open wall cavity with no air break to the attic space (i.e., no wall top-plate or intermediate wall blocking). Of further concern is the lack of insulation in the walls thereby creating conditions that are ideal for rapid fire development and spreading to the attic space where the old unprotected pine timbers are highly combustible. Other noted concerns are the lack of fire extinguishers in the building – especially in the absence of an active suppression system. Fire extinguishers should be located throughout the building including occupied spaces and unoccupied spaces including the mechanical rooms – all employees should be trained on proper use by the Rye Fire Department. Extinguishers should be inspected annually by the Rye Fire Department.

Emergency egress was inspected and appears to function as required. That is, egress points were clearly marked, emergency lighting was present, and access to the egress points was clear. Fire evacuation routes were not observed in the building and should be clearly posted at key locations throughout the building including meeting rooms and corridors. It is recommended that evacuation routes for each floor be developed in coordination with the Rye Fire Department.

ADA Compliance

Parking
Handicap accessible parking spaces are provided and clearly marked in the main Town Hall parking area.

Access and Egress

The main south vestibule entry is an at-grade entrance with a single door and does not comply with ADA requirements for wheelchair access. Other ADA compliance issues include no elevator access to the second floor offices. Methods to improve existing access to the Town Hall include installing a wider south entry door, reconfiguring the vestibule, and installing automatic door openers. Major renovation plans for the building should consider ADA access to all public spaces including second floor offices.

Lavatory Facilities

The public lavatory facilities do not comply with ADA space requirements to accommodate wheelchair access. Major renovations plans for the Town Hall should consider providing ADA compliant lavatories.

Kitchen Facilities

As currently configured, the kitchens do not comply with ADA standards for wheelchair access including countertop and sink access. Major renovations plans for the Town Hall should consider providing ADA compliant kitchen facilities.

Alarms

In addition to audible alarms, ADA requires that visual alarms are also present in occupied areas. Strobe light alarms were observed in most of the common areas of Town Hall, however, they are not present in the lavatories. It is recommended that strobe light alarms be added to the common lavatories.

4.0 SUSTAINABILITY ASSESSMENT

Although based largely upon the building performance evaluation, the following sustainability assessment provides a more holistic approach to evaluating the site and building and assessing overall sustainability, which by implication, also measures building performance. Because much of the information provided in the Performance Evaluation narrative, the reader should review that section to establish a competent understanding of the site, building, and all components.

This assessment is consistent with current industry sustainability initiatives and more specifically the intent of the U.S. Green Building Council (USGBC), *Leadership in Energy and Environmental Design* (LEED) program. The following sections provide a qualitative assessment of the Town Hall and a general description of recommended performance and sustainability enhancements.

Site

The Town Hall building and associated infrastructure are located within a 200-acre parcel of Town owned land. Aside from the Town Hall facilities, current land use designations include a Town cemetery, deeded conservation lands, protected wetlands, and Town recreation facilities (Figure 1).

Storm water within the Town Hall site generally flows northwest to southeast eventually draining to wetlands and estuaries at the southernmost edge of the Town parcel (Figure 1). Runoff controls are limited to some catch basins and piping located on the west and east sides of the building. Inspection of the catch basins revealed a substantial amount of sediment (Photographs 158, 160, and 161) and cleaning of the catch basins is recommended. Landscaped areas are covered with native grasses, groundcover, trees, and shrubs. Mature deciduous trees to the north and east provide adequate shading for the building during summer months, however, the south building face has no natural shading.

Because most of the site runoff flows onto the Town owned parcel vegetated lands where it eventually infiltrates prior to reaching the southeast wetlands and estuaries, no additional treatment controls are recommended. Existing vegetation is in good condition and all soils are well stabilized.

The site is well planted to the north and west including mature deciduous trees and shrubs. Recommendations include planting additional native deciduous shade trees on the south side of the building to help shade south building face and reduce the substantial solar heat gain during cooling periods. Other potential site enhancements for the Town Hall site include reducing turf areas and replacing with low-maintenance, native drought-tolerant groundcover, shrubs, and mulch. Recommended plants include native shrubs and spreading groundcover to reduce mowing and maintenance requirements.

Other potential site sustainability initiatives include encouraging reduced air emissions and fuel conservation and by providing preferred parking for low-emissions and fuel-conserving/alternative energy vehicles.

Water

Water is supplied to the Town Hall by a State regulated private utility company (Aquarian Water) and water is sourced from deep wells located in Rye and surrounding communities. Because there are no industrial or irrigation systems for the Town Hall, water usage is limited to the plumbing fixtures in the lavatory and kitchen areas. Section 2.0 presents suggestions for reducing water consumption with low-flow fixtures.

Energy and Atmosphere

Mechanical Systems

As presented in Section 2.0, the existing heating and cooling system consists of several systems including an oil-fired boiler and packaged DX air handler, electric resistance heating units (Recreation Office), and split DX air-conditioning units. The current systems are inefficient and the main heating system appears to be inadequate to satisfy building demand during peak heating periods. The boiler unit also requires frequent maintenance and repair. The boiler has a low-efficiency combustion resulting in increased particulate and gas emissions to the atmosphere (carbon dioxide, nitrogen oxides, and sulfur dioxide). There are no heat-recovery units and combustion heat is directly exhausted contributing to atmospheric warming. Occupant comfort could be significantly improved by increasing heating and cooling zones and occupant control. Based on the system assessment and the current configuration, the existing heating and cooling systems are recommended for replacement.

Replacement of the heating system should consider replacing all heating and cooling units with a single high-efficiency oil-fired unit, gas-fired unit, or an electric heat-pump system. Compared to conventional heating oil, domestically derived natural gas and propane gas have higher combustion efficiencies, lower stack emissions, and gas burning units require less maintenance than oil burning units. Although natural gas is a superior fuel compared to propane, regional availability may be limited in Rye. Alternative systems include high-efficiency electric heat pump systems with local VAV units – these are particularly efficient where simultaneous heating and cooling is required and they can supply multiple zones from a single unit. It is also recommended that high efficiency filters having a Minimum Efficiency Reporting Value (MERV) of 13 or better be installed on the air distribution system(s) to improve indoor air quality.

Alternative humidification systems should also be considered including direct-injection (isothermic), electrode, and electric element humidification units. Multiple local systems would improve system controllability and efficiency.

In summary, design of a new HVAC system should consider:

- Single packaged high-efficiency heat-pump system with multiple zones (15-20).
- Programmable thermostat management with setbacks and pre and post-occupancy ventilation.
- Heat-recovery system.
- Carbon dioxide sensors and automatic exhaust fan controls.
- Humidity system including sensors and automatic controls.
- High efficiency filtration system with MERV of 13 or better.
- Installing new ductwork with minimum insulation rating of R-10.

Domestic Hot Water

Potential improvements for domestic hot water supply include installing local high-efficiency tankless units at each sink. This would reduce energy consumption and water consumption by providing instant hot water at the tap. Additional benefit includes eliminating the heat loss from uninsulated distribution piping in wall cavities.

Thermal Envelope

The existing thermal envelope for the original Town Hall structure is very poor and does not comply with current energy code standards (IECC, 2009). Assuming that the concrete slab floor is six-inches thick, the R-values range from 1.4 to 2.4 depending on the floor covering material. Although the perimeter wall construction varies somewhat, the walls are uninsulated and the estimated assembly R-value is 6.0. The ceiling/attic floor R-value is approximately 22. Assembly descriptions and associated R-values for the floors, walls, and roofs are summarized in Table 4.1.

Table 4.1 – Thermal Envelope R-Values

Building Component	Assembly Description	Effective Assembly R-Value(1)
Floors – Carpet	6" Concrete w/ carpet	2.4
Floors – Tile	6" Concrete w/ tile	1.4
Perimeter Walls	Cedar clapboard siding, 16" timber frame wall, 5/8" plaster & lathe, paneling	6
Ceiling / Attic Floor	10" Loose-fill fiberglass	22
Roof	¾" Plank sheathing, asphalt shingles	1.5

(1) Assembly values include interior air films (0.68 for walls and 0.61 for ceilings) and exterior air films (0.17).

Recommendations include insulating all walls in the original building and additions. The most economical and least intrusive approach is to improve the walls from the interior by filling the frame cavities with an expanding foam or loose-fill insulation product which would be applied from the attic wall cavity and through small holes in the wall plaster. An IR camera should be used during wall insulation to ensure that all wall cavities are filled. Attic floor insulation should be improved by placing additional loose-fill insulation to increase the insulation depth to at least 18-inches. Other options for the attic include removing the fiberglass loose-fill insulation and applying a sprayed-on foam insulation directly onto the plaster and lathe ceiling.

Replacement of all existing windows with high-efficiency units would substantially improve the efficiency of the building envelope. However, if the original windows are to be preserved based on their historic significance, then it is recommended that the sash cord and weights be removed and the cavity filled with insulating foam. The windows should be sealed and the sash should be caulked to the frame using a polyethylene caulking. All other window units, including those in the newer rear addition, should be completely replaced with high-efficiency double-pane units.

Renewable Energy Considerations

To explore potential renewable energy applications, the following table (Table 4.2) presents a preliminary evaluation of potential technologies that might be practically implemented for the Town Hall considering site constraints and building function. Each renewable energy application should consider economics including initial capital costs and future cost-savings as well as the feasibility of the application based on specific site and building characteristics.

All of the proposed renewable energy applications would improve the sustainability of the Rye Town Hall. With the exception of Green Grid Power, each technology poses unique risks with respect to function, operating costs, and future costs of nonrenewable energies including coal, gas, and oil. The one consistent consideration among all of the renewable technologies is that the larger scale the application, the more economically feasible it becomes. Therefore, the Town might consider large-scale renewable energy applications that could support multiple buildings and facilities including the Public Library, Public Safety Complex, and Recreation Facilities. Community-wide systems should also be considered to reduce installation costs and maintenance costs – a potential community partner includes the Congregational Church.

Table 4.2 – Potential Renewable Energy Applications

Energy Application	Economic Considerations	Feasibility Assessment
Photovoltaic Systems	PV systems are relatively expensive and without significant State financial incentives, the ROI period is long.	A relatively large area would be required to justify the installation expense. The building axis is oriented on the north-south axis providing a large roof area directly facing south. The south roof-plane is unobstructed and would provide an ideal location for PV panels.
Solar Domestic Hot Water	Systems are relatively expensive due to installation of piping network and they have a substantial ROI period.	Considering that the domestic hot water demand is very low for the Town Hall, the payback would be significant.
Combined Heat and Power Systems	CHP or cogeneration systems are proven technology in the industrial sector. Systems are typically developed for large power demand industry and commercial facilities.	Because the unit is powered by a combustion engine, noise and exhaust emissions are a concern considering the proximity to residential areas. A large fuel storage tank would be necessary.
Geothermal Heating/Cooling	Geothermal heating/cooling systems can be very cost-effective systems depending on site constraints and are very simple and proven technology. ROI in the New England area varies from 5-20 years for the wells and piping system (not including equipment).	The Town Hall site and adjoining parcel is large and wells could be easily sited. Because the building is relatively small, the payback period will be substantial (>15 years). A community system could be constructed to reduce the cost and increase the scale of the system.
Wind Power	Small-scale wind power systems are very costly compared to the energy savings. Systems are proving to be less efficient than expected in New England.	Wind towers would require a State permit and a Town zoning variance based on the height. The town-owned lands to the southeast may provide conditions favorable for a wind turbine – a study would be required.
Biomass Heating	Biomass systems can be cost effective assuming an endless supply of inexpensive biofuel.	Technology for small-scale applications is relatively new. Biomass fuel is a commodity with limited availability and pricing will increase with demand.
Green Grid Power	Regulated power supply from private energy companies provided at a higher rate. No capital investment in technology that can become obsolescent. Can terminate agreement at anytime.	Energy is developed by alternative Green technologies including wind farms, hydroelectric, and PV farms. Typically requires a minimum contract term (1-2 yrs.).

Materials and Resources

The Town Hall currently has a recycling program and diligent separation of recyclable wastes is encouraged. Other sustainable initiatives may include using only non-toxic cleaners. Building materials can also be replaced with Green building materials that reduce the use of natural resources and toxins. For example, the existing carpeting and wall paint contain a high level of volatile organic compounds (VOCs) that are released to the indoor air over time. Replacement of these materials should consider using zero-VOC products. Incorporating rapidly renewable natural materials such as bamboo, cork, and other products should also be considered as part of any major building renovation projects.

Indoor Environmental Quality

Heating and Cooling Venting

As discussed in Section 2.0, outdoor air supply to the existing air handling unit is inadequate and increased ventilation would improve indoor air quality. This is best achieved by designing a new HVAC system that includes air quality monitoring, increased outdoor air supply, and heat recovery units.

Humidity Control

Measured relative humidity levels in the Town Hall were within the recommended range of 25% to 60%. As discussed in the preceding Mechanical Systems section, installation of a humidification system should be considered as part of a new HVAC systems design.

Lighting

Replacement or retrofitting of the existing fluorescent fixtures will reduce reliance on electrical energy for the Town Hall. As mentioned in Section 2.0, PSNH offers a program to help finance the cost of retrofitting existing fixtures. Other recommendations include changing all incandescent light bulbs to compact fluorescent bulbs and installing motion sensitive controls on light switches in common areas such as lavatories, meeting rooms, kitchens, and offices.

Daylighting

Daylighting within the Town Hall is provided by the double-hung window units on the lower and upper floors. Table 4.3 presents a summary of the window areas for each wall in the Town Hall.

Table 4.3 – Daylighting Areas

Wall Orientation	Wall Area (sf)	Window Area (sf)	% Total
North	1,912	141	7.4%
South	1,912	228	11.9%
East	1,140	39	2.0%
West	1,140	79	6.9%
TOTAL:	6,104	487	8.0%

Minimum daylighting standards as defined by LEED require a minimum glazing factor of 2% in at least 75% of regularly occupied spaces. The Town Hall far exceeds the recommended standards with a net window area of 8.0% of the total wall area.

Radon Gas

Radon gas is a naturally occurring radioactive gas that is regionally present within the New England region. Radon gas can enter buildings through small cracks in the foundation walls and floors and accumulate in the indoor atmosphere. The Town Hall does not contain a radon mitigation system – to ensure that radon concentrations are below the EPA threshold; annual radon testing in the lower levels of the building is recommended.

5.0 ENERGY MODELING

Method and Purpose

Using the eQUEST energy simulation program (v. 3.63), a more quantitative assessment of the Town Hall energy consumption was completed. This simulation program is recognized and accepted by the U.S. Department of Energy (DoE), Energy Efficiency and Renewable Energy (EERE) program and the USGBC LEED program. Independent models were completed to provide a more accurate evaluation of energy performance based on the building configurations and the designated use. Local public utility rates for electric (Public Services of New Hampshire) were used in all simulations. Heating oil pricing of $2.80 per gallon ($2.01/therm) based on current, averaged local market pricing is assumed. Natural gas and propane rates are $1.65/therm based on current Keyspan commercial rates. Net electric costs are estimated at $0.14/kWh based on current PSNH small commercial rates.

Two independent models were developed for the Town Hall including a baseline model representing existing building conditions and a model for total renovation of the building and systems. It is noted that the eQUEST is somewhat limited when replicating conditions in existing buildings and that there are variables that must be assumed based on unknown building conditions and use characteristics. Therefore, the simulation model should be considered as a tool used to establish benchmark conditions to which building and systems enhancements can be evaluated against to determine the enhancements that provide best value in terms of energy performance.

The baseline simulation provides benchmark conditions against which enhancements are measured. Integrated into the baseline model, several Energy Efficiency Measures (EEM) were simulated the results of which were compared to existing conditions to establish best value. Based on this simulation, the EEMs that provide best value for the Town Hall are improving the building envelope including adding insulation to the walls, attic floor, and basement floor. The second simulation model assumes several major enhancements are completed as part of a building renovation project. This includes improving the building envelope, reconfiguration of the interior spaces consistent with current functions, installation of new HVAC systems including a high-efficiency electric heat pump unit, and improved thermostat management.

The simulations consider the current operating schedule of the Town Hall and that thermostat management is implemented. That is, it assumes that the HVAC system operates one hour before opening and one hour after closing for each scheduled day. The normal occupancy schedule is presumed to be 7:00 am to 7:00 pm Monday through Friday with weekends and holidays as non-occupied periods. Occupied set temperatures in the renovation model are 68°F and 74°F for heating and cooling periods respectively. Non-occupied setback temperatures are assumed to be 64°F during heating periods and 82°F for cooling periods.

Simulation reports for each simulation scenario are presented in Exhibit G and include:

- Detailed monthly and annual energy consumption by use category;
- Estimated monthly and annual energy costs;
- Monthly peak consumption by use category; and,

- Summary monthly and annual consumption by energy type (electric and gas/oil).

Because there are many variables affecting actual consumption and associated costs including building use and occupancy, actual efficiencies of existing equipment and systems, controls, actual utility costs, and limitations inherent to the energy simulation software, the presented values should be considered within a -15% to +10% range.

Simulation Results

Table 5.1 presents the estimated energy consumption reductions and associated cost savings for the proposed EEM enhancements to the existing building and HVAC system. EEM item 1 and the associated cost savings are not included in the new HVAC models presented in Table 5.1. However, the predicted cost savings in Table 5.2 are modeled with the new heat pump HVAC system.

Table 5.1 – Energy Efficiency Management Savings

Potential Building Enhancements		Est. Annual Energy Reduction		Est. Annual Energy Savings(1)
No.	EEM Description	Oil / NG (therms)	Electric (kWh)	
1	Improve Building Envelope – Insulate Walls (R30) & Attic Floor (R38)	788	15,620	$3,772
2	Improve Building Envelope – Insulate Floor (R10)	952	11,380	$3,507

(1) Estimated costs are based on current (June 2009) public utility and heating-oil rates for the southern NH region.

Table 5.2 presents the results of the three simulated HVAC systems – model output is presented in Exhibit G. The first simulation is the baseline model representative of the existing building envelope and HVAC systems. The second HVAC system consists of a new high-efficiency electric heat pump with an inverter compressor, a heat recovery system, and thermostat management. Because this new system would be most practical as part of a total building renovation project, it also assumes an improved building envelope which significantly increases the resulting energy efficiency.

The total annual predicted energy reduction cost savings based on the eQUEST simulation is $10,242. Within the -15% to +10% range, the potential cost savings are $8,706 to $11,266.

Table 5.2 –HVAC System Simulation Comparisons

HVAC Systems					Est. Annual Energy Consumption		Est. Annual Energy Cost(1)		
Heating	Fuel	AFUE (%)	Cooling	Distribution	Oil / NG (therms)	Electric (kWh)	Oil / NG	Electric	Total
Hot Water Coil to Air (existing)	Oil	75	Packaged & Split DX condensers (existing)	Air-handler & non-ducted (existing)	3,174	59,830	$6,380	$8,376	$14,756
HE heat-pump w/ inverter compressor w/ heat recovery	Electric	93	Single packaged variable DX condenser	Multiple VRFZ cassettes	0	32,241	$0	$4,514	$4,514
Total Annual Savings (with new HVAC and envelope improvements):									$10,242

(1) Estimated costs are based on current (June 2009) utility and heating-oil rates for the southern NH region.

6.0 SUMMARY RECOMMENDATIONS

The following summary recommendations are provided with the intent of improving the overall performance and sustainability of the Town Hall facility. Determining which recommendations are appropriate for the building depend on the planned use designation and lifecycle, Town of Rye initiatives, and budgetary means. The red flag ( ) symbol included the text body denotes recommendations that are included in one of the three tier categories. The three tier categories are based on life safety concerns, implementation costs, potential energy reduction and cost savings, operation and maintenance costs, and occupant comfort.

1. **Tier I Recommendations**: Tier I recommendations include maintenance related items that are relatively simple and low-cost to implement. They also include critical items associated with life-safety concerns and items that if left unattended to could result in damage to building components. Tier I recommendations are presented in Table 6.1.
2. **Tier II Recommendations**: Tier II recommendations are those that should be considered in current budgetary planning for building improvements – they can be major or minor improvements. They generally will provide substantial energy savings and/or improved occupant comfort. Tier II recommendations are presented in Table 6.2.
3. **Tier III Recommendations**: Tier III recommendations are major improvements affecting one or more building components. These are generally longer-term capital improvements that may be more economical to complete as part of a larger improvement project. Tier III recommendations are presented in Table 6.3.

Included in the tables are budgetary costs to implement the associated initiative. These costs are provided for planning purposes only and more detailed estimates should be prepared as initiatives are selected for implementation.

Considering the magnitude of the recommended improvements for the Town Hall, a major renovation project would provide the most prudent approach as costs would be less than completing numerous independent improvements. Additionally, the design of all building components (including HVAC, building envelope, electrical systems, lighting systems, fire protection, and plumbing systems) should be completed as a single effort to optimize building performance and ensure that all systems are well integrated.

Table 6.1 – Tier I Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	The building foundation system has deteriorated and connection to the framing structure could not be determined.	Complete a more rigorous engineering inspection of the foundation system and structural connections.	$4,700
2	A large penetration exists in the 3rd floor records storage room south wall.	Seal penetration and repair the wall.	$500
3	Much the gutter sections have fallen off and remaining sections are poorly connected creating potential water damage to fascia & soffit especially during freeze-thaw conditions.	Remove remaining gutter sections.	$800
4	Evidence of bird and rodents (bats) nesting in attic.	Inspect attic by a pest professional to mitigate damage to the building.	$500
5	Timber connection dowel pins on truss and column connections in attic are loose.	Re-insert dowels and add steel lag bolts, or, replace wooden dowels with new oak dowel pins.	$2,000
6	Nesting debris in belfry pan.	Clean pan and remove debris.	$300
7	Belfry louvers and gaps may allow water leakage and pest entry.	Seal gaps and louvers (NOTE: Do not seal louvers until attic exhaust fans area installed to ensure ventilation).	$1,000
8	Doors do not completely seal at the frame and threshold.	Inspect all doors, adjust, and add new weather-stripping.	$500
9	Condition of existing buried fuel-oil tank unknown.	Inspect tank to verify integrity.	$700
10	It is expected that the existing HVAC system provides inadequate building ventilation.	Complete air quality measurements should be completed during peak cooling and heating periods.	$500
11	Electrical outlets and circuits may be overloaded.	Have a licensed electrician inspect electrical wiring system.	$500
12	The number of outlets in office spaces is insufficient and extension cords and multi-plugs are used.	Replace extension cords and plugs with surge protectors with internal circuits. This also simplifies powering down phantom load equipment.	$300
13	The outlet beneath the first floor kitchen sink is not GFCI protected.	Replace outlet with a GFCI unit.	$80
14	Exposed unshielded wiring in second floor corridor at electrical panel.	Construct a chase to cover the exposed wiring.	$500
15	Existing lighting fixtures are old and inefficient.	Retrofit existing fluorescent units and install CFLs in all incandescent fixtures (utilize PSNH program). NOTE: Do not complete if building renovation is planned in near future.	$1,200
16	No insulation on domestic hot water piping.	Install insulation on exposed piping.	$400
17	Septic system should be maintained to prevent environmental release and ensure proper operation.	Clean and inspect septic system annually.	$700/year
18	Misc. electronic equipment including computers, printers, photocopiers, chargers increase electrical consumption and internal heat load.	Plug electronics into surge protection units where multiple items can be powered off with a single switch. Turn-off all electronics when not in use.	$200
19	Broken asbestos floor tiles in mechanical rooms can create inhalation hazard.	Remove all tiles in mechanical room by licensed abatement contractor.	$2,200
20	Electrical outlets in basement mechanical room where flooding is evident are not GFCI protected.	Install GFCI protected outlets in mechanical room.	$200

21	Substantial amount of combustible debris (wood and paper) beneath old stage creating a potential fire hazard.	Remove all combustible debris.	$1,000
22	Fire evacuation routes are not clearly posted.	Develop evacuation routes in coordination with Rye Fire Dept. and post evacuation routes for first and second floors and post in common areas.	$0
23	Radon gas infiltration is a significant occupant hazard in New England.	Complete annual radon testing in basement spaces.	$200/year
24	Stormwater catch basins are filled with sediment restricting water flow.	Remove sediment from catch basins and piping.	$300

Table 6.2 – Tier II Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	The existing Town Hall building does not appear to support the required town functions.	Complete a Space Planning Study to define current and future needs.	$5,000
2	Moisture damage noted on the ceiling and walls in the northeast stairwell.	Repair the plaster ceiling and walls and re-paint.	$1,200
3	The attic space provides a significant heat load to the building.	Install two thermostatically controlled exhaust fans in main attic and addition attic.	$2,000
4	Original windows allow air intrusion into building.	Permanently seal the windows with caulking, re-glaze panes, remove sashcords and weights, and insulate cavities.	$7,500
5	South facing windows have no natural shading and allow substantial solar heat gain to the building.	Install exterior overhangs or interior UV reflective shades to south-facing windows.	$1,500-$3,000
6	Much of the original exterior trim moldings and boards (fascia and soffit trim, corner boards, etc.) have deteriorated.	Repair and replace trim moldings and boards as necessary and re-paint.	$18,000
7	Second floor refrigerator is very inefficient and increases heat loads to building.	Replace old refrigerator with a new EnergyStar rated unit.	$500
8	Lighting switches in secondary areas are manual toggle switches.	Replace toggle switches with motion-sensitive controllers.	$800
9	There are no fire suppression systems in an older building that is susceptible to fire.	Install fire suppression systems in all conditioned spaces, mechanical rooms, and attic.	$24,000
10	Lavatories do not contain visual fire notification.	Install strobe light alarms in lavatories.	$1,800

Table 6.3 – Tier III Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	The existing HVAC systems including the boiler, air-handler, and multiple air-conditioning units are inefficient and require high maintenance. Ventilation and zoning is inadequate.	Replace the existing HVAC system with a high-efficiency heat-pump system having multiple VRFZs. System should include heat-recovery, increased outdoor air supply, humidity control, and air quality sensing and control.	$185,000
2	Existing electrical supply may be inadequate for building loads. Existing distribution system including wiring is poorly routed and secured. Numerous old wires make it difficult to diagnose the system.	Replace entire electrical system including installing a higher amperage circuit panel based on predicted loads, new wiring, additional outlets, and demolition of all old wiring.	$32,000
3	Lighting systems and fixtures are old and poorly configured for the spaces. Lighting densities are not adequate in many spaces.	Complete lighting design and install new lighting systems for entire building.	$18,000
4	Age and condition of water supply piping undetermined.	Determine age and condition of piping and replace as necessary.	$500-$4,000
5	The outdoor air damper in the boiler mechanical room is a passive louver allowing air infiltration.	Replace louver with a pressure actuated mechanical damper.	$800
6	Existing plumbing fixtures are old and inefficient.	Install low-flow aerators on sinks and retrofit or replace toilets with low-flow units.	$500-$2,000
7	Building access/egress does not comply with ADA requirements for wheelchair access.	Replace south entry doors with wider units and automatic openers.	$5,300
8	South face of building has no natural shading to reduce solar heat loading.	Plant deciduous shade trees in turf area.	$4,500
9	No wall insulation identified during inspection.	Insulate all wall cavities using combination of loose-fill and expanding foam.	$42,000
10	Windows in rear of building (Recreation Office) are inefficient.	Replace windows with high-efficiency units (3).	$1,800
11	Roofing system is showing indications of failure.	A new roofing system should be installed within the next 2 years including new sheathing, insulation, flashing, and shingles.	$32,000

FIGURE 1

Site Map

anix, LLC
4 Margaret Lane
Lee, NH 03861
(603)292-6245
www.anixcm.com

Town of Rye, NH
Town Hall
10 Central Road
Rye, NH 03870
Tel: 603.964.5523

ISSUE
06.06.09

RE-ISSUE

PROJECT NO.
09021

PROJECT
Town Hall PESA

DRAWN BY
TN

DESCRIPTION
Site Map

P

01

FIGURE 2

Building Use Designation Plan – First Floor

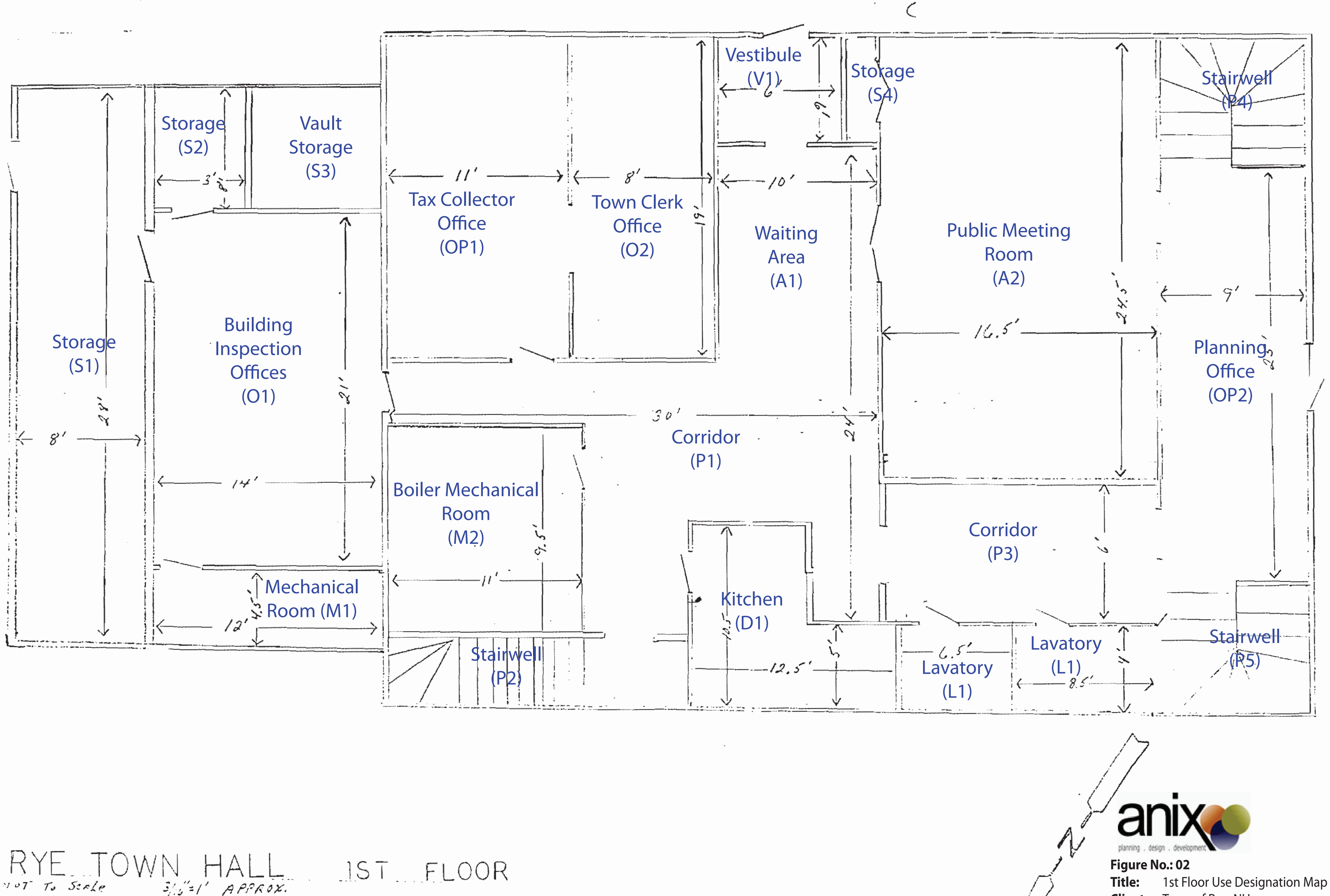

Figure No.: 02
Title: 1st Floor Use Designation Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

FIGURE 3

Building Use Designation Plan – Second Floor

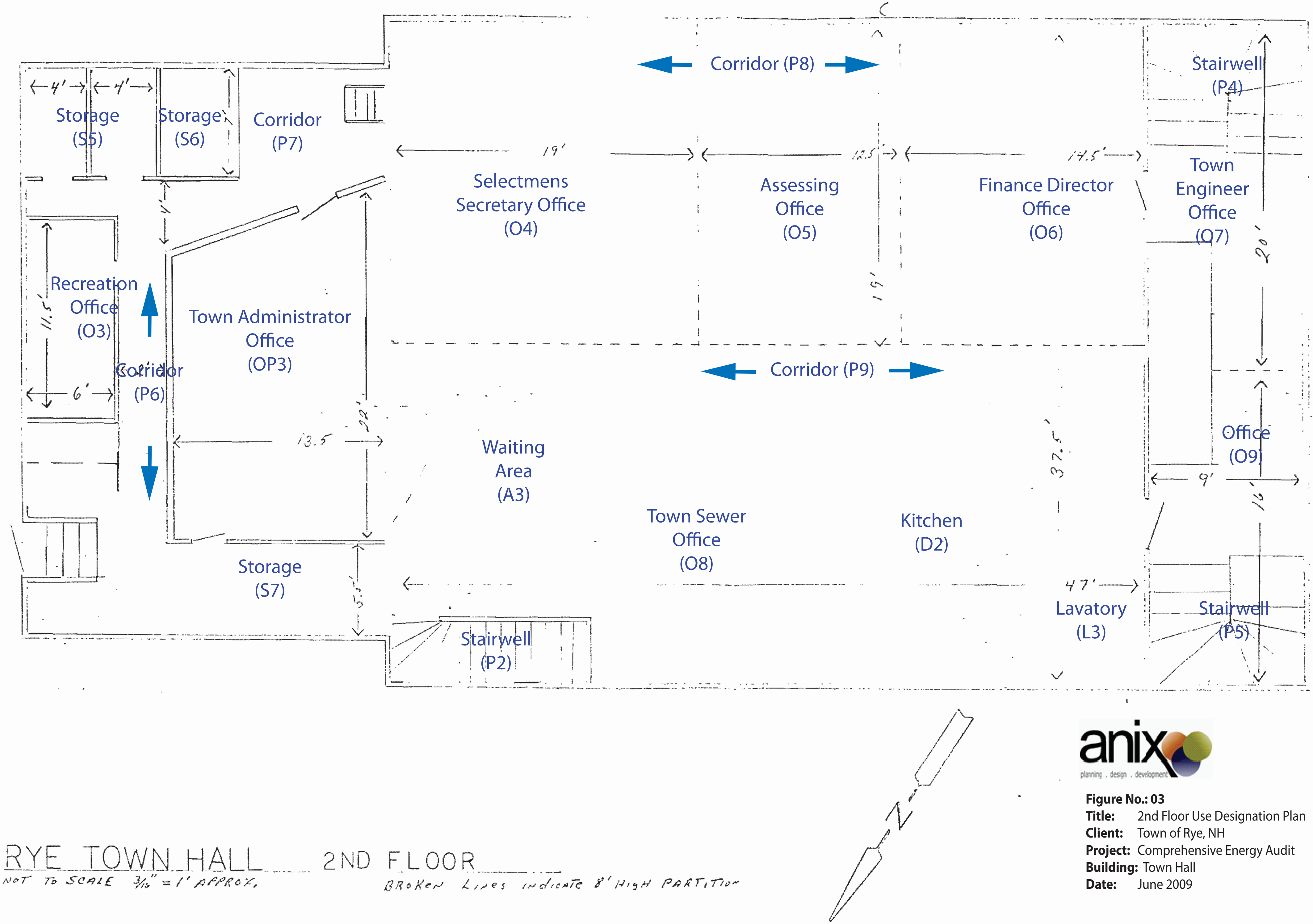

Figure No.: 03
Title: 2nd Floor Use Designation Plan
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

FIGURE 4

Carbon Dioxide Data Maps

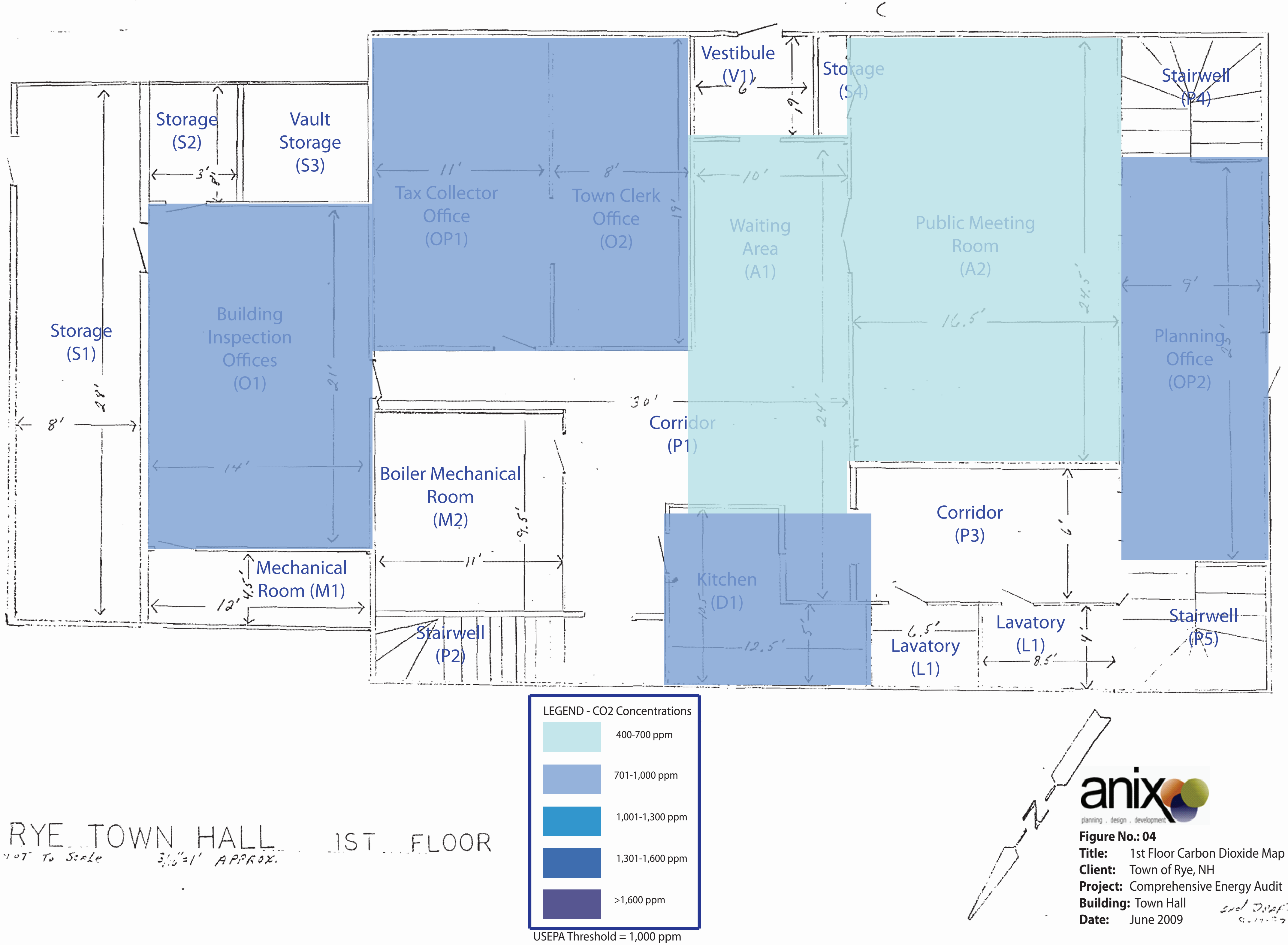

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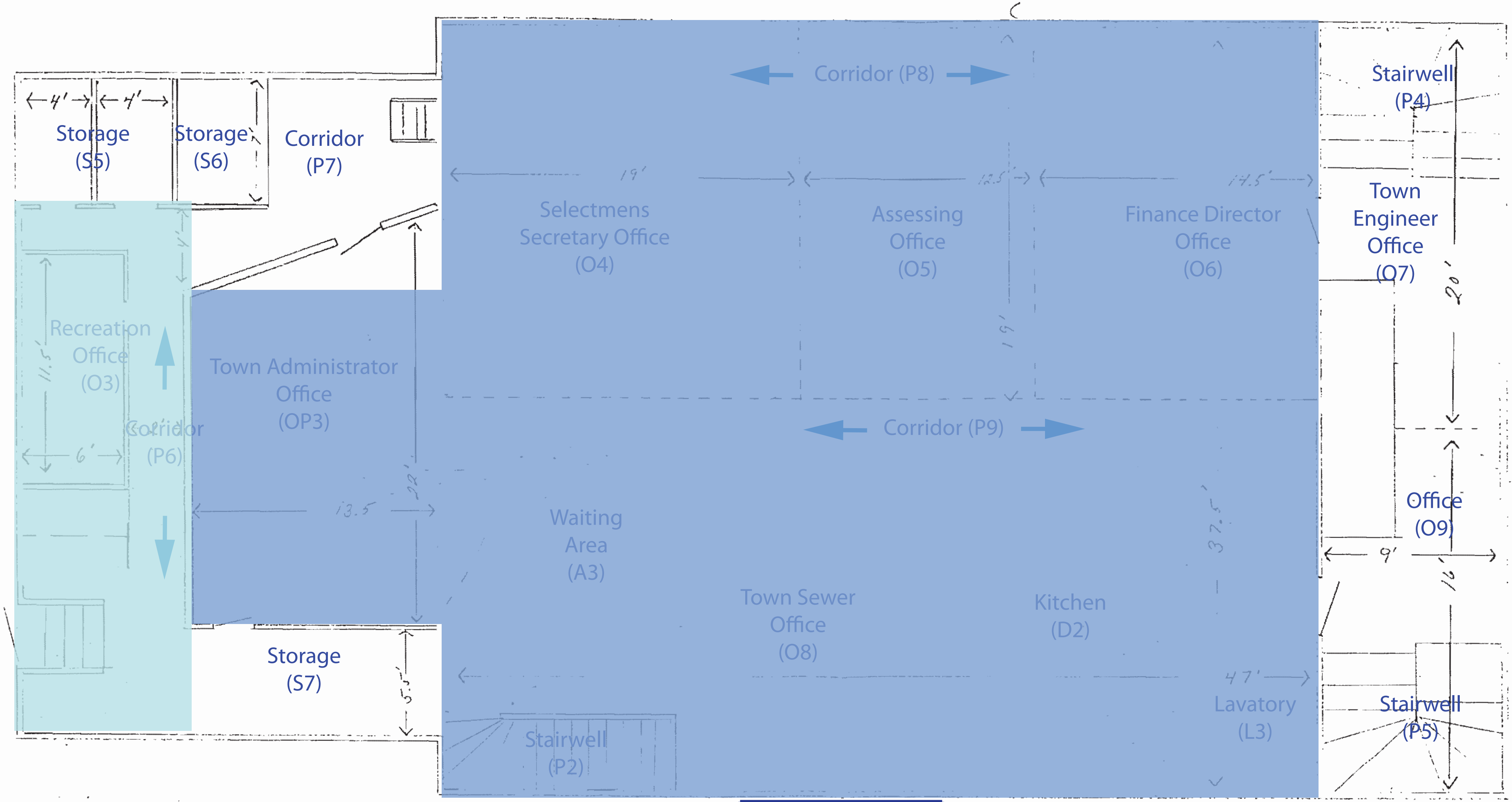
Figure No.: 04
Title: 1st Floor Carbon Dioxide Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009



RYE TOWN HALL 2ND FLOOR

NOT TO SCALE 3/16" = 1' APPROX.

BROKEN LINES INDICATE 8' HIGH PARTITION

LEGEND - CO2 Concentrations

- 400-700 ppm
- 701-1,000 ppm
- 1,001-1,300 ppm
- 1,301-1,600 ppm
- >1,600 ppm

N

USEPA Threshold = 1,000 ppm

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Figure No.: 03
Title: 2nd Floor Use Designation Plan
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

FIGURE 5

Relative Humidity Data Maps

Figure No.: 05
Title: 1st Floor Relative Humidity Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

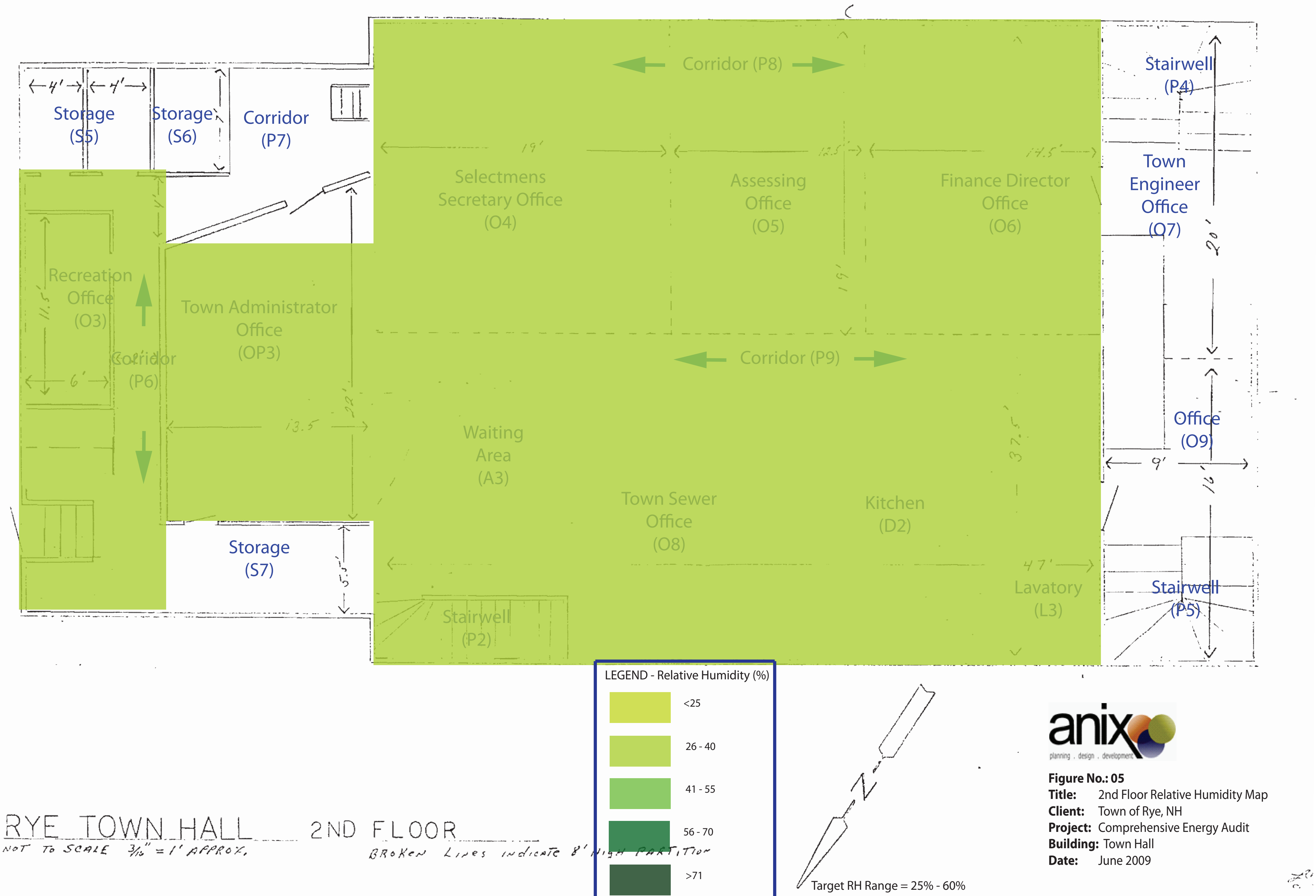

Figure No.: 05
Title: 2nd Floor Relative Humidity Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

FIGURE 6

Temperature Data Maps

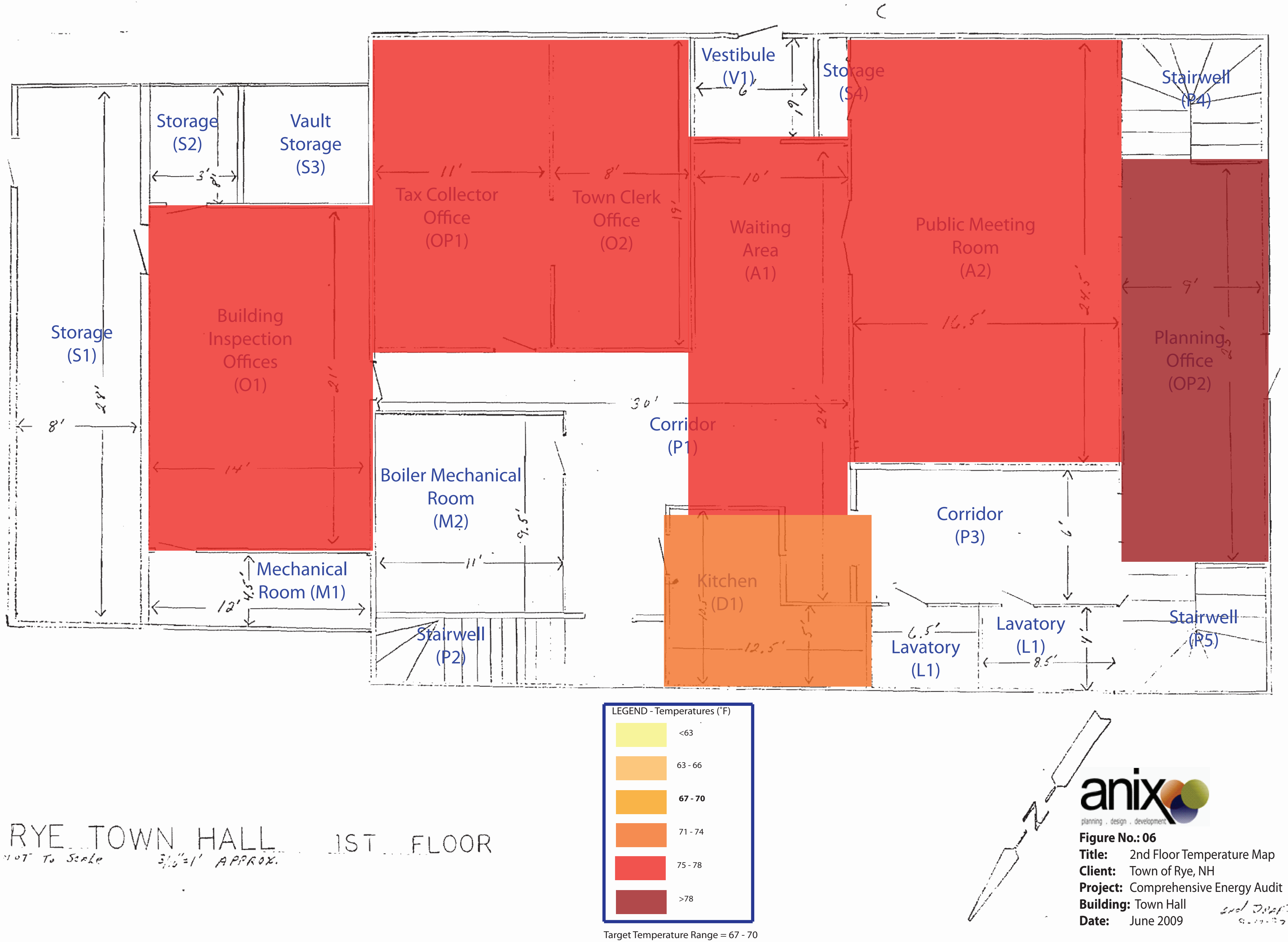

Figure No.: 06
Title: 2nd Floor Temperature Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

LEGEND - Temperatures (°F)

	<63
	63 - 66
	67 - 70
	71 - 74
	75 - 78
	>78

RYE TOWN HALL 2ND FLOOR

NOT TO SCALE 3/16" = 1' APPROX.

BROKEN LINES INDICATE 8' HIGH PARTITION

N

Target Temperature Range = 67 - 70

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Figure No.: 06
Title: 2nd Floor Temperature Map
Client: Town of Rye, NH
Project: Comprehensive Energy Audit
Building: Town Hall
Date: June 2009

Exhibit A

Photographs

(separate electronic file)

Exhibit B

Infrared Thermal Imaging Report

(separate electronic file)

Exhibit C

Indoor Air Quality Data

INDOOR AIR QUALITY DATA

Town of Rye - Town Hall

Jun-09

Date:	6/3/09
Ambient Temp (F):	65
Ambient RH:	60%

Date	Location 1	Floor	CO_2 (ppm)	Temp. (°F)	RH (%)
6/3/2009	Town Manager office	2	761	78.8	39.5
6/3/2009	Recreation office	2	525	81.5	33.3
6/3/2009	2nd flr S main office area	2	750	75.5	40.4
6/3/2009	2nd flr N kitchen	2	714	77.1	37.3
6/3/2009	2nd flr W lavatory	2	784	78.8	37.9
6/3/2009	3rd flr W storage room	3	706	78.4	38.1
6/3/2009	1st flr W planning office	1	794	80.2	39.8
6/3/2009	1st flr SW mtg room	1	627	77.1	29.5
6/3/2009	1st flr clerk lobby area	1	654	75.2	31.0
6/3/2009	1st flr S town clerk office	1	953	74.8	34.1
6/3/2009	1st flr E bldg inspector office	1	962	75.7	35.4
6/3/2009	1st flr N kitchen	1	727	73.4	33.3
6/3/2009	2nd flr N main area ceiling	2	770	74.8	36.4
6/3/2009	2nd flr S main area ceiling	2	973	78.2	37.4
		AVG.	***764***	***77.1***	***36.0***

Exhibit D

Carbon Dioxide Data Graph

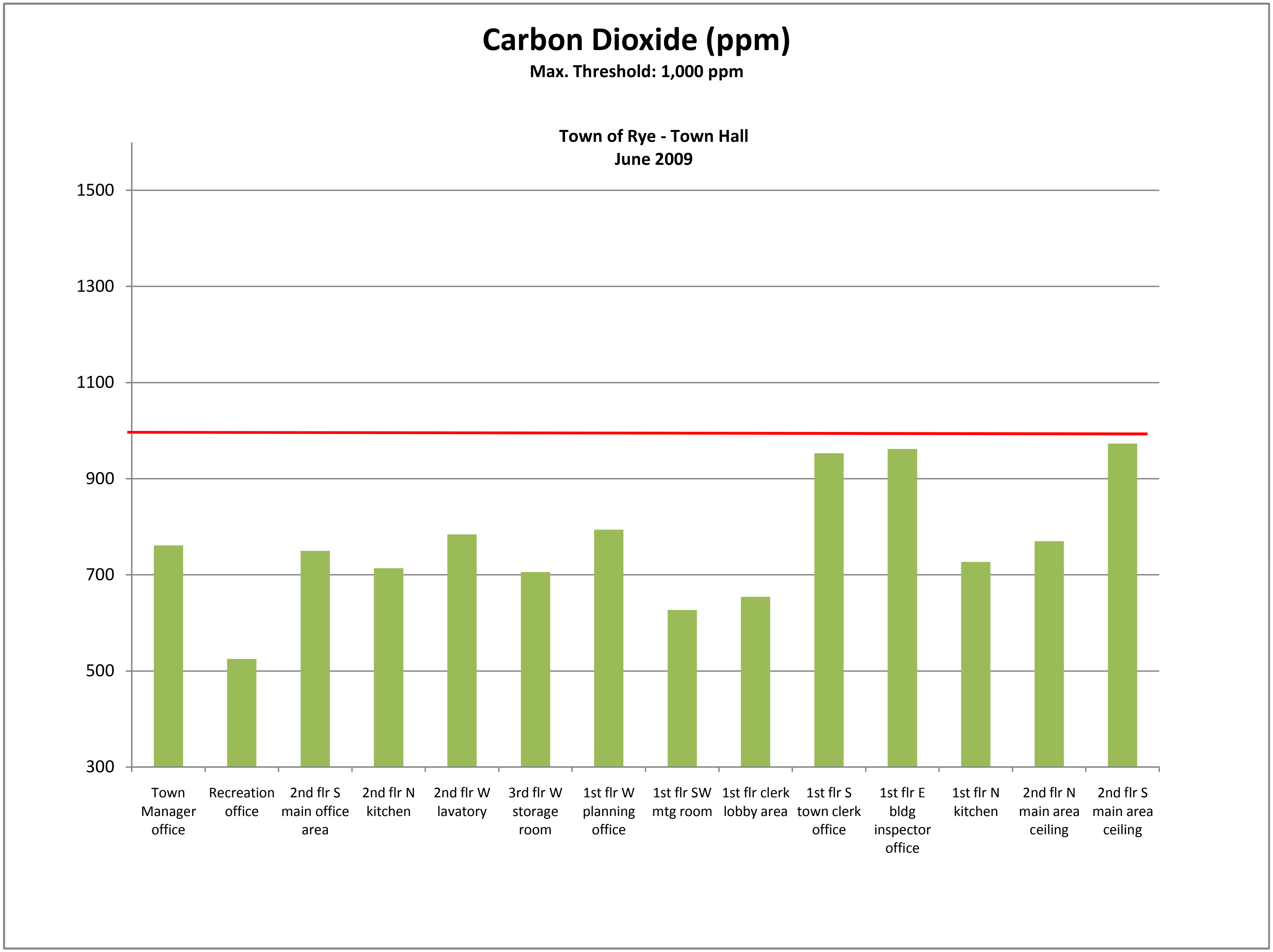

Carbon Dioxide (ppm)
Max. Threshold: 1,000 ppm
Town of Rye - Town Hall
June 2009
1500
1300
1100
900
700
500
300
Town Manager office
Recreation office
2nd flr S main office area
2nd flr N kitchen
2nd flr W lavatory
3rd flr W storage room
1st flr W planning office
1st flr SW mtg room
1st flr clerk lobby area
1st flr S town clerk office
1st flr E bldg inspector office
1st flr N kitchen
2nd flr N main area ceiling
2nd flr S main area ceiling

Exhibit E

Relative Humidity Data Graph

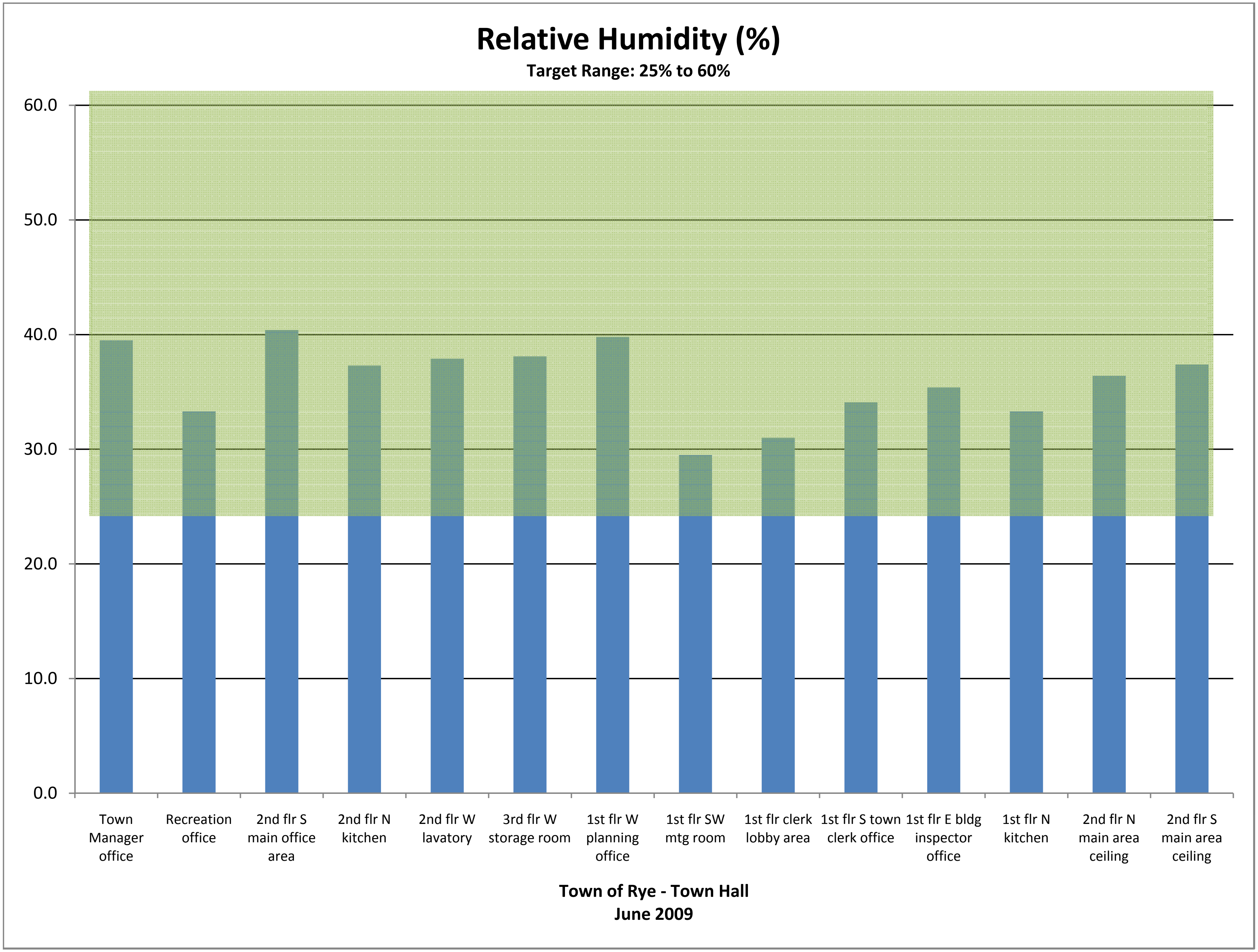

Relative Humidity (%)
Target Range: 25% to 60%
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Town Manager office
Recreation office
2nd flr S main office area
2nd flr N kitchen
2nd flr W lavatory
3rd flr W storage room
1st flr W planning office
1st flr SW mtg room
1st flr clerk lobby area
1st flr S town clerk office
1st flr E bldg inspector office
1st flr N kitchen
2nd flr N main area ceiling
2nd flr S main area ceiling
Town of Rye - Town Hall
June 2009

Exhibit F

Temperature Data Graph

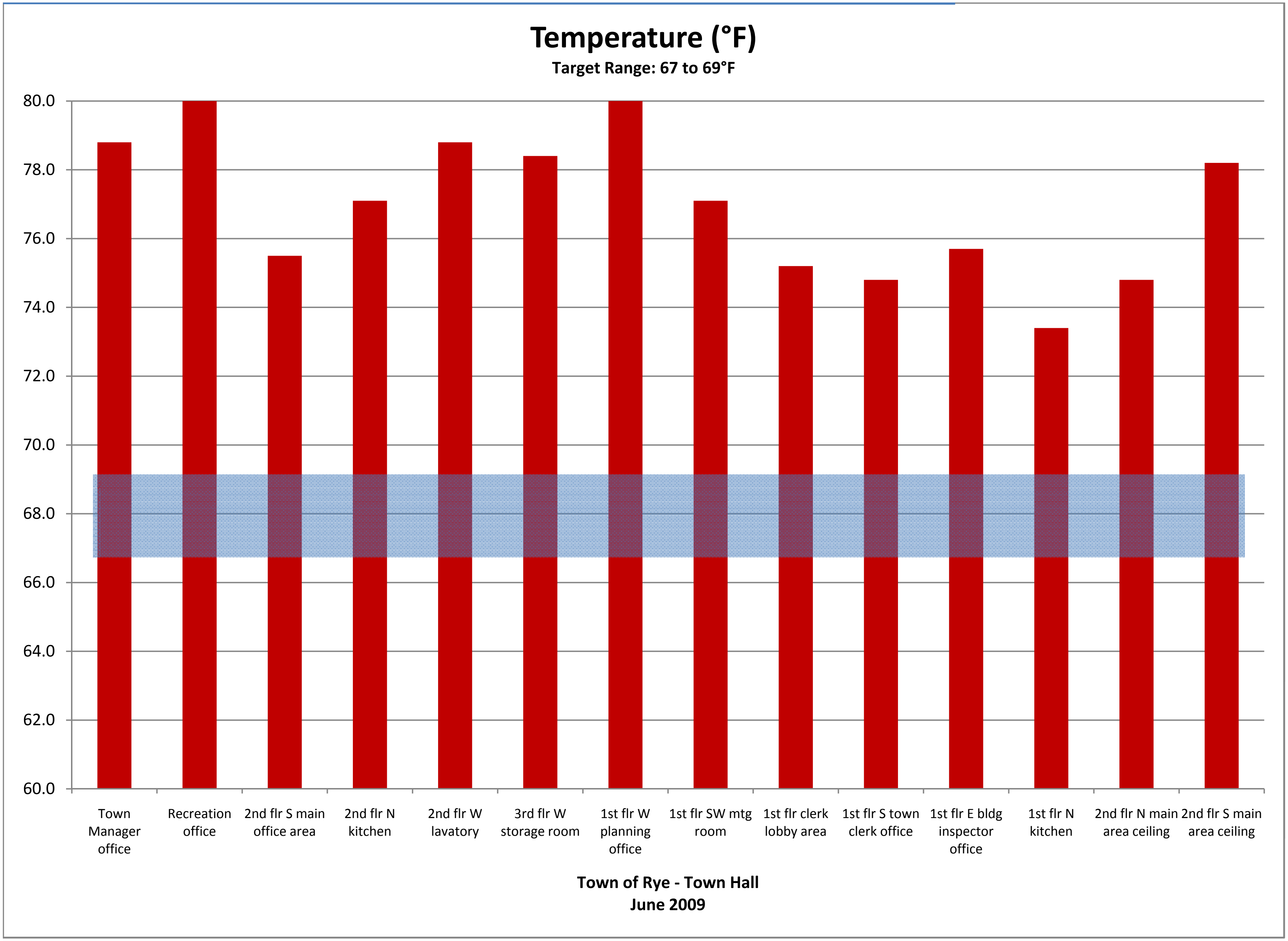
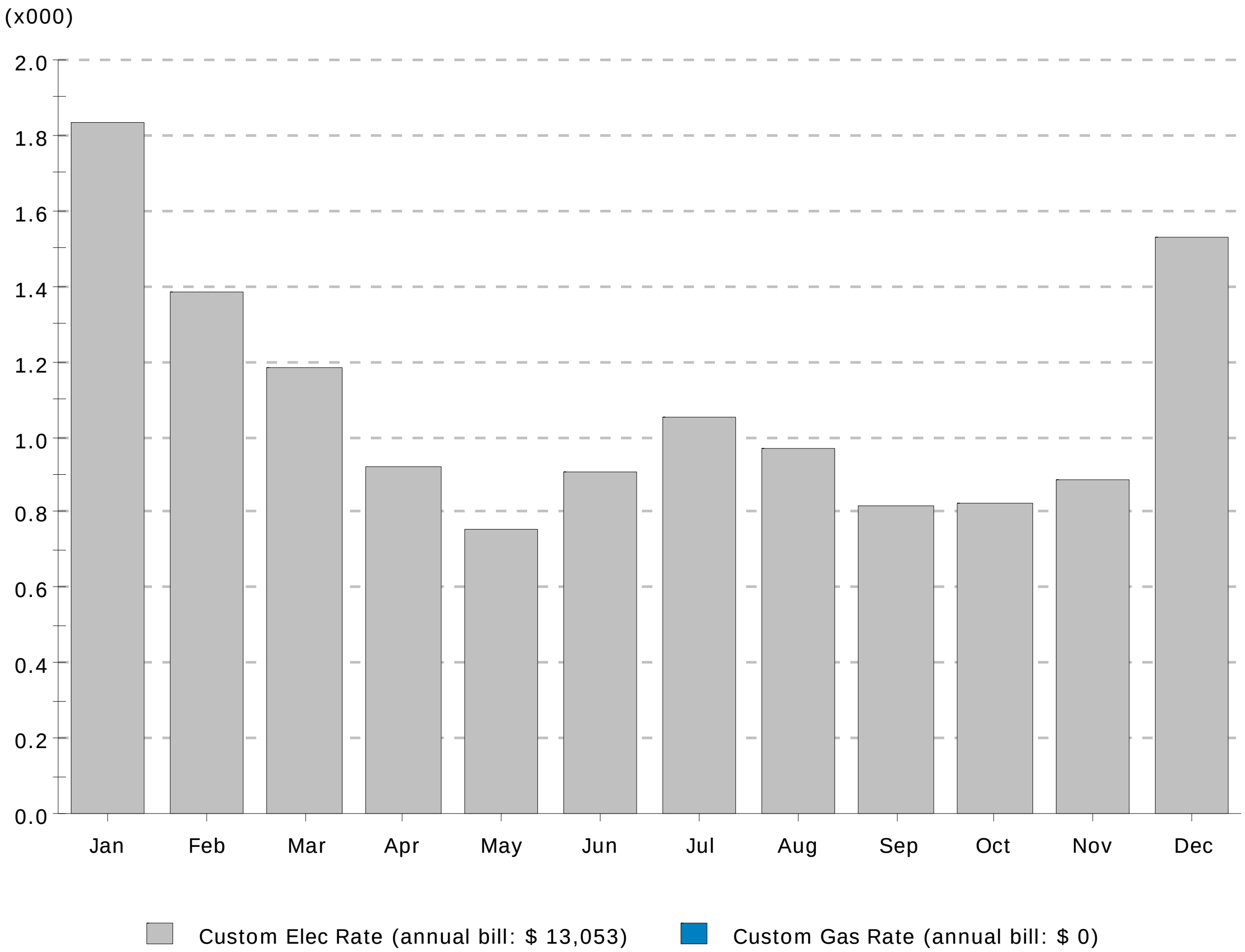

Temperature (°F)
Target Range: 67 to 69°F
80.0
78.0
76.0
74.0
72.0
70.0
68.0
66.0
64.0
62.0
60.0
Town Manager office
Recreation office
2nd flr S main office area
2nd flr N kitchen
2nd flr W lavatory
3rd flr W storage room
1st flr W planning office
1st flr SW mtg room
1st flr clerk lobby area
1st flr S town clerk office
1st flr E bldg inspector office
1st flr N kitchen
2nd flr N main area ceiling
2nd flr S main area ceiling
Town of Rye - Town Hall
June 2009

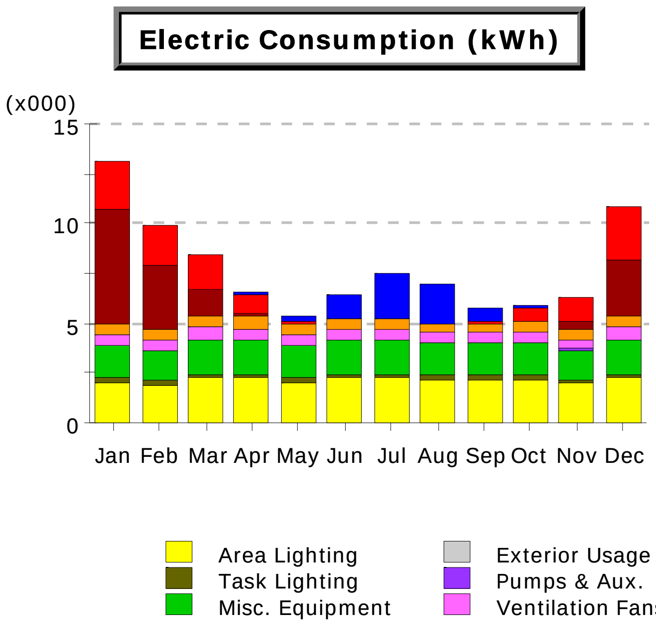
Exhibit G

Building Energy Simulation Reports

Monthly Utility Bills ($)



Total Annual Bill Across All Rates: $ 13,053



Electric Consumption (kWh x000)

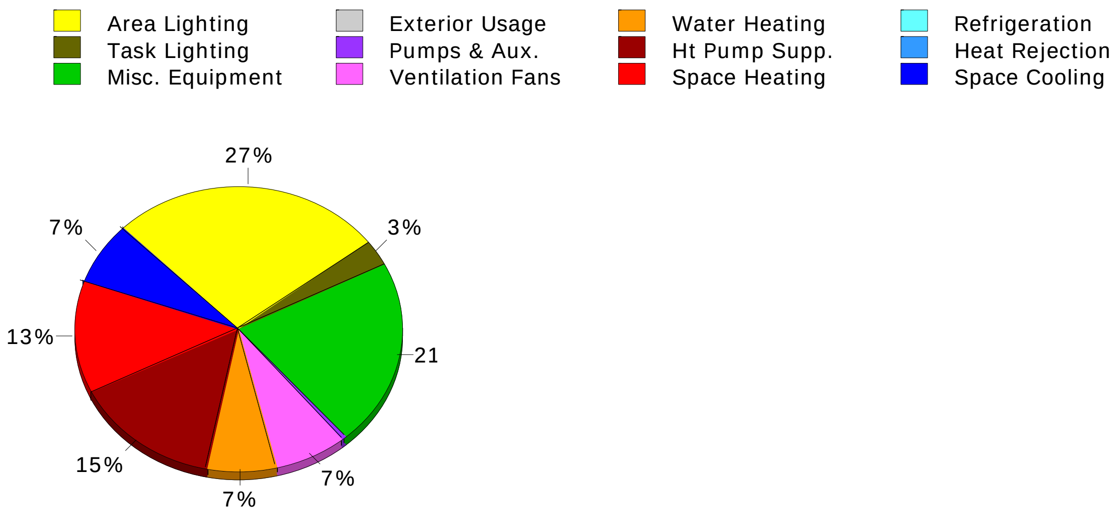
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.19	0.24	1.22	2.30	1.88	0.73	0.14	-	-	6.70
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	2.41	2.06	1.82	0.88	0.22	0.01	-	0.00	0.09	0.58	1.20	2.69	11.97
HP Supp.	5.72	3.13	1.22	0.14	-	-	-	-	-	0.09	0.43	2.86	13.58
Hot Water	0.55	0.55	0.63	0.62	0.53	0.54	0.50	0.46	0.45	0.47	0.46	0.57	6.33
Vent. Fans	0.53	0.50	0.58	0.58	0.53	0.58	0.58	0.55	0.55	0.55	0.50	0.58	6.61
Pumps & Aux.	0.05	0.05	0.05	0.04	0.03	0.01	0.00	0.00	0.01	0.04	0.05	0.05	0.37
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	1.59	1.48	1.69	1.67	1.59	1.67	1.69	1.64	1.62	1.64	1.52	1.69	19.46
Task Lights	0.21	0.20	0.24	0.24	0.21	0.24	0.24	0.22	0.22	0.22	0.20	0.24	2.69
Area Lights	2.04	1.93	2.23	2.23	2.04	2.23	2.23	2.14	2.13	2.14	1.94	2.23	25.54
Total	13.11	9.89	8.46	6.58	5.39	6.49	7.54	6.90	5.81	5.87	6.31	10.90	93.24

Gas Consumption (Btu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

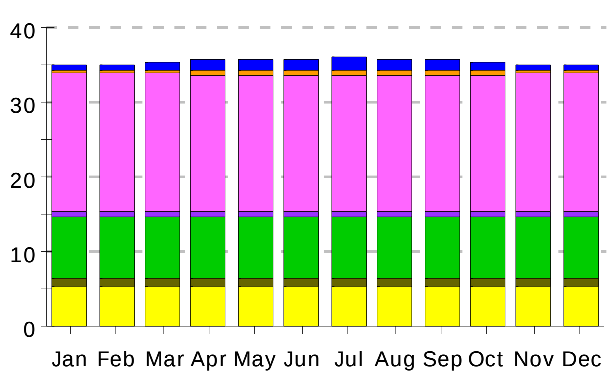
Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	6,697	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	11,965	-	-	-
HP Supp.	13,579	-	-	-
Hot Water	6,332	-	-	-
Vent. Fans	6,611	-	-	-
Pumps & Aux.	374	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	19,456	-	-	-
Task Lights	2,689	-	-	-
Area Lights	25,535	-	-	-
Total	93,239	-	-	-

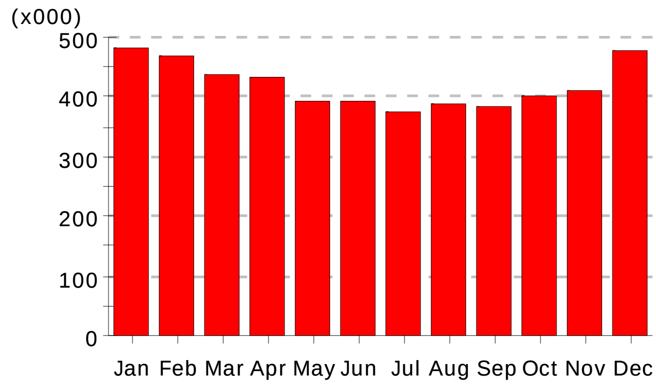


Electricity

Electric Demand (kW)



Gas Demand (Btu/h)



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

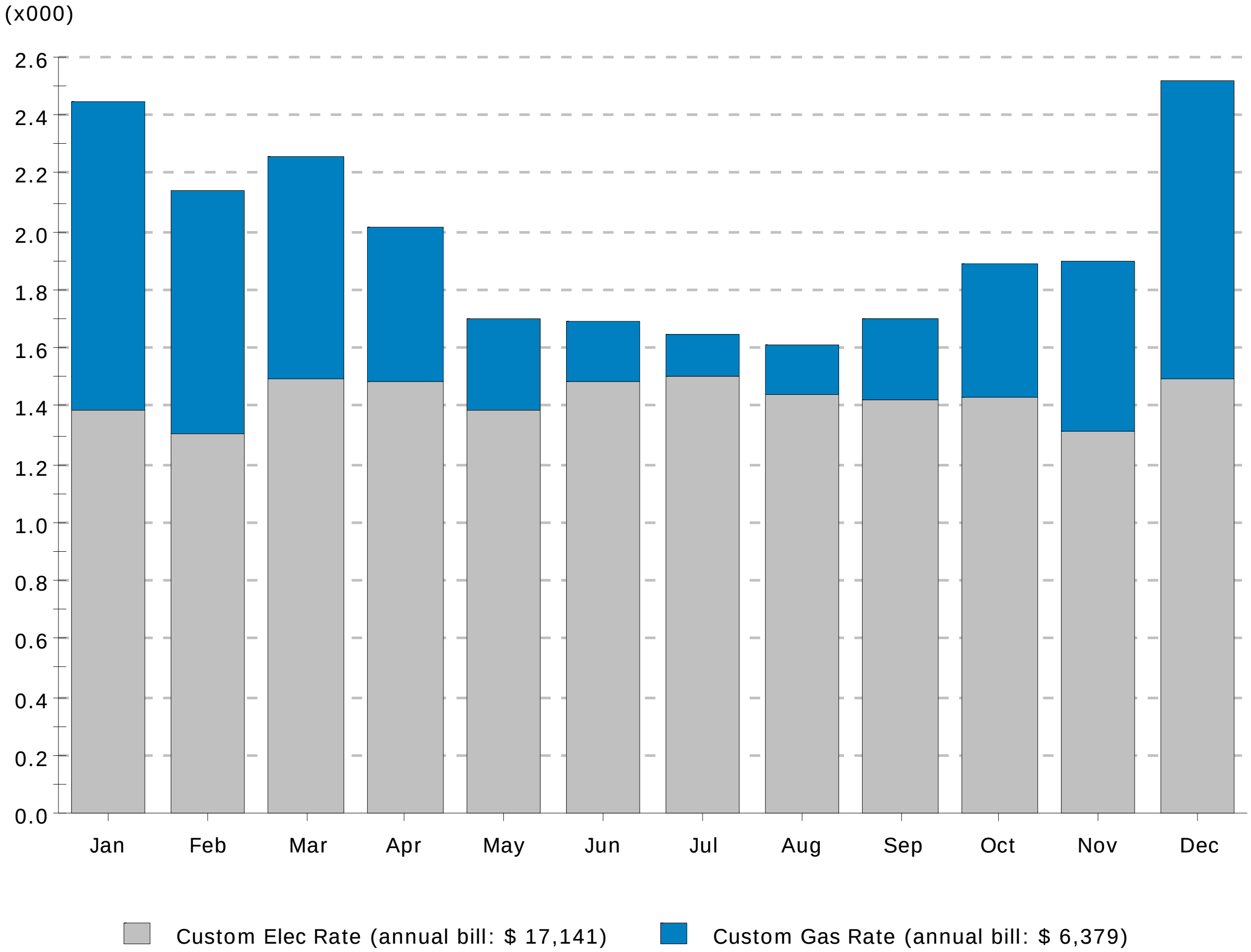
Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.69	0.72	0.76	1.42	1.28	1.60	1.76	1.61	1.43	1.28	0.79	0.75	14.09
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.61	0.64	0.64	0.62	0.59	0.54	0.50	0.48	0.48	0.50	0.54	0.58	6.71
Vent. Fans	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	219.94
Pumps & Aux.	0.67	0.67	0.67	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.67	0.67	7.39
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	99.56
Task Lights	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	14.65
Area Lights	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	63.47
Total	35.11	35.16	35.21	35.75	35.58	35.85	35.97	35.80	35.62	35.50	35.13	35.13	425.82

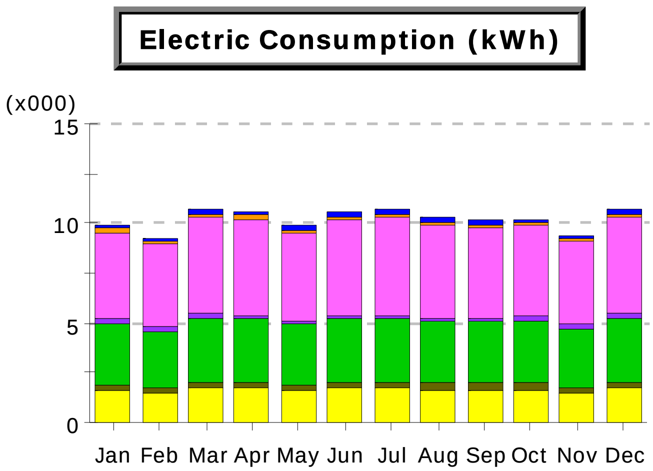
Gas Demand (Btu/h x000)

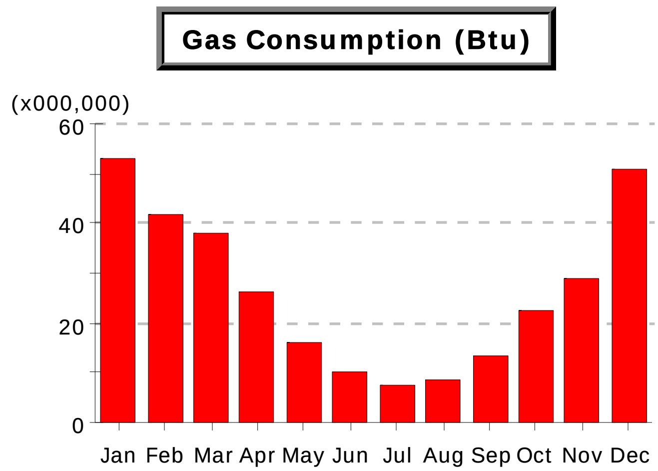
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	480.8	469.0	439.7	434.3	394.6	391.7	375.5	389.2	386.0	402.9	411.1	478.5	5,053.3
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	480.8	469.0	439.7	434.3	394.6	391.7	375.5	389.2	386.0	402.9	411.1	478.5	5,053.3

Monthly Utility Bills ($)



Total Annual Bill Across All Rates: $ 23,520





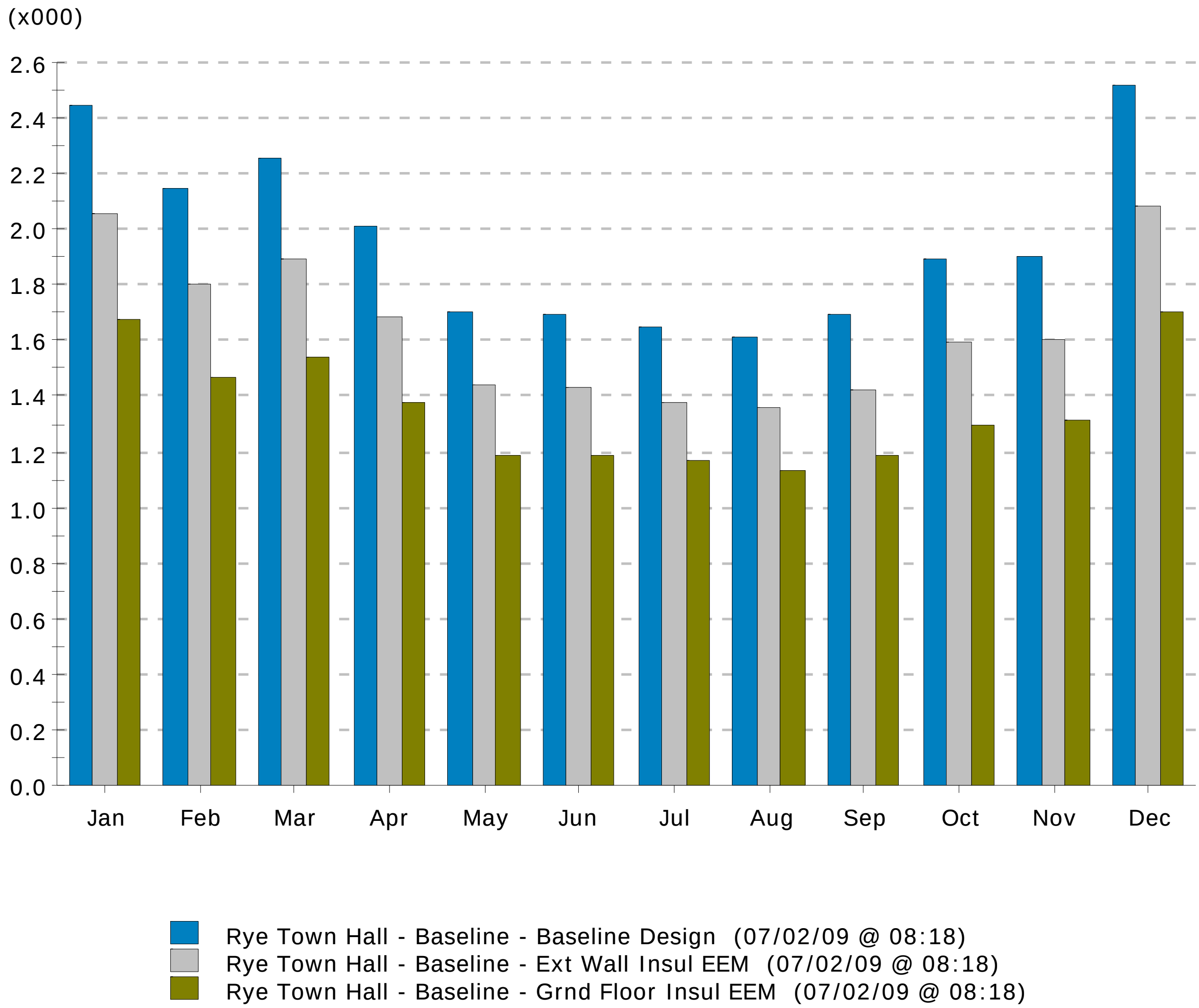
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.14	0.14	0.17	0.20	0.18	0.27	0.32	0.28	0.22	0.18	0.15	0.16	2.39
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.18	0.17	0.19	0.19	0.16	0.16	0.15	0.14	0.14	0.15	0.15	0.18	1.94
Vent. Fans	4.40	4.18	4.84	4.84	4.40	4.84	4.84	4.62	4.62	4.62	4.18	4.84	55.21
Pumps & Aux.	0.21	0.20	0.22	0.21	0.17	0.16	0.15	0.15	0.16	0.19	0.20	0.23	2.23
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	3.06	2.83	3.21	3.16	3.06	3.16	3.21	3.14	3.08	3.14	2.94	3.21	37.20
Task Lights	0.29	0.28	0.32	0.32	0.29	0.32	0.32	0.31	0.31	0.31	0.28	0.32	3.68
Area Lights	1.60	1.50	1.72	1.71	1.60	1.71	1.72	1.66	1.65	1.66	1.52	1.72	19.78
Total	9.88	9.30	10.68	10.62	9.87	10.61	10.71	10.29	10.18	10.24	9.41	10.66	122.44

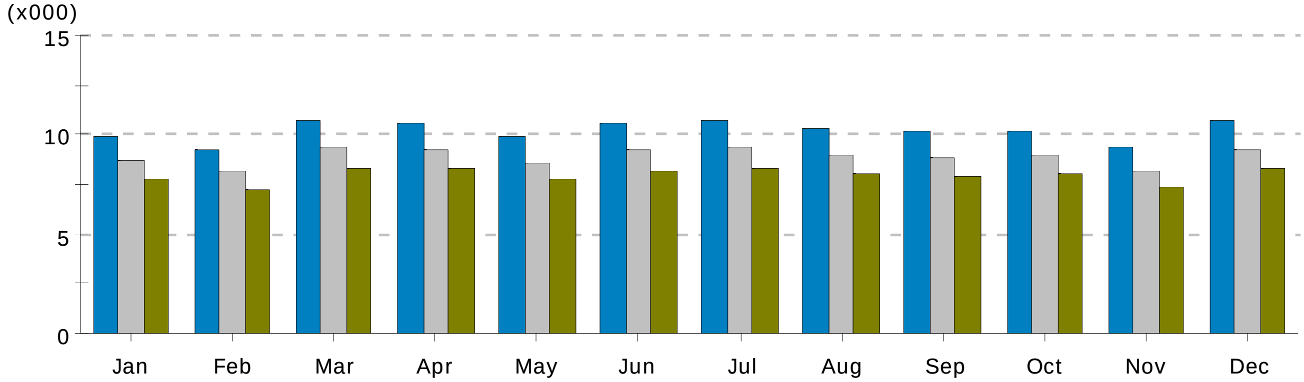
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	53.01	41.96	38.06	26.09	16.00	10.27	7.42	8.55	13.48	22.74	28.89	50.89	317.36
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	53.01	41.96	38.06	26.09	16.00	10.27	7.42	8.55	13.48	22.74	28.89	50.89	317.36

Monthly Utility Bills ($)



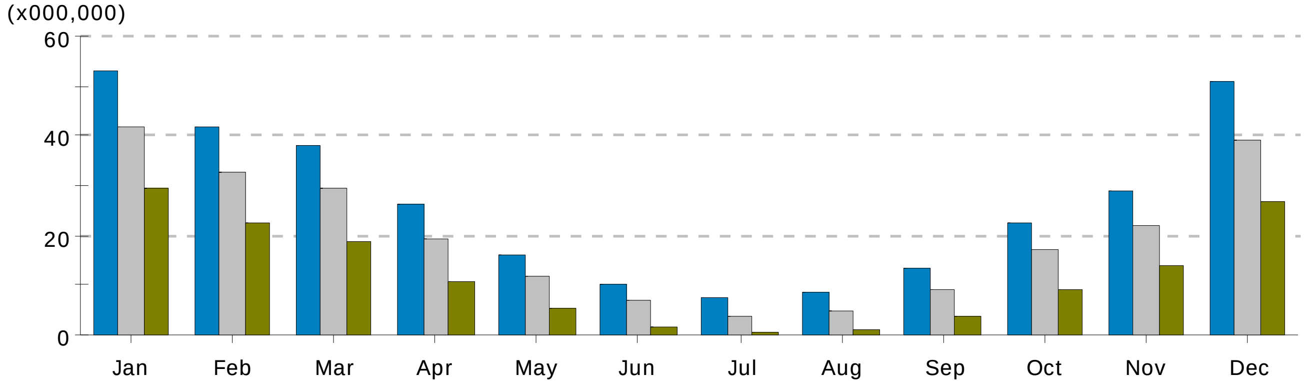
Electric Consumption (kWh)



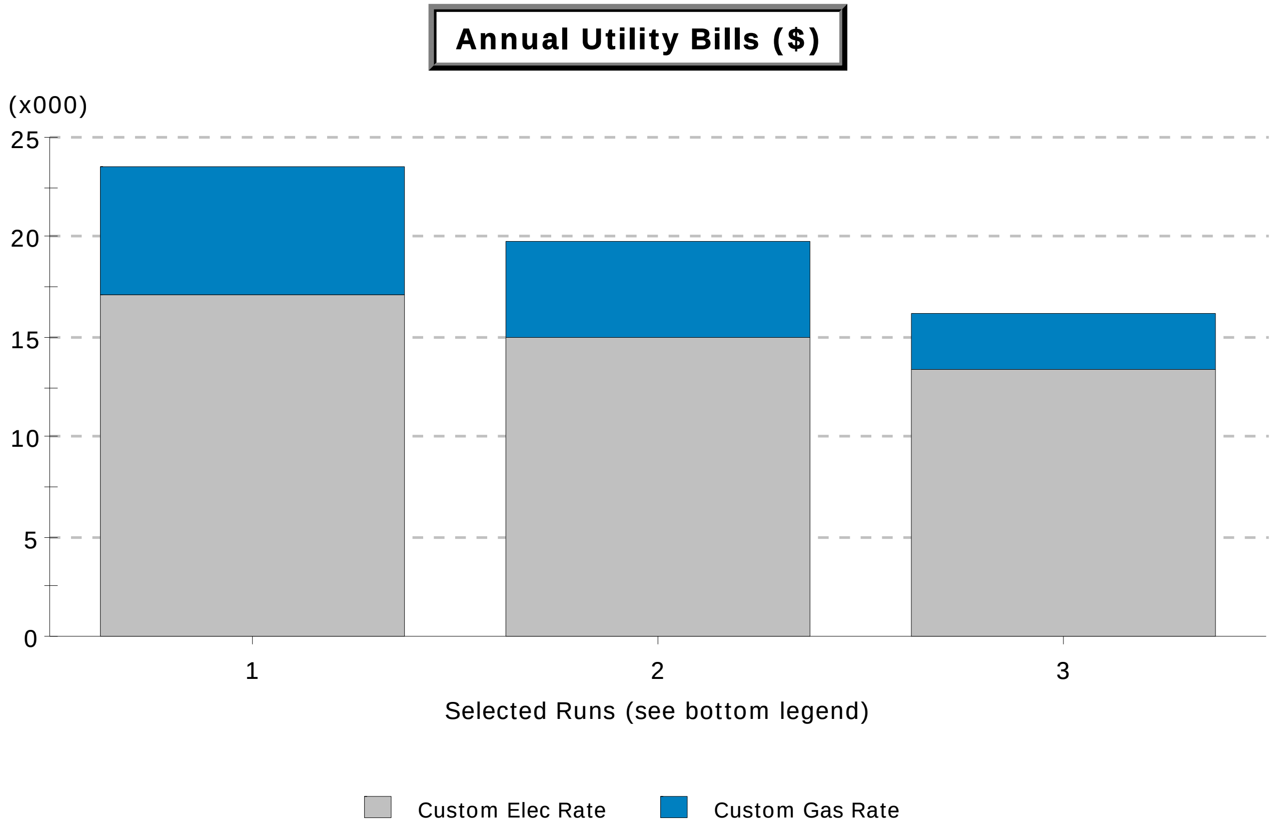
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	9.88	9.30	10.68	10.62	9.87	10.61	10.71	10.29	10.18	10.24	9.41	10.66	122.44
Run 2.	8.65	8.13	9.32	9.25	8.63	9.23	9.31	8.96	8.87	8.94	8.24	9.30	106.82
Run 3.	7.74	7.27	8.33	8.26	7.72	8.23	8.30	8.00	7.92	7.99	7.38	8.31	95.44
Run 4.													
Run 5.													

1. Rye Town Hall - Baseline - Baseline Design (07/02/09 @ 08:18)
2. Rye Town Hall - Baseline - Ext Wall Insul EEM (07/02/09 @ 08:18)
3. Rye Town Hall - Baseline - Grnd Floor Insul EEM (07/02/09 @ 08:18)

Gas Consumption (Btu)



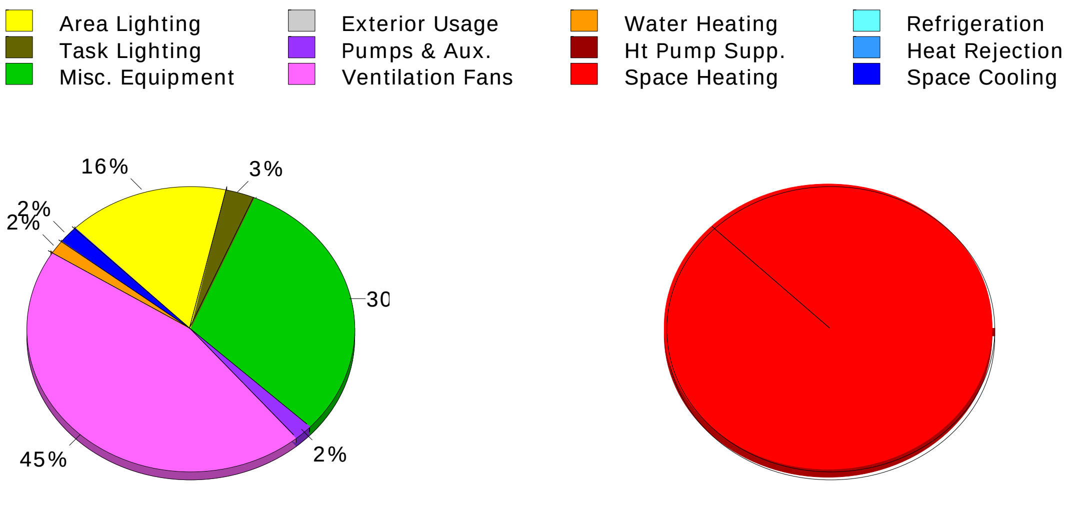
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	53.01	41.96	38.06	26.09	16.00	10.27	7.42	8.55	13.48	22.74	28.89	50.89	317.36
Run 2.	41.92	32.87	29.44	19.40	11.76	7.04	3.48	5.05	9.16	17.07	22.17	39.12	238.48
Run 3.	29.30	22.24	18.57	10.98	5.47	1.62	0.32	0.83	3.89	8.89	14.13	27.03	143.25
Run 4.													
Run 5.													



1. Rye Town Hall - Baseline - Baseline Design (07/02/09 @ 08:18) (annual bill: $ 23,520)
2. Rye Town Hall - Baseline - Ext Wall Insul EEM (07/02/09 @ 08:18) (annual bill: $ 19,748)
3. Rye Town Hall - Baseline - Grnd Floor Insul EEM (07/02/09 @ 08:18) (annual bill: $ 16,241)

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	2.39	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	317.36	-	-
HP Supp.	-	-	-	-
Hot Water	1.94	-	-	-
Vent. Fans	55.21	-	-	-
Pumps & Aux.	2.23	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	37.20	-	-	-
Task Lights	3.68	-	-	-
Area Lights	19.78	-	-	-
Total	122.44	317.36	-	-



Electricity

Natural Gas