3.0 Part 2: Energy Audit

3.1 Acknowledgements of Part 2: Energy Audit

The Energy Audit Report and Excel RPCA Model were completed by Jason Bing and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 2.1 (Version 2, December 2013).

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Part 2 Energy Audit Report and Excel RPCA Model were Received and Reviewed by Owner:

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Rental Assistance Demonstration (RAD):
PART 2: ENERGY AUDIT

727 Miller Avenue, Ann Arbor, Michigan 48103
MILLER MANOR

PREPARED FOR Norstar Development USA, LP
733 Broadway
Albany, NY 12207

AND The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8208E-2-96

PIC # MI064

DATE October 7, 2013

AKTPEERLESS

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727 MILLER AVENUE
ANN ARBOR, MICHIGAN 48103

for

Ann Arbor Housing Commission
727 MILLER AVE
ANN ARBOR, MICHIGAN 48103

AKT PEERLESS PROJECT NO. #8208E-2-96

1.0 Executive Summary

This report presents the findings and recommendations from a building energy and water audit conducted at Miller Manor located at 727 Miller Avenue in Ann Arbor, Michigan. The energy and water audit follows industry standards and acceptable practice for assessing energy and water performance of commercial and multi-family buildings. The audit has been conducted by AKT Peerless and has involved a coordinated effort between AKT Peerless, the Client and the building operating staff.

Documents were provided for review, interviews and field investigations were conducted, and building systems were analyzed. In the year analyzed (January 2012 to December 2012) the Ann Arbor Housing Commission spent $145,193 on all utilities. Tenants are not separately metered at Miller Manor, and this total ($145,193) represents all energy and water costs associated with the property.

AKT Peerless identified seven (7) separate Energy Conservation Measures (ECMs) and one (1) Water Conservation Measure (WCM). The annualized savings of all recommendations totals $11,028 (at current energy and water prices), with the potential to reduce total energy consumption and GHG emissions by 8%. If fully implemented, the payback period from annual energy savings for these ECMs is estimated to be 5.4 years.

Measures best suited for implementation at the End of Useful Life (EUL), advanced ECMs, and measures recommended for further evaluation have been identified and are included in Sections 11.0 of this report.

A preliminary energy use assessment was conducted prior to the cost reduction measure analysis. The figure below describes the historical annual energy consumption and cost for the subject property.

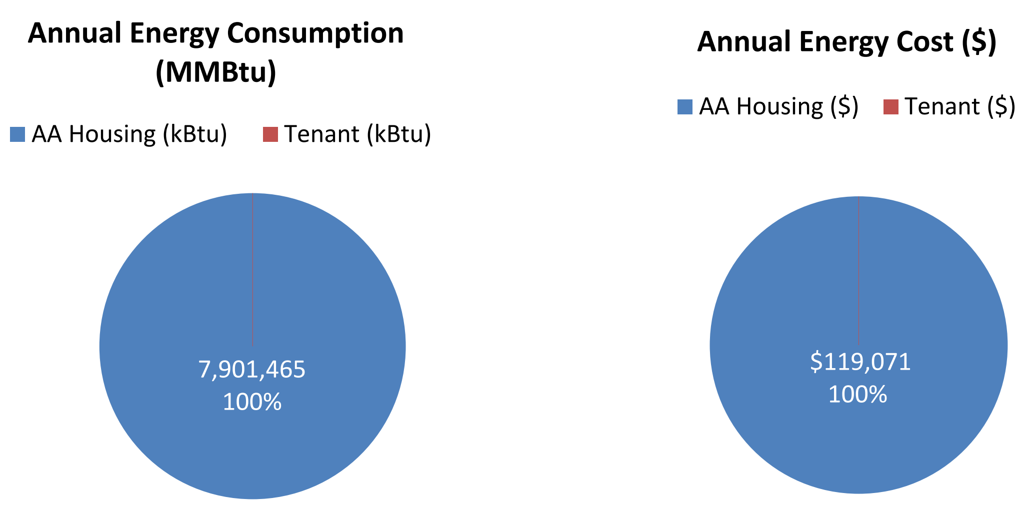
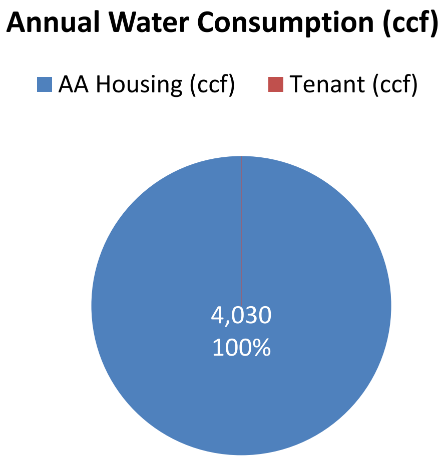


Figure 1. Historical Annual Energy Consumption and Cost



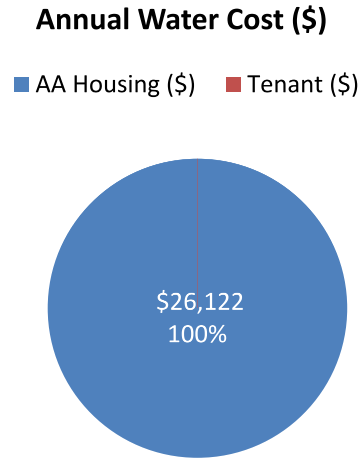


Figure 2. Historical Annual Water Consumption and Cost

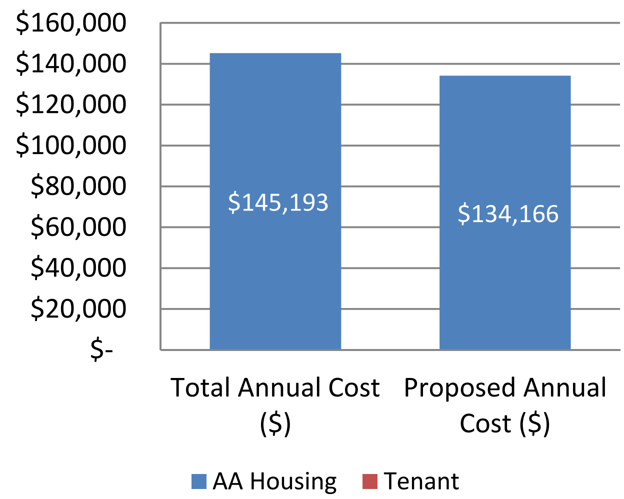
The implementation costs and annual savings estimates for each proposed Energy and Water Conservations Measures are presented in the following table.

Table 1. Financial Summary of All Energy Conservation Measures

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Interior Lighting Retrofit	ECM1	$3,680	$1,786	2.1
Occupancy Sensors	ECM2	$400	$217	1.8
Exterior Lighting Retrofit	ECM3	$1,800	$545	3.3
LED Exit Sign Retrofit	ECM4	$1,800	$545	3.3
Utilize Existing Programmable Thermostats	ECM5	$0	$980	0.0
Install Programmable Thermostats	ECM6	$5,200	$2,351	2.2
Replace Inefficient Air Conditioners	ECM7	$33,800	$3,041	11.1
Replace Inefficient Toilets	WCM1	$13,000	$1,563	8.3
Total		**$59,680**	**$11,028**	**5.4**

Table 2. Impact Summary

% Energy Savings	7%
% Water Savings	8%
% Cost Savings	8%
Annual Cost Savings ($)	$11,028
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	8%



2.0 Purpose and Scope

Norstar Development USA, LP, on behalf of the Ann Arbor Housing Commission (the Client), retained AKT Peerless Environmental & Energy Services (AKT Peerless) to conduct a RPCA Energy Audit of Maple Meadows located at 727 Miller Avenue in Ann Arbor, Michigan.

AKT Peerless' scope of work for this Energy Audit is based on its proposal PE-14248, dated January 9, 2013 and revised March 15, 2013 and authorized by Norstar Development USA, LP on behalf of the Ann Arbor Housing Commission (the Client), and the terms and conditions of that agreement.

In addition to a comprehensive energy and water conservation analysis, a summary of greenhouse gas emissions related to building energy use has been included in this report.

The purpose of this report is to assist the Client in evaluating the current energy and water use and energy and water cost of the subject property relative to other, similar properties; and also to identify and develop modifications that will reduce the energy and water use and /or cost of operating the property. This report will identify and provide the savings and cost analysis of all practical measures that meet the client's constraints and economic criteria, along with a discussion of any changes to operation and maintenance procedures. It may also provide a listing of potential capital-intensive improvements that require more thorough data collection and engineering analysis, and a judgment of potential costs and savings. Additionally, this report will identify the feasibility of green energy technologies, as well as, determine if further analysis is recommended.

Relevant documentation has been requested from the client that could aid in the understanding of the subject property's historical energy use. The review of submitted documents does not include comment on the accuracy of such documents or their preparation, methodology, or protocol. The following documents were available for review while performing the analysis:

- Energy Utility Bills
- 2009 United States Greenhouse Gas Inventory, Annex 2
- USEPA Climate Leaders Calculator for Low Emitters
- HUD Residential Energy Benchmark Tool
- HUD Residential Water Use Benchmarking Tool
- National Oceanic Atmospheric Administration "Normal Monthly Heating Degree Days (Base 65)" and "Normal Monthly Cooling Degree Days (Base 65)"

3.0 Additional Scope Considerations

In addition to fully satisfying the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Procedures for Commercial Building Energy Audits, Second Edition 2011, Level II guidelines, this report includes all the necessary requirements of an Energy Audit as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in October 2012 (Version 1). These items are identified as follows:

- An initial assessment of the potential feasibility of installing alternative technologies for electricity, heating and cooling systems, and hot water heating at the property. (See Section 11.0)
- An expected end of useful life study for all recommended energy and water efficiency measures.
- Recommendations of any additional professional reports needed (including, for example alternative energy system feasibility studies, air infiltration tests for energy loss and ventilation needs, blower door tests, infrared imaging, duct blasting, etc.)

4.0 General Information

4.1 Audit Team

This audit is the result of a collaborative process between the following AKT Peerless and client personnel:

Table 3. Audit Team

Name	Organization	Title
Henry McElvery	AKT Peerless	Technical Director of Energy Services
Lance Mitchell	Ann Arbor Housing Commission	Facilities and Maintenance Property Manager
Jennifer Hall	Ann Arbor Housing Commission	Executive Director

4.2 Audit Process

AKT Peerless collected historical energy data and floor plans for the building. The square footage of all spaces was determined and the size and location of pertinent mechanical equipment was documented. AKT Peerless conducted a walk-through survey of the building on November 8, 2012 and then on April 16, 2013, collecting specific information on the mechanical, electrical, and plumbing systems as well as occupancy, scheduling, and use patterns.

AKT Peerless utilized industry accepted measuring devices, including but not limited to: a blower door to quantify air infiltration, an infrared camera to visually identify areas of potential energy loss, and a ballast discriminator to identify existing ballast types. Light levels were measured using a light meter in various areas to compare to Illuminating Engineering Society of North America (IESNA) recommended levels.

A visual inspection of the mechanical equipment, lighting systems, controls, building envelope and plug loads was performed. Mechanical equipment nameplate data was recorded and the specifications and performance data were reviewed and used in this analysis.

4.3 Energy Calculations Methodology

The primary methods of energy calculation for this analysis were simplified manual and spreadsheet tabulations based on professional standards. Actual calculation methods are discussed in each applicable section.

The energy end use consumption breakdown, found later in this report, is based on 2003 Commercial Buildings Energy Consumption Survey (CBECS) data for Lodgings of relatively similar scale and age. The benchmark information provided in the 2009 Residential Energy Consumption Survey (RECS) and CBECS survey allowed our audit team to approximate the total energy end use consumption for the facility.

5.0 Property Description

This section summarizes physical characteristics and general use of the subject property.

5.1 Location

The subject property is located in ASHRAE Climate Zone 5A. According to National Oceanic and Atmospheric Administration recording of heating and cooling degree days, on an annual basis Ann Arbor, Michigan is expected to experience an average of 6,818 heating degree days and 840 cooling degree days with a basepoint temperature of 65 degrees Fahrenheit.

5.2 Property Characteristics

General information pertaining to the subject building is summarized in the following table:

Table 4. Property Characteristics

Primary Building Type / Occupancy	Multi-Family (Apartments in 5 or More Unit Buildings)
Region	ASHRAE 5A
Date of Construction	1977
Approximate Total Square Footage	89,250 sq ft

The subject property Primary Building Type is designated as Multi-Family (Apartments in 5 or More Unit Buildings). For all energy performance comparisons presented in this report the subject building will be compared to similar buildings of the same Primary Building Type.

5.3 Property Spaces

Spaces refer to the building as a whole and the rooms that comprise the building. Typically, the various space types will serve specific functions within the facility. The following table identifies the space types for the subject building.

Table 5. Summary of Property Spaces

Space	Use	Sq Footage	% of Total Area
Multi-family Housing	Multi-family Housing	89,250 ft^2	100%

5.4 Building Occupancy

Occupancy schedule has a significant impact on a facilities energy usage. In fact, the relationship between occupancy and system operating schedules and setpoints are typically more important than equipment efficiencies. The occupancy schedules for the subject building as follows:

Table 6. Building Occupancy Schedule

Area	Day	Time	Use	Average Population
Office & Shop	Monday-Friday	9:00am-5:00pm	Staff	15
Apartments	All	24/7	Residents	120

5.5 General Construction

The multi-family residential property has one, 7-story building containing 89,250 square feet and 104 apartment units. The site area is approximately 1.06 acres. Construction of the property was completed in 1977. Significant renovations were performed in 1993, with the addition of the office wing at the front of the building. Based on structures of similar size, configuration, and geographic location, it is assumed that the foundation consists of a conventional, reinforced concrete, slab on grade foundation. The building is constructed of cast in-place concrete framing, and interior concrete masonry unit (CMU) walls. The upper floors and roofs are constructed with cast-in-place concrete decks.

5.6 Building Envelope

This section summarizes physical characteristics of the subject building envelope.

5.6.1 Walls and Wall Insulation

The exterior walls are finished with brick masonry veneer. Portions of the exterior walls are accented with exterior insulation and finish system (EIFS) covered molding. The walls were reported to be insulated. Standard construction practice for the time period of construction typically consists of 4” of batt insulation in the walls. The construction plans indicated batt insulation in the exterior walls and rigid insulation at door and window openings.

5.6.2 Roof and Roof Insulation

The primary roofs are classified as flat roofs. The roofs are finished with a single ply, elastomeric membrane. The membrane color is black. The main roof, office roof, and maintenance shop roof are topped with gravel ballast. As-built insulation values were not available.

5.6.3 Windows and Other Fenestrations

The resident unit windows and elevator lobby windows are vinyl-framed, double-pane glazed, sliding units. The windows along the office wing and common areas are vinyl-framed units with fixed, double-pane glazing.

5.6.4 Doors

The building's exterior entrance doors are aluminum-framed storefront systems with full glass panels set in metal frames. The apartment unit corridor entry doors are solid wood doors set in metal frames. Interior entrance doors to the apartments contain lever hardware, keyed deadbolts, and spy-eyes. Patio and balcony doors are typically insulated sliding glass doors with screens.

The exterior overhead service doors at the maintenance garage are painted metal doors with glass lights and flush panels and are equipped with mechanical openers.

5.7 Heating, Ventilation, and Air Conditioning (HVAC)

There is a central HVAC system for the building. Hot water for the central heating system is supplied by six, gas-fired, atmospheric boilers. The boilers each have a rated input capacity of 594 MBH and are located in the boiler room. The boilers have a rated thermal efficiency of 80%. The boilers are vented to the exterior via natural draft. The exhaust flues do not have vent dampers. Circulating pumps provide hot water to each temperature-controlled space via a two-pipe distribution system. There are two circulating pumps (primary / backup) rated at 5 HP each.

The lobby is cooled by two ductless split system air conditioners. The fan coil units are wall-mounted in the lobby. The condensing units are roof-mounted and have a cooling capacity of two tons each. Efficiency data was not available for the ductless systems. Based on the age of the units, an EER of 7 was assumed. The community room and common kitchen are heated only with an air handling unit (AHU) and hot water coil.

Heating and cooling are provided in the office wing by individual, direct-expansion, constant-volume, gas-fired, packaged, rooftop-mounted, HVAC units. There are a total of two units, each with a cooling capacity of 10 tons. The air-conditioning section has a rated EER of 10.1. The units have a heating input rating of 45,000 Btu/hr and a rated thermal efficiency of 80%.

Supplemental heating is provided in the boiler room, maintenance garage, and mechanical room by ceiling mounted, gas-fired unit heaters. The unit heaters have a rated input capacity of 125,000 Btu/hr each and a thermal efficiency of 80%. The unit heaters are controlled by individual wall-mounted thermostats.

Each apartment is heated by hot water baseboard heating units mounted on an exterior wall in each room and supplied with hot water by the central boilers. A single thermostat controls the zone valve for each resident unit. Each apartment is cooled by one through-the-wall air-conditioning units mounted on the exterior wall. The air-conditioning units are estimated to have a rated cooling capacity of 8,000 to 10,000 Btu/hr and a current EER of 7.0.

The building is equipped with a mechanical ventilation system. Two Reznor model #RPB400S gas-fired packaged MUA units are located on the roof and deliver 3,200 CFM of outside air each to two ventilation shafts supplying fresh air to the corridors. There are also several roof mounted exhaust fans, some of which are not operational.

Domestic hot water is supplied by two, gas-fired boilers controlled with a Honeywell controller. Each boiler has a rated input capacity of 627 MBH and is located in the boiler room. The boilers have a rated thermal efficiency of 82%.

5.8 Lighting

This section describes this property's interior and exterior lighting.

5.8.1 Interior Lighting

Interior lighting is provided in the common areas and corridors by fluorescent light fixtures. The fluorescent light fixtures contain magnetic ballasts, utilizing T-12 bulbs. Electronic ballasts with T-8 bulbs are used in the office area and the maintenance shop. The exit signs are illuminated by fluorescent lighting. Interior lights are typically on up to 24 hours per day in the lobbies, corridors, and stairwells. Interior lighting is typically turned off at night in mechanical spaces and other common areas. The interior lighting is controlled by wall switches. Interior lighting is provided in each apartment unit by one 4-lamp compact fluorescent fixture and three linear fluorescent light fixtures.

5.8.2 Exterior Lighting

The outside grounds of the Miller Manor property are lighting throughout the evening hours for safety and security. Site observations revealed a total of ten (10) identical exterior wall pack fixtures. The existing exterior wall packs are of the high intensity discharge (HID) type with metal halide (MH) or high pressure sodium (HPS) lamps that appeared to be 100 watts each. Control of the exterior wall packs was reported to be by photocell.

6.0 Energy Use Analysis

This section provides information on energy delivery to the subject property.

Energy use and cost indices for each fuel or demand type, and their combined total, have been developed using generally accepted industry methods and benchmarking tools provided by the Department of Housing and Urban Development (HUD) . The Energy Utilization Index (EUI) and cost index of the subject building are compared (benchmarked) with the EUI and cost index of similar buildings evaluated in the Residential Energy Consumption Survey (RECS) and Commercial Building Energy Consumption Survey (CBECS) conducted by the Energy Information Administration (EIA) of the United States Department of Energy.

AKT Peerless analyzed utility bills for the time period covered by provided records. The following figures summarize the most recent annual energy consumption and costs for this property.

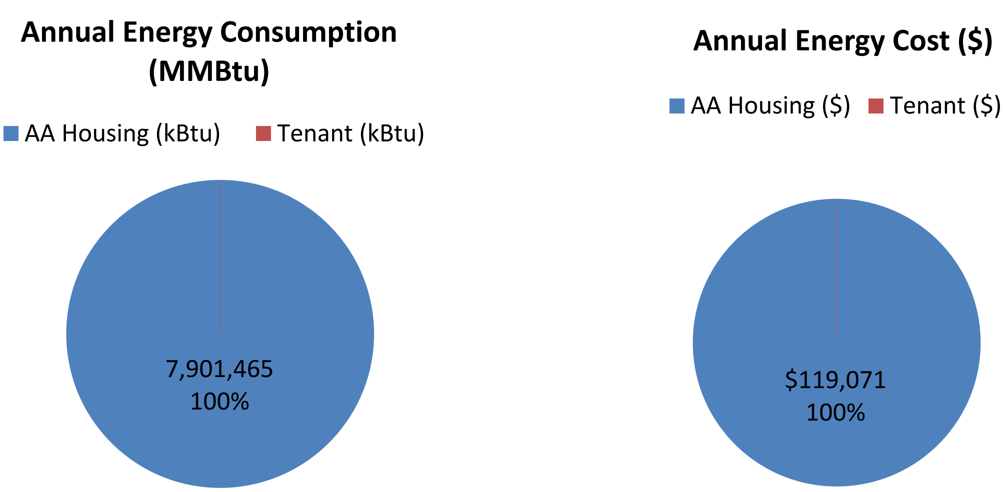


Figure 3. Historical Annual Energy Consumption and Cost

6.1 Electricity

For the time period covered by client provided records, historic electricity use is summarized in this section.

Providers	Number of Meters	Unit of Consumption
DTE	1 - # 8986897	kWh

Electricity bills were analyzed for a twelve month time-frame, from January 2012 through December 2012. The AAHC paid a total of $75,991 for electricity in this time frame. Total consumption was 681,150 kWh. The blended rate (consumption and demand) for electricity was $0.11 per kWh.

Figure 3 below represents the comparison of electricity consumption (kWh) and annual cooling degree days (CDD). A degree day compares the outdoor temperature to a standard indoor temperature of 65 degrees Fahrenheit. The more extreme the outdoor temperature, the higher the degree day number. Therefore, degree-day measurements can be related to the amount of energy needed for space heating and cooling as compared to the outdoor temperature.

The increase in space cooling typically required during the warmer temperatures of the summer months is reflected by the blue bars. It should be noted that the peak CDDs experienced in July are matched by the level of electrical consumption reflected.

It is possible that some increase in winter electrical consumption is due to longer operation of the building lighting systems, as well as increased operation of fans and other equipment associated with the building heating system.

From this data, a base load of approximately 48,240 kWh per month is established for the facility.

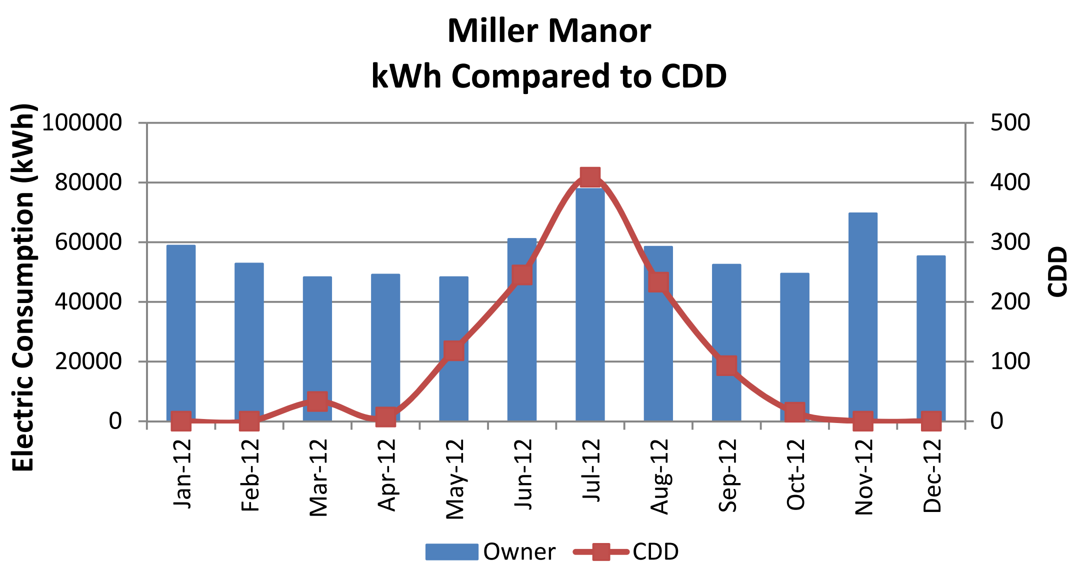


Figure 4. Electricity Consumption Graph

Table 7. Annual Electric Metrics

Consumption	681,150 kWh		**Cost per kWh***	$0.112 / kWh
Energy Use Intensity	7.63 kWh / ft^2		**Cost per ft^2**	$0.85 / ft^2
MMBtu	2,325 MMBtu		**Electricity Cost**	$75,991

*Cost per kWh is a blended rate including all demand and customer costs.

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated electricity consumption breakdown by end use.

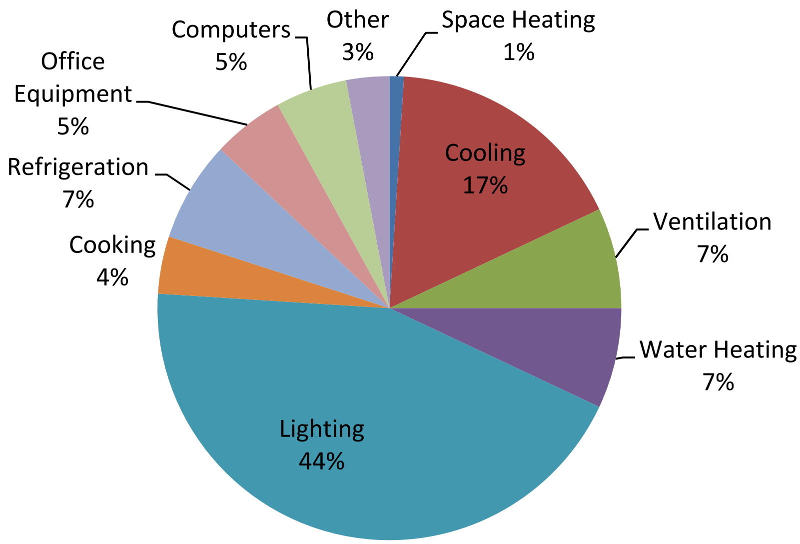


Figure 5. Estimated Electricity Consumption Per End Use

6.2 Natural Gas

For the time period covered by client provided records, historic natural gas use is summarized in this section.

Providers	Number of Meters	Unit of Consumption
DTE	1 - # 7109632	Therm

Natural gas bills were analyzed for a twelve month time-frame, from January 2012 through December 2012. The AAHC paid a total of $43,080 for natural gas in this time frame. Total consumption was 55,767 therms (1 therm = 100,000 Btu) during the time frame assessed. The average rate for natural gas was $0.773 per therm.

Figure 3 below represents the comparison of natural gas consumption (Therms) and annual heating degree days (HDD). A degree day compares the outdoor temperature to a standard indoor temperature of 65 degrees Fahrenheit. The more extreme the outdoor temperature, the higher the degree day number. Therefore, degree-day measurements can be related to the amount of energy needed for space heating and cooling as compared to the outdoor temperature.

It shows the increase in natural gas consumption at the facility in the winter months when heating degree days are the highest. This represents the increase in space heating (packaged rooftop units and the central boiler plant) required during the colder temperatures of the winter months. As seen in the chart, therm consumption is reduced dramatically in June, July, August, and September as the requirements for heating are low during these months.

From this data, a base load of approximately 560 therms per month is established for the facility. This base load can be attributed to domestic water heating.

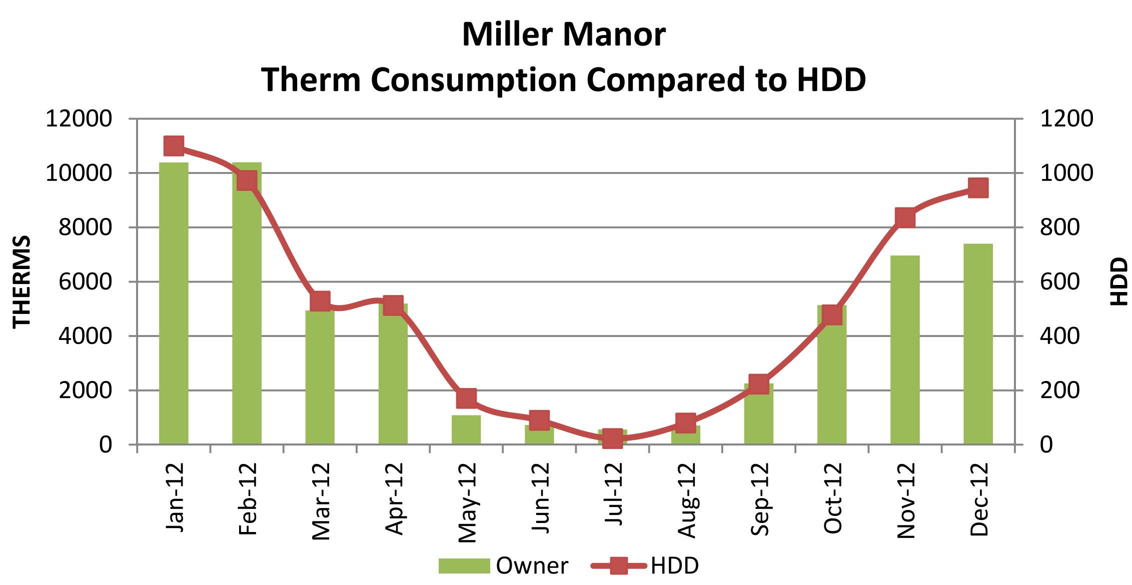


Figure 6. Natural Gas Consumption Graph

Table 8. Annual Natural Gas Metrics

Consumption	55,767 therms		**Cost per therm**	$0.773 / therm
Energy Use Intensity	0.63 therms / ft^2		**Cost per ft^2**	$0.48 / ft^2
MMBtu	5,577 MMBtu		**Natural Gas Cost**	$43,080

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated natural gas consumption breakdown by end use.

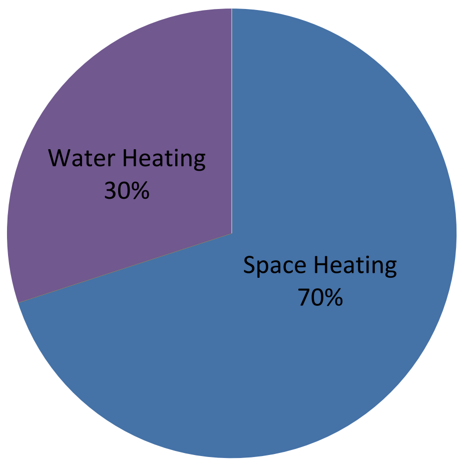


Figure 7. Estimated Natural Gas Consumption Per End Use

6.3 Domestic Water Use

For the time period covered by client provided records, historic domestic water use is summarized in this section.

Providers	Number of Meters	Unit of Consumption
City of Ann Arbor	1	100 cubic feet (CCF)

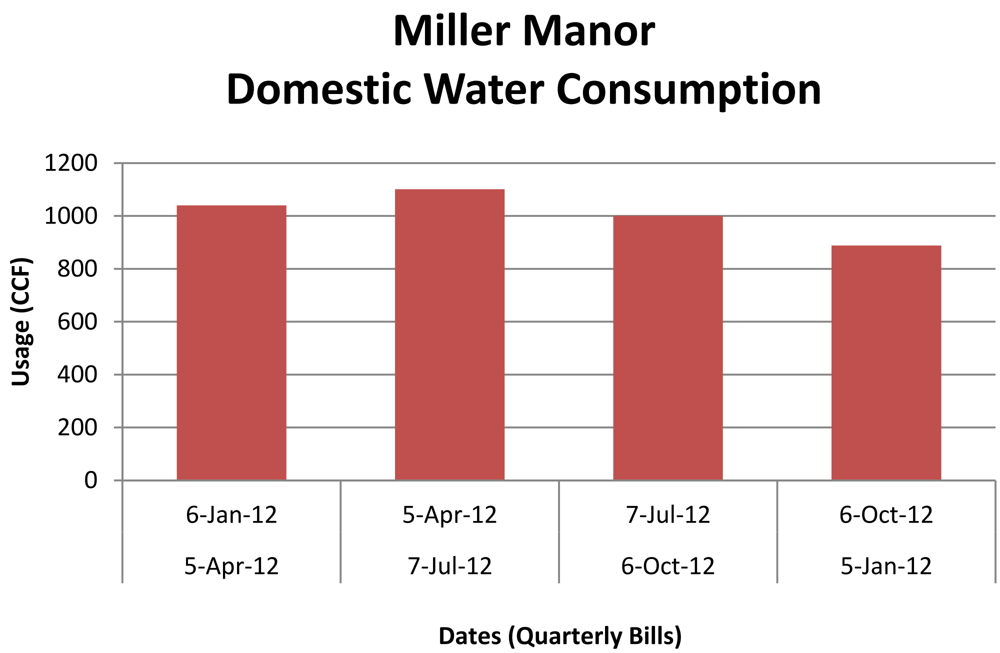


Figure 8. Domestic Water Consumption Graph

Table 9. Annual Domestic Water Metrics

Consumption	4,030 CCF 3,014,440 gallons
Water Cost	$26,122

Cost per CCF	$6.48 / CCF
Cost per ft^2	$0.35 / ft^2

Total annual water consumption was 4,030 CCF (3,014,440 gallons). Average cost for domestic water and sewer on an annual basis is $6.48 per CCF. Total annual domestic water and sewer cost is $26,122.

According to the EPA, residential water use accounts for more than half of the publicly supplied water in the United States. For this reason, the EPA has introduced the WaterSense program to identify possible water efficiency methods and technologies for consumers throughout the country. Considering the responsibility that typically lies with the tenants, multi-family homes are no stranger to excessive water usage. Fortunately, implementation of improved technologies throughout these facilities can impact the water supply as well as the rising overhead costs associated with distribution and collection.

The HUD Energy Benchmarking Tool was used to compare water consumption data for the subject property to typical water consumption data for similar HUD properties. The tool utilizes normalized data from its database of more than 9,100 buildings to provide comparative metrics on domestic water consumption based on a facility's historic water data and design characteristics. Finally, a score is generated for the analyzed building to identify its ranking among similar buildings.

The Residential End Uses of Water study (REUWS) published in 1999 by the AWWA Research Foundation and the American Water Works Association is a research study that examined where water is used in single-family homes in North America. Conducted by Aquacraft, PMCL, and John Olaf Nelson, the REUWS was the largest study of its kind to be completed in North America and efforts are underway to repeat the effort and obtain updated results. The "end uses" of water include all the places where water is used in a single-family home such as toilets, showers, clothes washers, faucets, lawn watering, etc. The full REUWS final report is available to the public at no charge from the Water Research Foundation (WRF).

Figure 8 below shows the REUWS typical domestic water consumption breakdown by end use.

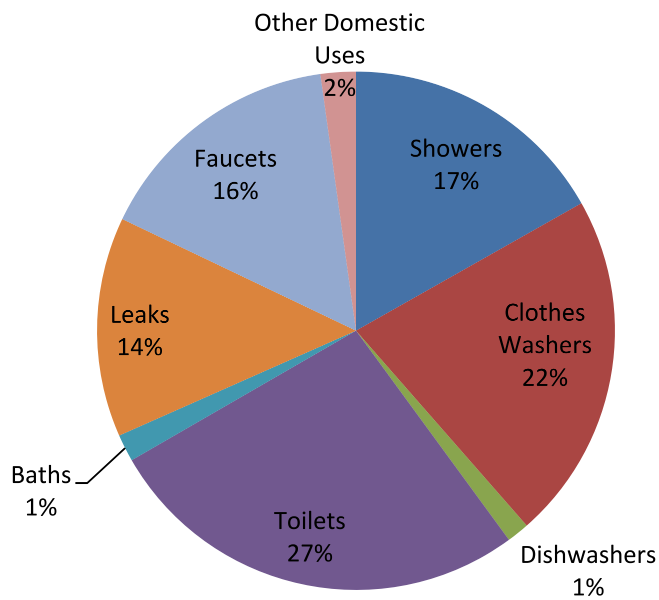


Figure 9. Domestic Water Typical End Use

6.4 End Use Consumption and Cost Breakdown

The disparate energy types (electricity and natural gas for this facility) and water costs have been aggregated to provide a breakdown of total utility cost into end use components. The breakdown of energy consumption and cost is based the energy use breakdown, as described in Section 4.3, Energy Calculations Methodology.

The following table and charts detail the breakdown of energy and water costs. It should be noted that the consumption percentage identified in Section 5.1 Electricity, Section 5.2 Natural Gas, and Section 5.3 Domestic Water Use and the overall cost percentage for each end use are different. This is due to the cost difference for purchasing each energy type.

Miller Manor currently pays $32.69 per MMBtu of electricity, $7.73 per MMBtu of natural gas, and $6.48 per CCF of water.

Table 10. Annual Energy Use Breakdown

Categories	Electricity (MMBtu)	NG (MMBtu)	Total Consumption (MMBtu)	Consumption (%)
Space Heating	23	4,753	4,777	60%
Cooling	396	0	396	5%
Ventilation	163	0	163	2%
Water Heating	163	823	986	12%
Lighting	1,023	0	1,023	13%
Cooking	93	0	93	1%
Refrigeration	163	0	163	2%
Office Equipment	116	0	116	1%
Electronics	116	0	116	1%
Other	69	0	69	1%
TOTAL	**2,325**	**5,577**	7,901	**100%**

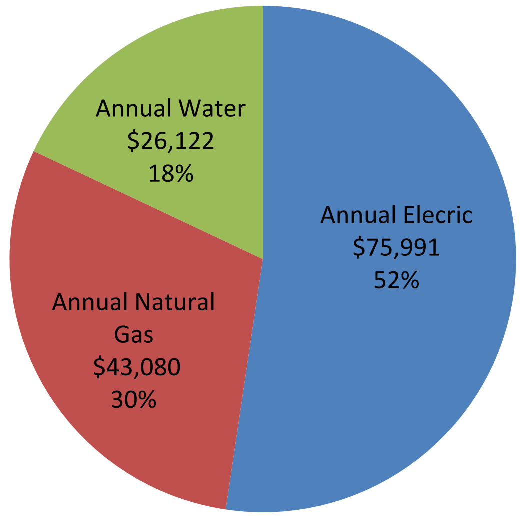


Figure 10. Annual Utility Cost Summary

7.0 Performance Benchmarking

7.1 Energy Performance Benchmark

A benchmark is a standard by which something can be measured. Energy Benchmarking is the comparison of one building's energy consumption to the use of energy in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the Energy Benchmarking Tool to establish if a building's energy consumption is higher or lower than expected energy usage for similar buildings. AKT Peerless utilized the HUD Energy Benchmarking Tool to quantify the performance of the subject building relative to the family of HUD residential buildings.

This statistical analysis of the HUD tool is based on filters for the building's location, gross square footage, total number of units and year of construction (refer to the appendix for more information regarding dataset filters). This filtered data set is used to calculate the benchmarks for an overall benchmark Energy Use Intensity (EUI) as well as the Energy Cost Intensity (ECI). The benchmarks shown in the portfolio summary are derived from the statistical analysis described in this section.

The following table compares the building energy performance of the subject property and the established benchmark.

Table 11. HUD Residential Energy Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	40	50
EUI (Energy Use Index)	88.5 kBtu/ft^2	77.4 kBtu/ft^2
$ ECI (Energy Cost Index)	1.33 $ / ft^2	1.17 $ / ft^2

The HUD Residential Energy Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings.

7.2 Water Performance Benchmark

Water Benchmarking is the comparison of one building's water utilization to the use of water in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the preliminary benchmarking tool to establish if a building's water utilization is higher or lower than normal usage for similar buildings.

In order to develop the water consumption benchmarking tool, water consumption data was collected through voluntary release of information from thousands of buildings in nearly 350 PHAs nationwide.

Regression analyses were performed on these datasets to see which of over 30 characteristics were most closely linked to water conservation.

Your building will score from 0 - 100, where 0 means water consumption is probably excessive and 100 means that the building probably uses water very efficiently. Important: this is a whole-building tool. Water use inputs include resident-paid consumption, when applicable/available.

The table below quantifies the performance of a use-defined building relative to the family of HUD residential buildings.

Table 12. HUD Residential Water Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	67	50
WUI (Water Use Intensity)	33.8 gal/ft^2	48.0 gal/ft^2
WCI(Water Cost Intensity)	0.29 $ / ft^2	0.42 $ / ft^2

8.0 Operations and Maintenance (O&M) Opportunities

Operation and maintenance make up the largest portion of the economic and environmental life cycle of a building and have become primary considerations of building owners and operators. Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency. Inadequate maintenance of energy-using systems is a major cause of energy waste in both the Federal government and the private sector. Improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.

The following recommendations are believed to have the opportunity to reduce energy and water consumption for the facility.

8.1 Develop a Preventative Maintenance Plan for Equipment

The Facilities & Maintenance Property Manager (Lance Mitchell) has already begun a preventative maintenance plan for equipment. *Planned* or preventative maintenance is proactive (in contrast to reactive) and allows the maintenance manager control over when and how maintenance activities are completed. When a maintenance manager has control over facility maintenance, budgets can be established accurately, staff time can be used effectively, and the spare parts and supplies inventory can be managed more efficiently.

Regardless of which strategy is used, maintenance should be seen as a way to maximize profit and/or reduce operating costs. From this perspective, the main functions of a maintenance department/staff are as follows:

- Control availability of equipment at minimum cost
- Extend the useful life of equipment
- Keep equipment in a condition to operate as economically and energy efficiently as is practical

The maintenance department/staff would be responsible for the following tasks:

- Maintenance planning
- Organizing resources, including staffing, parts, tools, and equipment
- Developing and executing the maintenance plan
- Controlling maintenance activities
- Budgeting

At the time of the assessment, the Facilities Director indicated that a plan is currently being established for the housing authority. It is recommended this continue. Additional considerations for the future plans should include, but not be limited to:

- Energy efficiency for vacant apartments at move-out
- Tenant education
- Tenant support maintenance program
- Tenant incentives program

8.2 Institute an Energy Star Purchasing Policy

Energy costs associated with electrical plug loads should be minimized where possible. Plug loads are electrical devices plugged into the building's electrical system and generally include things like appliances, computers, printers, and office equipment such as fax machines and copiers. When purchasing appliances, computers, and office equipment, the U.S. EPA ENERGY STAR standards should be specified. Manufacturers are required to meet certain energy efficiency criteria before they can label a product with the ENERGY STAR emblem, so these products represent your best energy saving value.

8.3 Turn off Pilot Lights

Turning off Pilot Lights on heating units during the cooling season can result in modest annual natural gas and electrical savings.

Be sure that the shutdown is performed at the beginning of the cooling season and reignited at the end of the season by qualified professionals or maintenance professionals.

8.4 Water Heater Tank and Pipe Insulation

A water heater keeps water continually heated to a specific, set temperature. As the water loses heat through the tank walls during periods of non-use, the burner or heating element has to reheat the water. An insulation jacket will reduce the heat loss and, as a result, the energy required to maintain the hot water temperature and the water heater will not need to cycle as often. The insulation jacket enables the heater to bring the water up to temperature quicker, too, saving additional energy. Certain manufacturers may prohibit this on newer models. Please consult the tank manufacturer for newer models.

During periods of non-use, the heated water will rise to the top of the tank. The pipes can actually draw heat out of the tank, like a *wick*, and should be insulated. The first ten feet of hot and cold piping, if accessible, should be wrapped. If the water heating system is located in an unconditioned (cold) area, all accessible piping should be insulated.

8.5 Adequately Seal Doors and Windows

Infiltration is the flow of air through openings in a building. In order to reduce infiltration, the cracks and holes in a building must be adequately sealed. Maintaining caulking and weather stripping in good condition saves both money and energy. It also preserves the building and improves the comfort of its occupants. Verify that all doors and windows are adequately sealed. Verify that doors in existing vestibules are being closed to prevent unnecessary infiltration. Also, inspect the exterior of the buildings for cracks or other damage.

In particular, seal air leaks like the one shown on the right. This is located above the community room drop ceiling and below the non-functioning exhaust fan. **This introduces unconditioned outdoor air (OA) into the**

plenum space which is a plenum return for the community room air handler! Energy savings from sealing this air leakage can be difficult to quantify, but it is significant and has a quick payback.

Older windows can be a major source of heat loss and air leakage, and can greatly impact the heating load on a building. A detailed engineering study is generally required to determine the best way to upgrade windows. However, be sure to consider low-e high performance glazing when window replacement becomes necessary. The additional cost will usually be paid for in energy savings in less than ten years.

Solutions to increase the efficiency of high use doors/doorways near the warehouse should be investigated. Additionally, any abandoned (exhaust or other equipment) openings in the roof should be identified. Further analysis would be required to identify a cost savings for sealing the perimeter openings.

9.0 Proposed Energy Conservations Measures (ECMs) and Water Conservation Measures (WCMs)

The energy and water audit of the facility identified seven (7) energy conservation measures (ECMs) and one (1) water conservation measures. These ECMs are estimated to provide approximately $11,028 in annual savings. The investment required to implement all of the measures before the inclusion of applicable utility incentives is estimated to be $59,680. These savings measures are summarized within this section.

All ECMs listed in this section can be implemented independently without impact on savings potential of other ECMs. Order of implementation is not expected to affect potential savings.

Incentives are not included in the calculation of payback times and savings calculations. Utilizing available incentives is expected to reduce project costs and decrease simple payback.

Table 13. Financial Summary of ECMs and WCMs

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Interior Lighting Retrofit	ECM1	$3,680	$1,786	2.1
Occupancy Sensors	ECM2	$400	$217	1.8
Exterior Lighting Retrofit	ECM3	$1,800	$545	3.3
LED Exit Sign Retrofit	ECM4	$1,800	$545	3.3
Utilize Existing Programmable Thermostats	ECM5	$0	$980	0.0
Install Programmable Thermostats	ECM6	$5,200	$2,351	2.2
Replace Inefficient Air Conditioners	ECM7	$33,800	$3,041	11.1
Replace Inefficient Toilets	WCM1	$13,000	$1,563	8.3
Total		**$59,680**	**$11,028**	**5.4**

Table 14. Energy Savings Summary of ECMs and WCMs

ECM Description	kWh Annual Savings (kWh)	Therm Annual Savings (Therms)	GHG Reduction (Metric Tons)	Water Reduction (gallons)
Interior Lighting Retrofit	16,013	0	11.85	0
Occupancy Sensors	1,947	0	1.44	0
Exterior Lighting Retrofit	4,885	0	3.62	0
LED Exit Sign Retrofit	4,888	0	3.62	0
Utilize Existing Programmable Thermostats	3,172	810	6.65	0
Install Programmable Thermostats	0	3043	16.16	0
Replace Inefficient Air Conditioners	27,255	0	20.17	0
Replace Inefficient Toilets	0	0	-	180,310
Totals	**58,160**	**3,853**	**63.50**	**180,310**

9.1 ECM1 - Interior Lighting Retrofit

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Emissions (Metric Tons)**
$3,680	$1,786	2.1	16,013	0	11.85

Recommendation Description

Miller Manor had various types of linear florescent lighting fixtures installed throughout the building. Site observations revealed the building was still using older, less efficient T12 lamps with magnetic ballasts in certain areas, while the majority of the building has been upgraded to T8 lamps with electronic ballasts. Site observations revealed (48) 2 lamp, 4ft T12 recessed fixtures throughout the first floor (mainly hallway), (4) 4 lamp, 4ft T12 fixtures in the elevators, (4) 2 lamp, 4ft T12 canopy fixtures in the trash area, and (4) 2 lamp, 4ft T12 surface fixtures in the laundry room. All of this lighting (trash area and laundry room are assumed) operates 24/7.

It is recommended that these fixtures be retrofit with T8 lamps and electronic ballasts as soon as possible. T12 lamps and magnetic ballasts are inefficient and are being phased out. Since July 2012, the majority of T12 lamps are no longer being manufactured, causing many commercial facilities to upgrade to T8 lamps. Many of the utility companies that have offered incentives for T12 replacement have stated that the funds are diminishing and may not be offered in the next year. Newer electronic ballasts are more efficient and can be paired with dimming controls or occupancy sensors without modification.

For the same reasons as described above, the remaining T12 fixtures located in the boiler room, electric room, storage areas, and kitchen (total of 16 fixtures) should also be retrofit; as well as the remaining T12 fixtures within the tenant units. The operating hours (burn time) of these fixtures are more difficult to define, and they are not included in the economic calculations of this ECM.

Assumptions

A lighting survey of the property was conducted by AKT Peerless during the walk-through. A table of existing and proposed interior lighting, complete with burn hours, can be found in the appendix.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum(\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives
DTE Energy's Multifamily Program is offering incentives for replacing existing T12 lamps and magnetic ballasts with T8 lamps and electronic ballasts. Incentive is per fixture and is determined following the approval of the DTE final application.
Expected Useful Life Study
Fluorescent lamps operating twenty-four hours per day have an average life of 3 years. Lighting fixtures typically have an expected useful life of 20-25 years.

9.2 ECM2 - Occupancy Sensors for Lighting Control

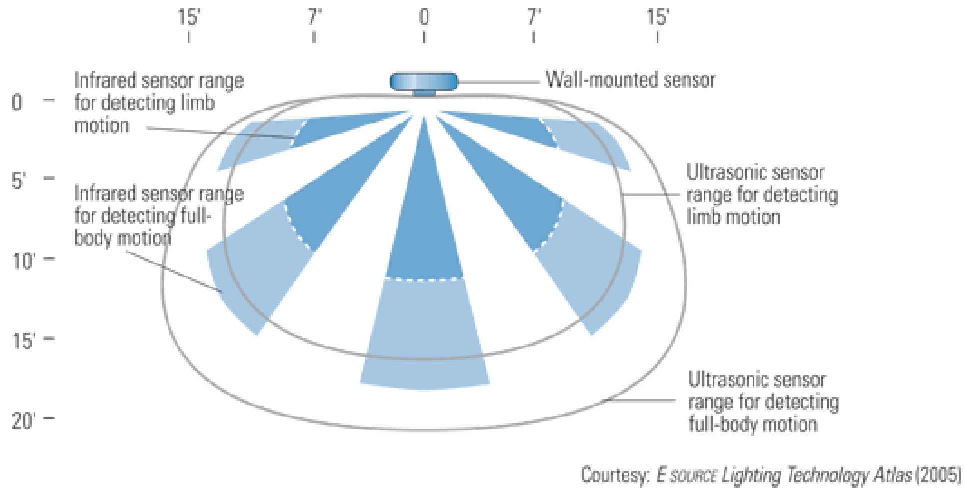
Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Emissions (Metric Tons)**
$400	$217	1.8	1,947	0	1.44

Recommendation Description

The simplest way to reduce the amount of energy consumed by lighting systems is to turn lights off when they are not needed. In the Miller Manor building, the majority of lighting fixtures are controlled directly with the manual switches which are turned on by the staff or tenants. This ECM calculates the energy savings expected by installing occupancy sensors in the Community Center and Laundry room. Installing occupancy sensors can better regulate the necessity of lights in these areas of varied occupancy.

Excerpt from the Energy Star website:
Occupancy sensors are most effective in spaces where people move in and out frequently in unpredictable patterns: for example, private offices, lecture halls, auditoriums, warehouses, restrooms, and conference rooms. Occupancy sensors are less likely to be effective in open-plan offices, where one or more people may be present throughout the day or in reception areas, lobbies, retail spaces, or hospital rooms. The savings achievable with occupancy sensors, even in the most appropriate spaces, varies widely, depending on local conditions.

The three most common types of occupancy sensors are passive infrared (PIR), ultrasonic, and those that combine the two technologies. PIR devices are the least expensive and most commonly used type of occupancy sensor. They detect the heat emitted by occupants and are triggered by changes in infrared signals when, for example, a person moves in or out of the sensor's field of view. PIR sensors are quite resistant to false triggering and are best used within a 15-foot radius. Ultrasonic sensors can detect motion at any point within the contour lines. Infrared sensors "see" only in the wedge-shaped zones, and they do not generally see as far as ultrasonic units. Some sensors see farther straight ahead than to the side. The ranges shown here are representative; some sensors may be more or less sensitive.



Occupancy Sensor Coverage Patterns

Ultrasonic devices emit a sound at high frequency—above the levels audible to humans and animals. The sensors are programmed to detect a change in the frequency of the reflected sound. They cover a larger area than PIR sensors and are more sensitive. They are also more prone to false triggering. For example, ultrasonic sensors can be fooled by the air currents produced by a person running past a door, moving curtains, or the on-off cycling of an HVAC system.

Hybrid devices that incorporate both PIR and ultrasonic sensors are also available. These take advantage of the PIR device's resistance to false triggering and the higher sensitivity of the ultrasonic sensor. Some hybrid sensors combine PIR with sensors for audible sound. That design has proved useful in cases where the frequencies used in ultrasonic sensors interfere with equipment such as hearing aids—a problem that is less frequent than it used to be because sensor manufacturers have learned to use frequencies that minimize the issue.

Evaluating the economic feasibility of an installation is best done by monitoring lighting and occupancy patterns. The use of inexpensive automatic data logging systems will indicate the total amount of time the lights are on when the space is vacant, the time of day the savings take place, and the frequency of lamp cycling. Data can also be gathered through the use of recording ammeters connected at lighting breaker panels; through random surveys, such as observing a building's exterior at night or interviewing custodial and security personnel; and through existing timers, scheduling controllers, and energy management systems.

Whatever way the data is gathered, it is important to account for seasonal variations in operation in order to avoid incorrectly extrapolating short-duration data to a full year. This information will help lead to an informed decision on the economic feasibility of potential occupancy-control opportunities.

Sensor placement is also crucial to success. Wall-mounted sensors are suitable in smaller rooms—offices, bathrooms, and equipment rooms that are only intermittently occupied. In larger spaces or wherever the lighting load is higher, it is better to mount the sensor in the ceiling. Some units can be mounted in the corner or on the wall near the ceiling.
Source - www.energystar.gov

It is recommended to install occupancy sensors in the Community Center and Laundry room. Occupancy sensors could also be beneficial in the mechanical / boiler room, electrical room, storage areas, trash room, and first floor kitchen, but these areas are not included in this ECM calculation as the operating hours are more difficult to estimate accurately. Payback times would likely be greater for these areas, unless lights are typically left on after people leave these areas.

Assumptions

Savings estimates for this ECM are based on a 30% reduction of existing usage for the lighting fixtures in the subject areas. Existing burn hours in these areas were assumed to be 2,190 hours per year in the Community Center and 8,760 hours per year in the laundry room.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives
DTE Energy's Multifamily Program is offering incentives for install occupancy sensors in the appropriate locations. It should be noted that in areas where occupancy sensors are installed, the minimum amount of time for the lights to stay on when no movement is sensed should be 10 minutes. Either passive infrared or ultrasonic sensors will qualify under the rebate. Incentives are per fixture and are determined following the approval of the final application.
Expected Useful Life Study
Occupancy sensors typically have an expected useful life of approximately twenty years.

9.3 ECM3 - Exterior Lighting Retrofit

Summary					
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Emissions (Metric Tons)
$1,800	$545	3.3	4,885	0	3.62

Recommendation Description

The outside grounds of the Miller Manor property are lighting throughout the evening hours for safety and security. Site observations revealed a total of ten (10) identical exterior wall pack fixtures. The existing exterior wall packs are of the high intensity discharge (HID) type with metal halide (MH) lamps that appeared to be 100 watts each.

The existing HID exterior lighting is outdated, and significantly more efficient lighting options are readily available. For this application, it is recommended that exterior lighting be retrofitted with more efficient light emitting diode (LED) lighting.

Along with significant electrical savings at equivalent lumen output, maintenance will be greatly reduced as the LED lights proposed have an L70 lifespan of 100,000 hours. L70 is an industry standard to express the useful lifespan of an LED. It indicates the number of hours before light output drops to 70% of initial output. Maintenance reduction is not factored into the savings calculated for this report. LED lighting is considered a green technology due to the high fixture efficacy and the absence of mercury, arsenic, and ultraviolet (UV) light.

This ECRM analysis was based on replacing the existing wall pack fixtures with model #WPLED13 (RAB Lighting,) **or equivalent**, 13 watt high performance LED wall packs. These LED wall packs have driver input wattage of **15 watts** and an **equivalent light output to 150 watt metal halide**. A specification sheet for the analyzed model is included in the appendix.

The initial cost of this project is the material cost for ten (10) of the subject exterior wall packs. The fixtures have provisions for junction box and surface mount for recessed box applications, and are assumed to be installed by in-house maintenance staff. Again, the additional savings associated with reduced maintenance costs are not included in the calculated savings.

Assumptions

Existing exterior wall packs are 100 watt metal halide with an input wattage of 124 watts per fixture.

Installation of new LED wall packs would be performed by in-house maintenance staff at no additional labor cost.

New LED wall packs would be operated by the in-place photocell control that was reported to control the existing wall packs. If this control does not exist or is unsatisfactory, an option for 120V photocell control (built-in) is available for approximately $15 additional cost per LED wall pack.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives

DTE Energy's Multifamily Program is offering incentives for energy efficient exterior lighting replacement.

Expected Useful Life Study

Most of the lamps in the exterior light fixtures were installed in 2000 and have an expected useful life of six years. It is believed that the lamps will need to be replaced in the near future. The expected useful life of an LED replacement fixture is typically around 15 years.

9.4 ECM4 - LED Exit Sign Retrofit

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Emissions (Metric Tons)**
$1,800	$545	3.3	4,888	0	3.62

Recommendation Description

Site observations revealed a total of thirty-six (36) exit signs in the facility. Exit signs operate 24 hours per day. The signs observed had two (2) compact fluorescent, 9W lamps (CFT9W - 9W CFL G23 BASE 2700K 6.5L equal to PL9S/27/ECO F9BX/SPX27) for a total input wattage of 20 watts per fixture.

Recommendation is to retrofit the existing exit signs with LED retrofit kits having a total input wattage of 4.5 watts per fixture.

This ECRM analysis was based on retrofitting the existing exit signs with model #ZXE-5000 (Radionic) **or equivalent**, 4.5 watt LED retrofit kits. A specification sheet for the analyzed model is included in the appendix.

The LED exit sign retrofit kits use about 12 times less than an incandescent exit sign and 5 times less than a fluorescent exit sign. These kits also very bright - the light output is 77 lumens per watt. The kits were designed to outlast other incandescent and fluorescent exit signs. This translates into far less maintenance costs, since staff do not need to replace incandescent or fluorescent lamps that keep burning out. The LED's have an estimated life of over 50,000 hours, while incandescent last for under 2000, and fluorescents under 5000 hours. The additional savings associated with reduced maintenance costs are **not** included in the calculated savings.

The initial cost of this project is the material cost for thirty-six (36) exit sign retrofit kits. The manufacturer claims a 10 minute installation time per exit sign, and these kits are assumed to be installed by in-house maintenance staff.

Assumptions

Installation of new LED exit sign retrofit kits would be performed by in-house maintenance staff at no additional labor cost.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives
Under the DTE Energy Multi-family Program Incentives, there are incentives for installing LED exit signs in common area corridors, stairwells, and building exit areas.
Expected Useful Life Study
The expected useful life of a typical LED exit sign is approximately ten years.

9.5 ECM5 - Utilize Existing Programmable Thermostats

Summary							
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Estimated Incentive	Simple Payback with Incentive (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Emissions (Metric Tons)
$0	$980	0	$0	$0	3,172	810	6.65

Recommendation Description

The newer addition of the facility (office and maintenance area) is conditioned by a pair of rooftop packaged units (RTU) with gas-fired heat and a cooling capacity of 10 tons each. One of the RTUs serves the maintenance area and conference room, while the other identical unit serves the remaining general office area of the addition. Each of the RTUs is controlled by a separate Honeywell programmable (touch screen) thermostat, but site observations revealed that temperature setbacks are not programmed for unoccupied periods.

It is recommended that the existing programmable thermostats are utilized by programming setback

temperature schedules. The schedules will incorporate the occupancy of the building, and take away the guess work of controlling the temperature of the building. The temperatures can be setback to the proposed setpoints, thereby saving energy on heating and cooling during unoccupied hours. Due to the high amounts of traffic in the building, it is also recommended that the thermostats be encased in lockboxes to protect the temperatures settings from tampering. A complete list of current and proposed temperature settings is included below.

	Cooling Occupied	Cooling Unoccupied	Heating Occupied	Heating Unoccupied
Baseline Setpoints	75 °F	75 °F	70 °F	70 °F
Proposed Setpoints	75 °F	85 °F	68 °F	60 °F

Calculations

Calculations were performed using an energy savings calculator that was developed by the U.S. EPA and U.S. DOE for estimating purposes. The calculator was modified to more closely represent the actual building heating / cooling load. Weekday typical usage pattern used a 12 hour nighttime setback and weekend typical usage pattern used a 24 hour setback.

Assumptions

The subject energy savings calculator assumes the following:
Savings per Degree of Setback (Heating Season) = 3% based on Industry Data 2004
Savings per Degree of Setback (Cooling Season) = 6% based on Industry Data 2004

The "Savings per Degree of Setback (Cooling Season)" was modified to 4% for a more conservative estimate. The baseline energy consumption for heating and cooling dedicated to this section of the building was estimated using a combination of the consumption profiles in Section 5.1 and 5.2, percentage floor area of the facility, and the auditor's judgment. Resultant consumption was 525 MMBtu for heating and 60 MMBtu for cooling dedicated to this section of the building.
Incentives
DTE Energy's Multifamily Program is not offering incentives for this no cost ECM.
Expected Useful Life Study
Thermostats (manual and programmable) typically have an expected useful life of fifteen years.

9.6 ECM6 - Install Programmable Thermostats in Tenant Units

Summary

Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Emissions (Metric Tons)
$5,200	$2,351	2.2	0	3,043	16.16

Recommendation Description

The tenant units at Miller Manor (104 total) are heated with hydronic baseboard convectors which receive hot water from the main boiler plant. Control of the tenant unit heat is via manual thermostats located in each individual unit. Each manual thermostat operates a zone valve which allows the flow of hot water through the baseboard convectors when actuated.

It is recommended that programmable thermostats are installed in the individual tenant units to control the heat. The programmable thermostats would allow a nighttime setback to be employed, thereby saving energy on heating during overnight hours.

Because the thermostats are located within the tenant space, they should be a “tamper-proof” type design. This type of thermostat was specifically designed to help owners/managers of "all utilities paid" apartments. A two-step setpoint limiting process insures that temp limits will stay in effect. It also allows the tenant some control over the temperature setting.

Recommended temperature settings are included below.

	Heating Daytime Setting	Heating Nightime Setback
Baseline Setpoints	70 °F	70 °F
Proposed Setpoints	69 °F	65 °F

Calculations

Calculations were performed using an energy savings calculator that was developed by the U.S. EPA and U.S. DOE for estimating purposes. The calculator was modified to more closely represent the actual building heating / cooling load. Weekday and weekend typical usage pattern used an 8 hour nighttime setback of 65 degrees.

Assumptions

The subject energy savings calculator assumes the following:
Savings per Degree of Setback (Heating Season) = 3% based on Industry Data 2004

The baseline energy consumption for heating and cooling dedicated to this section of the building was estimated using a combination of the consumption profiles in Section 5.1 and 5.2, percentage floor area of the facility, and the auditor's judgment. Resultant consumption was 4,350 MMBtu for heating dedicated to the individual tenant units.

A reduction of 1 degree daytime setback (70 degree to 69 degree) was assumed in addition to the 8 hour nighttime setback of 65 degrees.

Incentives

DTE Energy's Multifamily Program is currently offering direct install incentives to install programmable thermostats.

Expected Useful Life Study

Manual thermostats have an expected useful life of 15 years. At the time of replacement, it is recommended that the manual thermostats be replaced with programmable thermostats with the same expected useful life.

9.7 ECM7 - Replace Inefficient Air Conditioners

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Emissions (Metric Tons)**
$33,800	$3,041	11.1	27,255	0	20.17

Recommendation Description

Due to age or lack of proper maintenance, or both, older air conditioners may not operate as efficiently as they did when they were new. In addition, technological developments have produced great advances in air conditioning efficiency, making many older air-conditioning systems obsolete. Replacing older air-conditioning units can generate substantial electricity and cost savings.

Recommendation is for the replacement of the through-the-wall resident unit air conditioners with new Energy Star models. The units are expected to have rated cooling energy efficiency ratios (EER) of approximately 7.0. New Energy Star rated through-the wall units (without louvered sides) have an EER 9.4 or better. The calculation used for this ECM assumes an average EER of 7.0 for the current units and assumes replacement with a unit having an EER of 9.8.

The “without louvered sides” refers to the side louvers that extend from a room air conditioner model in order to position the unit in a window. The ENERGY STAR room air conditioner criteria covers models with and without louvered sides. A model without louvered sides is placed in a built-in wall sleeve. Such products are commonly referred to as "through-the-wall" or "built-in" models.

Calculations

Calculations were performed using an energy savings calculator that was developed by the U.S. EPA and U.S. DOE for estimating purposes of 104 Energy Star qualified room air conditioners. The calculator results are included in the appendix of this report.

Assumptions

The calculation used for this ECM assumes an average EER of 7.0 for the current units and assumes replacement of 104 units having an EER of 9.8 and a cooling capacity of 10,000 Btu/hr.

Incentives

DTE Energy’s Multifamily Program is not currently offering incentives to replace old air conditioners.

Expected Useful Life Study

Window air conditioners have an expected useful life of fifteen years. Many of the window units are at or near their expected useful life.

9.8 WCM1 - Replace Inefficient Toilets

Summary				
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Water Savings (gal/yr)**	**GHG Emissions (Metric Tons)**
$13,000	$1,563	8.3	180,310	N/A

Recommendation Description

In some areas, water and sewer rates have increased dramatically over the past few years and are rivaling the cost of energy. Reducing water use through conservation strategies can generate significant cost savings. Miller Manor staff should be commended on implementing low flow shower heads and faucet aerators within the tenant units (reported complete in summer of 2012).

Significant advances in technology over the past decade have resulted in the availability of reliable, high-quality water-saving toilets on the market. Older toilets typically have a flush volume of 3.5 gallons per flush (GPF) or greater. The standard for new toilets is 1.6 GPF. It was reported that approximately 50% of the toilets in resident units are older toilets.

It is recommended that the older toilets be replaced with new toilets meeting the 1.6 GPF criteria. Even better would be to purchase toilets certified with the WaterSense label. Such toilets use 20 percent less water than the current federal standard, while still providing equal or superior performance. WaterSense, a program sponsored by the U.S. Environmental Protection Agency (EPA), is helping consumers identify high performance, water-efficient toilets that can reduce water use in the home and help preserve the nation's water resources.

Assumptions

Calculation of savings is based on replacing a total of 52 toilets using 3.5 GPF with new toilets using 1.6 GPF. A value of 5 flushes per occupant per day (from the REUWS survey referenced in Section 5.3) was used, assuming one occupant per unit. This method produced a water savings of 180,310 gallons per year. Estimated cost for toilet replacement is $250 each.

Incentives

Some water providers offer rebates and incentives for replacing inefficient toilets. Contact your provider to see if there is a program available.

Expected Useful Life Study

Toilets have an expected useful life of approximately 20 years. It is believed that the older toilets at Miller Manor are approximately 20 years old and should be replaced soon.

10.0 ECMs Recommended for Further Evaluation

The following capital intensive measures may be feasible but would require an additional, detailed engineering analysis.

10.1 FE1 - Replace Inefficient Boiler Plant

The boilers in place are atmospheric, modular units with a rated thermal efficiency of 80%. There are a total of six boilers, grouped in two sets, one containing four boilers and the other containing two boilers. The six boilers are identical Burnam model # 810B-NI with a rated input capacity of 594 MBH. These boilers are expected to be original to the building and to have surpassed or are approaching their expected useful life. Two of the boilers (#4 and #6) are currently off-line due to leaks.

Boiler plant control is via a Tekmar #258 which regulates the supply water temperature from the boiler plant based on the outdoor air temperature. It is recommended that the control module is checked for correct setting and shifting of the heating curve. As outdoor temperatures become colder, heat losses from a building increase and require the addition of more heat in order to prevent the indoor air temperature from becoming colder as a result. This Tekmar reset control measures the outdoor temperature, and as the outdoor temperature becomes colder the control will balance the heat loss by making the heating supply water hotter. The Heating Curve is used to calculate exactly how hot to make the supply water at different outdoor temperatures, as it determines the number of degrees the supply water temperature is raised for each degree the outdoor temperature falls. The staff should also be aware that the existing control allows for time of day temperature schedules, so a boiler plant night setback could be achieved using this control.

At the time of boiler plant replacement, it is highly recommended to analyze the incremental price difference of purchasing high efficiency boilers. Newer modulating, power vented models are available with efficiencies near 88% and modulating-condensing (mod-con) boilers are on the market with peak efficiencies of 92% and above.

Mod-con boilers have the ability to modulate their firing rate based on the load. These boilers extract the maximum amount of heat from the combustion process through the use of a second heat exchanger. This gives mod-con boilers a higher efficiency than non-condensing boilers, especially at part load, when mod-con boilers reach their highest efficiency. High-recovery, low-mass boiler can rise to operating temperature quickly without concern on thermal shock with proper system and control design.

Using the gas consumption values from section 5.2, **only an 8% gain in boiler efficiency would be expected to result in an energy cost savings of approximately $3,000 a year**. Again, high efficiency boilers should be considered.

10.2 FE2 - Make-Up Air Units

Ventilation air is introduced into Miller Manor with two make up air (MUA) units. Two Reznor model #RPB400S gas-fired packaged MUA units are located on the roof and deliver 3,200 CFM of outside air each to two ventilation shafts supplying fresh air to the corridors.

Indoor air quality is an important aspect of facility management as it directly relates to resident health. The municipal code may set forth minimum ventilation rates for multi-family buildings, as in many cases local regulations will govern the ventilation requirements.

This report does not attempt to specify the required ventilation for the subject facility, but does comment that the introduction of outside air (OA) has a significant effect on energy use.

ASHRAE 62.1 "Ventilation for Acceptable Indoor Air Quality" is a nationally accepted standard that provides acceptable ventilation rates per person and is related to the occupational density and activity within the space. The ventilation rates specified by ASHRAE effectively dilutes the carbon dioxide and other contaminants created by respiration and other activities; it supplies adequate oxygen to the occupants; and it removes contaminants from the space.

Building with variable occupancy levels, can often reduce both heating and cooling energy consumption by employing demand controlled ventilation (DCV). With DCV, rather than a fixed amount of outdoor air, outside air can be controlled based on the concentration of CO_2 and other pollutants inside the building. There are many variables that must be taken into consideration when contemplating a retrofit to demand controlled ventilation. These include the type of air distribution system, already in place, the controllability of various dampers, interconnectivity with building automation system, evaluation of ventilation requirements per current building codes, heating and cooling capacity of existing equipment, and so forth. It is recommended to check your municipal code to find out the minimum ventilation rate required and if a DCV strategy can be implemented with the existing or replacement make up air system.

It is recommended to inspect the existing controls for the MUA units and repair as required. At the time of the site visit, the outside of the concrete block ventilation shaft was measured to be 113 degrees. This was on a mild day and represents a significant energy loss. Even when the control is operating normally, a fully modulating gas valve for tempering outside air during the heating season would offer significant energy savings over the existing system.

It is also recommended to insulate the section of supply duct that is located outdoors on these units. This is a short duct run, but represents an energy loss during the heating season.

11.0 Feasibility Study of Green Technologies

The following Green Energy Technologies were evaluated for their application at the subject property:

11.1 Photovoltaic for Electricity

Implementing photovoltaic panels for electricity at the subject property has been considered by the Ann Arbor Housing Commission. The south-facing orientation of each of the roofs at this property provides optimal solar energy collection. Unfortunately, renewable energy incentives are not currently available to the Client to offset high installation costs.

11.2 Solar Thermal for Hot Water Heating

Hot water usage at the subject property is not high enough to justify initial costs of solar heating therefore the property is not a viable candidate of solar thermal for hot water heating. Further study is not recommended.

11.3 Wind Turbine

The property is not a viable candidate of installing wind turbines due to insufficient wind power in this geographic area. Further study is not recommended.

11.4 Combined Heat and Power

The property has less than 80 units (a rule of thumb for minimum number of units for feasibility) and does not have a central power source. The property is not a viable candidate of implementing combined heat and power and further study is not recommended.

11.5 Fuel Cells

Due to the high initial costs associated with fuel cells, implementation is not recommended at the subject property. Further study is not recommended.

12.0 Recommendations & Impact

Based on the analysis described in this report, AKT Peerless believes substantial energy conservation opportunities are available, and recommends implementation of all proposed ECMs.

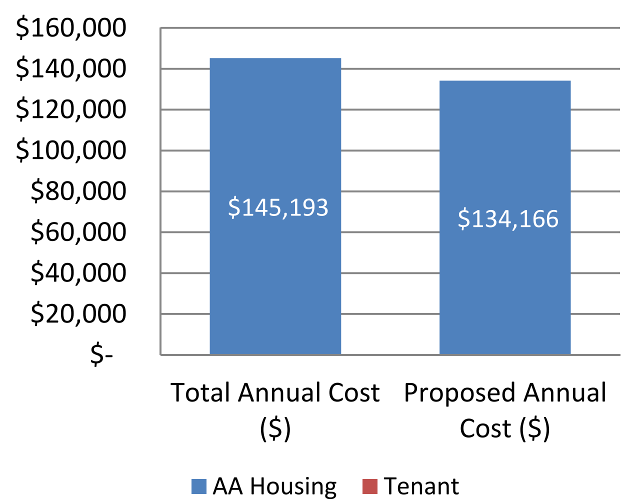
The combined annual EUI for the subject building is 88.53 kBtu per square foot per year. The annual energy cost index is $1.33 per square foot per year. Reduction of fuel (non-electrical) and electrical energy consumption through the implementation of recommended ECMs will potentially result in a reduced EUI of 81.99 kBtu per square foot per year, a potentially reduced annual cost index of $1.21 per square foot per year, and potential total annual energy cost savings of $11,028 per year.

An additional result of implementing the recommended ECMs would be the reduction of greenhouse gas (GHG) emissions by 63.50 metric tons. Measurements of greenhouse gas emissions are based on data gathered from the United States Environmental Protection Agency (USEPA) eGRID database.

The subject building is located in eGRID electric utility sub-region RFCW. Greenhouse gas emissions from electrical consumption are based on emissions data measured at the electrical generating facilities serving consumers located in the specified eGRID utility sub-region, and therefore greenhouse gas emissions and the estimated reduction in greenhouse gas emissions reflect the mix of fuel sources used by the regional electrical utilities serving the subject property. Emissions factors for natural gas consumption are based on data gathered from the 2009 United States Greenhouse Gas Inventory, Annex 2.

Table 15. Impact Summary

% Energy Savings	7%
% Water Savings	8%
% Cost Savings	8%
Annual Cost Savings ($)	$11,028
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	8%



13.0 Limitations

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained in herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, third parties, or the secondary information sources cited in this report is complete or accurate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

ASHRAE *Procedures for Commercial Building Energy Audits* recommends that the Energy Analyst apply a consistent definition of building square footage to both the subject building and to similar buildings used for energy performance comparisons. AKT Peerless cannot evaluate the accuracy or consistency of building square footage measurements of similar buildings included in the comparison database.

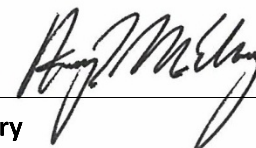
The Energy Analyst has not verified the accuracy of building floor area as reported by the building owner/operator and has not verified that the building owner/operator's definition of building usage is consistent with the definitions used in the CBECS.

The Energy Analyst has not evaluated the potential financial savings from changing to a different utility price structure.

Also, the Energy Analyst has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to the energy analyst and information not reported to the energy analyst may influence the findings of report. Information provided by the owner/operator of the subject building or other client representatives is summarized in the appendix, including utility bills and energy invoices.

14.0 Signatures

Report submitted by:



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Building Performance Institute

Recent annual electricity consumption, cost is summarized in the following tables:

Natural Gas

NATURAL GAS UBA									
AAHC Site:	MILLER MANOR								
Meter #:	7109632								
Month	Start	End	Days	HDD	Consumption Therms	Actual (0) Estm. (1)	Delivery $	Gas $	Total $
Jan-12	4-Jan-12	3-Feb-12	30	1100	10389	0	$ -	8011.44	$8,011
Feb-12	3-Feb-12	5-Mar-12	31	973	10400	0	$ -	8017.72	$8,018
Mar-12	5-Mar-12	3-Apr-12	29	529	4941	0	$ -	3896.42	$3,896
Apr-12	3-Apr-12	2-May-12	29	513	5194	0	$ -	4094.66	$4,095
May-12	2-May-12	5-Jun-12	34	171	1089	0	$ -	840.16	$840
Jun-12	5-Jun-12	5-Jul-12	30	90	727	0	$ -	594.64	$595
Jul-12	5-Jul-12	4-Aug-12	30	23	560	0	$ -	460.6	$461
Aug-12	4-Aug-12	2-Sep-12	29	80	707	0	$ -	575.43	$575
Sep-12	2-Sep-12	1-Oct-12	29	223	2257	0	$ -	1783.3	$1,783
Oct-12	1-Oct-12	1-Nov-12	31	478	5140	0	$ -	3947.85	$3,948
Nov-12	1-Nov-12	2-Dec-12	31	478	6963	0	$ -	5405.52	$5,406
Dec-12	2-Dec-12	4-Jan-13	33	478	7400	0	$ -	5452.57	$5,453
					55,767				**$43,080**
									$0.773 $/Therm

Electricity

ELECTRICAL UBA									
AAHC Site:	MILLER MANOR								
Meter #:	8986897								
Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Consumption Charges ($)	Total Charges ($)
Jan-12	15-Dec-11	19-Jan-12	35	1100	0	0	58800	6512.08	$6,512
Feb-12	19-Jan-12	19-Feb-12	31	973	0	0	52800	6076.87	$6,077
Mar-12	19-Feb-12	19-Mar-12	29	529	33	0	48240	5813.84	$5,814
Apr-12	19-Mar-12	18-Apr-12	30	513	7	0	49120	5864.53	$5,865
May-12	18-Apr-12	17-May-12	29	171	118	1	48240	5977.16	$5,977
Jun-12	17-May-12	18-Jun-12	32	90	245	0	61040	6829.36	$6,829
Jul-12	18-Jun-12	18-Jul-12	30	23	409	0	77760	8502.33	$8,502
Aug-12	18-Jul-12	18-Aug-12	31	80	233	0	58400	6916.33	$6,916
Sep-12	18-Aug-12	20-Sep-12	33	223	93	0	52400	6055.95	$6,056
Oct-12	20-Sep-12	19-Oct-12	29	478	15	0	49440	5853.6	$5,854
Nov-12	19-Oct-12	16-Nov-12	28	478	15	0	69630	5405.52	$5,406
Dec-12	16-Nov-12	15-Dec-12	29	478	15	0	55280	6183.51	$6,184
							681,150	**$75,991**	**$75,991**
								$0.112	**$0.11156**
								$ / kWh	**Blended $/kWh**

HUD Residential Energy Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up, and elevator buildings.

The HUD Residential Energy Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" to come back to this page.

***Directions**: Provide entries in ALL the grey spaces that apply for your Building Description and Annual Energy Consumption.*

Building Description

Preliminary: 9/17/07

Building Name: Miller Manor (optional entry)

5-digit Zip Code: 48103 — Not Sure?

Mapping Location: *Ann Arbor, MI*

Heating Degree Days: 6569

Cooling Degree Days: 626

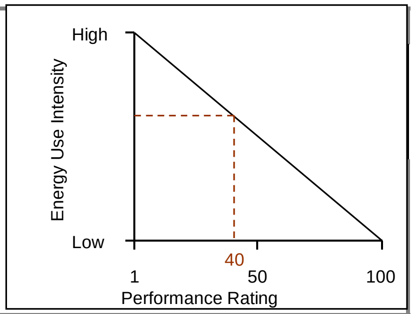
	Gross Floor Area (ft2)	Total Number of Units	Is This a Multifamily Building with Central Laundry? (Y/N)	Is this a Multi-Family Walkup Building? (Y/N)	Heated Floor Area (ft2)	Year Built
Building Description:	89,250	104	Y	N	89,250	1977

Annual Consumption

	Electricity	Gas	#2 Fuel Oil	#4 Fuel Oil	District Steam	District Hot Water	Propane
Select Units:	kWh	Therms	Gal	Gal	kLbs	MMBtu	Gal
Energy	681,150	55,767					
Cost ($)	75,991	43,080					
Calculated unit cost:	$0.11 $/kWh	$0.77 $/therm	$/gallon	$/gallon	$/klbs	$/kBtu	$/gallon

Results

	Your Building	HUD Typical
Score Against Peers	**40**	**50**
Building Site Energy Use (kBtu/year)	**7,900,784**	**6,908,253**
Site Energy Use Intensity (kBtu/ft2-year)	**88.5**	**77.4**
Energy Cost Intensity ($/ft2-year)	**1.33**	**1.17**
Total Annual Energy Cost ($/year)	**119,071**	**104,113**



HUD Residential Water Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up and elevator buildings.

The HUD Residential Water Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" text to come back to this page.

Directions: Provide entries in the gray spaces below with your building description and annual water consumption.

Building Description

ORNL 8/22/2007

Building Name: Miller Manor (optional entry)

5-digit Zip Code: 48107 — *Not Sure?*

Mapping Location: ***Ann Arbor, MI***

	Gross Floor Area of Building(s) (ft2)	Building(s) is Single-Family Detached or Semi-Detached? (Y/N)	Is Residents Water Use Paid Directly by the PHA? (Y/N)	Number of Units in Building(s)	Number of Units in Building(s) with In-Unit Laundry Hookups or Central Laundry Access?	How Many Buildings share this Water Meter?
Building Description:	89,250	N	Y	104	104	1

Annual Consumption

Building Annual Water Use:	3,014,440	(gallons/year)
Building Annual Water Use Cost:	26,122	($/year)
Average Annual Water Cost:	**$0.867**	($/100 gallons)

Results

	Your Building	HUD Typical
Score Against Peers	**67**	**50**
Annual Water Use (gal/year)	**3,014,440**	**4,284,432**
Annual Water Use Intensity (gal/ft2-year)	**33.8**	**48.0**
Annual Water Cost Intensity ($/ft2-year)	**0.29**	**0.42**
Total Annual Water Cost ($/year)	**26,122**	**37,127**

Photo 1: Visitor Entrance and Service Doors

Photo 2: Front Elevation

Photo 3: Office Area and Service Door

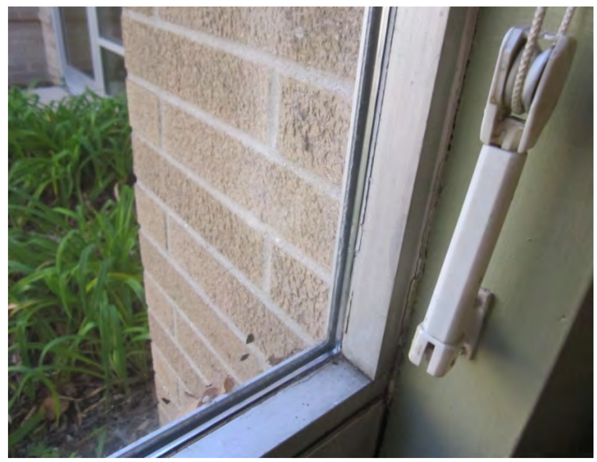


Photo 4: Double Pane Windows

Photo 5: Unit Air-Conditioners

Photo 6: Exit Sign/Fire Alarm/CO Detector

Photo 7: Vending Machine Area

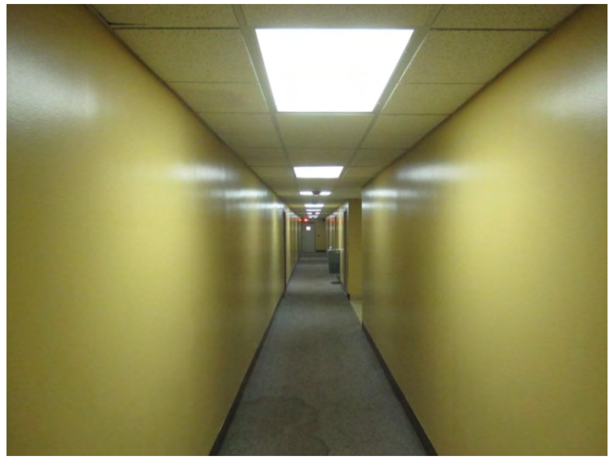


Photo 8: Hallway Lighting

Photo 9: Baseboard finned-tube heating units

Photo 10: Tenant air conditioner

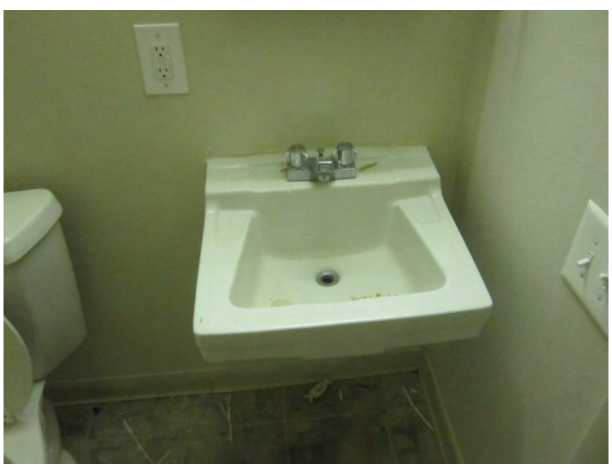


Photo 11: Typical Bathroom Sink

Photo 12: Resident Gas Range Oven

Photo 13: Typical refrigerator

Photo 14: Tenant unit exhaust fan

Photo 15: Modular boilers

Photo 16: Insulated Hot Water Piping

Photo 17: Natural draft exhaust venting

Photo 18: Domestic Water Boilers

Photo 19: Make-up air unit (1 of 2)

Photo 20: Interior fan coil unit

Photo 21: Common Area washing machines

Photo 22: Common Area Dryers

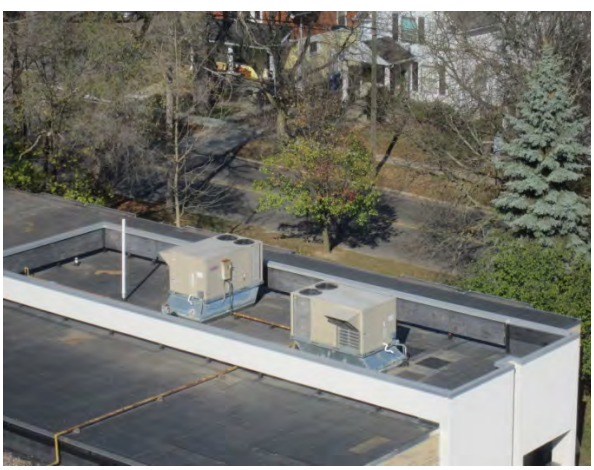


Photo 23: Rooftop of office area

Photo 24: Split system condensing unit for lobby

Photo 25: Packaged rooftop unit for west end of office area

Photo 26: Packaged rooftop unit for east end of office area

Photo 27: Split system condensing unit for community room

Photo 28: Hot water unit heater in stairwell

DTE Energy Multifamily Program Lighting Specifications

LIGHTING SPECIFICATIONS

All lighting projects are expected to comply with the Illuminating Engineering Society of North America (IESNA) recommended lighting levels or the local code.
All final applications must include manufacturers' specification sheets for lamps and ballasts. All incentives are for one-for-one replacements except as noted.

Compact Fluorescent Lamps, Screw-In (≤ 31 Watts)
Incentives are available for the replacement of incandescent lamps with CFLs that are ENERGY STAR® rated or that meet ENERGY STAR® criteria. The lamps must have a luminous efficacy of ≥ 50 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Lamps, Screw-In (> 31 Watts)
Incentives are available for the replacement of incandescent lamps with high wattage CFLs. The new lamp must have a luminous efficacy of ≥ 65 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Fixtures
Incentives are available for upgrades to interior hardwired compact fluorescent fixtures. Replacement fixtures must be new fixtures or modular hardwired retrofits with hardwired electronic ballasts. The compact fluorescent ballast must be programmed start or programmed rapid start with a power factor (PF) ≥ 0.90 and a total harmonic distortion (THD) ≤ 20%. Incentive is per fixture.

Compact Fluorescent Reflector Flood Lamps
Incentives are available to install CFL reflector flood lamps to replace incandescent reflector flood lamps. The CFL reflector flood lamps must have a luminous efficacy of ≥ 33 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFL's purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

42W 8-Lamp Compact Fluorescent High Bay Fixture
Incentives are available in high-bay applications (ceiling heights over 15 feet) for replacing any lighting fixtures greater than or equal to 350W with 42 Watt, 8 lamp compact fluorescent fixtures. Replacement fixtures must contain specular reflectors and electronic ballasts with a power factor (PF) ≥ 0.90. Incentive is per fixture.

ENERGY STAR® Qualified LED Recessed Down Light
Incentives are available to replace incandescent recessed lights with ENERGY STAR® qualified LED recessed down lights. Replacement lights must have a minimum efficacy of 35 lumens per watt. Incentive is per lamp. *Note: This incentive is not available for lamps purchased at retail stores participating in the DTE Energy lamp discount program. Incentive for lamps purchased from those retailers is included in the discounted price.*

Standard Linear Fluorescent Retrofit
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T8 or T5 lamps and electronic ballasts. The new fixture lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for a minimum of 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic discharge (THD) ≤ 20 % at full power output. For 2 and 3-foot lamps, ballasts must have THD ≤ 32 % at full light output. Incentive is per fixture.

High Output T8/T5 Lamp and Ballast replacing T12 Fluorescent Lamp
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T5HO or T8HO lamps and electronic ballasts. The replacement lamps must have a CRI ≥ 80. Incentive is per fixture.

Low Wattage 4-foot T8 Lamps (Lamps Only)
Incentives are available for replacing 32 Watt T8 lamps with reduced (low) wattage T8 lamps when an electronic ballast is already present. The lamps must be reduced wattage in accordance with the Consortium for Energy Efficiency© (CEE©) specifications (www.cee1.org) and as summarized in Table 2 below. Low wattage lamps must be either 25W or 28W and CEE© Listed. Qualified products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Incentive is per lamp.

High Performance 4-foot T8 Lamp and Ballast
Incentives are available for replacing existing T12 or T12HO lamps and magnetic ballasts or standard T8 lamps and electronic ballasts with high performance T8 lamps and electronic ballasts. Replacement fixtures must high performance in accordance with the Consortium for Energy Efficiency© (CEE©) high performance T8 specification, available at www.cee1.org, which and is summarized in Table 1 below. A list of qualified lamps and ballasts can be found at: http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must meet the specification in order to be eligible for an incentive. Incentive is per fixture.

LIGHTING SPECIFICATIONS

Table 1: High Performance T8 Specifications

High Performance T8 and T5 Characteristics				
Mean System Efficacy	≥ 90 Mean Lumens per Watt (MLPW) for Instant Start Ballasts			
	≥ 88 MLPW for Programmed Rapid Start Ballasts			
Performance Characteristics for Lamps				
Color Rendering Index (CRI)	≥ 80			
Minimum Initial Lamp Lumens	≥ 3100 Lumens *			
Lamp Life	≥ 24,000 Hours			
Lumen Maintenance or Minimum Mean Lumens	≥ 94% or ≥ 2900 Mean Lumens			
Performance Characteristics for Ballasts				
Ballast Efficacy Factor (BEF) BEF = (BFx100)/Ballast Input Watts	**Instant Start Ballast (BEF)**			
	Lamps	Low BF ≤ 0.85	Norm 0.85 < BF ≤ 1.0	High BF ≥ 1.01
	1	> 3.08	> 3.11	NA
	2	> 1.60	> 1.58	> 1.55
	3	≥ 1.04	≥ 1.05	≥ 1.04
	4	≥ 0.79	≥ 0.80	≥ 0.77
	Programmed Rapid Start Ballast (BEF)			
	1	≥ 2.84	≥ 2.84	NA
	2	≥ 1.48	≥ 1.47	≥ 1.51
	3	≥ 0.97	≥ 1.00	≥ 1.00
	4	≥ 0.76	≥ 0.75	≥ 0.75
Ballast Frequency	20 to 33 kHz or ≥ 40 kHz			
Power Factor	≥ 0.90			
Total Harmonic Distortion	≤ 20%			

* For lamp with color temperatures ≥ 4500k. 2950 minimum initial lamp lumens are allowed.

Low Wattage 4-foot T8 Lamp and Ballast

Incentives are available for replacing T12 systems with reduced (low) wattage lamp and electronic ballast systems. The lamps and ballasts must meet the Consortium for Energy Efficiency© (CEE©) specification (www.cee1.org) and summarized in Table 8-2 on the following page. Qualified lamp and ballast products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must qualify in order to receive an incentive for the system. Incentive is per fixture.

Table 2: Reduced (Low) Wattage 4-foot Lamps and Ballasts

Performance Characteristics for Lamps(1)		
Mean System Efficacy	≥ 90 MLPW	
Color Rendering Index (CRI)	≥ 80	
Minimum Initial Lamp Lumens	≥ 2585 Lumens for 28 W ≥ 2400 Lumens for 25 W	
Lamp Life(2)	≥ 18,000 hrs at three hours per start	
Lumen Maintenance –or- Minimum Mean Lumens(3)	≥ 94% -or- ≥ 2430 Lumens for 28 W ≥ 2256 Lumens for 25 W	
Performance Characteristics for 28 and 25 W Ballasts		
Ballast Frequency	20 to 33 Hz or ≥ 40 kHz	
Power Factor	≥ 0.90	
Total Harmonic Distortion	≤ 20%	
Performance Characteristics for Ballasts(4), 28 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.52
	2	≥ 1.76
	3	≥ 1.16
	4	≥ 0.88
Performance Characteristics for Ballasts(4), 25 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.95
	2	≥ 1.98
	3	≥ 1.32
	4	≥ 0.99

(1) Lamps ≥ 4500 K and/or 24,000 hours have a system efficacy specified ≥ 88 MLPW. Minimum initial and mean lumen levels are specified as follows: for 28 W lamps, limits are 2600/2340. For 25 W lamps, limits are 2300/2185.

(2)Life rating is based on an Instant Start Ballast tested in accordance with ANSI protocols. When used for Programmed Start Ballast, life may be increased depending upon the operating hours per start.

(3) Mean lumens measures at 7,200 hours

(4) Multi-Voltage Ballasts must meet or exceed the listed Ballast Efficiency Factor when operated on at least one of the intended operating voltages.

LIGHTING SPECIFICATIONS

High Output T5 and 4-foot T8 New Fixture Replacing HID

Incentives are available for replacements of HID fixtures with T8 or T5HO lamps and electronic ballasts. The T8 or T5HO lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤ 20% at full light output. This incentive is available for high-bay and low-bay fluorescent applications. Incentive is per fixture.

Pulse Start Metal Halide (retrofit only)

Incentives are available for replacing existing HID fixtures with pulse start metal halide fixtures in high-bay applications. Incentive is per fixture.

Exterior HID to LED/Induction Lighting Retrofit

Incentives are available for exterior applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate > 3,833 hours per year (> 10.5 hours per day). Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Eligible applications include canopy lighting and wall-packs. This incentive can be combined with incentives for exterior/garage bi-level control. Incentive is per fixture.

Garage HID to LED/Induction Lighting Retrofit

Incentives are available for garage and parking deck applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate 8760 hours per year or whenever the garage is open. Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Incentive is per fixture.

Exit Signs

Incentives are available for high-efficiency exit signs replacing or retrofitting an existing incandescent exit sign. Electroluminescent, T1, and LED exit signs are eligible. Non-electrified and remote exit signs are not eligible. All replacement exit signs must be UL or ETL listed, have a minimum lifetime of 10 years, and have an input wattage ≤ 5 Watts per face or be ENERGY STAR® listed. Incentive is per sign.

LED Traffic and Pedestrian Lights

Incentives are available for LED traffic lights on a per-signal basis (including arrows) that replace or retrofit an existing incandescent traffic signal. At minimum, red and green lamps must be retrofitted to qualify for the signal incentive. LED Signals must have a wattage of ≤17 watts per signal. Incentives are not available for spare lights. Lights must be hardwired, with the exception of pedestrian hand signals. Incentive is per signal.

Occupancy Sensors

Incentives are available for occupancy sensors for low occupancy interior areas, which automatically turn lights on when movement is detected. The minimum amount of time for the lights to stay on when no movement is sensed (delay set time) should be 10 minutes. The sensors can be passive infrared (PIR) or ultrasonic. All sensors should be hard-wired and control interior lighting fixtures. *To assist in rebate processing, provide the inventory of the controlled fixtures with the Final Application*. Incentive is per sensor.

Central Lighting Control

Incentives are available for automated central lighting control systems with override capabilities. This measure includes time clocks, package programmable relay panels, and complete building automation controls. Photo-sensors may also be incorporated into the central lighting control system. Incentive is per 10,000 square feet of controlled area.

Switching Controls for Multilevel Lighting

Incentives are available to install switching controls for multilevel lighting which may be used with daylight or occupancy sensors. If combined with daylight sensors, the controls must be commissioned in order to ensure proper sensor calibration and energy savings. This measure is applicable to spaces that require various lighting schemes such as classrooms, auditoriums, conference rooms and warehouses with skylights. Incentive is per 10,000 square feet of controlled area.

Daylight Sensor Controls

Incentives are available for new daylight sensor controls in spaces with reasonable amounts of sunlight exposure and areas where task lighting is not critical. The controls can be on/off, stepped, or continuous (dimming). The on/off controller should turn off artificial lighting when the interior illuminance meets the desired indoor lighting level. Daylight sensor controls are required to be commissioned in order to ensure proper sensor calibration and energy savings. Incentive is per 10,000 SF of controlled area.

Exterior Lighting, Bi-Level Control with Override

Incentives are available for retrofitting existing, exterior HID lighting with bi-level controls that reduce lighting levels by at least 50% when the space is unoccupied. The HID lighting must have an electronic ballast capable of reduced power levels, and be coupled with motion sensors to bring the light back to full lumen output for security reasons. Eligible controls include on-off controls, dimmers, and hi-lo ballast controls. This measure is applicable to exterior fixtures that are on during the night. Incentive is per fixture.

Light Tube

Incentives are available for new light tubes (tubular skylights) 10 inches to 21 inches in diameter. This measure is applicable to spaces that normally require electric lighting during peak hours (1 - 4 p.m. weekdays during the summer). The light tube must still allow an adequate amount of light during overcast conditions and must be coupled to daylight sensing controls. Incentive is per tube.

Delamping

Incentives are available for the permanent removal of existing fluorescent lamps. Permanent lamp removal is the net reduction in the quantity of lamps after a project is completed. Customers are responsible for determining whether reflectors are necessary in order to maintain adequate lighting levels. Lighting retrofits are expected to meet the Illuminating Engineering Society of North America (IESNA) recommended light levels. Unused lamps, lamp holders, and ballasts must be removed permanently from the fixture and disposed of in accordance with local regulations. This measure is applicable when retrofitting from T12 lamps to T8 lamps only. Removal of lamps from a T12 fixture that is not being retrofitted with T8 lamps is not eligible for this incentive, but may be eligible for other incentives. Incentive is per lamp removed.

HVAC (ELECTRIC) SPECIFICATIONS

Programmable Thermostat Setback/Setup (Air Conditioning)

Incentives are available for replacement programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® standards, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

General Clause for Heating Measures

Prescriptive incentives are available only for retrofit projects using natural gas as the primary fuel source. If a dual-fuel system is used, or if natural gas is the back-up or redundant fuel, the custom incentive application must be used. The incentives for boilers are only available for equipment used in space heating conditions, except for steam traps. Equipment for process load may be eligible for custom incentives.

Steam Trap Repair/Replacement

Incentives are available for the repair or replacement of steam traps that have failed open and that are leaking steam. Incentive is not available for traps that have failed closed or that are plugged. Replacement with an orifice trap is not eligible. Incentive is available once per 24 month period, per facility. Steam trap repair work must be recorded and the service report must be attached to the incentive application. Incentive is per repaired or replaced trap. The report must contain:

- Name of Survey/Repair Technician
- Survey/Repair Date
- System nominal steam pressure
- Annual hours of operation
- Number of steam traps serviced
- Per steam trap:
  - ID tag number, location and type of trap
  - If repair or replaced:
    - Orifice Size
    - Pre-and Post Conditions (e.g., Functioning/Not Functioning, Leaking/Not Leaking)

Pipe Wrap - Steam Boiler

Incentives are available for insulation applied to bare steam boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Pipe Wrap - Hot Water Boiler

Incentives are available for insulation applied to bare hot water boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Programmable Thermostat Setback/Setup (Gas Heat)

Incentives are available for new programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® criteria, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

Boiler Tune-up (Space Heating Boilers Only)

Incentives are available for tune-ups to natural gas fired, space heating boilers. Burners must be adjusted to improve combustion efficiency as needed. The incentive is available once in a 24 month period. Boiler size must be 110 MBH or greater. The service provider must perform before and after combustion analyses and attach the tune-up report to the Final Application. Incentive is per boiler. Tune-up report must contain the following information:

- Name of the technician performing tune-up
- Date of tune-up
- Boiler type (hot water, low pressure steam, high pressure steam)
- Boiler nameplate information (make, model, capacity)
- Annual hours of operation
- Pre-and Post combustion analysis results (an electronic flue gas analyzer must be used) including
    - o Combustion efficiency
    - o Stack temperature
    - o Flue gas levels of O2, CO2 and CO
- Statement that the following were performed:
    - o Check and adjust combustion air flow and air intake as needed
    - o Check burner and gas input
    - o Check draft control dampers
    - o Clean burners, nozzles, combustion chamber and heat exchanger surface (when weather or operating schedule permits
    - o Check combustion chamber seals
    - o Check for proper venting
    - o Complete visual inspection of system piping and installation
    - o Check safety controls

Boiler Water Reset Control

Incentives are available for boiler water reset controls added to existing boilers operating with a constant supply temperature. Incentives are for existing space heating boilers only. A replacement boiler with boiler reset controls is not eligible. The system must be set so that the minimum temperature is not more than 10°F above manufacturer's recommended minimum return temperature. For controls on multiple boilers to be eligible, control strategy must stage the lag boiler(s) only after the lead boiler fails to maintain the desired boiler water temperature. Incentive is per boiler.

YOUR ENERGY SAVINGS

YourEnergySavings.com

DTE Energy

DTE Energy
Multifamily Program

DTE Multifamily Program Application

Required Site Information

SITE NAME	FEDERAL TAX ID

SITE ADDRESS

CITY	STATE	ZIP CODE

SITE REPRESENTATIVE NAME	SITE REPRESENTATIVE PHONE #
SITE REPRESENTATIVE EMAIL ADDRESS	**SITE REPRESENTATIVE FAX #**
SECONDARY REPRESENTATIVE NAME	**SECONDARY REPRESENTATIVE PHONE #**

Required Management Company/Owner Information

MANAGEMENT COMPANY NAME	FEDERAL TAX ID

MAILING ADDRESS

CITY	STATE	ZIP CODE

MANAGEMENT COMPANY REPRESENTATIVE NAME	MANAGEMENT REPRESENTATIVE PHONE #
MANAGEMENT COMPANY EMAIL ADDRESS	**MANAGEMENT COMPANY FAX #**
SECONDARY REPRESENTATIVE NAME	**SECONDARY REPRESENTATIVE PHONE #**

Required Site Information

ELECTRICITY PROVIDER	ELECTRIC ACCOUNT NUMBER	GAS PROVIDER	GAS ACCOUNT NUMBER
YEAR BUILT	**TOTAL # OF UNITS**	**TOTAL # OF BUILDINGS**	**TOTAL # OF VACANT UNITS**

TOTAL NUMBER OF FLOORS	DOES BUILDING HAVE BASEMENTS?	MAX # OF BATHROOMS PER UNIT
MAX # OF SHOWERS PER UNIT	**MAX # OF SINKS PER BATHROOM**	**AVERAGE SQUARE FOOTAGE OF UNITS**

Optional Site Information

TOTAL # OF SHOWERS ON PROPERTY	TOTAL # OF SINKS ON PROPERTY	ARE WATER HEATERS IN UNITS?

4.0 Part 3: Utility Consumption Baseline

AKTPEERLESS

4.1 Acknowledgements of Part 3: Utility Consumption Baseline

The Consumption Narrative Report and Utility Consumption – Summary and Utility Consumption – Monthly worksheets in the RPCA Model were completed by Linnea Fraser and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 3.2 (Version 2, December 2013).

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Building Performance Institute

Date: February 10, 2014 .

Part 3 Consumption Narrative Report and Excel RPCA Model were Received and Reviewed by Owner:

Lori Harris
Norstar Development USA, LP
733 Broadway
Albany, NY 12207
Phone: 518-431-1051
Fax: 518-431-1053

Date: ___________________________

AKTPEERLESS

Rental Assistance Demonstration (RAD): UTILITY CONSUMPTION BASELINE

727 Miller Avenue, Ann Arbor, Michigan 48103

MILLER MANOR

PREPARED FOR Norstar Development USA, LP
733 Broadway
Albany, NY 12207

AND The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8208E-3-90

PIC # MI064

DATE February 10, 2014

Table of Contents

1.0 EXECUTIVE SUMMARY

1.1 Purpose and Scope of Work

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

1.2 Subject Site Description

1.2.1 General Site Description

The subject property is a multi-family building with one hundred and four (104) tenant units. The subject building was constructed in 1971 and contains seven (7) stories with a basement. The site contains ninety-nine (99) one bedroom/one bathroom units and five (5) two bedroom/one bathroom units. The subject complex is generally referred to as Miller Manor.

1.2.2 Site Utilities and Usage

All of the units at the subject property are on a combined electric meter. There is one electric and one gas meter for the entire site. Therefore, there is one (1) electric meter, one (1) natural gas meter, and one (1) water meter at the site.

1.3 Baseline Site Energy Consumption

The Actual Site Energy Use, Energy Use Intensity (EUI), Weather Normalized Site Energy Use and Weather Normalized EUI displayed below are consistent with the ASHRAE Procedures for Commercial Building Energy Audits. This methodology establishes the property's baseline use and cost conditions that are representative of the building's energy performance.

This statistical analysis removes the bias of independent variables such as historic weather, occupancy and operating hours. These calculations have been normalized to the mean values of the independent variables impacting the building's energy performance and represent the most probable performance under actual conditions accounting for weather, occupancy and operating hour variability.

As the subject site has been 100% occupied for the duration of the analysis period, no pro-forma adjustment factors to the consumption have been made.

1.3.1 Actual Site Energy Use and EUI

Actual Site Energy Use	Actual Site Energy Use Intensity (EUI)
7,901,465 kBtu/yr	88.53 kBtu/ ft^2/yr

1.3.2 Weather Normalized Site Energy Use and EUI

Weather Normalized Site Energy Use	Weather Normalized Site Energy Use Intensity (EUI)
8,522,668 kBtu/yr	95.49 kBtu/ft^2/yr

2.0 INTRODUCTION

2.1 Purpose

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

2.2 Scope of Work

AKT Peerless' scope-of-services is based on its proposal PE-14248, dated January 9, 2013 and revised March 15, 2013 and authorized by Norstar Development USA, LP (the Client), and the terms and conditions of that agreement.

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

3.0 SUBJECT SITE DESCRIPTION

3.1 General Site Description

The subject property is a multi-family building with one hundred and four (104) tenant units. The subject building was constructed in 1971 and contains seven (7) stories with a basement. The site contains ninety-nine (99) one bedroom/one bathroom units and five (5) two bedroom/one bathroom units. The subject complex is generally referred to as Miller Manor.

3.2 Current/Planned Use of the Property

The subject property has been used as a multi-family structure and operated by the AAHC since its initial construction in 1971. AAHC is participating in HUD's Rental Assistance Demonstration pilot program and intends to continue operating the building as a multi-family residential facility.

4.0 ENERGY CONSUMPTION ANALYSIS

This section provides information on energy utilities associated with the subject property.

4.1 Electricity

The following figure (Figure 4.1) identifies monthly electrical consumption (kWh) in comparison to cooling degree days (CDD). Cooling Degree Days (CDD) are roughly proportional to the energy used for cooling a building, while Heating Degree Days, (HDD) are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

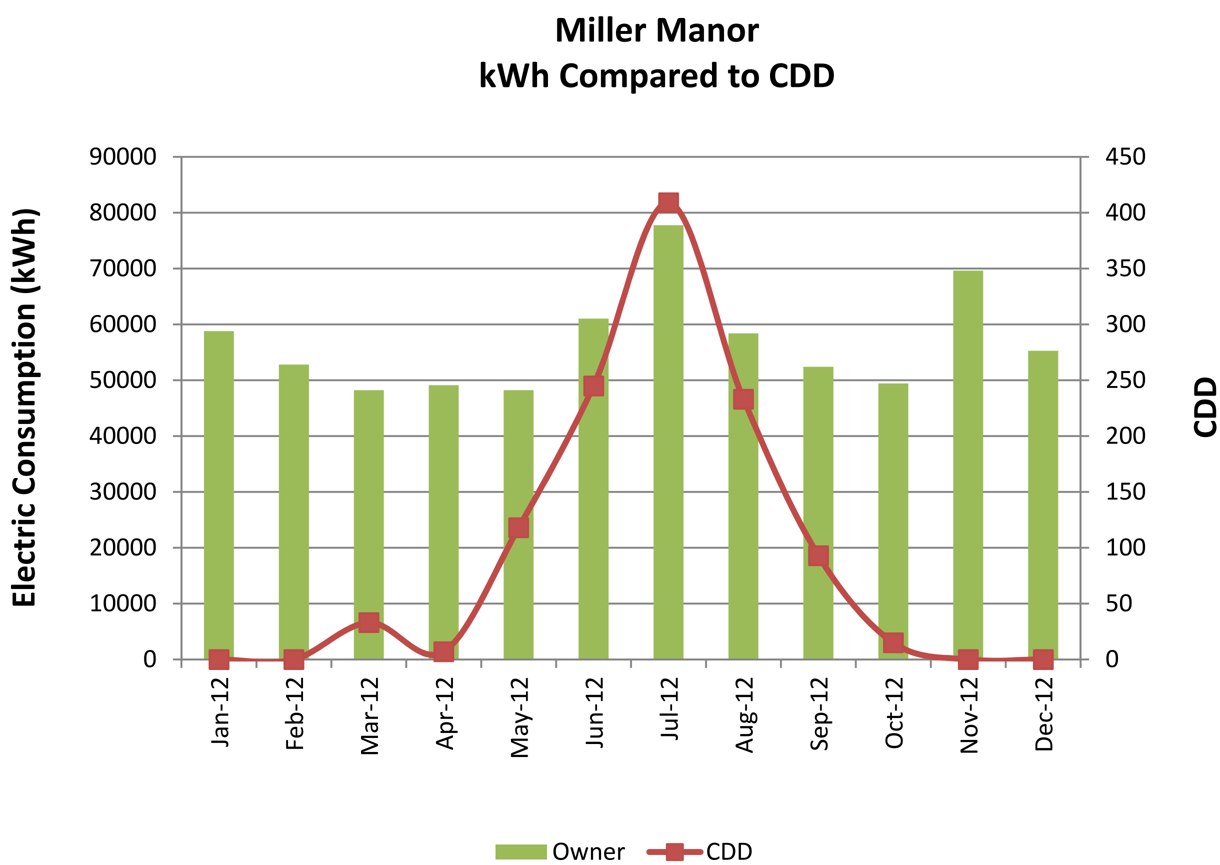

Figure 4.1 Electricity Consumption Graph

The following table (Table 4.1) identifies key information regarding the electric utility associated with the property.

Table 4.1 Annual Electricity Metrics

Vendor	DTE Energy
Meters on Site	Residential and Non-Residential (Common) - One (1)
Use for Residential	Lighting, electric appliances, tenant plug loads, tenant ac window units (if present), washing machines, furnace blower and control.
Use for Non-Residential	Exterior lighting, community center lighting, electric appliances, plug loads, ac units, furnace blower and control.
Responsible for Payment	Residential and Non-Residential - Owner

Rate	Residential and Non-Residential - $0.1116 / kWh
Site Consumption	681,150 kWh / year (2,324,765 kBtu / year)
Energy Use Intensity (EUI)	7.63 kWh / ft^2 (26.05 kBtu / ft^2)
Weather Normalized Site Consumption	664,700 kWh / year (2,268,620 kBtu / year)
Weather Normalized EUI	7.45 kWh / ft^2 (25.42 kBtu / ft^2)

AKT Peerless received tenant electric bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (kWh). For the subject property, Miller Manor, monthly electrical data was included from June 2011 to December 2012. The most current twelve (12) months of electrical data provided (January 2012 through December 2012) were used for this analysis and input into the RPCA model.

The actual electric consumption was adjusted to produce a weather-normalized summary of electric consumption. This process involved the following steps:

- CDD for the base year billing periods were calculated. Source for CDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (kWh) and CDD were normalized by number of days in each billing period.
- Relationship between usage (kWh/day) and weather (CDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average CDD per month.

4.2 Natural Gas

The following figure (Figure 4.2) identifies monthly natural gas consumption (therms) in comparison to heating degree days (HDD). HDD are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

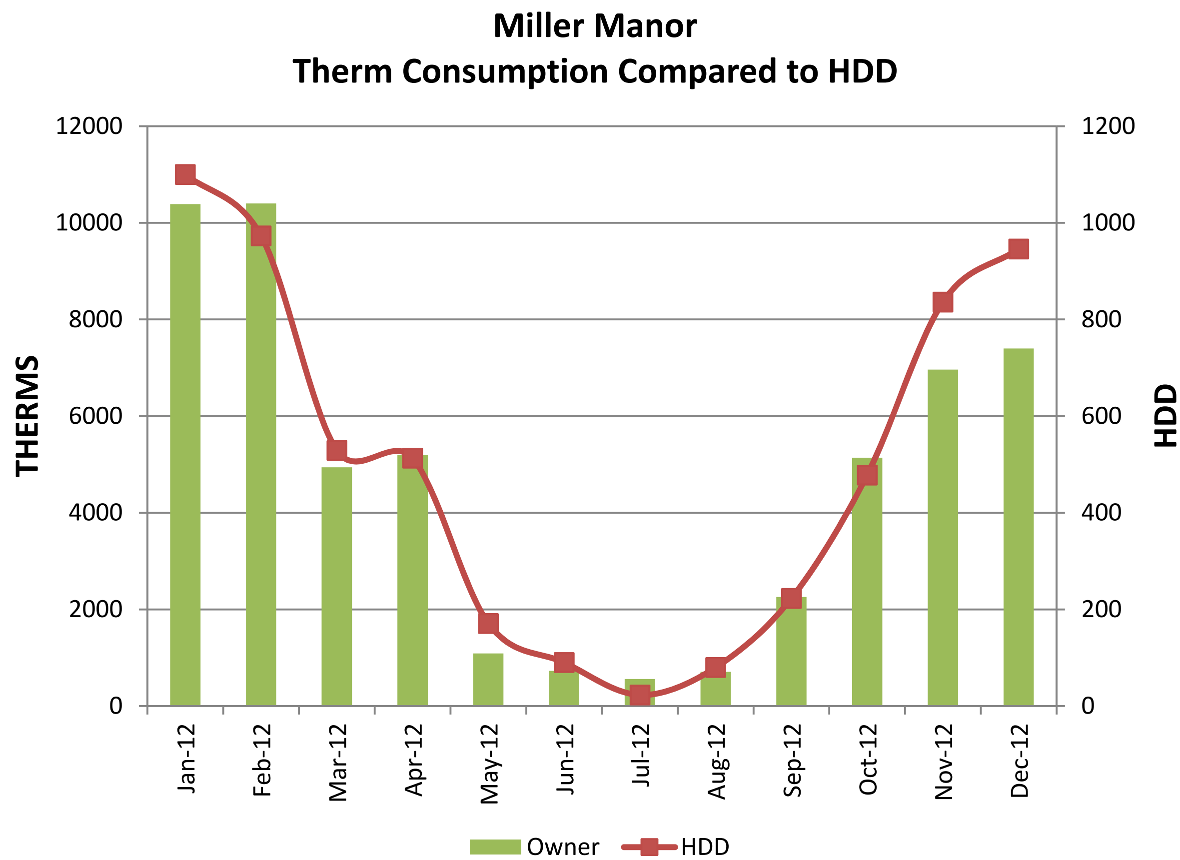

Figure 4.2 Natural Gas Consumption Graph

The following table (Table 4.2) identifies key information regarding the natural gas utility associated with the property.

Table 4.2 Annual Natural Gas Metrics

Vendor	DTE Energy
Meters on Site	Residential and Non-Residential (Common) - One (1)
Use for Residential	Gas-fired furnaces for space heating, ranges for cooking, dryers for laundry.
Use for Non-Residential	Community center gas-fired furnace for space heating, ranges for cooking
Responsible for Payment	Residential - Tenant Non-Residential - Owner
Rate	Residential and Non-Residential - $0.773 / therm
Site Consumption	55,767 therms / year (5,576,700 kBtu / year)

Energy Use Intensity (EUI)	62.48 kBtu / ft^2
Weather Normalized Site Consumption	62,541 therms / year (6,254,048 kBtu / year)
Weather Normalized EUI	70.07 kBtu / ft^2

AKT Peerless received tenant natural gas bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (therms). For the subject property, Miller Manor, monthly natural gas data was included from June 2011 to December 2012. The most current twelve (12) months of natural gas data provided (January 2012 through December 2012) were used for this analysis and input into the RPCA model.

The actual natural gas consumption was adjusted to produce a weather-normalized summary of natural gas consumption. This process involved the following steps:

- HDD for the base year billing periods were calculated. Source for HDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (therms) and HDD were normalized by number of days in each billing period.
- Relationship between usage (therms/day) and weather (HDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average HDD per month.

5.0 LIMITATIONS

5.1 Assumptions

The Ann Arbor Housing Commission (AAHC), the property owner, released utility information to AKT Peerless delivered directly from the utility provider(s), DTE Energy. It is assumed that this monthly usage and cost data is accurate and contains no data gaps or errors.

Information on how the utilities are utilized was generated from conversations with AAHC staff and results of the RPCA through the Energy Audit.

5.2 Limitations and Exceptions

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, owner, third parties, or the secondary information sources cited in this report is complete or accurate.

AKT Peerless has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to AKT Peerless and information not reported to AKT Peerless may influence the findings of report.

AKT Peerless has not verified the accuracy of building floor area as reported by the owner.

Should additional information become available to the Client or Owner that differs significantly from our understanding of conditions presented in this report, AKT Peerless requests that such information be forwarded immediately to our attention so that we may reassess the conclusions provided herein and amend this project's scope of services as necessary and appropriate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

6.0 SIGNATURES

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