Energy Audit Report

Riley Park Place

806 10th Street NW, Calgary, AB

Prepared for **Norfolk Housing Association**

Prepared by **Sustainable Projects Group**

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Executive Summary

SPG conducted an energy audit for Norfolk Housing Association at Riley Park Place to assess current energy performance and identify energy conservation measures (ECMs). The audit consisted of a site visit and data analysis based on observations made by the site auditor as well as information provided by Norfolk Housing Association.

The building's average annual consumption, cost, and greenhouse gas (GHG) emissions are summarized in the table below.

Table 1 Energy performance

Utility	Consumption	Energy (GJ/yr.)	Cost ($/yr.)	GHGs (t CO_2e/yr.)
Electricity	61,741 kWh/yr.	222	$13,274	33.3
Natural gas	1,504 GJ/yr.	1,504	$13,846	76.4
Water	2,322 m^3/yr.		$10,692	1.6
Total		**1,726**	**$37,812**	**111.3**

The report has been prepared to meet the energy and greenhouse gas (GHG) reduction targets of the Canada Greener Affordable Housing (CGAH) program. A total of 11 ECMs and one measure for additional consideration were identified. If all recommended ECMs, including onsite energy generation measures, are implemented (excluding additional consideration measures), the building's energy performance would improve by 85%, with an 89% reduction in GHG emissions, meeting the program's requirements.

The implementation of all recommended ECMs would cost $1,021,330, and save $28,821 per year, for an overall payback period of ~22 years. The implementation of all recommended ECMs would reduce the building's energy use intensity (EUI), greenhouse gas intensity (GHGI), energy cost intensity (ECI), and water use intensity (WUI). These results are outlined in the table below.

Table 2 Impact of ECMs on performance

Performance metric	Baseline performance	Benchmark	Performance after ECMs	Potential reduction
EUI (GJ/m^2)	0.87	0.82	0.21	76%*
GHGI (kg CO_2e/m^2)	56.00	91.10	6.14	89%
ECI ($/$m^2$)	$13.64		$5.53	59%
WUI (m^3/m^2)	1.17		0.81	31%

**Excluding on-site energy generation measures*

The identified ECMs, as well as the interactive effects ECMs have on one another when installed together, are outlined in the table below.

Table 3 ECM Summary

ECM		Annual Savings					Finance		
		Electricity (kWh/yr.)	Natural Gas (GJ/yr.)	Water (m^3/yr.)	GHGs (t CO_2e/yr.)	Utility Cost	Project Cost	Simple Payback (yrs.)	Net Present Value @5%
1	Pipe Insulation	0	259	0	13.1	$2,226	$977	<1	$25,361
2	Intelligent Parking Outlets	23,232	0	0	12.5	$4,881	$12,776	2.5	$70,074
3	Hydronic Heating Additive	0	54	0	2.8	$467	$4,950	7.2	-$514
5	Low Flow Water Fixtures	0	115	716	6.3	$5,070	$66,062	10.2	$44,118
7	Energy Star Dryer	2,257	0	0	1.2	$474	$7,960	13.1	-$1,666
8	BAS	0	150	0	7.6	$1,293	$61,859	24.8	-$39,788
9	Heat Pump (Boiler Supplement)	0	997	0	50.6	$8,573	$429,592	25.7	-$283,292
10	Condensing Boiler	0	87	0	4.4	$752	$63,874	38.1	-$44,774
11	Condensing Furnace	0	24	0	1.2	$208	$20,549	42.5	-$17,006
12	Elevator Regenerative Drive	1,284	0	0	0.7	$270	$247,842	>50	-$243,265
Energy generation measures:									
4	Rooftop Solar	40,958	0	0	22.1	$8,605	$104,890	10.1	$70,487
Net interactive effects		**0**	**-465**	**0**	**-23.6**	**-$3,999**	**$0**		
Total (accounting for interactions)		**67,730**	**1,222**	**716**	**99.1**	**$28,821**	**$1,021,330**	**21.8**	**-$483,011**
For additional consideration									
6	Programmable Thermostats	0	152	0	7.7	$1,304	$22,585	10.9	-$324

1. Introduction

Norfolk Housing Association retained Sustainable Projects Group (SPG) to conduct an energy audit for Riley Park Place. The purpose of this energy audit is to assess energy consumption and identify energy conservation measures (ECMs) with the intent to inform sound energy management decisions. The audit process involves the following stages:

- Creating an inventory of in-scope building components
- Developing an understanding of building systems, operation, and history
- Compiling utility data
- Determining utility baselines and benchmarking
- Calibrating an energy model including all in-scope end-uses
- Identifying and quantifying ECMs, including estimating potential savings and financial feasibility
- Providing insight and recommendations for energy management

This analysis draws on the following sources of information:

- Observations, notes, and pictures taken by SPG during the site assessment
- Communication, written and oral, with Norfolk Housing Association staff
- Documentation provided by Norfolk Housing Association, including:
    - Electricity data for the period of June 2023, to June 2024
    - Water data for the period of May 2023, to June 2024
    - Natural gas data for the period of January 2023, to May 2024
    - Mechanical drawings
    - Architectural drawings
    - Previous energy audit report
    - Building condition assessment
    - Other as applicable

This study is subject to following limitations:

- The information made available to SPG, as described above, was considered. Where/if key information was not available, attempts to find the information from published resources or best-guess assumptions guided by professional judgement and/or experience were made as needed.
- The accuracy of the information provided to SPG was not independently verified. All provided information was taken at face value.
- The information gathered by SPG during the site assessment was limited to the spaces that were accessible given the conditions at the time of visit. Information about inaccessible or concealed elements was inferred or estimated, when possible, but in some cases may not have been considered.
- The site visit was limited to a visual, non-destructive survey. The survey is subject to practical limitations; all items may not have been individually confirmed. The viewing of items was prioritized based on their perceived importance to ensure a comprehensive yet efficient evaluation.

- Unless more contextual information was provided, the equipment operating conditions during the site visit were assumed to be representative of normal operation.
- The scope of the audit is limited to the following systems:
    - Building envelope
    - Heating, ventilation, and air conditioning (HVAC)
    - Domestic hot water (DHW)
    - Lighting
    - Water fixtures
    - Conveyance (elevator)
    - Large appliances

Key contacts

We acknowledge and thank all parties who have supported and contributed to this work. For project inquiries, please contact the following persons:

Table 4 Key contacts

Name	Organization	Role	E-mail
Tegan Gallilee-Lang	SPG	Energy Team Manager	tegang@suspg.com
Lance Giesbrecht	SPG	Operations Manager	lanceg@suspg.com
Derek Enns	Norfolk Housing Association	Asset Maintenance Lead	derek.e@norfolkhousing.ca

2. Building and Systems

Riley Park Place is a four-story, 1,988 m² multi-unit residential building located at 806 10th Street Northwest in Calgary, Alberta. Built in 1970, the property features 24 residential suites spread across levels 1 to 4. On average, the building accommodates approximately 33 residents daily.

Figure 1 Riley Park Place exterior (left), and simulated aerial view with red highlighting around in-scope building (right, Google Earth, 2024)

2.1. Building envelope

The building features a flat built-up roofing (BUR) system composed of roofing bitumen. The exterior walls are clad in clay brick, with painted clay brick accents on the east side. Exterior doors include glazed metal doors and metal hollow doors located on the rear side of the building. Residential spaces are equipped with vinyl-framed double-pane windows.

Figure 2 Example envelope components; roof (top left, Google Earth, 2024), door (top right), and window (bottom)

A thermal camera was used to view the building envelope and identify areas of poor performance. Images were captured of such areas, if discovered, and of areas showing typical performance. Typically, a minimum temperature differential of 10°C between the building's interior and exterior environments is required for a useful assessment. Since the exterior ambient temperature was ~14°C at the time of the audit, this requirement was not met. The thermal images taken during the site visit have been included below for reference, but they do not support assessments regarding envelope performance. Scheduling thermal scans during the winter months and ideally at night is recommended for effective assessments.

The thermal images show some heat loss, represented in yellow and red colours. Some heightened heat loss is normal at points in the envelope with lower thermal resistance, like at windows and doors. No major areas of concern were noted when reviewing the thermal images.

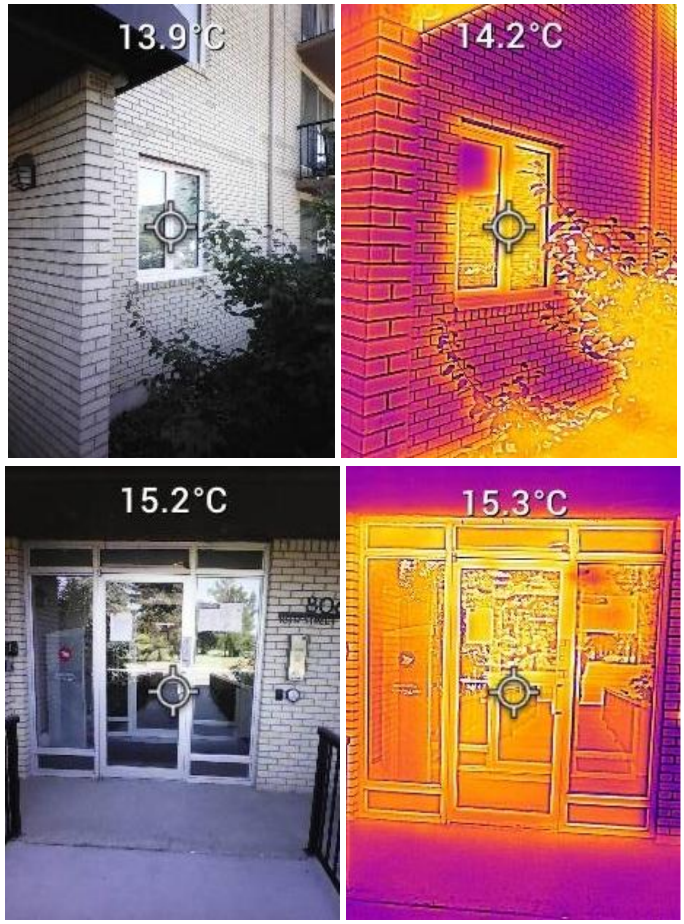

Figure 3 Example thermal images

2.2. Heating, Cooling, and Ventilation

Space heating

The hydronic heating loop system, located in the Level 1 boiler room, includes one boiler that is operated by Tekmar control system, and one circulating pump. Additionally, a gas furnace serves the hallways. Heating equipment is catalogued in the table below.

Table 5 Space heating equipment

Equipment	Qty (#)	Location	Service equipment	Make	Model	Serial number	Year	Rating	Efficiency (%)
Boiler	1	L1 Boiler Room	Hydronic Heating Loop	Allied	AAE-960-N-M	91-AAH-4435	1991	960,000 btu/h	~80%
Furnace	1	L1 Boiler Room	Hallways	Lennox	G8 110T	No Data	~1981	99,000 btu/h	80%
Circulating Pump	1	L1 Boiler Room	Hydronic Heating Loop	Armstrong	TQE 56B17D11008A	No Data	No Data	¾ hp	~80%

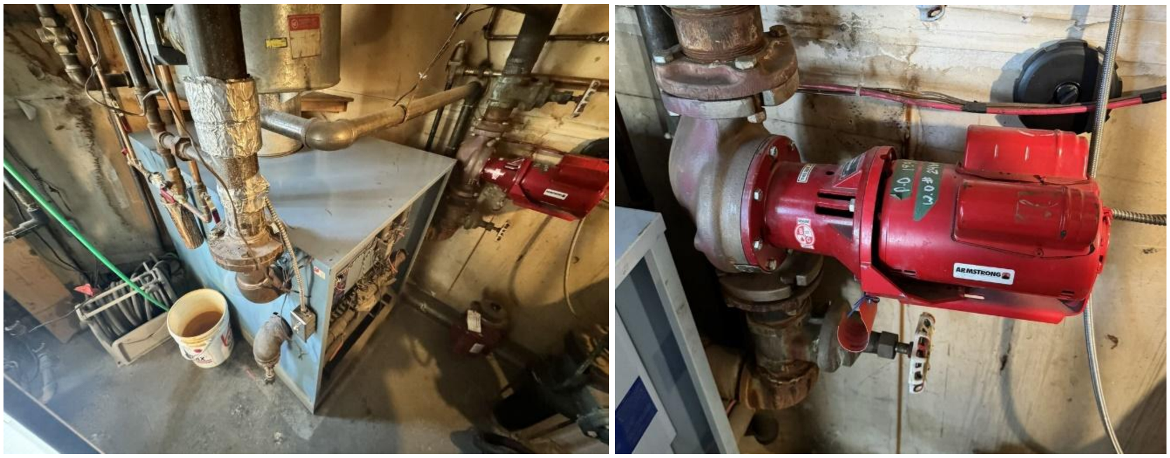

Figure 4 boiler (left) and circulating pump (right)

Ventilation

The furnace located in the Level 1 boiler room provides ventilation for the hallways using its blower fan and ductwork. Ventilation equipment is catalogued in the table below.

Table 6 Ventilation equipment

Equipment	Qty (#)	Location	Service area	Make	Model	Serial number	Year	Rating	Efficiency (%)	Estimated Airflow (CFM)
Furnace	1	L1 Boiler Room	Hallways	Lennox	G8 110T	No Data	~1981	1/3 hp	~80%	No Data

Figure 5 furnace

2.3. Domestic Hot Water

The building's domestic hot water (DHW) system is supported by one DHW heater that supplies the DHW loop. A circulation pump complements the system by recirculating heated water back to the heater, ensuring a consistent supply of hot water throughout the building. DHW equipment is catalogued in the table below.

Table 7 DHW Equipment

Equipment	Qty (#)	Location	Service area	Make	Model	Serial number	Year	Rating	Efficiency (%)
DHW Heater	1	L1 Boiler Room	DHW Loop	Bradford White	D75T3003N	XJ48503438	2021	270,000 btu/h	~80%
DHW Circulation Pump	1	L1 Boiler Room	DHW Loop	Grundfos	UP10-16 A PM	No Data	No Data	0.009 kW	90%

Figure 6 DHW Heater (left) and DHW Circulation pump (right)

2.4. Lighting

All interior and exterior lighting technology in the building is LED with exception to one compact fluorescent fixture at the exterior main entrance. The most common fixture was a LED A19 sconce. Control types include switches, occupancy sensors, breakers, timers, and daylight sensors. A complete lighting schedule is included in Appendix A.

Figure 7 Example lighting fixtures

2.5. Water Fixtures

The water fixture inventory is presented in the table below.

Table 8 Water fixtures

Area	Type	Qty (#)	Flow/flush rate
L1 - Laundry Room	Faucet, kitchen	1	2.2
L1 - Laundry Room	Clothes washer, commercial, front-loading	1	12.6
L1 - Laundry Room	Clothes washer, commercial, top-loading	1	15.4
103 - Bachelor	Faucet, lavatory, residential	1	2.2
103 - Bachelor	Toilet	1	1.6
103 - Bachelor	Faucet, lavatory, residential	1	2.2
103 - Bachelor	Showerhead, residential	1	2.5
105 – 2 Bedroom	Faucet, lavatory, residential	1	2.2
105 – 2 Bedroom	Toilet	1	1.6
105 – 2 Bedroom	Faucet, lavatory, residential	1	2.2
105 – 2 Bedroom	Showerhead, residential	1	2.5
104 – 1 Bedroom	Faucet, lavatory, residential	1	2.2
104 – 1 Bedroom	Toilet	1	1.6
104 – 1 Bedroom	Faucet, lavatory, residential	1	2.2
104 – 1 Bedroom	Showerhead	1	2.5
L1-4 Unaccessed Suites	Faucet, lavatory, residential	21	2.2
L1-4 Unaccessed Suites	Toilet	21	1.6
L1-4 Unaccessed Suites	Faucet, lavatory, residential	21	2.2
L1-4 Unaccessed Suites	Showerhead, residential	21	2.5


Figure 8 Example water fixtures

2.6. Meters

The following utility meters were identified:

Table 9 Utility meter inventory

Meter Description	Utility type	Number	Location
Whole building	Electricity	800025	L1 Boiler Room
Whole building	Natural gas	No Data	Exterior
Whole building	Water	8015161074	L1 Boiler Room

2.7. Other

This equipment is catalogued in the table below.

Table 10 Other equipment

Equipment	Qty (#)	Location	Service area	Make	Model	Serial number	Year	Rating	Efficiency (%)
Elevator	1	Elevator Room	Building	No Data	No Data	No Data	No Data	~20 hp	~80%
Dryers	2	Laundry Room	Laundry	Alliance	RDGLYFGS111CW01	903020740	No Data	7.3 kW	100%
Washers	1	Laundry Room	Laundry	Alliance	HWNLE2SP111CW01	1105025263	No Data	~5 kW	100%
Washers	1	Laundry Room	Laundry	Alliance	RFNKYFSP111CW01	903014285	No Data	~5 kW	~100%

Figure 9 dryers (left) and washers (right)

3. Performance

The building's energy and water performance were evaluated by analyzing utility data. The following table summarizes the source information:

Table 11 Utility data sources

Utility	Data type	Utility provider	Period	Notes
Electricity	Monthly utility bills from utility provider	Transalta	June 2023 to June 2024	All months within the data period have associated data.
Natural gas	Monthly utility bills from utility provider	Direct Energy	January 2023 to May 2024	All months within the data period have associated data.
Water	Monthly utility bills from utility provider	The City of Calgary	May 2023 to June 2024	All months within the data period have associated data.

3.1. Historical Data

Utility consumption trends are described below, alongside figures depicting monthly consumption. The tabulated monthly utility data is included in Appendix B.

Electricity

Due to only having twelve months of utility data, the identification of seasonal or other recurring trends is challenging. A notable peak in consumption is observed in January 2024. While the exact cause of this peak is unknown, it can be attributed to increased space heating demands during this colder month. Additional utility data would be required to confirm or reject this as a recurring trend. Baseload consumption is assumed to be attributed to loads that do not vary seasonally, such as ventilation and plug loads.

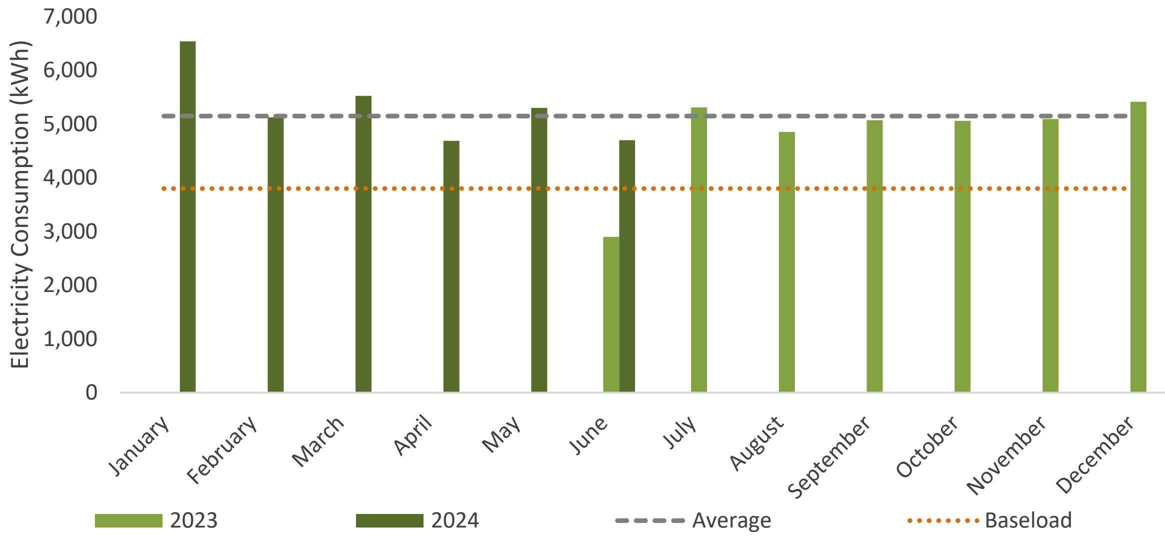

Figure 10 Electricity consumption over time

Natural gas

Natural gas consumption exhibits a non-homogeneous pattern characterized by a notable increase during the colder months, specifically January to March. The observed trend of increased consumption can be attributed to the amplified demand for heating systems for the entire building. The baseload consumption is primarily associated with space heating. Consumption from September to October 2023 were omitted, as they were deemed anomalous compared to trending natural gas consumption.

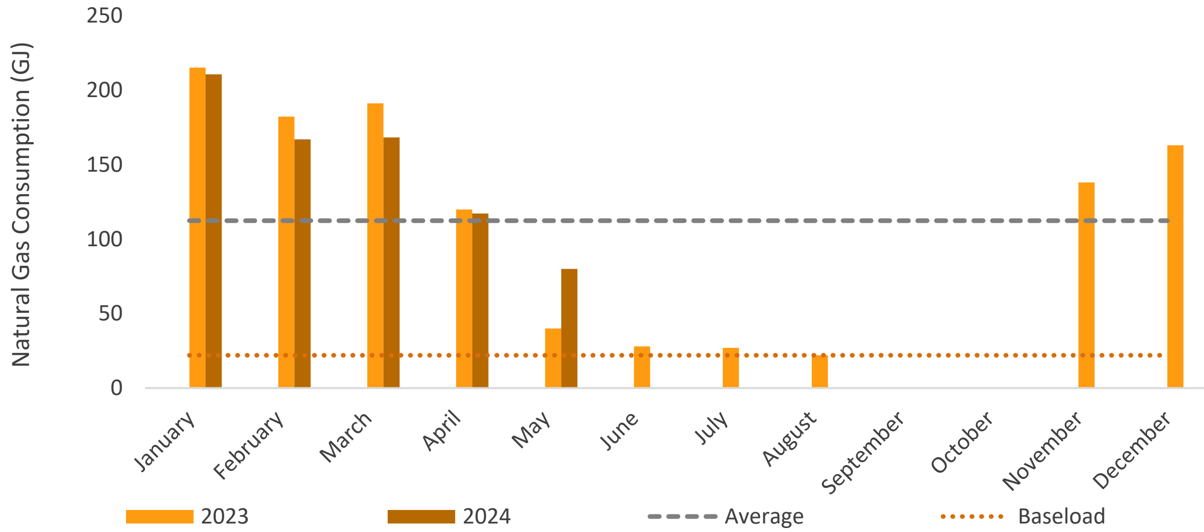

Figure 11 Natural gas consumption over time

Water

Water consumption remains relatively consistent, with a noticeable decrease observed in June 2024. The reason for this decline is currently unknown. Baseload consumption is primarily attributed to the use of fixtures such as faucets, urinals, showerheads, and toilets.

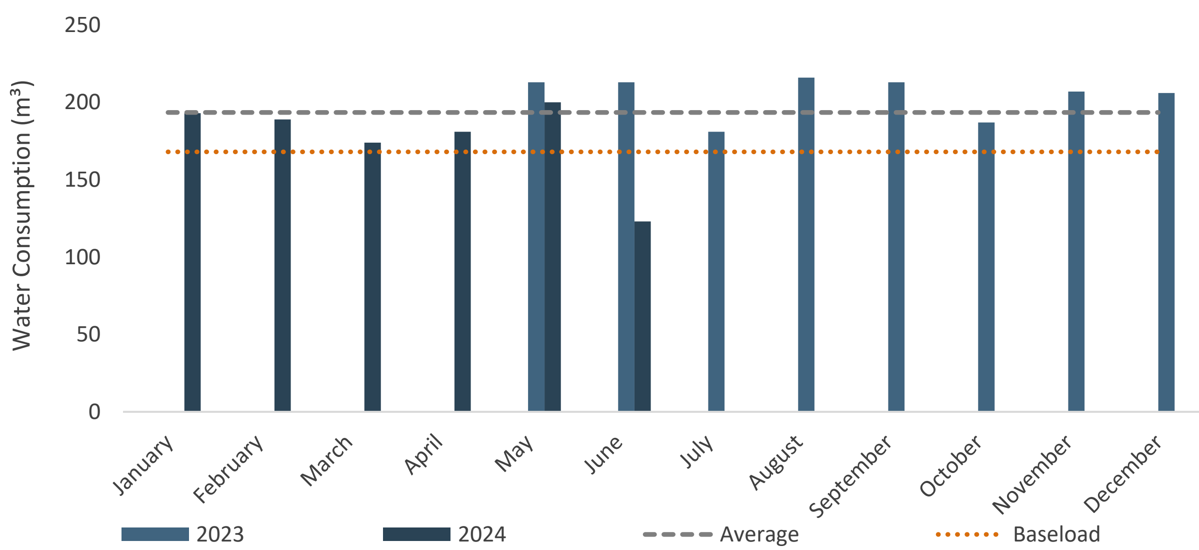

Figure 12 Water consumption over time

3.2. Baseline

The baseline annual consumption, cost and GHG emissions for each utility were calculated based on the average annual value for the entire period of available data. These results are presented in the table below.

Table 12 Baseline consumption, cost and GHGs

Utility	Consumption	Energy (GJ/yr.)	Cost ($/yr.)	GHGs (t CO_2e/yr.)
Electricity	61,741 kWh/yr.	222	$13,274	33.3
Natural gas	1,504 GJ/yr.	1,504	$13,846	76.4
Water	2,322 m^3/yr.		$10,692	1.6
Total		**1,726**	**$37,812**	**111.3**

Emission factors

The following table outlines the emission factors used to calculate GHGs for the baseline, and for the GHG reduction estimates in the ECM section.

Table 13 Emission factors

Utility	Emission factor	Source
Electricity	0.540 kg CO_2e/kWh	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada (2023). Part 3, Annex 13
Natural Gas	50.784 kg CO_2e/GJ	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada (2023). Part 2, Annex 6
Water	0.689 kg CO_2e/m^3	Maas, Carol. Greenhouse Gas and Energy Co-Benefits of Water Conservation. POLIS Project on Ecological Governance, University of Victoria. November 2008. Tables B-1 and D-3

Utility rates

An estimated marginal utility rate was used for each utility type to calculate cost savings from ECM implementation. The marginal utility rate is the rate representing only consumption-variable utility charges. This may include consumption charges, consumption-variable transmission/distribution/delivery charges, carbon taxes, municipal fees, and other federal and provincial taxes as applicable. This rate excludes all fixed charges such as monthly or daily service and delivery charges, and demand charges, which are typically not affected by ECM implementation.

The marginal utility rates were estimated using a linear regression analysis. The statistical relationship between cost and consumption was assessed in order to differentiate fixed and consumption-variable cost components. Only the most recent 12 months of utility data are typically included in this calculation, so that the marginal rate is reflective of current pricing. Natural gas consumption from September to October 2023 were omitted, as they were deemed anomalous compared to trending consumption.

The marginal utility rates for the building are outlined in the table below.

Table 14 Utility rates

Utility	Marginal utility rate
Electricity	$0.21/kWh
Natural Gas	$8.60/GJ
Water	$5.71/$m^3$

3.3. Benchmarking

Benchmarking is the evaluation of a building's performance by comparing it to other buildings with similar characteristics. Building performance is expressed per unit area, so that buildings of different sizes may be compared. Buildings are typically compared with others in the same country or region and the same general use category, since these will be expected to have similar energy sources and requirements.

Baseline values for energy use intensity (EUI), greenhouse gas emission intensity (GHGI), energy cost intensity (ECI), and water use intensity (WUI) are provided. The benchmark values for EUI are Canadian national median values by property type, and the benchmark values for GHGI are Canadian regional median values by property type from Energy Star Portfolio Manager (2023).

The table below outlines the baseline results for each metric, and the associated benchmarks, where they are available.

Table 15 Baseline performance and benchmarks

Metric	Baseline	Benchmark
EUI (GJ/m^2)	0.87	0.82
GHGI ($kgCO_2e/m^2$)	56.00	91.10
ECI ($\$/m^2$)	13.64	
WUI (m^3/m^2)	1.17	

3.4. End Uses

End uses were identified, and energy or water consumption was allocated to each end use. Quantifying how much of a utility a particular system consumes enables us to calculate utility savings from the implementation of ECMs.

Electricity

Electricity consumption was allocated to different end uses by considering a variety of factors, including equipment specifications, controls, schedules, typical runtimes, and utility baseload and variable consumption. The Plug Loads end use was estimated based on the difference between the consumption in other categories and the total estimated annual electricity consumption. The Plug Loads as included correspond to 5 W/m2, which is the estimated peak receptacle load value in the National Energy Code of Canada for Buildings 2017 (NECB) for the multi-unit residential building type.

The figure below shows the proportion of electricity consumed by the building's different end uses. Plug loads system, which include dryers, washers, and other miscellaneous uses, consume the most electricity in the building.

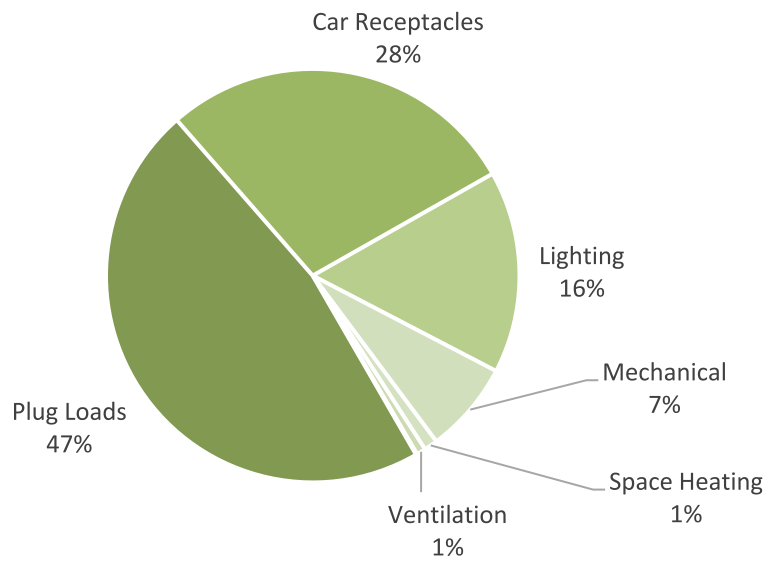

Figure 13 Electricity end uses

Natural gas

Natural gas consumption was allocated to different end uses by considering a variety of factors, including equipment specifications, controls, schedules, typical runtimes, and utility baseload and variable consumption. The figure below shows the proportion of natural gas consumed by the building's different end uses. The space heating system consumes the most natural gas in the building.

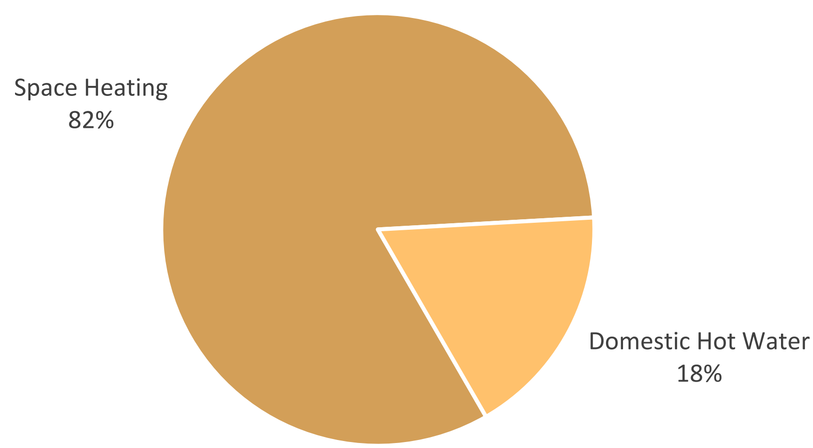

Figure 14 Natural gas end uses

Water

Water consumption was allocated to different end uses by multiplying the equipment flow rate by the estimated usage, while considering building occupancy and baseload and variable consumption. Values for use duration were taken from the LEED v4 indoor Water Use Reduction Calculator.

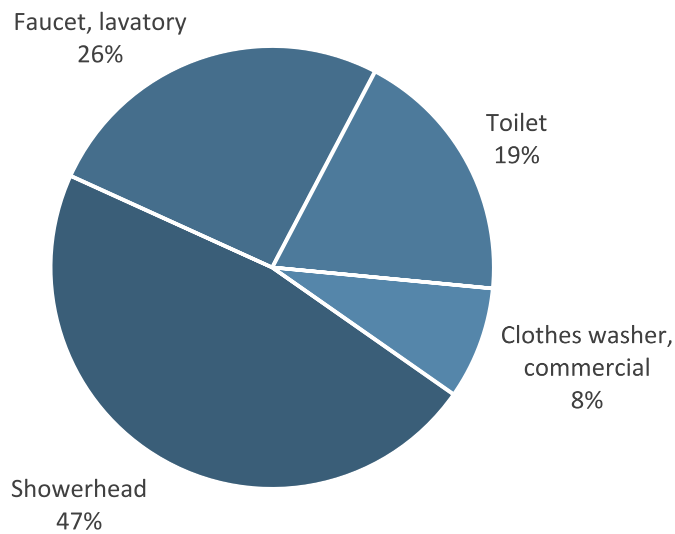

Figure 15 Water end uses

4. Energy Conservation Measures

An array of ECMs were identified which would improve energy and/or water performance. A wide variety of ECMs were considered, and only measures that could be implemented based on the building's unique characteristics were thoroughly investigated.

One measure for additional consideration is also outlined. These are measures which were investigated but are not recommended for implementation. This may be because there is no business case for the project, because our analysis is low confidence, because we have insufficient information to recommend the project, because the project directly conflicts with a recommended project, or as specified.

The metrics used to quantify each ECM and select details about the analysis methods are described below:

Cost

This metric describes the project's implementation cost, in Canadian dollars. The costs are class D, budgetary estimates (-20 to +30%). The actual project cost will be determined at the time of project initiation, to reflect current pricing, and in many cases following the completion of a detailed design. The cost estimates include the labour and materials for the project, but unless otherwise indicated, do not include engineering, design, travel, or other costs.

Utility Savings

This metric describes the reduction in annual energy or water consumption the project is estimated to achieve. Any negative savings, such as for electrification projects, represent an increase in utility consumption.

Interactive Effects

Each project has first been analyzed individually, with savings calculated as if no other projects are implemented. If multiple projects are implemented, the total savings may be reduced if multiple projects affect the same system. These interactions have been estimated using a generalized approach, described below.

The savings of each ECM are assigned as either a fixed-quantity reduction or a percentage reduction of the baseline consumption of a piece of equipment or group of equipment. This determination is made by an analyst based on the type of equipment and the type of measure being proposed. Where multiple ECMs impact the same equipment, the fixed reductions are summed together and then the percentage reductions are multiplied together, to determine the estimated interactive savings. Savings for groups of equipment are applied proportionally to all units within the group based on their baseline consumption.

Interactions between the system directly associated with an ECM and other systems, such as changes in internal heat gain due to a lighting upgrade, have typically not been considered. Measures for additional considerations were not accounted for when calculating interactive effects.

Results from project interactions are outlined in the 'net interactions' row of the ECM summary table, located at the end of this section. The 'total' row includes the sum of the ECMs and their interactions.

Cost Savings

This metric describes the estimated cost savings the project will achieve based on the utility consumption savings in the first year of the cashflow analysis. The cost savings ($/yr.) are calculated by multiplying the utility savings by the marginal utility rate. Note that the cost savings in subsequent years of the cashflow analysis change based on the modelled utility rate escalation, as described below.

Greenhouse Gas (GHG) Emission Savings

This metric describes the amount of GHG savings the project is estimated to achieve. It is measured in tonnes of carbon dioxide equivalent per year (tCO_2e). To calculate emissions savings, the fuel savings (kWh or GJ/yr.) are multiplied by the emission factor (tCO_2e/kWh or GJ). ECM lifetime GHG emissions savings are based on this annual savings value multiplied by the measure life, thus projected decreases in the electricity grid emission factor are not accounted for.

Simple Payback

This metric is the number of years it would take for the cost savings to be equal to the implementation cost. In other words, it is the length of time to earn back the project's cost. The lower the simple payback, the better. Note that the simple payback has been calculated considering utility rate escalation but without any discount rate applied to future cashflows.

Net Present Value (NPV)

Similar to simple payback, the NPV describes the financial feasibility of the project. In contrast to simple payback, it considers the opportunity cost, or the value that a certain amount of money today would have if it were to achieve a specified rate of return over time. The NPV encompasses the project cost and the annual cashflow analysis savings discounted at a rate of 5% per year, over the lifespan of the project. The higher the net present value, the better, and a value greater than zero is generally considered a worthwhile investment.

Utility Rate Escalation

The simple payback and the NPV account for utility cost escalation. Based on the GHG emission rate for each utility, that utility's marginal rate identified for the first year of the cashflow analysis is broken into a carbon tax component and a non-carbon tax component. The carbon tax component is increased based on the federal and/or provincial legislated carbon tax escalations to 2030, as applicable. Projected changes to the provincial electricity GHG emission intensity are accounted for in how this carbon tax component changes for electricity. The non-carbon tax component is escalated at a constant rate of 3.5% per year.

Each identified ECM is described in detail below.

4.1. Pipe Insulation

Adding insulation to exposed hot piping reduces heat loss from the fluid to the environment as it travels through the piping. By reducing heat loss within the system, the return fluid will be at a higher temperature, reducing the load on heating equipment. Consequently, the energy consumption will be reduced. This ECM explores adding insulation to exposed piping in the L1 boiler room for the space heating and domestic hot water system.

Table 17 Individual ECM Results

Labour Cost:	$634
Material Cost:	$343
Project Cost:	$977
Annual Natural Gas Savings:	259 GJ/yr.
Annual Utility Cost Savings:	$2,226
Simple Payback:	<1 yrs.
Measure Life:	10 yrs.
Annual GHGs	13.1 t CO_2e
Lifetime GHG Reduction:	131 tonnes CO_2e
Net Present Value:	$25,361
Internal Rate of Return:	263%

Savings and Cost Assumptions

- The estimated natural gas savings are calculated based on the difference between the existing heat loss from the uninsulated piping and the theoretical heat loss after an insulating layer has been added to the hot bare piping. These calculations are based on several assumptions such as room and fluid temperatures, piping material, wind factor, piping diameter, and the total length of uninsulated piping. Actual savings will depend on the real value of those variables, as well as insulation thickness and material selection.
- The project cost was sourced from vendors and includes materials and labour for adding insulation to a total ~75 feet of piping.

	Riley Park Place
Room temperature	28°C
Fluid temperature	70°C
Piping material	Aluminium
Piping diameter	Various

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 18: Pipe insulation - LCCA Key Outputs

Pipe Insulation - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$1,736
Operation NPV @ LCCA end year (Y0$; NPV)	$36,550
Total NPV @ LCCA end year (Y0$; NPV)	$34,815

Table 19: Pipe Insulation – Sensitivity Analysis

Pipe Insulation - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	$42,203	$34,815	$29,297
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	$20,149		$41,559
Fuel Rate/Maintenance Inflation (1% 2%,4%)	$37,026		$31,260

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Schedule a site visit by a qualified technician to assess piping layouts. SPG can assist with this.

4.2. Intelligent Parking Outlets

In cold temperatures, drivers may plug in their car block heaters while parked to keep engine components warm and ease start-up. Outlets fitted with programmable controls can deliver power intermittently, and only when temperatures fall below a set level. Without these controls in place the draw from parking outlets is constant when a vehicle is plugged in. This means that car block heaters are consuming electricity even when they no longer need to, for example if the outside temperature has increased past the point of needing to use the heater. Even when the exterior temperature is low enough to warrant the use of block heating, intermittent delivery of heat is sufficient. This ECM explores replacing all existing parking outlets at Riley Park Place with intelligent models.

Table 20 Individual ECM Results

Labour Cost:	$1,804
Material Cost:	$10,972
Project Cost:	$12,776
Annual Electricity Savings:	23,232 kWh/yr.
Annual Utility Cost Savings:	$4,881
Simple Payback:	2.5 yrs.
Measure Life:	20 yrs.
Annual GHGs:	12.5 t CO_2e
Lifetime GHG Reduction:	251 tonnes CO_2e
Net Present Value:	$70,074
Internal Rate of Return:	43%

Savings and Cost Assumptions

- 24 outlets were observed in the parking area. To calculate current electricity consumption from the outlets, we assumed that half the outlets are used to power 500W block heaters for 24 hours a day, 121 days per year. To calculate proposed consumption, we assumed that power would only be delivered to the outlets at temperatures below -5°C and would cycle 20 minutes on/10 minutes off.
- The project cost was sourced from a vendor and includes the materials and labour for outlet replacements. The installation time was assumed to be 30 minutes per unit.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM are presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 21: Intelligent Parking Outlets -LCCA Key Outputs

Intelligent Parking Outlets - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$14,67
Operation NPV @ LCCA end year (Y0$; NPV)	$38,426
Total NPV @ LCCA end year (Y0$; NPV)	$23,750

Table 22: Intelligent Parking Outlets – Sensitivity Analysis

Intelligent Parking Outlets - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**

Real Discount Rate (4%,6%,8%)	$31,087	$23,750	$18,336
Energy Rate ($0.05/kWh, $0.12/kWh, $0.20/kWh	$1,335		$49,367
Fuel Rate/Maintenance Inflation (1% 2%,4%)	$23,750		$23,750

*Most likely Scenario = real discount rate: 6%, energy rate: $0.12/kWh, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Obtain a formal quote from SPG or another electrical contractor

4.3. Hydronic Heating Additive

Hydronic heating system use water/glycol as the medium for heat transfer. These fluids have high surface tensions that detract from their heat transfer efficiency. Heating fluid additives reduce the surface tension of working fluids to improve thermal contact between the fluid and the inner wall of the piping system. This increases the thermal transfer rate, improving the overall efficiency of the heating system. This ECM explores introducing heating additive to the hydronic loop at Riley Park Place.

Table 23 Individual ECM Results

Labour Cost:	$300
Material Cost:	$4,650
Project Cost:	$4,950
Annual Natural Gas Savings:	54 GJ/yr.
Annual Utility Cost Savings	$467
Simple Payback:	7.2 yrs.
Measure Life:	8 yrs.
Annual GHGs	2.8 t CO_2e
Lifetime GHG Reduction:	22 tonnes CO_2e
Net Present Value:	-$514
Internal Rate of Return:	3%

Savings and Cost Assumptions

- 5% savings were applied to natural gas consumption from the boilers. Case studies from Endotherm, a hydronic heating additive supplier, have shown that consumption savings range from 5-8% for residential buildings.
- The material cost is sourced from Endotherm, and includes 4 gallons of additive
- The labour cost includes one hour of work at 300$/hr.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 24: Hydronic Heating Additive - LCCA Key Outputs

Hydronic Heating Additive - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$10,362
Operation NPV @ LCCA end year (Y0$; NPV)	$7,675
Total NPV @ LCCA end year (Y0$; NPV)	-$2,686

Table 25: Hydronic Heating Additive – Sensitivity Analysis

Hydronic Heating Additive - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$2,479	-$2,686	-$2,823
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$5,766		-$1,270
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$2,222		-$3,433

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM. Case studies can be provided upon request
- Schedule a free site assessment by a hydronic heating additive technician to finalize the volume of additive required and to determine if water treatment is required prior to installation

4.4. Rooftop solar

A solar photovoltaic (PV) system provides the building with on-site renewable energy generation. Riley Park Place is a good candidate for a solar PV system due to its large flat roof with southern exposure and minimal obstructions. This ECM explores adding a solar PV system to the building's roof.

Table 26 Individual ECM Results

Labour Cost:	$11,538
Material Cost:	$93,352
Project Cost:	$104,890
Annual Electricity Savings:	40,958 kWh/yr.
Annual Utility Cost Savings	$8,605
Simple Payback:	10.1 yrs.
Measure Life:	25 yrs.
Annual GHGs	22.1 t CO_2e
Lifetime GHG Reduction:	553 tonnes CO_2e
Net Present Value:	$70,487
Internal Rate of Return:	10%

Savings and Cost Assumptions

- The system was modelled using PVWatts software from NREL. A roof-mounted array with a tilt angle of 20° is represented and includes a 15% de-rate for snow cover and system losses. Considering the available roof space and the building's annual electricity consumption, an 18.2 and 18.8 kW DC systems were chosen.
- The model calculates potential annual electricity production based on the array location, typical local weather data, and other system parameters. The theoretical maximum performance is modelled. Real electricity production may vary.
- The project cost is based on SPG's experience with similar projects and includes the materials and labour for installing the solar array.
- The condition and structure of the roof will need to be assessed prior to project implementation to determine if it can support the additional load.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM are presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 27: Rooftop Solar -LCCA Key Outputs

Rooftop Solar - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$105,868
Operation NPV @ LCCA end year (Y0$; NPV)	$67,745
Total NPV @ LCCA end year (Y0$; NPV)	-$38,123

Table 28: Rooftop Solar – Sensitivity Analysis

Rooftop Solar - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)

Parameter	Low	Most likely*	High
Real Discount Rate (4%,6%,8%)	-$24,767	-$38,123	-$48,122
Energy Rate ($0.05/kWh, $0.12/kWh, $0.20/kWh	-$77,641		$7,040
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$38,123		-$38,123

*Most likely Scenario = real discount rate: 6%, energy rate: $0.12/kWh, fuel rate/maintenance inflation: 2%

Next Steps

- Confirm system compliance with relevant standards and requirements
- Finalize system size and parameters
- Obtain a formal quote from a solar contractor

4.5. Low Flow Water Fixtures

Upgrading water fixtures to models with low flow/flush rates would reduce water consumption while still meeting water delivery needs. For fixtures that deliver hot water (faucets and showerheads), fuel consumption associated with the DHW system will also be reduced. This ECM explores replacing eligible water fixtures in the building with low flow models.

Table 29 Individual ECM Results

Labour Cost:	$24,990
Material Cost:	$41,072
Project Cost:	$66,062
Annual Natural Gas Savings:	115 GJ/yr.
Annual Water Savings:	716 m^3/yr.
Annual Utility Cost Savings	$5,070
Simple Payback:	10.2 yrs.
Measure Life:	25 yrs.
Annual GHGs	6.3 t CO_2e
Lifetime GHG Reduction:	158 tonnes CO_2e
Net Present Value:	$44,118
Internal Rate of Return:	10%

Savings and Cost Assumptions

- Water savings were calculated based on estimated fixture usage and the existing and proposed flow rates. The proposed rates are 1.28 GPF for toilets, and 1.5 GPM for showerheads and faucets.
- Natural gas savings were calculated based on typical cold water/hot water ratios and the efficiency of the existing DHW system.
- The project cost includes the materials and labour for installing 24 toilets, 24 showerheads, and 49 faucets. The costs were derived from RSMeans and fixture vendors.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 30: Low Flow Water Fixtures -LCCA Key Outputs

Low Flow Water Fixtures - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$66,678
Operation NPV @ LCCA end year (Y0$; NPV)	$50,710
Total NPV @ LCCA end year (Y0$; NPV)	-$15,967

Table 31: Low Flow Water Fixtures– Sensitivity Analysis

Low Flow Water Fixtures - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$5,872	-$15,967	-$23,531
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$22,459		-$12,982

Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$14,989		-$17,541

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Finalize water fixture replacement schedule
- Obtain a formal quote from SPG or plumbing contractors

4.6. Energy star dryer

Energy Star certified residential clothes dryers consume less energy than other models with equivalent capacity. Riley Park Place has 2 dryers that are not Energy Star certified. This ECM explores replacing those units with Energy Star models.

Table 16 Individual ECM Results

Labour Cost:	$947
Material Cost:	$7,013
Project Cost:	$7,960
Annual Electricity Savings:	2,257 kWh/yr.
Annual Utility Cost Savings	$474
Simple Payback:	13.1 yrs.
Measure Life:	15 yrs.
Annual GHGs	1.2 t CO_2e
Lifetime GHG Reduction:	18 tonnes CO_2e
Net Present Value:	-$1,666
Internal Rate of Return:	2%

Savings and Cost Assumptions

- The energy savings were calculated by finding the difference in energy consumption between the existing units and dryers that have the minimum combined energy factor required for Energy Star eligibility.
- The project cost includes the materials and labour to install the dryers.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 32: Energy Star Dryer - LCCA Key Outputs

Energy Star Dryer - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$10,786
Operation NPV @ LCCA end year (Y0$; NPV)	$3,733
Total NPV @ LCCA end year (Y0$; NPV)	-$7,053

Table 33: Energy Star Dryer – Sensitivity Analysis

Energy Star Dryer - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$7,081	-$7,053	-$6,997
Energy Rate ($0.05/kWh, $0.12/kWh, $0.20/kWh)	-$9,231		-$4,565
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$7,053		-$7,053

*Most likely Scenario = real discount rate: 6%, energy rate: $0.12/kWh, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Engage a qualified contractor for an actionable quote

4.7. BAS

The building's HVAC system is currently controlled by manually adjusting simple thermostats and activating switches. A more advanced control system, such as a building automation system (BAS) might incorporate feedback from additional sensors, include additional on/off controls, and provide easy management of HVAC parameters through cloud-access software. Generally, a BAS facilitates centralized access to and control of equipment operation, a high level of coordination between different pieces of equipment, and automated adjustment of system parameters in response to external conditions. This ECM explores installing a BAS to promote more efficient use of HVAC equipment and ultimately save energy.

Table 34 Individual ECM Results

Project Cost:	$61,859
Annual Natural Gas Savings:	150 GJ/yr.
Annual Utility Cost Savings:	$1,293
Simple Payback:	24.8 yrs.
Measure Life:	15 yrs.
Annual GHGs	7.6 t CO_2e
Lifetime GHG Reduction:	115 tonnes CO_2e
Net Present Value:	-$39,788
Internal Rate of Return:	-7%

Savings and Cost Assumptions

- 10% savings were applied to the building's natural gas consumption from the boilers, furnace and DHW heater. This is a conservative estimate based on the building's HVAC configuration and age. Actual savings will depend on effective use of the installed system.
- The cost includes material and labour for the installation and commissioning of new controls, sensors, thermostats, and management software. Pricing was sourced from SensorSuite, a company specializing in automation systems for multi-unit residential buildings.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 35: BAS -LCCA Key Outputs

BAS - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$83,827
Operation NPV @ LCCA end year (Y0$; NPV)	$21,237
Total NPV @ LCCA end year (Y0$; NPV)	-$62,590

Table 36: BAS – Sensitivity Analysis

BAS - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$64,373	-$62,590	-$61,009
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$71,111		-$58,671

Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$61,305		-$64,655

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Obtain actionable quote from a qualified contractor

4.8. Heat pump (Boiler supplement)

Heat pump technology uses the vapour-compression cycle to transfer heat from one medium to another. The heat pump would extract heat from the outdoor air and transfer it to the heating hydronic loop in this application. Heat pumps transfer heat energy opposed to generating it, which can yield efficiency ratings exceeding 300%.

This ECM explores installing a heat pump to complement the current heating system. The heat pump will provide heat to the building in temperatures as low as -18°C. For temperatures lower than that, the existing boiler will provide heating, and so it must remain integrated with the heating system as a backup heating source.

Table 33 Individual ECM Results

Labour Cost:	$70,518
Material Cost:	$359,074
Project Cost:	$429,592
Annual Natural Gas Savings:	997 GJ/yr.
Annual Utility Cost Savings:	$8,573
Simple Payback:	25.7 yrs.
Measure Life:	15 yrs.
Annual GHGs	50.6 t CO_2e
Lifetime GHG Reduction:	760 tonnes CO_2e
Net Present Value:	-$283,292
Internal Rate of Return:	-7%

Cost and Savings Assumptions

- Savings were estimated based on the existing boiler consumption, the existing boiler efficiency rating, and a proposed average efficiency rating of 93.08% for the heat pump.
- The project cost includes the materials and labour for the complete installation.
- Maintenance costs were included in the analysis. However, no sources were found for this specific case, so a 10-year maintenance cost assumption of 15% was made based on professional judgment and comparisons to similar systems.

LCCA & Sensitivity Analysis

- The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 34: Heat Pump (Boiler Supplement) – LCCA Key Outputs

Low Flow Water Fixtures - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$582,154
Operation NPV @ LCCA end year (Y0$; NPV)	$140,760
Total NPV @ LCCA end year (Y0$; NPV)	**-$441,394**

Table 35: Heat pump (Boiler Supplement) – Sensitivity Analysis

Low Flow Water Fixtures - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$455,172	**-$441,394**	-$429,371
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$497,873		-$415,421
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$432,878		-$455,085

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Obtain formal quoting
- Ensure building electrical capacity can support the addition of a 100-kW air to water heat pump. Mechanical specialists should be consulted to confirm proper heat pump sizing to avoid under sizing, or oversizing, the heat pump. An undersized heat pump will constantly operate due to insufficient heating capacity. An oversized heat pump will use more energy than is necessary to heat the space.

4.9. Condensing Boiler

Non-condensing boilers experience heat loss through water vapour that is produced as a by-product of burning fuel. Condensing boilers condense that wastewater vapour to recover its energy and preheat the operating water. This heat recovery process enables condensing boilers to reach efficiencies of up to 96%.

This ECM explores upgrading the existing boiler, which has an 80% estimated thermal efficiency, to condensing model.

Table 37 Individual ECM Results

Labour Cost:	$7,906
Material Cost:	$55,968
Project Cost:	$63,874
Annual Natural Gas Savings:	87 GJ/yr.
Annual Utility Cost Savings	$752
Simple Payback:	38.1 yrs.
Measure Life:	25 yrs.
Annual GHGs	4.4 t CO_2e
Lifetime GHG Reduction:	111 tonnes CO_2e
Net Present Value:	-$44,774
Internal Rate of Return:	-4%

Savings and Cost Assumptions

- Energy savings were modelled by applying a 90% efficiency to existing boiler energy consumption.
- The project cost was sourced from RSMeans and includes materials and labour for the installation, related pipe fitting, electrical work, and commissioning of the proposed units.
- A 15% cost adjustment has been applied to account for additional equipment required in condensing boiler installations after they have been installed, this includes additional piping, pumps, and other components. This adjustment ensures improved flow rates and water quality while maintaining ease of use in the energy savings calculator. The increase addresses the potential underestimation of project costs, aligning with best practices for capturing accurate installation expenses.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 38: Condensing Boiler - LCCA Key Outputs

Condensing Boiler - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$64,469
Operation NPV @ LCCA end year (Y0$; NPV)	$12,351
Total NPV @ LCCA end year (Y0$; NPV)	-$52,118

Table 39: Condensing Boiler – Sensitivity Analysis

Condensing Boiler - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$49,916	-$52,118	-$53,812
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$57,074		-$49,839
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$51,370		-$53,319

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Obtain a formal quote from a mechanical contractor

4.10. Condensing Furnace

Non-condensing furnaces experience heat loss through water vapour that is produced as a by-product of burning fuel. Condensing furnaces condense that wastewater vapour to recover its energy and preheat the operating water. This heat recovery process enables condensing furnaces to reach efficiencies of up to 96%.

This ECM explores upgrading the existing furnace, which has an 80% rated thermal efficiency, to a condensing model.

Table 40 Individual ECM Results

Labour Cost:	$313
Material Cost:	$20,235
Project Cost:	$20,549
Annual Natural Gas Savings:	24 GJ/yr.
Annual Utility Cost Savings	$208
Simple Payback:	42.5 yrs.
Measure Life:	15 yrs.
Annual GHGs	1.2 t CO_2e
Lifetime GHG Reduction:	18 tonnes CO_2e
Net Present Value:	-$17,006
Internal Rate of Return:	-13%

Savings and Cost Assumptions

- Energy savings were modelled by applying a 95% efficiency to existing furnace energy consumption.
- The project cost was sourced from RSMeans and includes materials and labour for the installation of the proposed unit.
- The condensing process will generate wastewater that must be discharged into a nearby drain. Confirmation that the furnace is in proximity of a drain should be acquired prior to moving forward with the project.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 41: Condensing Furnace - LCCA Key Outputs

Condensing Furnace - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$27,846
Operation NPV @ LCCA end year (Y0$; NPV)	$3,409
Total NPV @ LCCA end year (Y0$; NPV)	-$24,437

Table 42: Condensing Furnace – Sensitivity Analysis

Condensing Furnace - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$25,787	-$24,437	-$23,346
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$25,805		-$23,808

Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$24,231		-$24,769

- *Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Confirm furnace is in proximity of a drain
- Obtain a formal quote from a mechanical contractor

4.11. Elevator Regenerative Drive

A regenerative drive captures waste energy from braking in the elevator system and makes it available as electricity for the elevator to use, thus reducing consumption. This ECM explores replacing the current elevator drive at Riley Park Place with a regenerative drive.

Table 46 Individual ECM Results

Labour Cost:	$25,563
Material Cost:	$222,279
Project Cost:	$247,842
Annual Electricity Savings:	1,284 kWh/yr.
Annual Utility Cost Savings:	$270
Simple Payback:	>50 yrs.
Measure Life:	20 yrs.
Annual GHGs	0.7 t CO_2e
Lifetime GHG Reduction:	14 tonnes CO_2e
Net Present Value:	-$243,265
Internal Rate of Return:	-21%

Savings and Cost Assumptions

- 29% energy savings were applied to current elevator consumption. This value was sourced from ThyssenKrupp, an elevator manufacturer, and represents the average savings for replacing their SCR drive with a VVVF (variable voltage variable frequency) regenerative drive.
- The cost was sourced from RSMeans and represents the materials and installation for a variable voltage drive. Note that the cost does not include equipment that must be replaced in order for the controller to communicate properly with the elevator.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM are presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 47: Elevator Regenerative Drive -LCCA Key Outputs

Elevator Regenerative Drive - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$284,697
Operation NPV @ LCCA end year (Y0$; NPV)	$2,123
Total NPV @ LCCA end year (Y0$; NPV)	-$282,574

Table 48: Elevator Regenerative Drive – Sensitivity Analysis

Elevator Regenerative Drive - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$283,315	-$282,574	-$273,885
Energy Rate ($0.05/kWh, $0.12/kWh, $0.20/kWh	-$283,813		-$281,159
Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$282,574		-$282,574

*Most likely Scenario = real discount rate: 6%, energy rate: $0.12/kWh, fuel rate/maintenance inflation: 2%

Next Steps

- Engage your preferred elevator contractor
- Schedule a site assessment to more accurately estimate savings and obtain a quote

4.12. Programmable Thermostats (Additional Consideration)

Programmable thermostats facilitate automation of building temperature setpoints. By using scheduling functions, for example, the setpoint could be automatically lowered during the hours when the building is unoccupied. During low setpoint periods, the heating system operates less frequently, realizing natural gas savings.

This ECM explores replacing the non-programmable thermostats in the building with programmable models, offering a cost-effective alternative to the recommended 'BAS' ECM.

Table 43 Individual ECM Results

Labour Cost:	$20,485
Material Cost:	$2,099
Project Cost:	$22,585
Annual Natural Gas Savings:	152 GJ/yr.
Annual Utility Cost Savings	$1,304
Simple Payback:	10.9 yrs.
Measure Life:	15 yrs.
Annual GHGs	7.7 t CO_2e
Lifetime GHG Reduction:	116 tonnes CO_2e
Net Present Value:	-$324
Internal Rate of Return:	5%

Savings and Cost Assumptions

- A 5% reduction to the heating system's energy consumption was applied to model energy savings. Actual savings will depend on effective use of programming capabilities.
- The project cost was sourced from RSMeans and includes the material and labour to install ~26 thermostats. This cost may vary should the building in reality have more or fewer thermostats than estimated.

LCCA & Sensitivity Analysis

The LCCA and sensitivity analysis for this ECM is presented below. The parameters evaluated for the sensitivity analysis are discount rate, energy rate and cost escalation.

Table 44: Programmable Thermostats - LCCA Key Outputs

Programmable Thermostats - LCCA Key Outputs	
Capital NPV @ LCCA end year (Y0$; NPV)	-$30,605
Operation NPV @ LCCA end year (Y0$; NPV)	$21,420
Total NPV @ LCCA end year (Y0$; NPV)	-$9,185

Table 45: Programmable Thermostats – Sensitivity Analysis

Programmable Thermostats - Sensitivity analysis for total NPV @ LCCA end year (Y0$; NPV)			
Parameter	**Low**	**Most likely***	**High**
Real Discount Rate (4%,6%,8%)	-$6,999	-$9,185	-$10,729
Energy Rate ($4/GJ, $8.11/GJ, $10/GJ)	-$17,780		-$5,233

Fuel Rate/Maintenance Inflation (1% 2%,4%)	-$7,889		-$11,269

*Most likely Scenario = real discount rate: 6%, energy rate: $8.11/GJ, fuel rate/maintenance inflation: 2%

Next Steps

- Engage SPG to further discuss this ECM
- Obtain a formal quote from a mechanical contractor

4.13. Summary

11 ECMs and one measure for additional consideration were identified. The implementation of every recommended ECM would cost $1,021,330, save $28,821 per year, for an overall payback period of ~22 years. The following table summarizes the selected ECMs.

Table 49 ECM Summary

ECM		Annual Savings					Finance		
		Electricity (kWh/yr.)	Natural Gas (GJ/yr.)	Water (m^3/yr.)	GHGs (t CO_2e/yr.)	Utility Cost	Project Cost	Simple Payback (yrs.)	Net Present Value @5%
1	Pipe Insulation	0	259	0	13.1	$2,226	$977	<1	$25,361
2	Intelligent Parking Outlets	23,232	0	0	12.5	$4,881	$12,776	2.5	$70,074
3	Hydronic Heating Additive	0	54	0	2.8	$467	$4,950	7.2	-$514
5	Low Flow Water Fixtures	0	115	716	6.3	$5,070	$66,062	10.2	$44,118
7	Energy Star Dryer	2,257	0	0	1.2	$474	$7,960	13.1	-$1,666
8	BAS	0	150	0	7.6	$1,293	$61,859	24.8	-$39,788
9	Heat Pump (Boiler Supplement)	0	997	0	50.6	$8,573	$429,592	25.7	-$283,292
10	Condensing Boiler	0	87	0	4.4	$752	$63,874	38.1	-$44,774
11	Condensing Furnace	0	24	0	1.2	$208	$20,549	42.5	-$17,006
12	Elevator Regenerative Drive	1,284	0	0	0.7	$270	$247,842	>50	-$243,265
Energy generation measures:									
4	Rooftop Solar	40,958	0	0	22.1	$8,605	$104,890	10.1	$70,487
Net interactive effects		**0**	**-465**	**0**	**-23.6**	**-$3,999**	**$0**		
Total (accounting for interactions)		**67,730**	**1,222**	**716**	**99.1**	**$28,821**	**$1,021,330**	**21.8**	**-$483,011**
For additional consideration									
6	Programmable Thermostats	0	152	0	7.7	$1,304	$22,585	10.9	-$324

The implementation of every recommended ECM would reduce the building's EUI, GHGI, ECI, and WUI. These results are outlined in the table below.

Table 50 Impact of ECMs on performance

Performance metric	Baseline performance	Benchmark	Performance after ECMs	Potential reduction
EUI (GJ/m^2)	0.87	0.82	0.21	76%*
GHGI ($kgCO_2e/m^2$)	56.00	91.10	6.14	89%
ECI ($\$/m^2$)	$13.64		$5.53	59%
WUI (m^3/m^2)	1.17		0.81	31%

**Excluding on-site energy generation measures*

5. About Us

SPG – Sustainable Projects Group

Sustainable Projects Group (SPG) is a leading design-build energy efficiency company dedicated to driving actionable sustainability in the built environment. We specialize in providing comprehensive solutions tailored to our diverse clientele:

- ASHRAE Energy Audits
- Building Condition Assessments (BCAs)
- Energy Modeling
- Energy Retrofits & Clean Technology Installations
- Funding Support
- Engineering Design
- Construction Management
- Energy Management Software (JOBI)

Rooted in our mission to eliminate GHG emissions from the built environment, SPG embodies values of sustainability, innovation, integrity, and excellence in every project we take on.

Next Steps

Knowledge is power. An energy audit is the first step to realizing sustainable building operations. Here are some recommendations to turn your data into action:

- Carry out an **LED lighting upgrade**. Our lighting analysis is fully actionable, meaning you can quickly execute on recommendations without the need for further analysis or engineering.
- Conduct a **building condition assessment**. Combining a building assessment with an energy audit allows us to align ECMs with equipment replacement times, creating an optimized implementation plan that aligns with your capital deployment strategy.
- Engage in **detailed engineering** of selected measures. As Prime Consultants, SPG will cover everything from applying for available **funding** opportunities to engineering **design**, **construction management**, and **measurement & verification.**
- Integrate your data with **JOBI,** SPG's revolutionary energy management software. JOBI uses a dynamic framework that facilitates capital alignment and optimization to achieve portfolio-wide decarbonization and millions of dollars in energy cost savings.

Connect with SPG today to learn more or request a demo!

6. Appendices

6.1. Appendix A - Lighting inventory

Table 51 Lighting inventory

Section	Room	Fixture	Qty (#)
L1	Boiler Room	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	2
L1	Elevator Room	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	1
L1	Laundry Room	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	1
L4	Hallway	1L-LED-20W-Sconce-Ceil Sfc	4
L3	Hallway	1L-LED-20W-Sconce-Ceil Sfc	4
L2	Hallway	1L-LED-20W-Sconce-Ceil Sfc	4
L1	Hallway	2L-2x2ft-LED-14W-Troffer-Rcs	4
Stairwell	North Stairwell	1L-LED-20W-Sconce-Ceil Sfc	6
Stairwell	South Stairwell	1L-LED-20W-Sconce-Ceil Sfc	6
L1	Main Lobby	1L-LED-14W-Sconce-Wall Sfc	2
L1	Main Lobby	1L-LED-15W-Sconce-Ceil Sfc	1
L1	Vestibule	1L-LED-15W-Sconce-Ceil Sfc	1
L1	Suite 103 - Bachelor	2L-A19-LED-9W-Sconce-E26-Ceil Sfc	3
L1	Suite 103 - Bachelor	4L-A19-LED-9W-Sconce-E26-Wall Sfc-Van	1
Exterior	Main Entrance	1L-A19-LED-9W-Sconce-E26-Ceil Sfc	1
Exterior	Main Entrance	1L-CFL-26W-Keyless-Ceil Sfc	1
Exterior	Rear Parking	2L-Large-LED-80W-Wall Pack-Wall Sfc	2
L1	Suite 105 - 2 Bedroom	1L-A19-LED-9W-Sconce-E26-Ceil Sfc	2
L1	Suite 105 - 2 Bedroom	2L-A19-LED-9W-Sconce-E26-Ceil Sfc	2
L1	Suite 105 - 2 Bedroom	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	1
L1	Suite 105 - 2 Bedroom	4L-A19-LED-9W-Sconce-E26-Wall Sfc-Van	1
L1	Suite 104 - 1 Bedroom	1L-A19-LED-9W-Sconce-E26-Ceil Sfc	3
L1	Suite 104 - 1 Bedroom	2L-A19-LED-9W-Sconce-E26-Ceil Sfc	1
L1	Suite 104 - 1 Bedroom	4L-A19-LED-9W-Sconce-E26-Wall Sfc-Van	1
L1	Suite 104 - 1 Bedroom	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	1
L1-4	Unaccessed Suites - 2 Bedrooms	1L-A19-LED-9W-Sconce-E26-Ceil Sfc	28
L1-4	Unaccessed Suites - 2 Bedrooms	2L-A19-LED-9W-Sconce-E26-Ceil Sfc	28
L1-4	Unaccessed Suites - 2 Bedrooms	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	14
L1-4	Unaccessed Suites - 2 Bedrooms	4L-A19-LED-9W-Sconce-E26-Wall Sfc-Van	14
L1-4	Unaccessed Suites - 1 Bedroom	1L-A19-LED-9W-Sconce-E26-Ceil Sfc	21
L1-4	Unaccessed Suites - 1 Bedroom	2L-A19-LED-9W-Sconce-E26-Ceil Sfc	7
L1-4	Unaccessed Suites - 1 Bedroom	4L-A19-LED-9W-Sconce-E26-Wall Sfc-Van	7
L1-4	Unaccessed Suites - 1 Bedroom	1L-A19-LED-9W-Keyless-E26-Ceil Sfc	7

6.2. Appendix B - Utility data

Electricity

Table 52 Electricity utility data

	2023		2024	
	Cost ($)	Consumption (kWh)	Cost ($)	Consumption (kWh)
January			$1,454	6,535
February			$1,035	5,122
March			$1,139	5,520
April			$974	4,684
May			$1,066	5,299
June	$1,153	2,900	$1,018	4,695

July	$1,063	5,307		
August	$1,208	4,851		
September	$314	5,069		
October	$1,773	5,055		
November	$1,079	5,090		
December	$1,083	5,411		
Total	**$7,673**	**33,683**	**$6,686**	**31,855**

Natural gas

Table 53 Natural gas utility data

	2023		2024	
	Cost ($)	**Consumption (GJ)**	**Cost ($)**	**Consumption (GJ)**
January	$1,921	215	$1,982	210
February	$1,562	182	$1,395	167
March	$1,682	191	$1,433	168
April	$1,092	120	$1,279	117
May	$458	40	$871	80
June	$289	28		
July	$294	27		
August	$246	22		
September	$502	146		
October	$1,112	301		
November	$1,158	138		
December	$1,513	163		
Total	**$10,216**	**1,126**	**$6,960**	**743**

Water

Table 54 Water utility data

	2023		2024	
	Cost ($)	**Consumption (m^3)**	**Cost ($)**	**Consumption (m^3)**
January			$789	193
February			$771	189
March			$732	174
April			$744	181
May	$1,041	213	$826	200
June	$1,095	213	$544	123
July	$945	181		
August	$1,090	216		
September	$1,092	213		
October	$962	187		
November	$993	207		
December	$821	206		
Total	**$8,039**	**1,636**	**$4,406**	**1,060**

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