Low Carbon Design Brief

Town Hall, Halton Hills

1 Halton Hills Dr., Georgetown, ON

September 9, 2020

IESC Project No. G1301

Final Report

INTERNAT ENERGY SOLUTIONS

1 EXECUTIVE SUMMARY

1.1 Project Summary and Recommendations

Internat Energy Solutions Canada ('IESC') has been tasked by the Corporation of the Town of Halton Hills ('the Town') to examine the feasibility of a high-performance building retrofit of their Town Hall, located at 1 Halton Hills Drive in Georgetown, Ontario. The intent is to develop a 10-year plan to ultimately achieve Zero Carbon Building (ZCB) certification as defined by the Canada Green Building Council (CaCBC). The design brief includes the analysis of four retrofit pathways, their associated energy performance, greenhouse gas (GHG) emissions, and complete life cycle cost and financial analyses.

It is recommended for the Town to pursue a geothermal based system retrofit (Pathway 2 or 4), as this approach utilizes a renewable and passive source of energy and allows for the complete electrification of the site. In addition, the Town has experience with the implementation and operation of these systems in other buildings which will serve as an advantage. Although Pathway 4 is slightly more attractive from a financial perspective, key advantages to Pathway 2 over Pathway 4 include a lower associated residual value (decommissioning of building equipment before end of useful life), a less complex design and implementation process, and decreased staff impact.

In the event that the Town faces a budget restriction related to this project, it is recommended to implement Pathway 1, as it is the most attractive option from a financial perspective. In addition, implementation of this option allows for future work at the building, and the potential to transition to a Zero Carbon Building.

The Town should evaluate all factors and considerations presented in this report when making the decision on how to pursue Zero Carbon Building certification of the Town Hall, and when developing the 10-year retrofit plan for the building. Upon identification of the desired plan of action, a high-level implementation plan should be assembled, taking into account lifecycle of existing building systems and planned capital projects.

1.2 Methodology Summary

A complete data and document review was performed by IESC as well as a site visit in order to fully understand the existing building systems and performance. A baseline energy model was created and calibrated to historical utility data, which allows for the accurate representation of the operation of the existing building.

Once the existing building and site were fully understood, four retrofit Pathways were developed and analyzed in detail within this study. Each option includes retrofit components of the existing building systems (building envelope, mechanical and electrical). In addition, renewable energy strategies are presented, as well as building automation system (BAS) control strategies, while taking into account additional considerations such as future building expansion and COVID-19 response.

The retrofit Pathways were analyzed using energy modelling techniques to predict the overall performance of each Pathway at the end of the 10-year implementation and upon application for ZCB certification. Table 1 summarizes the financial analysis as well as energy and GHG emission performance of the four Pathways, including Class C cost estimates.

1.3 Rates and Assumptions

Utility rates, GHG emission factors, and other assumptions are based on the Town's recommendations and 2019 *Corporate Energy Plan:*

Utility Rates

- Electricity rate (2018): $0.17/kWh (5.9% annual escalation rate)
- Natural gas rate (2018): $0.2583/$m^3$ (2% annual escalation rate)

GHG Emission Factors[1]:

- Electricity: 0.02 kg/kWh
- Natural gas: 1.916 kg/m^3

Other:

- Inflation/discount rate: 2.5%
- Carbon offset cost (average): $20/tonne$CO_2$

[1] National Inventory Report (NIR, 2019) 1990 - 2017: Greenhouse Gas Sources and Sinks in Canada

1.4 Pathway Summary

Table 1

Pathway	Description	Total Construction Costs[2]	Incentives & Grants	O&M Costs[3] (20 years)	Annual Energy Costs (present value)	Annual Energy Consumption	Annual GHG Emissions	Net Present Value[4]	Internal Rate of Return[4]
		$CAD				ekWh	$kgCO_2e$	$CAD	-
1	Optimize Existing	$3,220,900	$424,274	$105,245	$81,035 (21% ↓)	596,240 (30% ↓)	35,167 (45% ↓)	$422,238	3.7%
2	Geothermal	$3,559,200	$459,028	$81,559	$86,972 (16% ↓)	511,601 (40% ↓)	10,232 (84% ↓)	($25,697)	2.4%
3	HVAC Overhaul	$3,311,500	$425,377	$88,581	$90,490 (12% ↓)	532,292 (37% ↓)	10,646 (83% ↓)	$30,383	2.6%
4	Maximum Savings	$3,815,100	$493,586	$88,581	$83,691 (19% ↓)	494,298 (42% ↓)	9,846 (85% ↓)	$59,818	2.7%

[2] Construction costs have been based on the preliminary designs developed by IESC and have been prepared by a third-party cost consultant. The Class C cost report is included in Appendix D – Cost Estimate Reports (Class C). Cost estimates exclude consultant fees, land acquisition costs, permits and development charges, soil testing, construction or project management fees, independent inspection and testing, legal fees, disbursements, owner supplied furnishings, fixtures and equipment, operational expenses, financing, loan fees and interest charges, building renewal items not associated with energy efficiency upgrades, VFRS temporary relocation costs, Harmonized Sales Tax (HST)

[3] Only with respect to equipment and measures presented in this report and within each Pathway.

[4] Full Life Cycle Cost Analysis tables for each option are provided in Appendix C – Life Cycle Cost Analysis (LCCA)

TABLE OF CONTENTS

2 BACKGROUND AND CONTEXT

Based on the Town's 2019 *Corporate Energy Plan*, and the passing of *Resolution No. 15.1*, significant efforts have been established and are being put in place for the Town to systematically introduce low-carbon decision making in the management of their existing building portfolio and new construction. The Town has set a target of becoming a net-zero municipality by the year 2030.

The Town's *Resolution No 15.1* discusses Canada's annual average temperature increase rate projection and the effect that will be seen in the Town's population in the form of heat stress illnesses, and mortality and productivity rates. As a result, *Resolution 15.1* declares a climate emergency for the Town, noting that the reduction of greenhouse gas (GHG) emissions be deemed of the highest priority for the Town. These declarations are supported by recent reports and calls for action, such as those from the Intergovernmental Panel on Climate Change (IPCC), C40 Cities, and the Canada Green Building Council (CaGBC), which emphasize the need for immediate action to take place to develop the knowledge and design expertise to retrofit existing buildings to have zero operational carbon emissions.

2.1 Project Description

The strategy for the retrofit of the Town Hall is intended to be a 'zero over time' approach to achieve Zero Carbon Building (ZCB) certification in the short-term (10 years). This process will serve as a roadmap to achieve cost effective deep energy retrofits over time. Although at the core, this transformation is a technical one, there are also many aspects to the transformation that will need to address the way that the Town personnel and its citizens use the buildings that they work and visit each day. Allowing for this transformation to occur will require pilot projects, in the short term, that will lay the important foundation and lessons learned that can be built on moving forward.

As there is not a universal solution to achieve ZCB certification for a building, it is important for the Town Hall to be assessed comprehensively in order to explore as many feasible options as possible. This requires an approach centered on developing a comprehensive understanding of the functional requirements and utilization of the existing building, and a review of current project funding, and any opportunities for external funding opportunities. Then with the help of building energy simulation tools, the energy and GHG performance improvements from major renovations can be modelled prior to any changes occurring to the building itself. This modelling also provides a sense of the future operational costs of the building, and when combined with detailed costing analysis gives the Town a clear understanding of the environmental and financial impacts of the design options.

The following report looks to provide all relevant information in a clear manner to the Town and provide recommendations on the path forward that best matches the Town's priorities. Its contents are supported by a process that saw significant feedback and contributions from various Town staff, and also from industry professionals.

2.2 Existing Site

Town Hall is located at 1 Halton Hills Drive in Georgetown, Ontario. It is a 2-storey building, completed in 1989 with a total floor area of 40,000 ft^2.The building is understood to have the majority of its occupation from Monday through Friday, 8:30am to 4:30pm, and currently serves as office and meeting space for many of the Town's departments. It is estimated that at full capacity, the building contains 150 to 160 working staff.

The lower floor of the building contains an open atrium space which serves as a cafeteria and general circulation area. Other major space types include, closed offices, open plan offices, circulation areas, kitchenettes, staff lounges, and a central server room. The majority of the building's mechanical equipment is housed in a penthouse. The building is conditioned primarily by heat pumps, supplemented by perimeter baseboard heating in the winter. Fresh air is supplied into plenums by a make-up air unit and distributed by the heat pumps. The building's cooling tower and roofing system were both replaced in 2019.

The building site and grading slopes from North to South, resulting in the lower level being partially below grade. The site contains a large outdoor surface parking area to the North of the building.

Figure 1

3 METHODOLOGY

3.1 Site Visit, Data Collection and Document Review

In order to understand the existing building systems and operation, multiple inquiries and conversations with building operations staff were had, supplemented by an in-depth review of existing building reports and documents, along with a site visit performed by IESC in May 2020.

Information and documents that were provided by the Town and have been reviewed by IESC include the following:

- Original building drawings (architectural, civil, structural, mechanical and electrical)
- Building drawings – renovation (2017)
- Building drawings and specifications – roof and cooling tower replacement (2019)
- Building utility data (electricity, natural gas and water, 2016 - 2019)
- Town of Halton Hills, 2020-2025 Corporate Energy Plan (2019)
- Third party reports:
    - ASHRAE Level II Energy Audit (‘Mindscape Innovations’, 2013)
    - Building condition assessment (‘Bold Engineering’, 2016)

These documents and their associated data were used throughout the report development in areas such as (but not limited to) energy modelling, Class B/C cost estimates, preliminary drawing development and third-party structural assessments.

3.2 Energy Modelling and Simulation

Energy-modeling is the virtual or computerized simulation of a building (or site) that focuses on energy consumption, utility bills, and life cycle costs of various energy related items such as air conditioning, heating, lights, and domestic hot water. Building simulation is the process of using a computer to build a virtual replica of a building. In layman's terms, the building is built in pieces on a computer and a simulation is performed taking that building through the weather of an entire year. In a way, building simulation is a method to quantitatively predict the future and thus has considerable value.

Integrated, “whole-building” energy modelling is a process in which all design options related to a building’s energy consumption and generation are simulated and mapped. It is increasingly being used in support of building energy code compliance, green building standard evaluation, and utility and government incentive programs.

From the site visits, data collection and document review, a baseline energy model was created of Town Hall using the software *DesignBuilder* (v6, EnergyPlus v8.9). The baseline model is calibrated to the historical utility data and is able to accurately predict the effect of changes to the various building systems.

Recent advances in both energy modelling software and computing power have made it easier to execute what are known as parametric simulations, or parametric modelling. These types of simulations consider a wide variety of design options that, when put together, create a large number of potential designs. In parametric simulations, rather than one static value for a design variable, a range of values are programed into the energy model. Applying these ranges across a set of design variables allows one to see the impact of each individual variable, or energy efficiency measure, both in isolation and in combination with any other measure, on pre-selected performance outcomes, such as annual energy use.

These designs can then be used to assess the cost or impact of the various combinations of design options. In short, parametric simulations expose the full range of performance potential and performance risk of a particular building design. A visualization map (or parallel coordinates plot), produced from the resultant building performance simulations, offers a way of including energy design modelling directly in the design and decision-making process.

Another energy modelling technique that is frequently used to analyze high level design decisions is referred to as *optimization*. This type of study is slightly more refined than parametric studies, and typically includes the analysis of up to 10 design variables. The optimization algorithm efficiently searches for and identifies the design options that best meet the key design performance objectives defined by the user such as “minimize construction costs” and minimize carbon emissions.” Unlike parametric studies, in optimization studies it is often not necessary for the entire simulation to be performed as the algorithm “learns” how the design variables affect the design objectives and automatically eliminate “non-optimal” designs. This process becomes useful when key design variables are identified, and a more efficient simulation process is required.

Both parametric and optimization energy modelling techniques were used in the development of this design brief in order to identify high level design choices that will have the most significant impact on the overall performance objectives of the study. These studies are outlined in Section 10.

3.3 Development of Retrofit Pathways

Once a complete understanding of the facility and its operations was obtained from the on-site work, data review, and baseline energy modelling, IESC held several internal brainstorming sessions, identifying all possible energy conservation measures (ECM), and renewable energy measures (REM) that could contribute to reaching the performance goals. The initial combination of these ECMs formed the basis of the four retrofit pathways that are presented in this report.

IESC worked with sub-consultants and Town staff to determine the most appropriate design options for the energy conservation measures outlined in each Pathway. From there, IESC worked with the Town in continuous communication and several review meetings, to obtain feedback and additional considerations with respect to the identified energy conservation measures and overall Pathways to ZCB certification.

3.4 Lifecycle Cost Analysis

IESC completed lifecycle cost (LCC) analyses for each of the retrofit Pathways identified. LCC analyses allow for the evaluation of the economic performance of a project, typically for the duration of its projected lifetime, taking into account the time value of money and various cashflows in each year.

In the case of this design brief, where projects are expected to be completed over a 10-year time period, the LCC analysis has been initiated in year 10, when all projects have been implemented. It has been assumed that the total project cost will be incurred in year 10, as well as the total amount of operational cost savings. A 20-year projection has been analyzed in the LCC analyses, as a requirement of the Town is that a financial return be achieved within 20 years of project implementation.

In reality, there will be incremental costs and savings seen from year 1 to year 10 (10-year implementation period), with the total savings being realized after all projects are completed in year 10. Although high level project scheduling has been proposed, at this stage a detailed project implementation schedule cannot be assumed for LCC analysis purposes, which is why the above strategy has been used.

The following costs and savings have been considered in each LCC analysis:

- Capital costs
- Building certification costs
- Operations & Maintenance (O&M) costs
- Replacement costs
- Utility cost savings
- Greenhouse gas (GHG) emissions savings
- Potential funding and incentive programs available
- An annual escalation rate applied to each energy utility:
- Discount rate of 2.5%

The Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated for each option. From a financial perspective, the option with the highest NPV and IRR would generally be the best choice.

4 PERFORMANCE TARGETS

4.1 Zero Carbon Building (ZCB)

In Canada, buildings can be certified under CaGBC's Zero Carbon Building (ZCB) Standard. A central aspect of the CaGBC's ZCB standard is the concept of a 'zero carbon balance' for existing buildings. This means that GHG emissions associated with building operations must be offset using low-carbon renewable energy either produced on-site or produced offsite. The CaGBC gives the following equation for calculation of a buildings carbon balance:

Figure 2 (CaGBC, Zero Carbon Building, Design Standard Version 2, March 2020)***

For the Town Hall this means that the net emissions on the site would be equal to the emissions from the combustion of natural gas on-site (direct emissions) plus the emissions from electricity consumption (indirect emissions) minus the avoided emissions from offsite green power and from exported green power. Any renewable energy generated on-site and used by the facility would reduce the electricity consumption of the site and is already taken into consideration in the calculations.

CaGBC has released Version 2 of this standard in 2020, with updates that include:

- Requirement to report or offset embodied carbon and refrigerants
- Multiple energy efficiency paths to choose from (ZCB Design v2)
- Airtightness modelling or testing
- Recognition of carbon offsets, if required (provide quote or proof of purchase)
- Requirement for impactful and innovative technologies and design approaches
- New and improved tools and resources

Under the ZCB version 2, two available pathways exist for existing buildings: the one-time "ZCB-Design v2" certification for new construction and major renovations to existing buildings, and the annual "ZCB-Performance v2" certification for existing buildings. The two pathways have differences as outlined below in Table 2.

In order to meet the ZCB Design Standard v2, the building must not only model a zero-carbon balance but must also demonstrate a high level of energy efficiency associated with the retrofit. The standard outlines three compliance pathways as shown in Table 2.

Table 2

		ZCB-Design v2	ZCB-Performance v2
Carbon	Zero carbon balance	Model	Achieve
	Embodied carbon (new construction materials)	Report	Buy Offsets/Credits
	Refrigerant leaks	Report	Buy Offset/Credits
	Carbon offsets	Provide quote	Provide proof of purchase
	Onsite combustion	Provide transition plan	Update plan (5 yrs.)
Energy	Energy efficiency	**Meet 1 of 3:** *Flexible Approach* • TEDI[5]: 32 kWh/m^2/yr. **and** EUI 25% better than NECB[6] 2017 • *Passive Design Approach* • TEDI: 22 kWh/m^2/yr. *Renewable Energy Approach* • TEDI: 32 kWh/m^2/yr. **and** zero-carbon balance[7]	Report energy use intensity
	Peak demand	Report seasonal peaks	
	Airtightness	Report and justify modelled value	Conduct testing (if ZCB-Design v2 certified)

For the Town Hall, it is recommended to pursue ZCB-Design certification if possible, and upon completion of the retrofit and successful ZCB-Design certification, the Town should pursue the ZCB-Performance certification in the years to follow. It is worth noting that depending on the retrofit pathway selected by the Town, ZCB Design certification may not be possible or advisable to pursue due to the aggressive energy efficiency requirements of the ZCB Design standard. In this case, it would be possible to pursue ZCB Performance certification directly.

It is recommended to involve all consulting teams relevant to the certification throughout all stages of the project. ZCB-Design certification is awarded based on the project's final design, and teams are eligible to apply for certification once issued for construction (IFC) documents are ready. ZCB-Performance certification is awarded based on one year of operating data if ZCB-Design certification has been achieved or based on three years of operating data if the project does not achieve ZCB-Design certification.

[5] Thermal Energy Demand Intensity (TEDI): space heating related energy use
[6] National Energy Code of Canada for Buildings (NECB)
[7] Without purchase of green power products or carbon offsets

5 INCENTIVE AND PROJECT FUNDING OPPORTUNITIES

5.1 Green Municipal Fund - Federation of Canadian Municipalities (FCM)

The FCM offers grant and loan programs for municipal projects and studies related to the environment, sustainability and energy. Loans are offered at a competitive rate and typically include a grant of up to 15% of the loan amount.

Funding is provided to projects which reduce energy consumption by at least 30% (minimum 20% through energy efficiency, maximum 10% through on-site renewable energy). Green building certifications are not required to secure funding, however retrofit changes must meet or exceed the national and provincial building codes (NECB 2011 or provincial derivatives).

5.1.1 Capital Project: Retrofit of Municipal Facilities

A capital project can qualify to receive a low-interest loan of up to $5 million and a grant worth up to 15% of the loan. The maximum loan amount is capped at 80% of the eligible project costs. As of Spring 2020 the program has moved to a continuous application process where applicants may submit initial review forms at any time and receive application forms upon approval of eligibility.

5.1.2 Pilot Project: Retrofit of Municipal Facilities

A pilot project assesses solutions in real life conditions and evaluates either a small-scale version of a project or, in the case of the Town Hall, a full-scale replicable version. It is understood that in order to qualify for this funding program, a strong indication would need to be made of how a successful pilot project at the Town Hall would lead to replication in the Town's other facilities.

A project can qualify to receive a grant of up to $500,000, capped at 50% of the eligible project costs. Applications are accepted year-round, and the offer will close when all funding has been allocated.

5.2 saveONenergy – Independent Electricity System Operator (IESO)

The saveONenergy retrofit program is but one initiative in the suite of saveONenergy "For Business" portfolio of provincial energy conservation programs that provides incentives to businesses and municipalities that replace existing equipment with high efficiency equipment that lower electricity consumption and peak demand.

Custom incentive programs are offered on the basis of projected electricity savings at rates ranging from $0.05/kWh saved to $0.10/kWh saved. Fixed rate incentives are also available for the replacement of existing equipment with high efficiency units, such as variable speed pumps.

5.3 Enbridge Gas – Custom and Fixed Incentive Programs

Enbridge's Smart Savings program offers financial incentives to owners who make capital improvements that result in reduced gas consumption. Fixed dollar incentives are available for smaller-sized condensing or high-efficiency boilers, air curtains, energy recovery ventilation and heat recovery ventilation systems. 'Custom' incentives for retrofits such as boilers, building and process controls, and building envelope upgrades, are calculated on projected annual natural gas savings at the rate of $0.20 per m^3 saved, up to 50% of eligible project costs to a maximum of $100,000.

6 EXISTING BUILDING PERFORMANCE

6.1 Utility Analysis and Building Performance Metrics

An analysis of the building's historical utility data from 2017 to 2019 was performed in order to determine the following performance metrics of the building. These three metrics, in addition to the baseline modelled values, are shown in Figure 3.

- **Total energy use intensity (TEUI):** total energy used on site (electricity and natural gas) normalized by total building floor area [ekWh/m^2]
- **Thermal energy demand intensity (TEDI):** total energy used on site (electricity and natural gas) for space heating related end uses, normalized by total building floor area [ekWh/m^2]
- **Greenhouse gas intensity (GHGI):** total greenhouse gas emissions related to building operation (electricity and natural gas consumption) normalized by total building floor area [ekgCO_2/m^2]

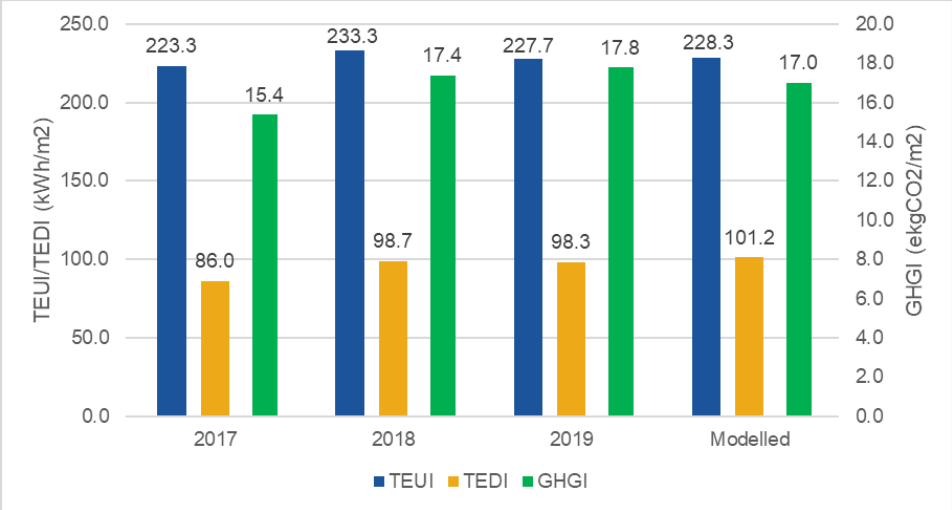


Figure 3

6.2 Baseline Energy Model Calibration

Historic electricity and natural gas consumption data for the building was used to calibrate the energy model. The 2018 calendar year was used as a baseline for model calibration. In addition, the weather normalized (2010-2020) utility (electricity and natural gas) consumption profiles were considered during model calibration. It is typical for a calibrated energy model to have slight differences between results and the operational data (utility bills). These slight differences are due to unpredictable or non-quantifiable factors that affect the energy use at the building such as building system maintenance and non-typical occupant behavior. The energy model simulates the building operation in an ideal or typical manner.

	Difference from Calibrated Model	
	Electricity	Natural Gas
2017	3%	12%
2018	2%	2%
2019	4%	6%
Normalized	1%	3%

Table 3

	Electricity Consumption [kWh]				
	2017	2018	2019	Weather Normalized	Calibrated Model
January	59,318	*66,437*	52,956	62,890	66,998
February	53,456	*57,017*	56,595	56,170	55,825
March	56,341	*53,840*	55,600	54,317	53,051
April	43,556	*43,495*	43,464	43,646	39,178
May	42,956	*39,963*	38,604	39,956	36,527
June	41,263	*40,118*	38,645	40,080	42,707
July	45,340	*46,954*	43,946	46,937	48,400
August	44,909	*44,639*	41,602	45,522	47,488
September	42,317	*39,946*	34,136	40,182	37,064
October	39,855	*41,043*	36,744	40,227	35,518
November	45,484	*49,269*	45,869	46,686	46,215
December	65,700	*54,288*	55,863	56,098	55,390
TOTAL	**580,495**	***577,008***	**544,023**	**572,711**	**564,362**

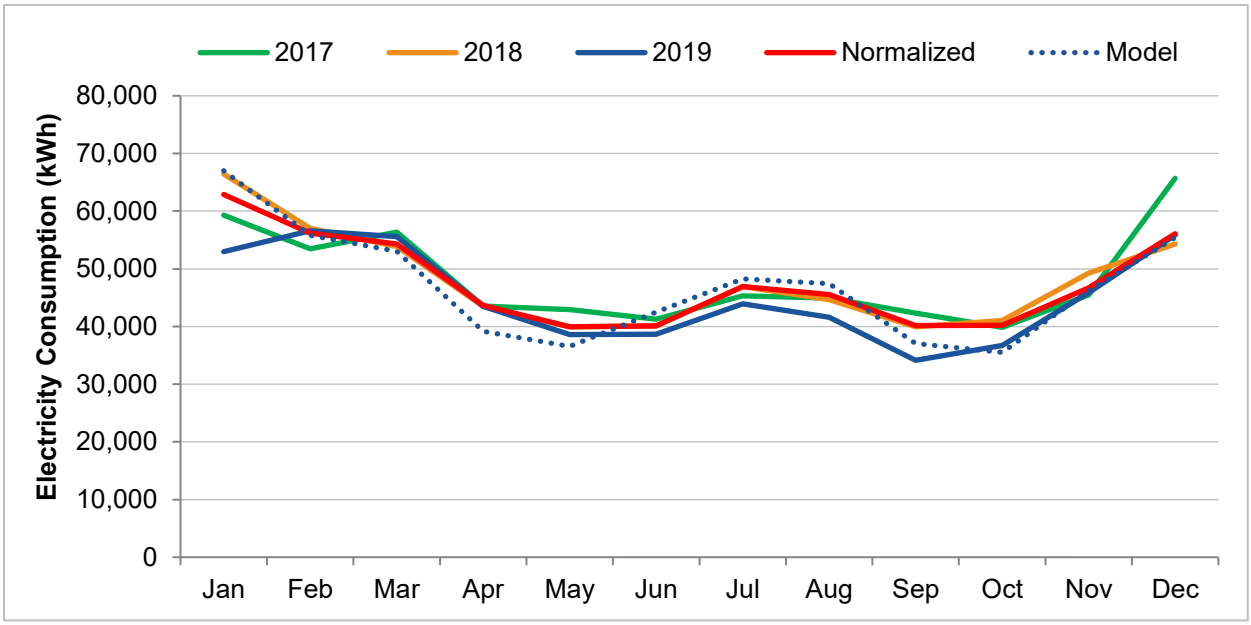


Figure 4

Table 4

	Natural Gas Consumption [m3]				
	2017	2018	2019	Weather Normalized	Calibrated Model
January	4,431	*5,530*	5,623	5,623	6,499
February	3,393	*3,680*	5,119	5,119	4,970
March	3,354	*3,798*	4,127	4,127	3,843
April	2,332	*1,746*	2,539	2,539	1,826
May	917	*685*	804	804	566
June	305	*663*	107	107	231
July	186	*685*	197	197	205
August	183	*685*	232	232	215
September	200	*608*	432	432	465
October	918	*1,642*	2,295	2,295	1,133
November	2,752	*3,657*	3,592	3,592	3,053
December	5,133	*4,665*	4,158	4,158	4,507
TOTAL	**24,104**	***28,004***	**29,226**	**26,560**	**27,512**

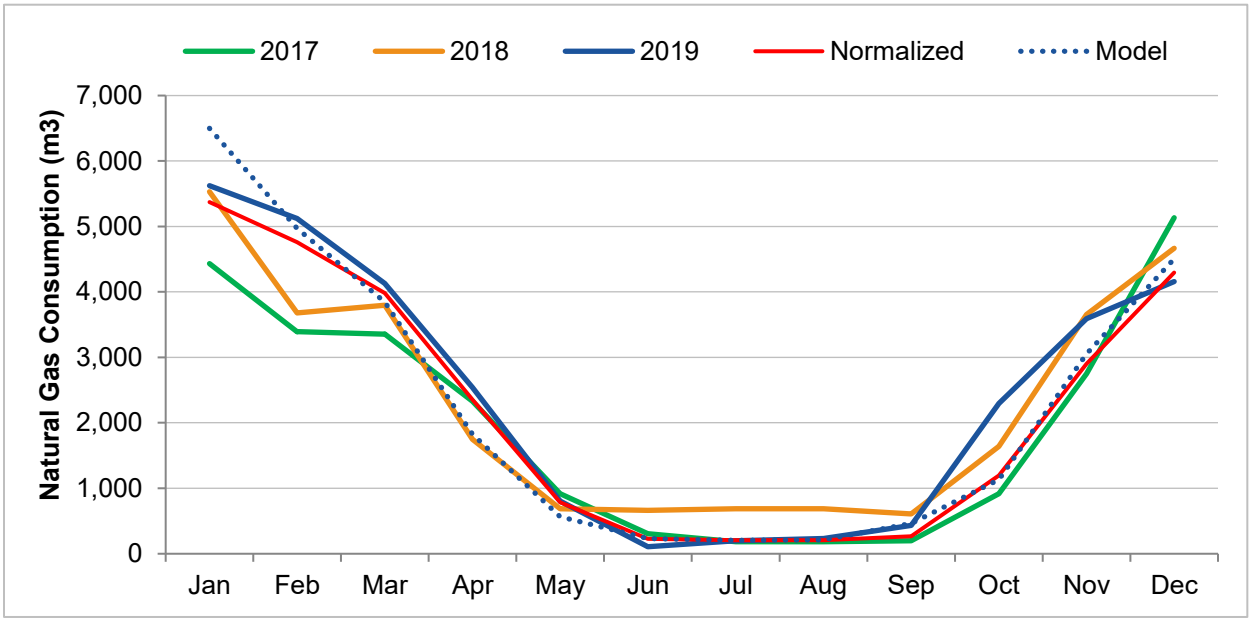


Figure 5

6.3 Energy End-Use Breakdown

The below building energy use breakdown is representative of the existing building operation and was determined by the calibrated energy model.

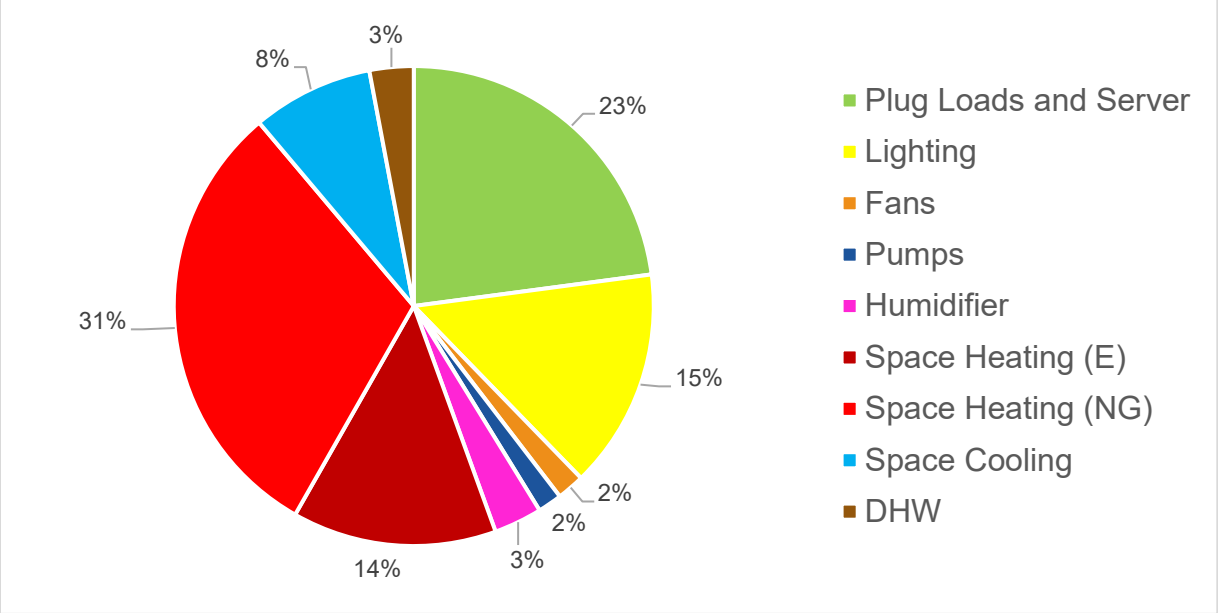


Figure 6

7 EXISTING BUILDING SYSTEMS

7.1 Building Envelope

The following sections describe the existing building envelope systems. Detailed drawings of the existing systems can be seen in Appendix A – Preliminary Design Drawings.

7.1.1 Roof

It is understood that the existing roof was installed in 2019, and consists of a typical inverted roofing system, complete with 100 [mm] of rigid insulation on a concrete or metal deck. The roof insulation is covered by a stone and gravel layer (or concrete pavers), which serve as a ballast and protects the roofing system from UV damage.

Based on the provided drawings, it is estimated that the existing roofing system provides a nominal insulation level of R-20 (R_{SI}-3.52 m^2-K/W).

7.1.2 Exterior Walls

The exterior walls of the building consist primarily of a brick façade-based assembly, with a concrete block (CMU) structure, and complete with 50 [mm] of rigid insulation. The existing wall and its level of insulation are assumed to be at original design conditions and are estimated to provide a nominal insulation level of R-10 (R_{SI}-1.76 W/m^2-K).

The building contains an atrium where the main cafeteria and circulation space is located. The exterior wall in this area is a curtain wall assembly which spans the lower and upper floors. The curtainwall assembly is original to building construction and consists of a double pane assembly, with aluminum framing, and an estimated U-value of 3.4 W/m^2-K.

7.1.3 Exterior Fenestration

The punched windows and fenestration throughout the property were observed to be original to building construction and consist of double-pane insulated glass units (IGUs), with built-in aluminum frame without thermal breaks. The estimated U-value of the punched windows and fenestrations is 3.4 W/m^2-K.

7.2 Heating, Ventilation and Air Conditioning (HVAC)

7.2.1 Ventilation

Fresh air to the building is provided by (1) 'Temprite Industries' (Model: GTDM 55 cc) indirect gas-fired make-up air unit (MUA) located in the mechanical penthouse. The MUA has a maximum input heat capacity of 687,000 [BTU/hr.] at 80% thermal efficiency and a maximum supply air capacity of 5,975 [CFM].

The MUA operates continuously at constant speed to provide fresh air to the building plenums, which is preheated in the winter, but not precooled in the summer. In the wintertime, the supply air is humidified by (1) 'Nortec' electric humidifier. The plenums on each floor are used for air recirculation, and fresh air distribution. The MUA is controlled by a timer which turns the unit ON and OFF based on building occupancy periods.

The MUA is understood to be original to building construction and is therefore at the end of its useful life. It is understood that the MUA is to be replaced in 2021.

7.2.2 Heating and Cooling Plants

The primary source for space heating and space cooling in the building are water-to-air (water source) heat pumps, located in the building's plenums. The heat pumps are supplied by a low-temperature hydronic (15% glycol) loop which the heat pumps use to either absorb energy from (heating mode) or reject energy into (cooling mode). The low-temperature hydronic loop is maintained at a temperature specified by the control system by central heating and cooling plants as outlined below.

The central heating plant located in the mechanical penthouse consists of (2) 'Raypak' (Model: H3-0514) gas-fired atmospheric boilers. The boilers have a rated heating input of 511,500 [BTU/hr.], at a thermal efficiency of 82%. The boilers are understood to date back to 2014.

The central cooling plant located in the mechanical penthouse consists of (1) 'BAC' (Model: F1843-LM) cooling tower. The cooling tower is understood to date back to 2019. The cooling tower operates on-demand to maintain a temperature setpoint for the low-temperature hydronic loop in the cooling season by rejecting heat into the exterior environment.

7.2.3 Heating and Cooling Terminals

The primary source for space heating and space cooling in the building are water-to-air (water source) heat pumps, located in the building's plenums and rooftop. There are approximately (54) heat pump units in the building, with various capacities and efficiencies. The heat pumps are understood to operate on demand when there is a call for heating or cooling in the space. This operation is controlled by zone thermostats which are set to 'Auto' mode.

The majority of the units are original to building design, while it is understood that some units have been replaced due to equipment failure. The original heat pumps are at the end of their useful lives and are understood to be scheduled for replacement in 2021.

Supplementary heat to the building's perimeter zones is provided by electric baseboards located at base of the majority of the above grade walls, and under exterior windows.

A dedicated 'Mitsubishi' split-type air conditioning system is used to cool the building's server room which is understood to be in operation throughout the year.

7.2.4 Domestic Hot Water (DHW)

DHW for the building is generated by (1) 'AO Smith' (Model: BT 100 300) gas-fired water heater located in the mechanical penthouse. The water heater is rated for a maximum input of 75,100 [BTU/hr.], at a thermal efficiency of 80%, and a storage capacity of 98 [gal.]. The water heater is understood to date back to 2016.

7.3 Lighting and Plug Loads

The majority of the lighting systems installed at the building are understood to be fluorescent based fixtures. All non-emergency lighting is operated manually by building staff, and no control systems are in place. The majority of exterior lighting fixtures observed were LED based fixtures (parking lot), however some high intensity discharge (HID) based wall packs are understood to exist on site.

The building contains typical office appliances and workstation equipment such as desktop computers, printers and monitors, as well as a select number of kitchen appliances in the kitchenettes and main cafeteria area which are all electric based. All networking and information backup is located in a central server room located on the upper floor.

8 RENEWABLE ENERGY ANALYSIS

When considering the feasibility of achieving a ZCB certification, it is always important to consider the renewable energy generation potential of the site to help offset operational GHG emissions at the building. However, under the program requirements renewable energy generation can only be used to offset indirect emissions (electricity), and for this reason the focus on the plan remains on the reduction or elimination of natural gas consumption on-site.

Since it is not necessary to offset all operational energy at the site, it is recommended to incorporate a renewable energy system that makes the most sense for the site, logistically and financially for the Town.

The following renewable energy systems were determined to be unfeasible or unbeneficial to the site due to space requirements or limited capacity and/or demand:

- Solar thermal (hot water)
- Building integrated wind power generation
- SolarWall system

8.1 Solar Photovoltaic (PV) System

Photovoltaic (PV) panels are made up of a number of PV cells that convert solar radiation into DC electricity which can then be used to power equipment directly or stored in the form of a battery for later use. The life expectancy of a typical PV panel is 25+ years with little maintenance required. The expected operations and maintenance (O&M) costs associated with the installation of a PV system at this site is low. Associated O&M activities over the lifetime of this system would include light cleaning work (only when deemed necessary to ensure performance) and the replacement of the system inverter after 10 years of operation.

Electricity consumers in Ontario who produce some of their own power from a renewable resource may take advantage of the “net metering” initiative. Net metering allows you to send excess electricity you generate from renewable resources to the distribution system for a credit toward your energy costs. The new rules will also allow power system owners to use storage systems when paired with renewable energy generation. In July 2017, a slight modification to the net metering regulations will allow excess generation credits to be carried forward for up to 12 months (increased from 11 months), including the 12th month, to offset future electricity costs on a rolling first in, first out basis. It should be noted that the regulations surrounding solar PV technology and its application is continuously evolving and can be expected to mature in Ontario in the coming years. Early engagement with the local distribution company (LDC) is recommended and critical to develop and achieve a successful project.

Two solar PV system installation types were considered as a part of this feasibility study: a rooftop mounted system and a carport system installation. A conventional rooftop PV system is mounted on a racking system and secured to the roof via a ballast such concrete. This type of mounting approach has the benefit of avoiding the need to penetrate the existing roofing system and secure to the building structure, however it adds significant mass to the building structure. If the existing building structure cannot accommodate for this additional load, reinforcements will need to be made. It has been determined that structural reinforcement of the Town Hall will be required in order to support the rooftop mounted solar PV system that is proposed in this report. This work would involve the addition of fiber reinforced panels (FRP) to structural beam faces and to the underside of floor/ceiling slabs. The budget that should be allocated for this structural reinforcement has been accounted for in the cost estimate for the rooftop mounted PV system. It should also be noted that an intrusive reinforcement project such as this would likely result in the

disruption of normal building operations while the work is being completed. The extent of this disruption is unknown; however, it is a negative aspect of this approach that should be considered.

The second system type considered is a carport-based installation. Carport PV systems are versatile installations that can be located in existing parking lots such as the one at Town Hall and offer other benefits such as vehicle coverage and integration with electric vehicle (EV) infrastructure. The system presented here represents the maximum capacity, with carport PV systems located at each of the site's existing parking spots. However, it should be noted that impacts on energy generation due to shading from the surrounding trees was taken into account in the simulation software. In addition, carports were not included in areas of the parking lot which were deemed to be overly shaded throughout the day – most notably on the East side of the parking lot.

The proposed carport system is oriented with the existing parking spaces (Southwest), in "V-shape" configuration (Figure 10). If the parking area is to be reconstructed as part of the potential building expansion, re-orienting the existing parking locations to a South orientation should be investigated. Orienting the carports to be South facing will provide an increase in annual energy generation, however this would involve a "single slope" carport configuration and considerations such as snow/ice removal and hazards must be taken into account.

Table 5

Scenario	System Size	System Cost	Structural Reinforcement Cost[8]	System Cost per kW	Electricity Production	Offset Utility Cost	Offset GHG Emissions
	kW	**$CAD**	**$CAD**	**$/kW**	**kWh**	**$CAD**	**ekgCO2**
1 – Rooftop	55	$115,000	$235,000	$6,364	64,470	$12,314	1,289
2 – Carport	190	$770,000	-	***$4,053***	228,918	$43,723	4,578

Based on the system characteristics, financial analysis and electricity production of the PV installation scenarios outlined in Table 5, it is recommended to install a carport based system as part of the Town's pursuit of Zero Carbon Building certification.

[8] Estimated cost is budgetary (+/- 15%) and has been calculated based on an assessment of the existing building's structural systems (see Appendix B – Third Party Reports and analysis)

Figure 7

Figure 8

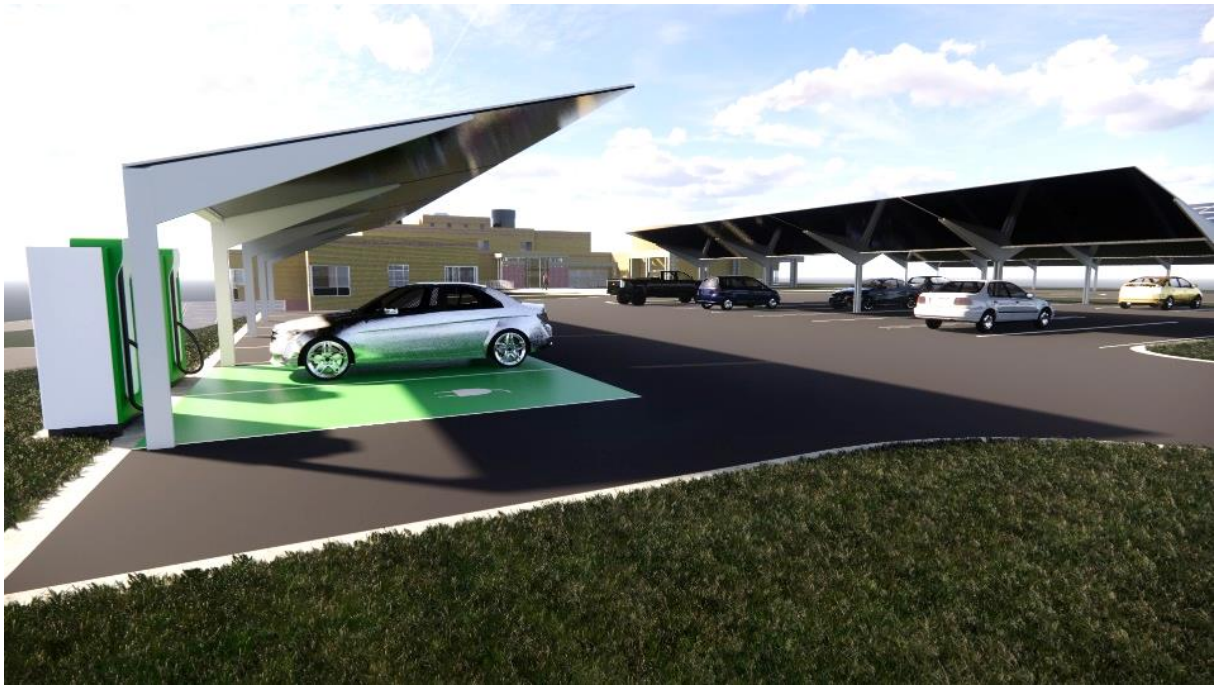


Figure 9

Figure 10

8.2 Additional Considerations

Two additional PV systems have been considered as part of this design brief; however, they are dependent on the theoretical concept of a physical expansion of the Town Hall building, and therefore have not been recommended as part of the final Pathways presented in this report.

8.2.1 Building Integrated Photovoltaic (BIPV)

Building integrated photovoltaic (BIPV) systems are used in place of conventional building envelope systems such as windows, skylights and roofs, and serve as a part of the overall building envelope system. The proposed BIPV system at the Town Hall is to be installed in place of the existing curtain wall on the Southeast façade of the building. This area is understood to be under consideration for the expansion of the building into the grounds surrounding the South side of the property, and as such its feasibility would be dependent on the details of this expansion. The curtainwall, spanning both floors in the common cafeteria atrium space is a favorable candidate for this technology, due to its size and orientation. In addition, a BIPV feature in a common space such as this, which is also visible to passersby on the street, can serve as an attractive feature for a building that is aiming to promote sustainability and innovation such as this.

8.2.2 Parkade Mounted Photovoltaic

The second PV system involves the theoretical construction of a two-level open air parkade in the existing parking lot area to the North of the building. The parkade construction has been discussed as a potential upon the Town Hall is expansion, as requirements for staff and visitor parking are increased. PV system integration to new open air parkades has become increasingly popular in many building sectors, as the mounting system and integration can be relatively simple if the design is incorporated from the first stages of the construction process.

Table 6

Scenario	System Size	System Cost (est.)	Annual Electricity Production	Annual Offset Utility Cost Potential	Annual Offset GHG Emission Potential
	kW	$CAD	kWh	$CAD	ekgCO2
3 – BIPV	15	$60,000	11,000	$1,389	220
4 – Parkade	165	$350,000*	205,000	$25,892	4,100

**Not incl. cost of parkade construction*

Figure 11

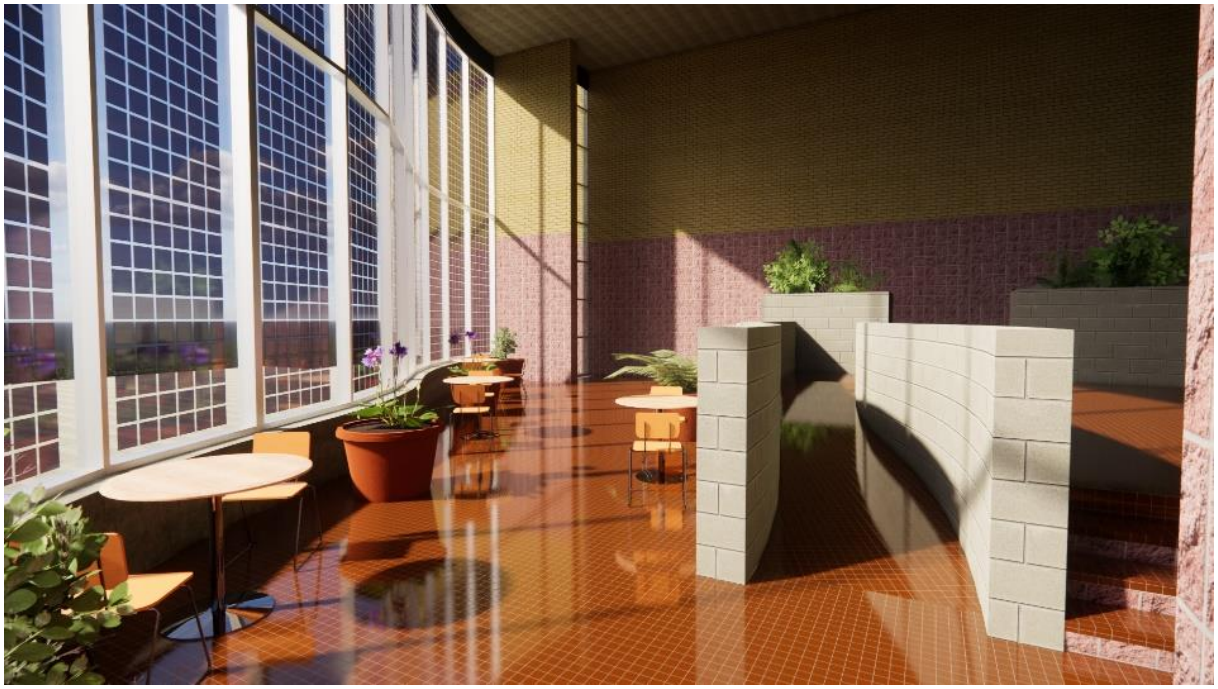


Figure 12

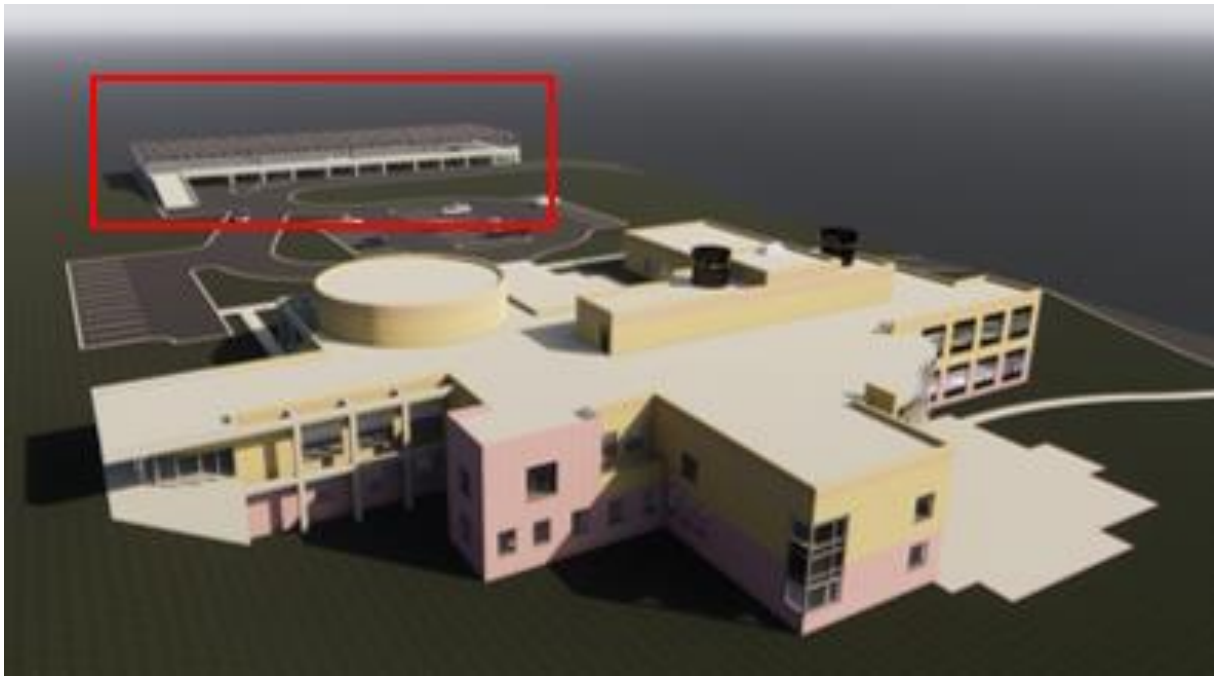


Figure 13

Figure 14

9 ENERGY CONSERVATION MEASURES

9.1 Building Envelope

As a part of this design brief, the existing building envelope was analyzed in detail in order to determine potential retrofit options for the roof, exterior walls and fenestration. It is of critical importance for any project with aggressive reduction targets such as this to improve the building envelope performance, reducing the overall loads and demand of the building, before implementing other energy efficiency measures.

All feasible retrofit options have been explored, while considering other influencing factors such as the existing component's lifecycle, and the financial requirements and commitments of the retrofit option. Solutions to each component retrofit option have been presented, and all detail drawings can be seen in Appendix A – Preliminary Design Drawings.

9.1.1 Roofing System

As the existing roof was installed in 2019, it has 25 to 30 years of useful life remaining, and any retrofit typically would not be considered to be a part of the 10-year plan presented in this design brief. Upon replacement, the following energy conservation measures should be considered:

9.1.1.1 Upgrade existing insulation levels

Premature replacement of roof surfacing to upgrade insulation levels escalates costs beyond what can be captured by an appreciable return on investment. However, certain circumstances could warrant the investigation of upgrading the roof's insulation levels, such as the installation of a rooftop mounted PV system.

Upon replacement, it is recommended to meet a minimum insulation level of approximately R-30, and up to R-35. It is expected that beyond an insulation level of R-35 diminishing returns on energy savings to investment requirement will be seen. An insulation level of R-30 corresponds to the current level prescribed by the Ontario Building Code (OBC). Such an upgrade will increase the thermal performance and reduce energy consumption of the building.

In addition, as insulation levels and overall height of the roof assembly increases, the potential of parapet reconstruction must also be taken into account. It is understood that at the Town Hall, an increase in roof insulation would result in the requirement for significant parapet reconstruction. It is possible that the additional construction cost represented by the parapet replacement would produce a financially unattractive project.

9.1.1.2 Green roof installation

A green roof not only serves as an attractive visual feature for buildings that wish to promote sustainability efforts but have benefits such as a reduction in building cooling load, a potential for additional amenity spaces, and improvements in stormwater management. A visual rendering of a potential green roof design for the Town Hall has been presented in Figure 15. It should be noted that a green roof installation would likely involve the requirement for reinforcement of the existing building structure. It is recommended that a green roof solution is considered for any new construction as part of the Town Hall's potential expansion plans.

Figure 15

9.1.2 Exterior Walls

As part of this design brief, the exterior wall retrofit options were explored and analyzed in detail. This analysis led to the conclusion and recommendation that a exterior wall retrofit should not be implemented as part of this 10-year plan due to the factors discussed below.

In some cases, depending on the wall type, existing wall retrofits allow for the addition of building materials to the exterior of the existing wall assembly, without demolition work. When possible, this approach results in significant savings in the form of demolition, landfill shipping and the associated labor costs.

Upon analysis of the existing exterior wall details and drawings provided by the Town, it was determined that any proposed retrofit would require the removal of all exterior wall components outboard of the existing concrete block (CMU) structure. This is mainly due to the existing wall being a rainscreen type assembly, which is constructed with an air gap behind the brick veneer to drain bulk water infiltration. Any building materials added to the exterior of the existing brick veneer would be thermally ‘bypassed’ by this air gap, rendering the new insulating materials added much less effective. As mentioned, this process of demolition and material processing (landfill) represents a significant added cost to any exterior wall retrofit project to take place at Town Hall.

As a result, an exterior wall retrofit project has not been presented in the design brief’s 10-year plan. Three retrofit options are presented below, which would be recommended to choose from if the Town were to pursue such a project. All retrofit options presented below have been analyzed from a hygrothermal (moisture and heat) dynamics perspective to ensure proper performance. The associated wall details and hygrothermal analysis report for each retrofit option can be seen in Appendix A – Preliminary Design Drawings and Appendix B – Third Party Reports and analysis.

The exterior wall retrofit options are not included in the four Pathways presented in this report, however they are expected to provide an overall thermal resistance value of R-25 to R-30, resulting in total annual energy savings of 35,600 ekWh.

9.1.2.1 Exterior Insulation and Finishing System (EIFS)

An EIFS is a continuous layer of insulation which is adhered directly to the existing concrete block structure. The insulation board is reinforced by a structural mesh and is finished on the exterior face by an acrylic

coating. The exterior finish is flexible in terms of aesthetic appearance, and it is even possible re-produce the existing brick veneer aesthetic of the Town Hall.

A visual rendering of a potential EIFS retrofit at the building can be seen below in Figure 16. It is estimated that an EIFS based exterior wall retrofit would have a project cost of $821,800 (including all labor, demolition and landfill costs). This cost estimate breakdown can be seen in Appendix D – Cost Estimate Reports (Class C).

Figure 16

9.1.2.2 Clip and Rail System

A clip and rail cladding solution consists of horizontal or vertical rails (girts), attached to clips, which are secured to the existing concrete block structure. These types of systems are typically quite thermally efficient, as only the clips will penetrate the exterior insulation. This makes the material selection for the clips and fasteners important and selecting a material with a low conductivity such as fiberglass with stainless steel screws will result in a higher performing system. Aesthetically this solution is also very flexible, as many different cladding systems can be used including adhered veneers, stone veneers and a wide range of metal or composite claddings.

A visual rendering of a potential clip and rail retrofit at the building can be seen below in Figure 17 It is estimated that a clip and rail based exterior wall retrofit would have a project cost of $868,800 (including all labor, demolition and landfill costs). This cost estimate breakdown can be seen in Appendix D – Cost Estimate Reports (Class C).

Figure 17

9.1.2.3 Insulated Metal Panel System

Insulated metal panel (IMP) systems, such as those offered by 'Kingspan', are insulating foam cores covered by a steel skin. The panels are typically fastened directly to the existing structure via hidden stainless-steel fasteners. These solutions are available in a wide variety of textures and colors; however, they are limited by the metal finish of the panels themselves.

A visual rendering of a potential IMP retrofit at the building can be seen below in Figure 18. It is estimated that an IMP based exterior wall retrofit would have a project cost of $974,100 (including all labor, demolition and landfill costs). This cost estimate breakdown can be seen in Appendix D – Cost Estimate Reports (Class C).

Figure 18

9.1.3 Exterior Fenestration

The existing fenestration is original to the building construction and is at the end of its useful lifetime. As such the thermal performance of the fenestration could be significantly improved by replacing them with modern high-efficiency units with less conductive framing materials and high-performance, insulated glass

units (IGUs). The upcoming replacement of the existing punched windows and curtain wall represents a significant opportunity for energy and GHG savings, as well as improved thermal comfort for building occupants, increased asset value and durability.

Four IGU and curtainwall performance levels have been assessed as a part of this design brief. In order of increasing performance level, the options assessed are:

Table 7

Tier	Type	Frame Material	U-value [W/m2-K]
1	Double pane	Aluminum	2.15
2		Fiberglass/PVC	1.85
3	Triple pane	Aluminum	1.20
4		Fiberglass/PVC	0.80

The recommended performance levels for each façade orientation has been determined via an optimization study, with the objective of minimizing operational GHG emissions and construction cost. The results of this study are summarized below, and the details can be seen in Section 10.2.

Table 8

Façade*	Curtain wall	North	South	East	West
Recommended Tier	4	4	1	4	1

**construction orientation*

It should be noted that this design selection represents an example of how the optimization study process can be utilized and does not represent a final design selection. Limitations or issues may arise including the requirement for a uniform glazing type to be used on each façade of the retrofit due to visual or aesthetic reasons.

9.1.4 Improved Air Tightness

In an ideal situation, the building envelope retrofit measures implemented should be designed to not only improve insulation levels of the envelope component, but also to improve the overall air tightness of the building and reduce overall air infiltration rates and resulting air changes. This is a critical aspect of a high-performance renewal, as unintended air infiltration and exfiltration are major causes of energy loss within existing buildings, of older vintage in particular. When aiming to improve overall air tightness levels, improvements to the existing exterior wall details and interfaces is critical. In addition, the proper ventilation balance in the building, and minimizing the resulting air pressure difference between inside and outside will play a role. Although an exterior wall retrofit is not being presented as part of this 10-year plan, there are other strategies that can be implemented to reduce air infiltration and exfiltration in the building.

Services and products, such as *"Aerobarrier"* (NERVA Energy) exist on the market today which are designed to improve the overall air tightness of existing buildings. A non-toxic water-based formula is

sprayed into the building, which is pressurized prior to application, allowing the sealant formula to naturally find its way to the building envelope's air leakage paths and seal them upon contact.

Before considering the use of a product and service such as this, it is recommended to perform a baseline air tightness testing of the Town Hall, via blower door testing methods. This will determine the existing air tightness of the building, and potential benefits that could be realized from the application of an air sealing measure such as this. This type of air sealing measure on a building of this size would require a significant amount of preparation work including the covering of any openings that are not to be sealed, the covering of any finished surfaces, or removal of all associated equipment and interior furnishing from the building. It would also require a period of time for the building to be unoccupied and empty while preparation and implementation is being done.

9.2 Ventilation

The existing MUA is scheduled to be replaced in 2021. Upon replacement, there are several energy conservation considerations to take into account in order to optimize the ventilation strategy in the building. In addition, these considerations will allow for certain control strategies to be implemented effectively in the future.

9.2.1 Correct Sizing

Since the Town Hall construction, significant developments have been made surrounding the amount of fresh air ventilation required for acceptable indoor air quality in buildings. These requirements are outlined in building standards such as *ANSI/ASHRAE Standard 62.1.* Prior to the development of these standards, ventilation units were often oversized in relation to the building size and occupancy type.

Upon application of ASHRAE 62.1 to the Town Hall building and occupancy characteristics, it has been determined that the existing MUA is oversized by approximately 86%. Considering a 50% increase in building floor area due to a potential building expansion, the existing MUA is still oversized by 30%.

Correctly sizing the new MUA will result in energy and GHG emissions savings in the form of thermal demand of the MUA heating, as well as supply fan and motor electricity consumption.

9.2.2 Heat and Energy Recovery

Another method to effectively save thermal energy in ventilation systems is through the recovery and use of the energy contained in exhaust air. In the existing ventilation design, air is exhausted from the plenums through and through the roof via several rooftop mounted exhaust fans.

Before exhausting this air into the external environment, it is possible to extract the thermal energy contained in this air and transfer is to the fresh air being supplied to the new MUA. Pre-heating the outdoor air in this manner will result in a reduction in the ventilation heating load. While a heat recovery ventilator (HRV) extracts only the heat (sensible energy) from the exhaust air, an energy recovery ventilator (ERV) will also extract the humidity (latent energy) from the exhaust air, resulting in additional energy savings from the reduction of the humidification load.

It is recommended to investigate the feasibility of equipping an HRV or ERV in the new MUA that is supplied with exhaust air from "*EF-3*" and "*EF-4*" located on the rooftop, in relatively close proximity to the mechanical penthouse.

9.2.3 Variable Speed Capabilities

Equipping the new MUA supply fan with a variable frequency drive (VFD) will allow the unit to modulate and control the amount of fresh air that is being delivered into the plenums, as opposed to only one constant speed (maximum supply capacity) being possible. This type of control is required in order to implement the demand control ventilation (DCV) strategy which is recommended as a part of the BAS strategy. A VFD equipped MUA will allow the amount of fresh air being supplied to the building to be dependent on the total amount of occupants in the building.

9.3 Heating and Cooling

9.3.1 Central Heating Plant – Condensing Boilers

Unlike conventional atmospheric boilers, condensing boilers can achieve thermal efficiencies up to 98%. These high efficiencies can be achieved by condensing the water vapor in the boiler's exhaust gases, and in doing so, recovering the latent heat of vaporization which would otherwise be wasted. The flue gasses are captured and sent through a secondary heat exchanger, which preheats the water returning from the hydronic loop. During this process the flue gas temperature is rapidly reduced, and this fall in temperature creates condensation.

In addition, condensing boilers are able to operate under higher efficiencies as return water temperatures are lowered, making them ideal for low-temperature hydronic loop installations such as at Town Hall. Upon future replacement of the existing heating boilers, it is recommended to install high efficiency condensing boilers. Upon discussion with Town staff, it is estimated that the existing boilers (installed in 2014) have approximately 10 to 15 years of remaining useful life and have recently undergone a major maintenance and repair overhaul. Therefore, replacing the existing boilers near the latter phases of the 10-year plan should align with the expected capital replacement.

9.3.2 Heat Pumps

It is understood that the existing heat pumps at the building are scheduled for replacement in 2021. Upon replacement, several design considerations should be taken into account during the equipment selection and specification stages in order to achieve the optimal performance and savings.

First, it is recommended that high efficiency units are selected, with heating and cooling efficiencies greater than the minimum values prescribed by building energy codes such as ASHRAE 90.1 and NECB 2017. These efficiencies are outlined below in Table 9.

Table 9

ASHRAE 90.1 2016	**Water Loop**		**Geothermal Loop**	
Mode	Heating	Cooling	Heating	Cooling
Coefficient of Performance (COP)	4.30	3.81	3.20	4.13

In addition, it is recommended that the new heat pumps have at least two speed capability, and ideally have variable speed capability. Having a fan motor that is able to operate at multiple speeds, as opposed to an ON/OFF operating fan, will allow for the precise control and BAS functions that are critical for energy and GHG emissions savings at this building. A PSC (permanent split capacitor) motor is typically able to operate

at HIGH and LOW fan speeds, while an ECM (electronically commutated motor) can operate at multiple speed and air flow profiles (typically four).

Finally, if the Town decides to pursue a geothermal system-based approach to the retrofit, it should be ensured that the selected heat pumps are capable of performing efficiently under geothermal loop conditions and temperatures. Most water source heat pumps on the market today are able to function under both typical hydronic loop temperatures and typical geothermal loop temperatures, however this should be confirmed upon equipment selection.

9.3.3 Geothermal Energy

Instead of using the existing active strategy to condition the heat pump loop (gas-fired boilers and a cooling tower as heat addition (winter) and heat rejection (summer) devices) it is possible to use the passive technique of a geothermal exchange field.

A heat exchange process between the heat pump loop and a series (or field) of underground vertical boreholes allows the heat pump loop to maintain a relatively stable temperature throughout the year and serve as the heat rejection and absorption medium. This is considered a form of renewable energy, as the water loop is passively conditioned using the ground. Geothermal heat pump systems are highly efficient and result in large energy savings, mostly due to this passive approach to the water loop conditioning, however they come at a relatively large implementation cost, and typically result in an increase in distribution energy (pumping) compared to conventional systems.

A geothermal exchange field could also be paired with a water source variable refrigerant flow (VRF) system as described below.

9.3.4 Variable Refrigerant Flow (VRF) System

VRF systems use a refrigerant network and distribution system as the heat transfer medium throughout the building, as opposed to the existing system which uses water. Refrigerant is distributed to terminal indoor units throughout the building which heat or cool the associated zone. Heat addition and rejection to the refrigerant loop is provided by central unit(s) which can be either air-source or water-source, meaning they absorb or reject heat from/into the outdoor air or a water loop.

A VRF based HVAC retrofit would involve a significant overhaul of the existing hydronic distribution network, as well as decommissioning of the water source heat pumps, boilers and cooling tower. VRF systems are able to operate in ‘heat recovery mode,’ meaning that energy can be transferred between zones that are in simultaneous heating or cooling. For example, if one zone is in cooling and is rejecting heat into the refrigerant network, another zone in the building that is in heating mode can utilize this rejected energy.

9.4 Building Automation Systems (BAS) and Controls

The advent of direct digital control (DDC) technology and its application to building operation has been widely accepted as one of the most important technological advances to maximize building comfort as well as minimize energy use. It provides building operators with the ability to alarm, track and monitor equipment operation and performance and can be utilized to provide trending information to allow building operators to address problems and flag potential issues before they occur.

It is understood that a BAS is to be installed in the building in 2021. This section outlines several features that the new BAS is recommended to contain in order to provide precise control and operation of the building

systems, while achieving energy and GHG emissions savings and providing improved thermal comfort to building occupants.

9.4.1 Basic Control Functions

Regardless of the HVAC system that is in place at the building, there are several basic functions that the new BAS should have. First, the BAS should define every thermal zone in the building, with the ability to monitor air conditions (temperature and humidity) and the associated setpoints in each zone. This will allow for the control of the terminal equipment (zone heating and cooling), be it baseboards, heat pumps or VRF indoor units.

Another important feature of the BAS is the control of the central plant (boilers/cooling tower, geothermal plant, or VRF plant) and the associated distribution network. Having central control of these pieces of equipment will enable their optimal operation to work together and will prevent costly breakdowns and unforeseen maintenance costs due to alarm and monitoring features.

The associated distribution network (hydronic loops, refrigerant network etc.) and its pumping and temperatures should also be controlled. It is understood that the existing heat pump loop already has a 'Honeywell' temperature controller which alters the heat pump loop temperature based on indoor air temperature. Automating and centralizing these control functions is preferred and will also allow for more refined control of these loop temperatures based on other variables such as outdoor air temperature (outdoor air reset).

It is recommended that a lighting control feature be included in the new BAS. It is understood that the existing lighting system is operated manually by building staff. Automating this procedure by including lighting control and scheduling in the new BAS will eliminate energy losses from human error (ie. Forgetting to shut off the light systems overnight).

9.4.2 Occupancy Sensor Based Control

In a building such as the Town Hall, that has varying occupancy throughout each day, week and year, an effective control strategy for the BAS is an occupancy sensor-based control. As total occupancy in the building fluctuates, it is important that the HVAC system responds accordingly to provide adequate indoor air quality conditions (fresh air, temperature etc.) for the occupancy level at that time. Moving to an occupancy-based control system instead of a timer or schedule-based control system allows the system to react to unpredictable changes in building occupancy, such as a building evacuation due to emergency. Occupancy sensors at all of the building's entrances and exits can be used to monitor total building occupancy and adjust the supply air capacity of the MUA unit in order to provide the minimum amount of fresh air required for the occupancy level. This technique is referred to as "demand-controlled ventilation" (DCV) and will result in energy savings in the form of fan consumption as well as thermal energy required to pre-heat the supply air in the wintertime.

The occupancy-based BAS should also be designed to adjust the HVAC operation based on zone occupancy conditions. Strategically placed occupancy sensors within the building can monitor various zones, and when the system deems the zone to be unoccupied, the associated terminal unit(s) will be ramped down (fan speed reduced) and a temperature setback will be applied.

9.4.3 Electric Baseboard Control

Supplementary space heating terminals, such as electric baseboards, are often overused when there is no central control system in place that can monitor and control the operation of the primary (heat pumps) and

supplementary heating terminals to ensure they are operating synergistically and optimally. The electric baseboards should only be used when the zone heating load is too high for the heat pump(s) to meet. The heat pumps are a more efficient source of heating and should be used primarily to meet the space loads.

It is recommended to integrate control of the electric baseboards in the new BAS to minimize the use of the baseboards in the perimeter zones and improve the overall heating efficiency of these zones.

9.5 Lighting Systems

It is recommended to replace all fluorescent, incandescent and halogen-based lighting fixtures with their LED equivalent. A properly designed LED lighting retrofit will improve color rendering and lighting quality in the spaces, providing a more comfortable work environment which has also been linked to increases in staff productivity. In addition, all remaining high intensity discharge (HID) based exterior fixtures should be replaced with their LED equivalent.

LED based lighting systems are up to 90% more efficient than incandescent based systems, and up to 30% more efficient than typical fluorescent based systems. Retrofitting the existing lighting systems with LED fixtures will provide electricity savings and reduce peak demand.

It should be noted that the project outlined in this design brief represents a replacement of each existing lighting fixture with its LED equivalent. Where possible, the potential to replace the existing lamps with LED lamps should be investigated. A lamp replacement can be considered when proper driver and ballast compatibility is present and will provide project costs savings compared to an entire fixture replacement.

9.6 Plug Loads

Upon equipment turnover, it is recommended to replace existing appliances with models that EnergyStar® rated (where applicable). Modern EnergyStar® rated appliances represent the most efficient appliances on the market, and for example an EnergyStar® refrigerator will consume approximately 15% less electricity than typical refrigerators[9].

In addition, there is an opportunity to introduce power management setting measures for the desktop and laptop computers to reduce dormant or “phantom” workstation energy consumption. Phantom loads represent the energy consumption of all electronic devices when they are in standby or sleep mode. There are several measures available to introduce the power management opportunities, including the following:

- **Employee Engagement:** encourage employees to enable and use the existing power-management capabilities of their PCs.
- **Deploying Power Management Settings:** all power management settings could be Group Policy enabled, providing a potentially significant cost savings. Specific power settings can be modified through individual Group Policy settings or built within a custom power plan that is deployable by using Group Policy.
- **Third-Party Software:** Use third-party software to establish and implement a computer power-management policy across the building’s LAN/WAN. Options include Nightwatchmen®, Verdien Surveyor® and The Big Fix®. These modern platforms will allow for scheduled wake-up prior to office hours to eliminate productivity losses and allow for security patch updates at all times.

[9] www.energystar.gov

- **Smart Power Bars:** turn off connected devices when they are not in use. Operation is based on programming a "main" device which controls all periphery devices plugged into the power bar, or through occupancy sensors which turn off all connected devices if the space is unoccupied for a certain duration.

Exploring the feasible and practical avenues for power management opportunities within the powered workstations is an energy conservation measure recommended for further study in partnership with the building's IT team.

9.7 Domestic Hot Water

9.7.1 Condensing Water Heater

Condensing storage tank water heaters can reach thermal efficiencies of over 94%, compared to a standard storage water heater with a thermal efficiency of 80%. This is achieved by utilizing the thermal energy stored in the combustion exhaust stream, as opposed to exhausting it directly as a source of heat loss. A condensing DHW heater has a flue designed with a larger surface area, allowing this additional heat transfer between the exhaust stream and the stored DHW.

9.7.2 Heat Pump Water Heater

Hybrid heat-pump water heaters use an electricity powered refrigeration cycle to absorb the ambient heat in the surrounding air and transfer it into the stored water. This operation can produce uniform energy factors (UEF) of up to 3.0 to 3.5.

This type of water heater has a backup conventional electric heating coil which is used when the heat pump can no longer satisfy the demand alone, however it is expected that this would not be required at this facility due to the relatively low DHW demand. Heat pump water heaters should be located in an area where thermal comfort is not critical such as a storage room or mechanical room, as their operation removes heat from the surrounding air.

9.8 Staff Engagement

It is very important to engage the Town Hall staff throughout the 10-year retrofit plan and process, as well as after the retrofit completion as an ongoing engagement. Significant changes are going to be made to their place of work, and the success of some of these components relies partially on the staff's education and response to these new building systems, technologies and strategies.

Staff engagement is an important component in any sustainability strategy for office buildings to promote staff adoption of efficiency behaviors and has shown to be effective, particularly when staff see peers engaged, when incentives are offered, and when marketing messages are tailored based upon staff values and interests. Use of trusted information channels and delivery of relevant information face-to-face by respected experts and/or peers increases the effectiveness of outreach efforts.

Properly designed and delivered staff engagement can go a long way in ensuring that staff and building owners realize the desired benefits of energy efficiency retrofits. It also offers one of the best chances for long lasting sustainable behavior on the part of new or older building occupants. Several tools are available to enhance staff engagement around energy, waste and water reduction, which reduce the associated costs and carbon footprint. In the first phase, it is recommended that an educational document be distributed to the staff and also permanently displayed in common areas (lobbies, elevators, washrooms, etc.).

In a second phase, the Town can work with a third-party group that will help manage engagement programs in different domains such as energy, waste and water conservation, fleet optimization, carbon foot-printing and carbon offsetting. Communication that is transparent and open is very important for the success of a staff engagement strategy. The Town should make data and information such as energy efficiency goals, total building energy use, and real-time energy information available to its staff. Energy goals and achievements made by the Town or the staff should be displayed in key areas such as entrance lobbies, elevator lobbies, and common areas.

10 ENERGY MODELLING

The utility calibrated baseline energy model (Figure 19), which accurately represents the existing building operation, was used to simulate the various energy conservation measures and combined retrofit Pathways. It was also used to perform parametric modelling and optimization analyses as outlined in the sections below.

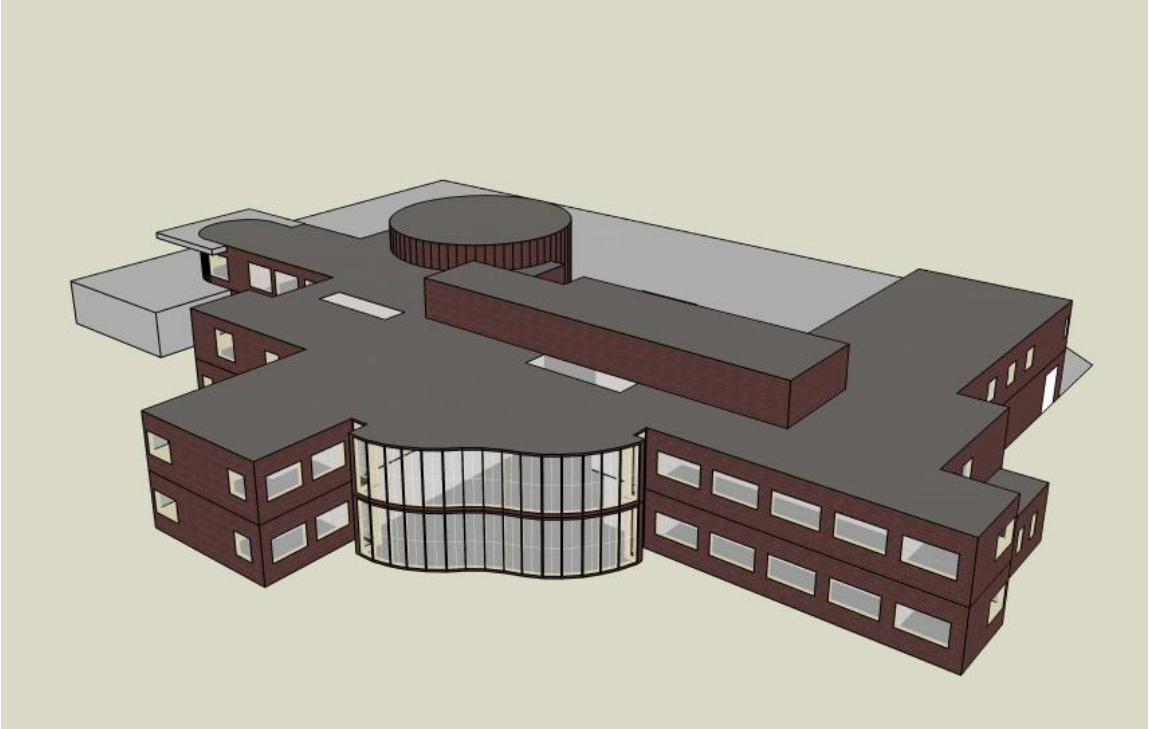


Figure 19

10.1 Parametric Modelling

Parametric modelling techniques consider a wide variety of design options that, when put together, create a large number of potential designs. In parametric simulations, rather than one static value for a design variable, a range of values are programed into the energy model. Applying these ranges across a set of design variables allows one to see the impact of each individual variable, or energy efficiency measure, both in isolation and in combination with any other measure, on pre-selected performance outcomes, such as annual energy use.

These designs can then be used to assess the cost or impact of the various combinations of design options. In short, parametric simulations expose the full range of performance potential and performance risk of a particular building design. A visualization map (or parallel coordinates plot), produced from the resultant building performance simulations, offers a way of including energy design modelling directly in the design and decision-making process.

In the case of the Town Hall and this design brief, parametric modelling was utilized at the beginning of the energy modelling process to obtain a high-level understanding of what magnitude of energy and GHG emission reductions will be possible at the building.

The study was also used to evaluate the potential for the building to meet the energy efficiency requirements of the *ZCB Design Standard* through the various retrofit Pathways outlined in Section 11. As mentioned in Section 4.1, the *ZCB Design Standard* requires for the building to achieve a thermal energy demand intensity (TEDI) of 32 kWh/m^2. As expected, this is quite an aggressive target for the Town Hall to pursue and would likely only be possible to achieve with a geothermal based heating and cooling system retrofit,

For example, the parametric analysis inputs for Pathway 1 are presented below in Table 10 and the parallel coordinates plot detailing the analysis results is shown in Figure 20.

Table 10

Variable	Unit	Input 1	Input 2	Input 3	Input 4
1.Boiler	Thermal efficiency, %	90	93	96	-
2.Energy Recovery Ventilator (ERV)	Effectiveness, %	55	65	75	-
3.Makeup Air Unit	Thermal efficiency, %	80	90	-	-
4.Heat Pumps	Coefficient of Performance (COP)	4.3	4.7	5.1	-
5.Fenestration	U-value, W/m^{2}K	2.15	1.85	1.45	0.80
6.Exterior Walls	R-value, ft^2-F-h/BTU	20	25	30	-
7.Roof	R-value, ft^2-F-h/BTU	30	40	-	-
TOTAL simulations	**1,296**				

Figure 20 shows the parallel coordinates plot for the parametric analysis performed on Pathway 1. Seven variables were analyzed, and two results (TEDI and energy savings) were output from the simulations. As can be seen, none of the design options are able to reach the energy efficiency goals of the ZCB Design Standard (32 ekWh/m^2), and the minimum TEDI achieved is approximately 34 ekWh/m^2. It has been determined that it is unlikely that Pathway 1 and Pathway 3 will be able to meet the energy efficiency requirements of the *ZCB Design Standard* (v2) and should therefore pursue the *ZCB Performance Standard* (v2) directly.

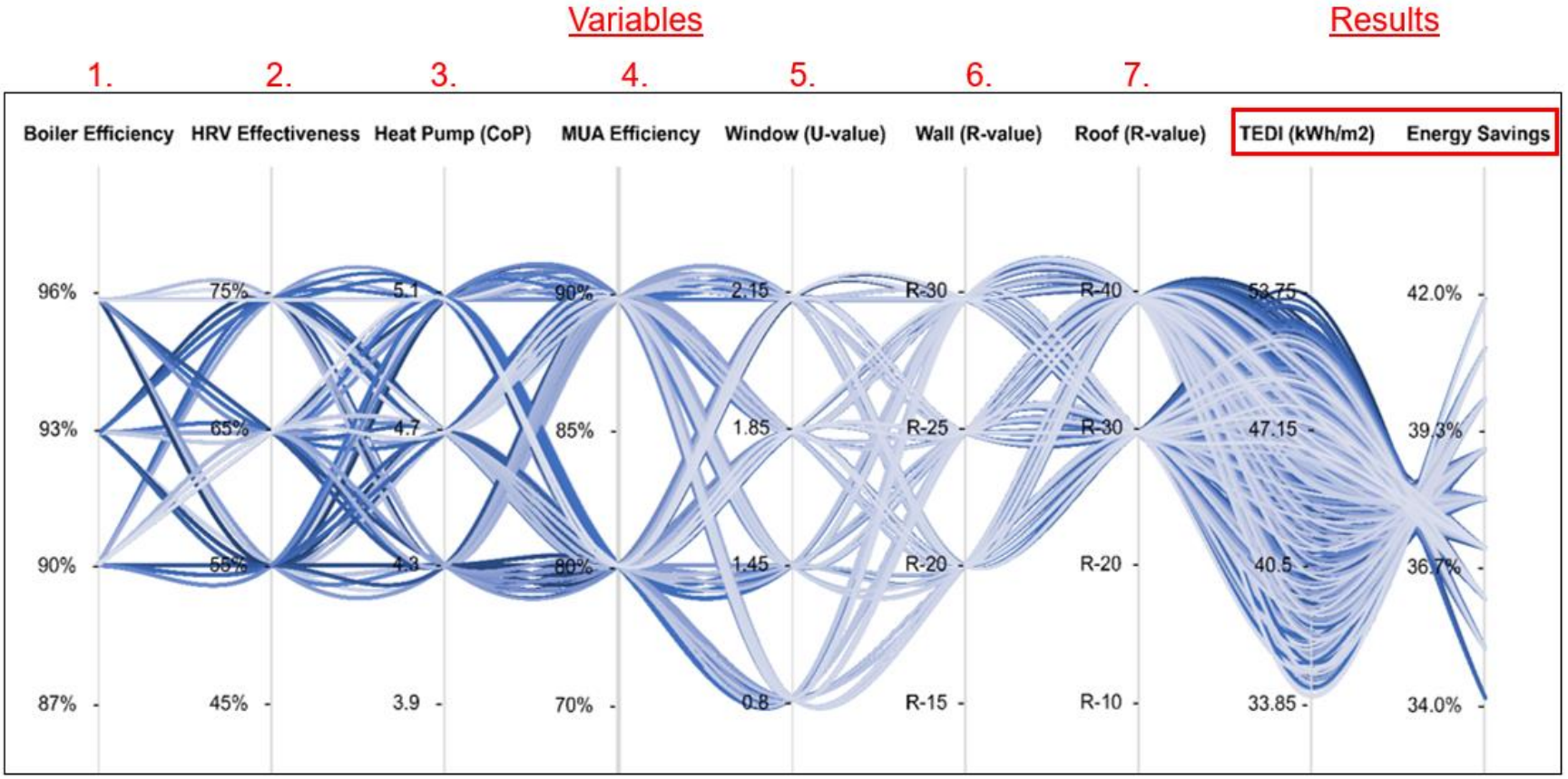


Figure 20

10.2 Optimization Analysis – Exterior Fenestration

As mentioned, optimization energy modelling techniques are used to efficiently search for and identify the design options that best meet the key design performance objectives defined by the user. Unlike parametric studies, in optimization studies it is often not necessary for the entire simulation to be performed as the algorithm “learns” how the design variables affect the design objectives and automatically eliminate “non-optimal” designs. This process becomes useful when key design variables are identified, and a more efficient simulation process is required.

In the case of this design brief, an optimization study is the preferred method to make high level design choices that are presented in this report. The exterior fenestration retrofit was analyzed in an optimization study in order to determine the optimal combination of window performance levels based on the façade orientation and window type. The design objectives selected in this study were to minimize both construction cost and operational GHG emissions.

Table 11 summarizes the design variables that were considered as a part of this study. Each of the below performance Tiers were applied to the punched window openings on the North, South, East, and West facades, as well as to the curtainwall facade.

Table 11

Tier	Glazing Type	Frame Material	U-value [W/m^2-K]
1	Double pane	Aluminum	2.15
2		Fiberglass/PVC	1.85
3	Triple pane	Aluminum	1.20
4		Fiberglass/PVC	0.80

(94) optimal designs have been identified as a part of this study that represent the design combinations that will minimize both construction costs and operational GHG emissions. These optimal designs can be visualized by the “pareto front” which is shown in the analysis results plotted in Figure 21 as the red data points.

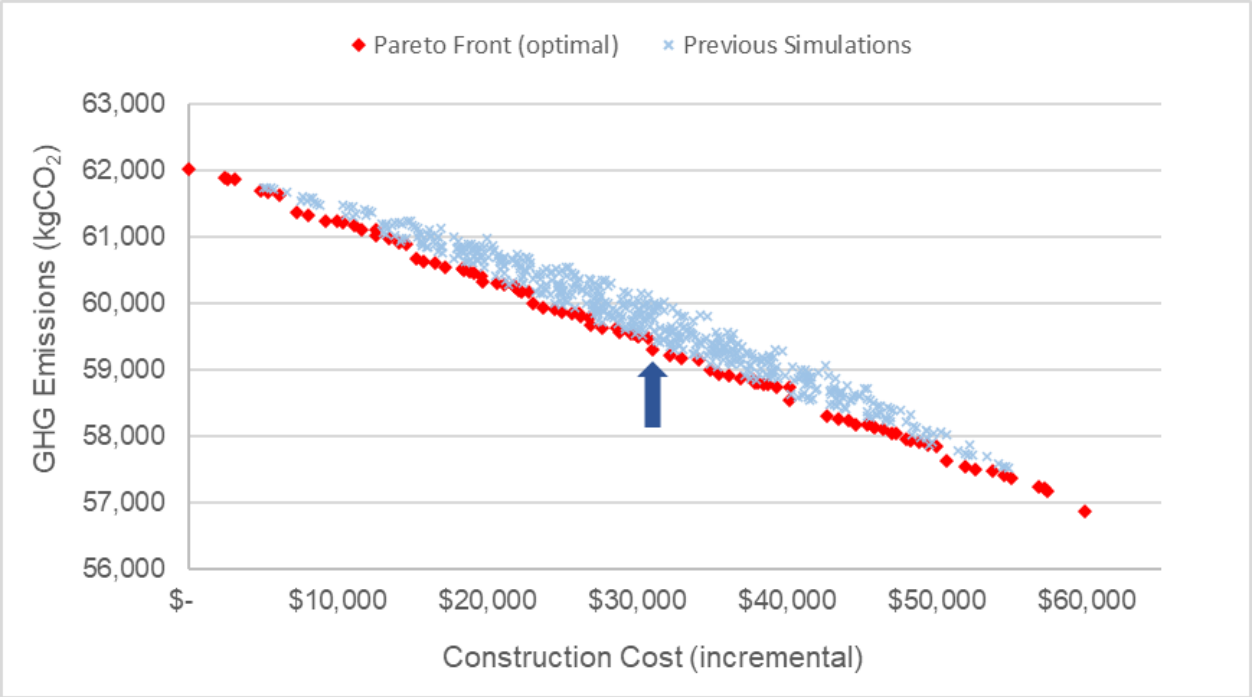


Figure 21

This analysis becomes increasingly powerful when more details of the project budget become known, at which time an optimal design selection can be made based on the available budget. For the purposes of this report, a “mid-range” optimal design selection has been made which represents both a moderate construction cost and reduction in operational GHG emissions.

It should be noted that this design selection represents an example of how the optimization study process can be utilized and does not represent a final design selection. Limitations or issues may arise including the requirement for a uniform glazing type to be used on each façade of the retrofit due to visual or aesthetic reasons.

Table 12

Façade*	Curtain wall	North	South	East	West
Recommended Tier	4	4	1	4	1

**construction orientation*

11 PATHWAYS TO ZERO CARBON BUILDING (ZCB) CERTIFICATION

11.1 Strategies Common to all Pathways

Building Envelope:

- **Windows:** replace all existing units with new insulated glass units (IGU), or curtain wall façade as per specifications below (example):
  - *Northwest (construction North) façade:* triple pane, fiberglass framed, U-value 0.80
  - *Southeast (construction South):* double pane, aluminum framed, U-value 2.15
  - *Northeast façade (construction East)*: triple pane, fiberglass framed, U-value 0.80
  - *Southwest façade (construction West)*: double pane, aluminum framed, U-value 2.15
  - Curtain wall (Cafeteria, Southeast): triple pane, fiberglass framed, U-value 0.80

Building Automation Systems (BAS)

Install BAS equipped with the following capabilities and control points (see specific BAS points list in provided mechanical drawings for each Pathway)

- Central plant monitoring and control
- Heat pump hydronic loop OR VRF distribution network monitoring and control
- Zone temperature and humidity monitoring and control
- Lighting control (ON/OFF scheduling)
- Optimization of electric baseboard use – only when primary conditioning equipment (heat pumps OR VRF) are unable to meet the heating load
  - Occupancy sensor-based control system (eg. “Feedback Solutions”)
  - Occupancy sensors at building entrances control total amount of fresh air delivered by MUA to the building plenums
  - Occupancy sensors in various zones control heat pumps, zone temperature setbacks and their associated fan/capacity output

Plug loads, lighting and auxiliary equipment

- Replace all existing lighting systems, fixtures/lamps with their LED equivalent
- Install EnergyStar rated appliances and office equipment

Renewable Energy Systems:

- Installation of a carport solar photovoltaic (PV) system in the existing outdoor parking lot
- Total capacity of 190 kW

11.2 Pathway 1 – Optimize Existing

This pathway to ZCB certification involves the optimization and efficiency increase of the existing building systems. The overall HVAC system and strategy at the building will remain the same. Improvements to building automation and controls, as well as building envelope retrofit work will be included.

Advantages:

- Lowest implementation cost and complexity of installation
- Most financially attractive Pathway over a 20-year evaluation period

Disadvantages:

- ZCB certification requires higher amount of carbon offsets to be purchased and an annually updated on-site combustion transition plan
- No possibility of full site electrification (natural gas consumption required for heating boilers)
- Unlikely to achieve *ZCB Design* certification due to energy efficiency requirements

The retrofit pathway includes the following elements and performance requirements over its 10-year implementation plan:

Heating, Ventilation, and Air Conditioning (HVAC):

- **Heating plant:** replace existing heating boilers (x2) with high efficiency condensing boilers
  - Minimum thermal efficiency: 93%
- **Ventilation:** replace existing MUA with a high efficiency condensing unit
  - Minimum thermal efficiency: 90%
  - Maximum supply air capacity of 4,600 CFM (Accounts for 200 staff, and 50% increase in total building floor area)
  - Equipped with variable frequency drive (VFD) control
  - Energy recovery ventilation (ERV) with building exhaust fans (“EF-3 and EF-4”)
  - Implement demand control ventilation strategy based on occupancy of zones (control system described in Section 11.1)
- **Terminal units:** replace all water source heat pumps with high efficiency units
  - Minimum coefficient of performance (COP): 3.8 (cooling), 4.3 (heating)
  - 2-speed (or variable speed) fan operation

Domestic Hot Water (DHW):

- Replace existing gas fired DHW heater with a condensing water heater

11.2.1 Implementation, Scheduling and Logistics

First stage (Years 1 to 5)

Capital projects already planned:

- *Ventilation:* MUA replacement with features outlined above
- *Building control and automation:* BAS installation with features outlined above
- *Terminal units:* water source heat pump replacement with high efficiency units

Other recommended project implementations:

- *Windows:* replace all existing units with new high-performance insulated glass units (IGU)
- *Lighting and plug loads:* replace all existing lighting systems, fixtures/lamps with their LED equivalent, and install EnergyStar rated appliances and office equipment

Second stage (Years 6 to 10) – ZCB Certification

- *Heating plant*: replace existing heating boilers with high efficiency condensing boilers
- *Domestic hot water*: replace existing gas fired heater with a hybrid heat pump water heater
- *Renewable energy systems*: Installation of a carport solar photovoltaic (PV) system in the existing outdoor parking lot

11.2.2 Performance and Lifecycle Cost Analysis (LCCA) Results

Table 13

LCCA (20-year period):	Unit	Pathway 1
Total Construction Cost	$CAD	$3,220,900
Incentives and Grants[10]	$CAD	$424,274
Net Present Value	$CAD	$442,238
Internal Rate of Return	-	3.7%

Table 14

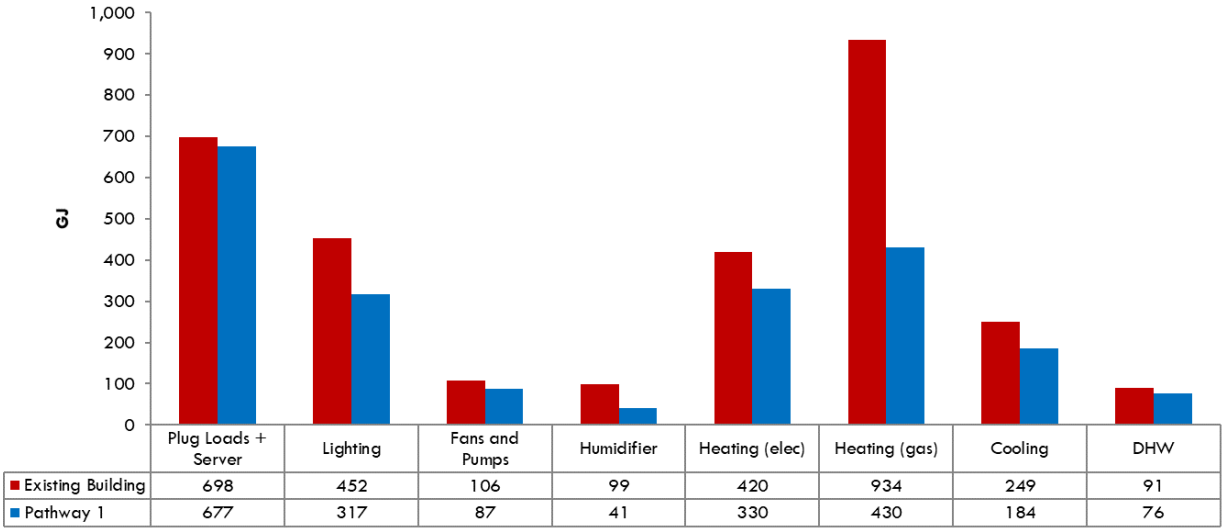
TOTAL ANNUAL:	Unit	Pathway 1	Savings
Energy Consumption	kWh	596,240	30%
Electricity Consumption	kWh	455,636	21%
Natural Gas Consumption	kWh	140,604	51%
Energy Cost	$CAD (yr.1)	$81,035	21%
GHG Emissions	$kgCO_2e$	35,167	45%
On-site Electricity Generation	kWh	228,918	-
	$CAD (yr.1)	$77,425	-
GHG Offsets Required	$CAD (yr.1)	$612	-

[10] Federation of Canadian Municipalities (FCM), Green Municipal Fund, Capital Project – Retrofit of Municipal Facilities (grant portion only, loans not included)

11.2.3 Energy Modelling Results

Table 15

	Electricity Consumption (kWh)		Natural Gas Consumption (kWh)	
	Calibrated Model	**Pathway 1**	**Calibrated Model**	**Pathway 1**
January	66,998	53,681	67,195	35,236
February	55,825	44,663	51,391	26,306
March	53,051	42,512	39,742	19,473
April	39,178	31,463	18,878	7,356
May	36,527	30,033	5,849	2,348
June	42,481	34,350	2,389	1,797
July	48,249	38,399	2,115	1,776
August	47,405	38,092	2,226	1,871
September	37,064	30,896	4,806	1,838
October	35,518	29,388	11,715	4,259
November	46,215	37,581	31,572	14,881
December	55,390	44,578	46,600	23,463
TOTAL	**563,901**	**455,636**	**284,478**	**140,604**



	Plug Loads + Server	Lighting	Fans and Pumps	Humidifier	Heating (elec)	Heating (gas)	Cooling	DHW
Existing Building	698	452	106	99	420	934	249	91
Pathway 1	677	317	87	41	330	430	184	76

11.3 Pathway 2 – Geothermal

This pathway to ZCB certification involves an overhaul of the building's central heating and cooling plants to incorporate a geothermal exchange-based system. The existing heat pump hydronic loop will remain in place. Improvements to building automation and controls, as well as building envelope retrofit work will be included.

Advantages:

- Use of existing building distribution network (heat pump hydronic loop)
- Potential for full site electrification
- Ability to tie in with capital projects already planned

Disadvantages:

- Implementation time and complexity (geothermal borehole field)

The retrofit pathway includes the following elements and performance requirements over its 10-year implementation plan:

Heating, Ventilation, and Air Conditioning (HVAC):

- **Central plant:** install geothermal system and borehole field to provide heat rejection/absorption to existing heat pump loop
  - 40 to 60 boreholes (est.) depending on depth of drilling that can be achieved
  - Existing heating boilers and cooling tower to be used as backup for geothermal system
- **Ventilation:** replace existing MUA with a water source heat pump unit
  - To be integrated into existing heat pump loop, and eventually geothermal loop
  - Maximum supply air capacity of 4,600 CFM (Accounts for 200 staff, and 50% increase in total building floor area)
  - Equipped with variable frequency drive (VFD) control
  - Energy recovery ventilation (ERV) with building exhaust fans ("EF-3 and EF-4")
  - Implement demand control ventilation strategy based on occupancy of zones (control system described in Section 11.1)
- **Terminal units:** replace all water source heat pumps with high efficiency units
  - Must be compatible with traditional heat pump loops and geothermal loops
  - Minimum coefficient of performance (COP): 3.8 (cooling), 4.3 (heating)
  - 2-speed (or variable speed) fan operation

Domestic Hot Water (DHW):

- Replace existing gas fired DHW heater with a hybrid heat pump water heater

11.3.1 Implementation, Scheduling and Logistics

First stage (Years 1 to 5)

Capital projects already planned:

- *Ventilation:* MUA replacement with features outlined above
- *Building control and automation:* BAS installation with features outlined above
- *Terminal units:* water source heat pump replacement with high efficiency units

Other recommended project implementations:

- *Windows:* replace all existing units with new high-performance insulated glass units (IGU)
- *Lighting and plug loads:* replace all existing lighting systems, fixtures/lamps with their LED equivalent, and install EnergyStar rated appliances and office equipment

Second stage (Years 6 to 10) – Target ZCB Certification

- *Central plant:* Install geothermal system and integrate into existing hydronic heat pump loop
- *Domestic hot water:* replace existing gas fired heater with a hybrid heat pump water heater
- *Renewable energy systems*: Installation of a carport solar photovoltaic (PV) system in the existing outdoor parking lot

11.3.2 Option Performance and Preliminary Cost Analysis

Table 16

LCCA (20-year period):	Unit	Pathway 2
Total Construction Cost	$CAD	$3,559,200
Incentives and Grants[11]	$CAD	$459,028
Net Present Value	$CAD	($25,697)
Internal Rate of Return	-	2.4%

Table 17

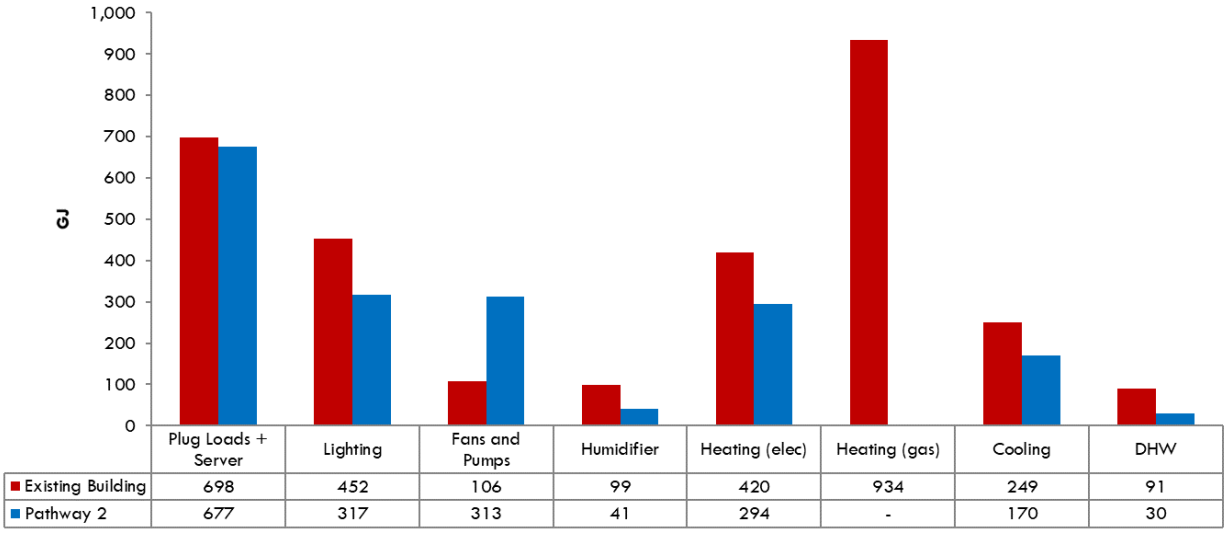
TOTAL ANNUAL:	Unit	Pathway 2	Savings
Energy Consumption	kWh	511,601	40%
Electricity Consumption	kWh	511,601	11%
Natural Gas Consumption	kWh	-	100%
Energy Cost	$CAD (yr.1)	$86,972	16%
GHG Emissions	$kgCO_2e$	10,232	84%
On-site Electricity Generation	kWh	228,918	-
	$CAD (yr.1)	$77,425	-
GHG Offsets Required	$CAD (yr.1)	$113	-

[11] Federation of Canadian Municipalities (FCM), Green Municipal Fund, Capital Project – Retrofit of Municipal Facilities (grant portion only, loans not included)

11.3.3 Energy Modelling Results

Table 18

	Electricity Consumption (kWh)		Natural Gas Consumption (kWh)	
	Calibrated Model	**Pathway 2**	**Calibrated Model**	**Pathway 2**
January	66,998	62,725	67,195	-
February	55,825	53,034	51,391	-
March	53,051	50,868	39,742	-
April	39,178	37,076	18,878	-
May	36,527	32,098	5,849	-
June	42,481	35,196	2,389	-
July	48,249	39,125	2,115	-
August	47,405	38,920	2,226	-
September	37,064	32,578	4,806	-
October	35,518	33,123	11,715	-
November	46,215	44,144	31,572	-
December	55,390	52,713	46,600	-
TOTAL	**563,901**	**511,601**	**284,478**	-



11.4 Pathway 3 – HVAC Overhaul

This pathway to ZCB certification involves an overhaul of the building's central heating and cooling plants to incorporate an air source VRF based plant. The existing heat pump hydronic loop must be decommissioned and replaced with the new refrigerant network throughout the building. Improvements to building automation and controls, as well as building envelope retrofit work will be included.

Advantages:

- Superior zoning control and heat recovery potential between zones requiring simultaneous heating and cooling
- Potential for full site electrification

Disadvantages:

- Significant overhaul of existing HVAC systems and distribution network – potential for more disruption to building operation and staff during construction
- Potential for equipment disposal before end of useful lifetime

The retrofit pathway includes the following elements and performance requirements over its 10-year implementation plan:

Heating, Ventilation, and Air Conditioning (HVAC):

- **Central plant:** install an air source VRF system and associated refrigerant distribution network throughout building
    - Decommission (remove if necessary) entire hydronic distribution network
    - Minimum COP: 3.2 (heating), 2.73 (cooling)
    - Equipped with heat recovery capabilities
- **Ventilation:** replace existing MUA with an air source heat pump unit
    - Maximum supply air capacity of 4,600 CFM (Accounts for 200 staff, and 50% increase in total building floor area)
    - Equipped with variable frequency drive (VFD) control
    - Energy recovery ventilation (ERV) with building exhaust fans ("EF-3 and EF-4")
    - Implement demand control ventilation strategy based on occupancy of zones (control system described in Section 11.1)
- **Terminal units:** remove all water source heat pumps and replace with VRF indoor units
    - Ducted VRF units to be installed in same locations as existing heat pumps, or non-ducted units placed in applicable zones
    - Incorporate server room into VRF network and remove existing AC unit

Domestic Hot Water (DHW):

- Replace existing gas fired DHW heater with a hybrid heat pump water heater

11.4.1 Implementation, Scheduling and Logistics

First stage (Years 1 to 5) – Target 40% Energy Reduction

Capital projects already planned:

- *Ventilation:* replace MUA with features as outlined above
- *Building control and automation:* install BAS with features as outlined above
- *Terminal units:* replace all water source heat pumps with high efficiency units

Other recommended project implementations:

- *Windows:* replace all existing units with new high-performance insulated glass units (IGU)
- *Lighting and plug loads:* replace all existing lighting systems, fixtures/lamps with their LED equivalent, and install EnergyStar rated appliances and office equipment

Second stage (Years 6 to 10) – Target ZCB Certification

- *Central plant:* Install air source VRF system and associated refrigerant network and indoor terminal units. Decommission existing hydronic network, plants and heat pumps
- *Domestic hot water:* replace existing gas fired heater with a hybrid heat pump water heater
- *Renewable energy systems*: Installation of a carport solar photovoltaic (PV) system in the existing outdoor parking lot

11.4.2 Option Performance and Preliminary Cost Analysis

Table 19

LCCA (20-year period):	Unit	Pathway 3
Total Construction Cost	$CAD	$3,311,500
Incentives and Grants[12]	$CAD	$425,377
Net Present Value	$CAD	$30,383
Internal Rate of Return	-	2.6%

Table 20

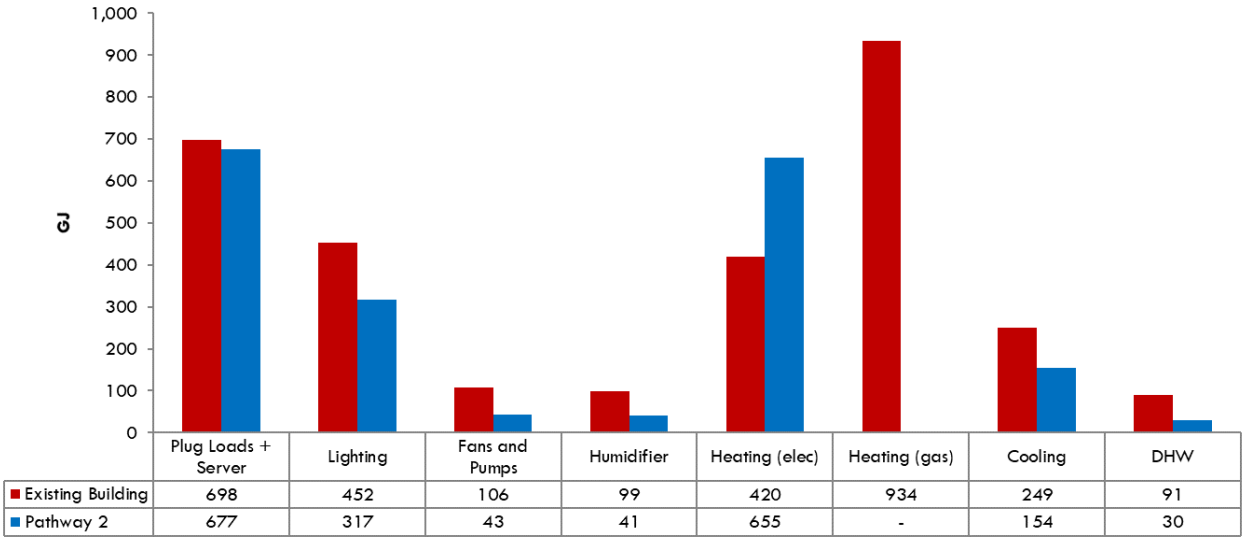
TOTAL ANNUAL:	Unit	Pathway 3	Savings
Energy Consumption	kWh	532,292	37%
Electricity Consumption	kWh	532,292	8%
Natural Gas Consumption	kWh	-	100%
Energy Cost	$CAD (yr.1)	$90,490	12%
GHG Emissions	$kgCO_2e$	10,646	83%
On-site Electricity Generation	kWh	228,918	-
	$CAD (yr.1)	$77,425	-
GHG Offsets Required	$CAD (yr.1)	$121	-

[12] Federation of Canadian Municipalities (FCM), Green Municipal Fund, Capital Project – Retrofit of Municipal Facilities (grant portion only, loans not included)

11.4.3 Energy Modelling Results

Table 21

	Electricity Consumption (kWh)		Natural Gas Consumption (kWh)	
	Calibrated Model	**Pathway 3**	**Calibrated Model**	**Pathway 3**
January	66,998	74,722	67,195	-
February	55,825	63,815	51,391	-
March	53,051	55,741	39,742	-
April	39,178	36,245	18,878	-
May	36,527	30,901	5,849	-
June	42,481	31,668	2,389	-
July	48,249	33,513	2,115	-
August	47,405	33,408	2,226	-
September	37,064	30,385	4,806	-
October	35,518	31,261	11,715	-
November	46,215	48,401	31,572	-
December	55,390	62,232	46,600	-
TOTAL	**563,901**	**532,292**	**284,478**	**-**



11.5 Pathway 4 – Maximum Savings

This pathway to ZCB certification involves an overhaul of the building's central heating and cooling plants to incorporate a water source VRF based plant coupled to a geothermal exchange field. The existing heat pump hydronic loop must be removed and replaced with the new refrigerant network throughout the building. Improvements to building automation and controls, as well as building envelope retrofit work will be included.

Advantages:

- Maximum overall savings (energy consumption and GHG emissions)
- Superior zoning control and heat recovery potential between zones requiring simultaneous heating and cooling
- Potential for full site electrification

Disadvantages:

- Significant overhaul of existing HVAC systems and distribution network – potential for more disruption to building operation and staff during construction
- Potential for equipment disposal before end of useful lifetime
- Implementation time and complexity (geothermal borehole field)

The retrofit pathway includes the following elements and performance requirements over its 10-year implementation plan:

Heating, Ventilation, and Air Conditioning (HVAC):

- **Central plant:** Install a water source VRF system and associated refrigerant distribution network throughout building
  - Decommission (remove if necessary) entire hydronic distribution network
  - Minimum COP: 2.8 (heating), 3.16 (cooling)
  - Equipped with heat recovery capabilities
  - Install a geothermal exchange field coupled to water source VRF units to provide heat rejection/absorption
  - 40 to 60 boreholes (est.) depending on depth of drilling that can be achieved
- **Ventilation:** replace existing MUA with a water source heat pump unit
  - To be integrated into existing heat pump loop, and eventually geothermal loop
  - Maximum supply air capacity of 4,600 CFM (Accounts for 200 staff, and 50% increase in total building floor area)
  - Equipped with variable frequency drive (VFD) control
  - Energy recovery ventilation (ERV) with building exhaust fans ("EF-3 and EF-4")
  - Implement demand control ventilation strategy based on occupancy of zones (control system described in Section 11.1)
- **Terminal units:** remove all water source heat pumps and replace with VRF indoor units
  - Ducted VRF units to be installed in same locations as existing heat pumps, or non-ducted units placed in zones where applicable
  - Incorporate server room into VRF network and remove existing AC unit

Domestic Hot Water (DHW):

- Replace existing gas fired DHW heater with a hybrid heat pump water heater

11.5.1 Implementation, Scheduling and Logistics

First stage (Years 1 to 5) – Target 40% Energy Reduction

Capital projects already planned:

- *Ventilation:* replace MUA with features as outlined above
- *Building control and automation:* install BAS with features as outlined above
- *Terminal units:* replace all water source heat pumps with high efficiency units

Other recommended project implementations:

- *Windows:* replace all existing units with new high-performance insulated glass units (IGU)
- *Lighting and plug loads:* replace all existing lighting systems, fixtures/lamps with their LED equivalent, and install EnergyStar rated appliances and office equipment

Second stage (Years 6 to 10) – Target ZCB Certification

- *Central plant*: install a water source VRF system, associated refrigerant network and indoor terminal units. Decommission existing hydronic network, plants and heat pumps
- Install a geothermal exchange field coupled to VRF units to provide heat rejection/absorption
- *Domestic hot water*: replace existing gas fired heater with a hybrid heat pump water heater
- *Renewable energy systems*: installation of a carport solar photovoltaic (PV) system in the existing outdoor parking lot

11.5.2 Option Performance and Preliminary Cost Analysis

Table 22

LCCA (20-year period):	Unit	Pathway 4
Total Construction Cost	$CAD	$3,815,100
Incentives and Grants[13]	$CAD	$493,586
Net Present Value	$CAD	$59,818
Internal Rate of Return	-	2.7%

Table 23

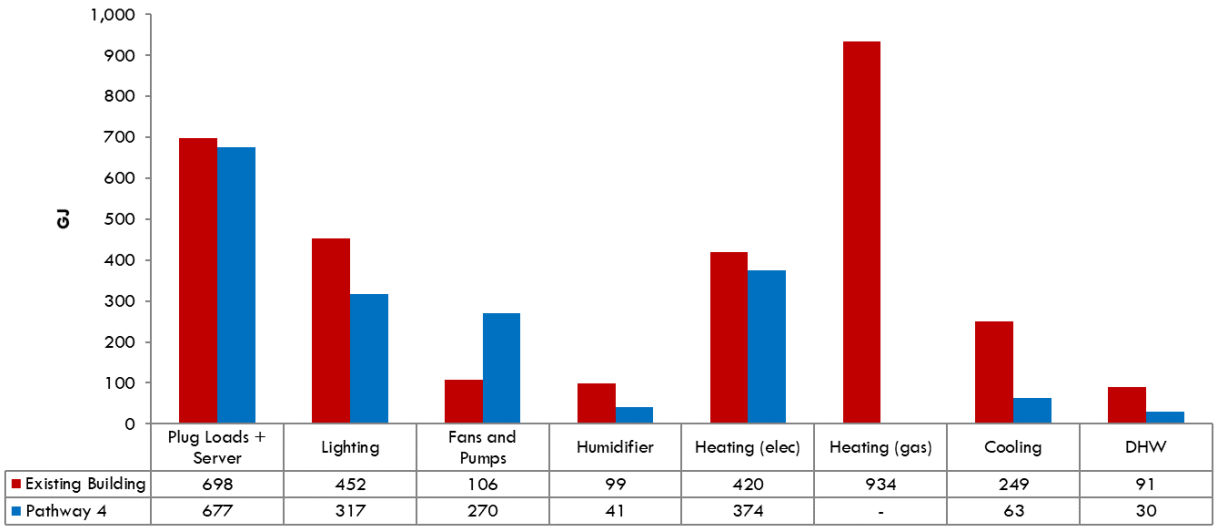
TOTAL ANNUAL:	Unit	Pathway 4	Savings
Energy Consumption	kWh	492,298	42%
Electricity Consumption	kWh	492,298	15%
Natural Gas Consumption	kWh	-	100%
Energy Cost	$CAD (yr.1)	$83,691	19%
GHG Emissions	$kgCO_2e$	9,846	85%
On-site Electricity Generation	kWh	228,918	-
	$CAD (yr.1)	$77,425	-
GHG Offsets Required	$CAD (yr.1)	$105	-

[13] Federation of Canadian Municipalities (FCM), Green Municipal Fund, Capital Project – Retrofit of Municipal Facilities (grant portion only, loans not included)

11.5.3 Energy Modelling Results

Table 24

	Electricity Consumption (kWh)		Natural Gas Consumption (kWh)	
	Calibrated Model	**Pathway 4**	**Calibrated Model**	**Pathway 4**
January	66,998	61,349	67,195	-
February	55,825	52,020	51,391	-
March	53,051	50,717	39,742	-
April	39,178	37,933	18,878	-
May	36,527	32,365	5,849	-
June	42,481	31,123	2,389	-
July	48,249	32,152	2,115	-
August	47,405	32,469	2,226	-
September	37,064	30,705	4,806	-
October	35,518	34,062	11,715	-
November	46,215	44,779	31,572	-
December	55,390	52,624	46,600	-
TOTAL	**563,901**	**492,298**	**284,478**	**-**



	Plug Loads + Server	Lighting	Fans and Pumps	Humidifier	Heating (elec)	Heating (gas)	Cooling	DHW
Existing Building	698	452	106	99	420	934	249	91
Pathway 4	677	317	270	41	374	-	63	30

11.6 Results Summary

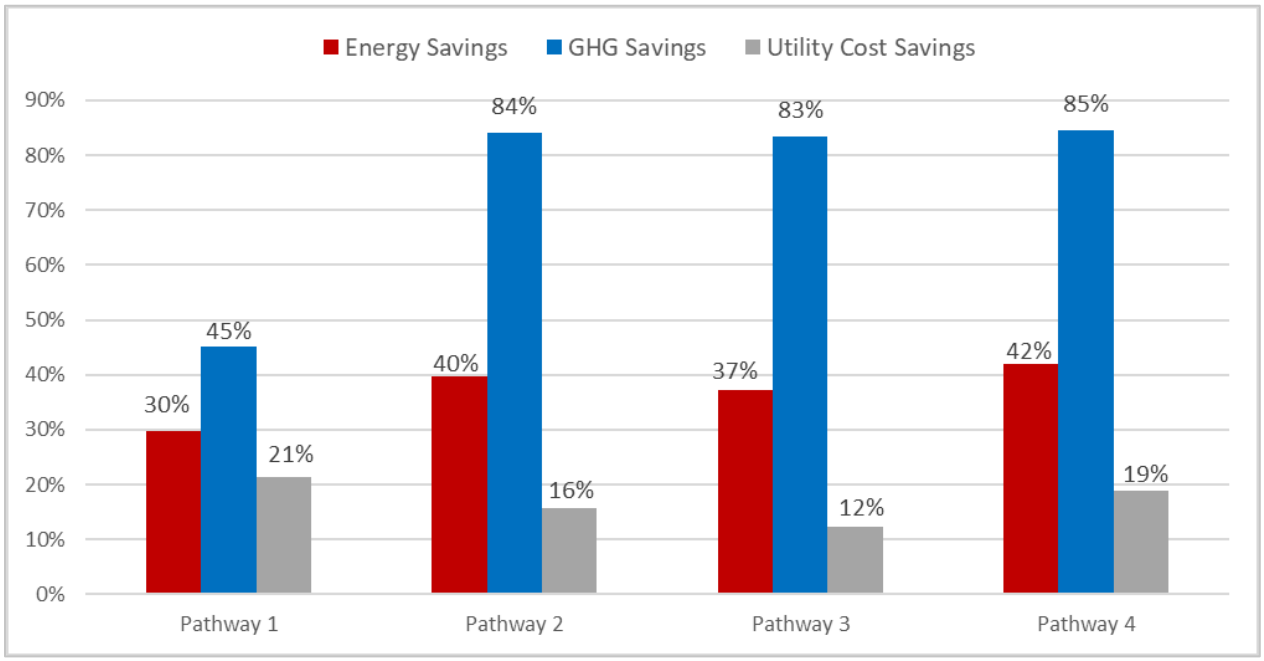
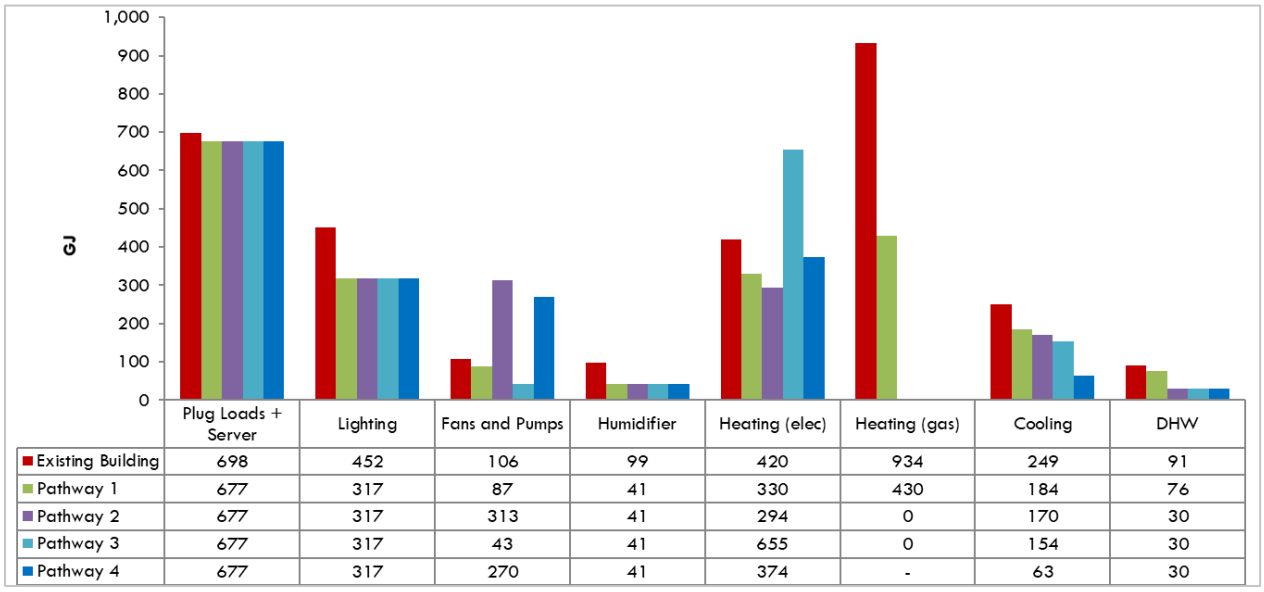


Figure 22



	Plug Loads + Server	Lighting	Fans and Pumps	Humidifier	Heating (elec)	Heating (gas)	Cooling	DHW
Existing Building	698	452	106	99	420	934	249	91
Pathway 1	677	317	87	41	330	430	184	76
Pathway 2	677	317	313	41	294	0	170	30
Pathway 3	677	317	43	41	655	0	154	30
Pathway 4	677	317	270	41	374	-	63	30

Figure 23

12 MEASUREMENT AND VERIFICATION

A critical aspect of any high performance retrofit comes after all projects are commissioned and involves the measurement and verification (M&V) of the energy, utility and GHG emissions savings that were projected. The M&V process is not only recommended, but it is required (in part) for successful certification under CaGBC's Zero Carbon Building performance standard (v2), which requires the submission of 12 months of operational utility data. Although to achieve ZCB performance standard certification, there is no requirement for energy and GHG emissions savings, it is recommended to complete the M&V process as it will serve as useful learning experience for the Town and will highlight where individual projects have been successful (savings are verified/as expected) or unsuccessful (savings are not as expected).

The purpose of this section is to provide a plan for the M&V process as outlined by the International Performance Measurement & Verification Protocol (IPMVP) and to ensure that the total energy and GHG emissions savings resulting from the retrofit can be verified. The intent of this plan is to establish guidance and concepts to accurately determine the savings by using the principles as described by the IPMVP. The IPMVP provides the framework and broad approach to the techniques used for the determination of savings associated with conservation strategies. There are four options for M&V that include Option A – Retrofit Isolation with key parameter measurement, Option B – Retrofit Isolation with all parameter measurement, Option C – Whole Facility, Option D – Calibrated Simulation.

The retrofit of the Town Hall will involve several different projects, that will occur over an approximate 10-year period, with expected project overlap. As such, it becomes difficult to perform M&V on individual projects using the Option C (Whole Facility) approach which relies on utility bill data over a certain period. It will be possible to perform M&V on a select number of individual projects, such as the lighting retrofit and the makeup air fan savings, using the Option A (Retrofit Isolation with key parameter measurement) or Option B (Retrofit Isolation with all parameter measurement). M&V using Option A or Option B involves the direct measurement of one or more variables before and after retrofit. The energy consumption associated with these projects are typically not seasonally or weather dependent, and therefore can be determined over a shorter time period of 1 to 2 weeks, or up to a month. A summary of the recommended ECMs that M&V can be performed on an individual basis are summarized below in

In order to facilitate accurate M&V of the projects, it is also recommended to install sub-meters (electrical and natural gas) to directly measure the utility consumption of key pieces of equipment. These sub-meters can be specified to be installed as part of the project implementation.

Table 25

	Measure/Analyze:	Sub-meter	IPMVP Option
MUA replacement	MUA electrical supply	N/A	Option A
Boiler replacement	N/A	Boilers gas supply	Sub-meter
Photovoltaic system	N/A	PV system production	Sub-meter
DHW retrofit	Natural gas utility bills (summer)	N/A	Option C
Lighting retrofit	Lighting electrical panels (all) **or** operating hours of all lighting systems via new BAS	N/A	Option A

M&V of individual projects that are weather dependent poses a challenge, as measurement would typically be required pre and post retrofit for the entire season (heating or cooling). For example, direct M&V of the natural gas savings associated with the heating boiler replacement or MUA replacement would require pre and post retrofit measurement for the entire heating season and would also require the installation of a natural gas sub-meter on the associated piece of equipment.

Since it will be impossible to measure all project savings individually, the overall M&V approach for the Town Hall should be Option C (Whole Facility) and should occur upon the completion and commissioning of all projects. At this point, a 12-month utility bill analysis can be performed, and overall savings can be determined via a weather normalized approach. Weather normalization of the pre and post retrofit utility data will result in calculated savings that are not influenced by weather differences between the pre and post retrofit period.

13 ADDITIONAL CONSIDERATIONS

13.1 Future Building Expansion

From discussions with Halton Hills staff, it is understood that there is a possibility that the Town Hall building will be expanded in the short-term future in order to accommodate for a growing workforce. Several expansion concepts were being developed for consideration at the time of this report generation. Expansion concepts are likely to incorporate a development of expanded public and service areas to the North and East of the Council Chambers and/or further expansion to the Southern areas of the building

The potential expansion of the Town Hall during the 10-year retrofit plan, would have an impact on several aspects of design and project implementation, however since at the time of this report it is a theoretical idea, these considerations have not been taken into account.

The first consideration, as discussed in Section 0, involves the potential renewable energy systems that may result with a building expansion. The need for additional parking spaces with the increased occupancy of the building may create the need for the construction of a new parking structure on the site, which would present the opportunity for additional PV capacity and system installation. In addition, the expansion has been discussed as taking place on the southeast portion of the building, which encompasses the curtainwall section. This presents the opportunity to re-design this façade of the building and open the discussion to building integrated photovoltaics (BIPV) to replace the curtainwall.

Upon building expansion, it is likely that the new section of the building will have a standalone HVAC system, isolated from the systems in the original building. If the building expansion took place simultaneously as a combined project with an HVAC system retrofit, it would be possible to integrate the two systems. However, if the expansion is completed before or after the main building's HVAC system retrofit, it would force the systems to have to be sized and designed independently.

13.2 Coronavirus (COVID-19) Impacts

Although the future impacts of the novel coronavirus (COVID-19) are completely unpredictable and unknown, there are several considerations that should be noted which concern the planning and implementation of this retrofit.

13.2.1 HVAC Systems Operation

Since COVID-19 was declared a global pandemic in March 2020, there has been an abundance of research and testing performed across all industries in an attempt to discover methods to help alleviate the presence of the virus in our built environment. Many of these methods have been concentrated on a building's ventilation system, since the virus spreads primarily through airborne droplets and particles, expelled when an infected person breathes, speaks, coughs, or sneezes. Generally, these droplets fall to the ground or other surfaces, while smaller particles can travel in the air for longer distances. It should be noted that this form of virus transmission (airborne) is still not fully understood, and basic principles of social distancing,

surface cleaning and disinfection, handwashing and other strategies of good hygiene are far more important than anything related to the HVAC system[14].

ASHRAE has released the following two formal statements regarding the transmission of the virus and the operation of HVAC systems during the pandemic:

> *Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.*
>
> *Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.*

A formal position document on infectious aerosols (airborne viruses) was released by ASHRAE in April 2020. ASHRAE's positions, pertinent to this design brief, are summarized as follows[15]:

Table 26

Evidence Lvl.	Description
A	Strongly recommend; good evidence
B	Recommend; at least fair evidence
C	No recommendation for or against; balance of benefits and harms too close to justify a recommendation
D	Recommend against; fair evidence is ineffective, or the harm outweighs the benefit
E	Evidence is insufficient to recommend for or against routinely; evidence is lacking or of poor quality; benefits and harms cannot be determined

- The design and construction team, including HVAC designers, should engage in an integrated design process in order to incorporate the appropriate infection control bundle in the early stages of design.
- Based on risk assessments, buildings and transportation vehicles should consider designs that promote cleaner airflow patterns for providing effective flow paths for airborne particulates to exit spaces to less clean zones and use appropriate air-cleaning systems. (Evidence Level A)
- Based on risk assessments, the use of specific HVAC strategies supported by the evidence-based literature should be considered, including the following:
    - Enhanced filtration (higher minimum efficiency reporting value [MERV] filters over code minimums in occupant-dense and/or higher-risk spaces) (Evidence Level A)

[14] Non-health care workplaces fall into the medium and lower exposure risk categories described in Guidance on Preparing Workplaces for COVID-19, U.S. Department of Labor, Occupational Safety and Health Administration OSHA 3990-03 2020.

[15] ASHRAE Position Document on Infectious Aerosols, approved April 14, 2020, expires April 14, 2023. (https://www.ashrae.org/about/position-documents)

  - Upper-room UVGI (with possible in-room fans) as a supplement to supply airflow (Evidence Level A)
  - Local exhaust ventilation for source control (Evidence Level A)
  - Personalized ventilation systems for certain high-risk tasks (Evidence Level B)
  - Portable, free-standing high-efficiency particulate air (HEPA) filters (Evidence Level B)
  - Temperature and humidity control (Evidence Level B)
- Non-healthcare buildings should have a plan for an emergency response. The following modifications to building HVAC system operation should be considered:
  - Increase outdoor air ventilation (disable demand-controlled ventilation and open outdoor air dampers to 100% as indoor and outdoor conditions permit).
  - Improve central air and other HVAC filtration to MERV-13 (ASHRAE 2017b) or the highest level achievable
  - Keep systems running longer hours (24/7 if possible)
  - Add portable room air cleaners with HEPA or high-MERV filters with due consideration to the clean air delivery rate (AHAM 2015)
  - Add duct- or air-handling-unit-mounted, upper room, and/or portable UVGI devices in connection to in-room fans in high-density spaces such as waiting rooms,
  - Maintain temperature and humidity as applicable to the infectious aerosol of concern.
  - Bypass energy recovery ventilation systems that leak potentially contaminated exhaust air back into the outdoor air supply.

13.2.2 Office Operation and Occupancy

It is expected that the pandemic will have a lasting effect on office occupancy patterns and team working dynamics, with many large employers implementing an indefinite “work from home” order. Many of the control and BAS strategies presented in this report will benefit the building operation in these scenarios. With variable occupancy patterns expected, an occupancy-based BAS such as the one proposed in this design brief will result in significant energy and GHG emissions savings. However, it should be noted that a complete shutdown of the building’s ventilation systems during unoccupied periods is not recommended during pandemic or emergency response scenarios as stated in the previous section.

13.3 Implementation – Logistics and Staff Disruption

Developing an accurate timeline for the implementation of any of the proposed Pathways in the report would require some information that is not readily available at the time of this report. Significant items that will impact the overall implementation schedule would be the following:

- Potential impacts due to the COVID-19 global pandemic
- Time of year of project kick-off and resulting construction scheduling (seasonality factor)
- Lead time of equipment
- Coordination with utilities for any net metering of renewable energy
- Selected contractors’ workload
- Organization with fire department to find alternative short-term building for operations

It is expected that regardless of the Pathway that is selected there will be significant efforts made in developing a timeline and schedule that will work with all the stakeholders. It should also be a priority of the project to allow for the proper time after the completion of the project to ensure the proper commissioning and training are provided to the building staff.

In general, engineering design for the various options is expected to take between four to six months to finalize. Several disciplines and specializations will be needed to complete some final assessments of the

building and then to optimize design. This feasibility report should provide the basis for the understanding of the building and provide recognition of the options that are available to provide the desired outcome. The preliminary drawings developed in this process will provide the basis for the tender documents that would go through an expected two-month bidding process. Final selection of the contractor may take another two months followed by a final month for contract signing and finalization of typical building permits.

All Pathways presented in this report involve significant work to the building, and disruption to the daily routines of staff is inevitable. However, there are strategies that can be implemented to minimize this disruption such as seasonal timing of the implementation of the various renewal components, relocation of some staff members (if possible) and staff engagement and education. Current building occupancy rates and patterns due to the COVID-19 pandemic may prove to be favorable towards the logistics of the building retrofit. With the building expected to remain at partial occupancy for the foreseeable future, staff disruption may be minimized in certain cases. If necessary, staff can be relocated for a period during the 10-year retrofit process. This relocation cost can be accounted for in the contingency item as seen in the cost estimates.

13.4 Climate Change Impact

Summer temperatures are rising in many parts of the world, including in Canada. The number of cooling degree days in a year has been consistently increasing due to climate change, and this trend is not expected to stop. As a result, maintaining a comfortable environment for all staff and providing adequate cooling is becoming an increasing priority.

All retrofit pathways presented in this report include the installation of robust cooling systems that have the ability and potential to meet the future required cooling demand of the local weather conditions. However, it should be mentioned that this impact should be taken into consideration once the design phase for the associated projects begins.

13.5 Rising Utility Costs

Local utility (electricity, natural gas and water) rates are expected to continue to rise on an annual basis partially due to the federal carbon tax. This is incorporated in the financial life cycle cost analysis with annual utility rate escalations of 2% and 5.9% for natural gas and electricity respectively.

13.6 Future Incentives and Funding Opportunities

With the federal carbon tax being upheld and the current governments commitment to addressing climate change, it is clear that there will be future incentives and funding opportunities available to help reduce GHG emissions for groups such as the MUSH sector (municipalities, universities, colleges, schools and hospitals), small and medium sized enterprises, and not-for profit organizations.

Details on these programs are not known yet, however it is important to keep in mind moving forward as the Town is looking to implement high performance retrofits across its entire building portfolio.

13.7 System Redundancy and Backup

Heating is a critical load in a cold climate such as Ontario. Although DHW is also vital in some building types, more flexibility can be observed from building occupants for this load, especially in office buildings. The existing Town Hall currently has redundancy built into its central heating plant (2 boilers), as well as

the ability for the MUA and electric baseboards to partially meet the heating load if the boiler plant were to fail.

The site is able to maintain critical functions as a result of a fuel powered backup generator located on-site. All presented retrofit Pathways will provide redundancy with two or more pieces of central plant (heating and cooling) equipment being installed, with backup provided by the backup generator in the case of Pathways 2, 3 and 4. It should noted that with Pathways 2, 3 and 4, it is recommended to re-evaluate the size of the backup generator and potentially install a larger capacity unit to accommodate for the additional electrical loads.

13.8 Fuel Switching

A consideration for Pathways 2, 3 and 4 is fuel switching and the impact it will have on the project cost and environment. In general, fuel switching from natural gas (on-site combustion) to electricity has a positive impact on site greenhouse gas (GHG) emissions. This impact is only expected to improve over the coming years as Ontario's power generation methods become "cleaner" and high GHG emitting sources of electricity generation continue to be eliminated. However, operational cost savings are diminished when fuel switching from natural gas to electricity due to current utility prices in Ontario.

When significant shifting of loads from natural gas to electricity take place, consideration must be paid to the existing electrical distribution service at the site and its potential need for upgrade. It is expected that the retrofit Pathways presented would not involve any significant upgrades to the existing electrical distribution system, due to the overall reduction of electrical load as a result of the high-performance renewal.

14 SUMMARY, RECOMMENDATIONS AND NEXT STEPS

Internat Energy Solutions Canada (IESC) has completed a low carbon design brief and feasibility study for the Town of Halton Hills assessing the technical and financial feasibility of performing a high-performance building renewal to achieve Zero Carbon Building certification at the existing Town Hall building.

The low carbon retrofit of the Town Hall is an important step for the Town of Halton Hills to undertake in the pursuit of its aggressive energy efficiency and GHG emission reduction goals and targets set forth for the coming years. A successful building renewal can serve as an example and retrofit template for many of the other buildings in Halton Hills moving forward, which is very valuable.

Certain strategies and technologies implemented here can also be applied to many of the Town's other building types in its portfolio. For example, the use of heat pump-based technology in retrofits, building envelope retrofit work, and on-site renewable energy generation. Lessons learned in the design and implementation of these strategies and technologies will serve the Town well as they move forward into their building portfolio retrofit.

Four high performance retrofit Pathways have been presented and analyzed in this report. At this time there is significant funding available from the Green Municipal Fund offered by the Federation of Canadian Municipalities (FCM), in the form of a loan and/or grant. It is recommended to take full advantage of all available funding sources at this time and pursue a high-performance building renewal that can be used as a showcase in the community and serve as framework for the rest of the Town's building portfolio retrofits. Although it is expected that there will be funding sources available for some time to come, there is no guarantee that these opportunities will continue to be available.

Going through the process of delivering a Zero Carbon Building certified renewal will be a very important experience for the Town, and the lessons learned from a project such as this will be beneficial moving forward. It will provide familiarity with the associated low-carbon technologies and develop the required internal knowledge in order to succeed in the GHG emission reduction goals set forth by the Town.

It is recommended for the Town to pursue a geothermal based system retrofit (Pathway 2 or 4), as this approach utilizes a renewable and passive source of energy and allows for the complete electrification of the site. In addition, the Town has experience with the implementation and operation of these systems in other buildings which will serve as an advantage. Although Pathway 4 is slightly more attractive from a financial perspective, key advantages to Pathway 2 over Pathway 4 include a lower associated residual value (decommissioning of building equipment before end of useful life), a less complex design and implementation process, and decreased staff impact.

In the event that the Town faces a budget restriction related to this project, it is recommended to implement Pathway 1, as it is the most attractive option from a financial perspective. In addition, implementation of this option allows for future work at the building, and the potential to transition to a Zero Carbon Building.

The Town should evaluate all factors and considerations presented in this report when making the decision on how to pursue Zero Carbon Building certification of the Town Hall, and when developing the 10-year retrofit plan for the building. Upon identification of the desired plan of action, a high-level implementation plan should be assembled, taking into account lifecycle of existing building systems and planned capital projects.

The table on the following page summarizes the key financial, energy, and GHG considerations for each Pathway.

Table 27

Pathway	Description	Total Construction Costs[16]	Incentives & Grants	O&M Costs[17] (20 years)	Annual Energy Costs (present value)	Annual Energy Consumption	Annual GHG Emissions	Net Present Value[18]	Internal Rate of Return[4]
		$CAD				ekWh	$kgCO_2e$	$CAD	-
1	Optimize Existing	$3,220,900	$424,274	$105,245	$81,035 (21% ↓)	596,240 (30% ↓)	35,167 (45% ↓)	$422,238	3.7%
2	Geothermal	$3,559,200	$459,028	$81,559	$86,972 (16% ↓)	511,601 (40% ↓)	10,232 (84% ↓)	($25,697)	2.4%
3	HVAC Overhaul	$3,311,500	$425,377	$88,581	$90,490 (12% ↓)	532,292 (37% ↓)	10,646 (83% ↓)	$30,383	2.6%
4	Maximum Savings	$3,815,100	$493,586	$88,581	$83,691 (19% ↓)	494,298 (42% ↓)	9,846 (85% ↓)	$59,818	2.7%

[16] Construction costs have been based on the preliminary designs developed by IESC and have been prepared by a third-party cost consultant. The Class C cost report is included in Appendix D – Cost Estimate Reports (Class C). Cost estimates exclude consultant fees, land acquisition costs, permits and development charges, soil testing, construction or project management fees, independent inspection and testing, legal fees, disbursements, owner supplied furnishings, fixtures and equipment, operational expenses, financing, loan fees and interest charges, building renewal items not associated with energy efficiency upgrades, VFRS temporary relocation costs, Harmonized Sales Tax (HST)

[17] Only with respect to equipment and measures presented in this report and within each Pathway.

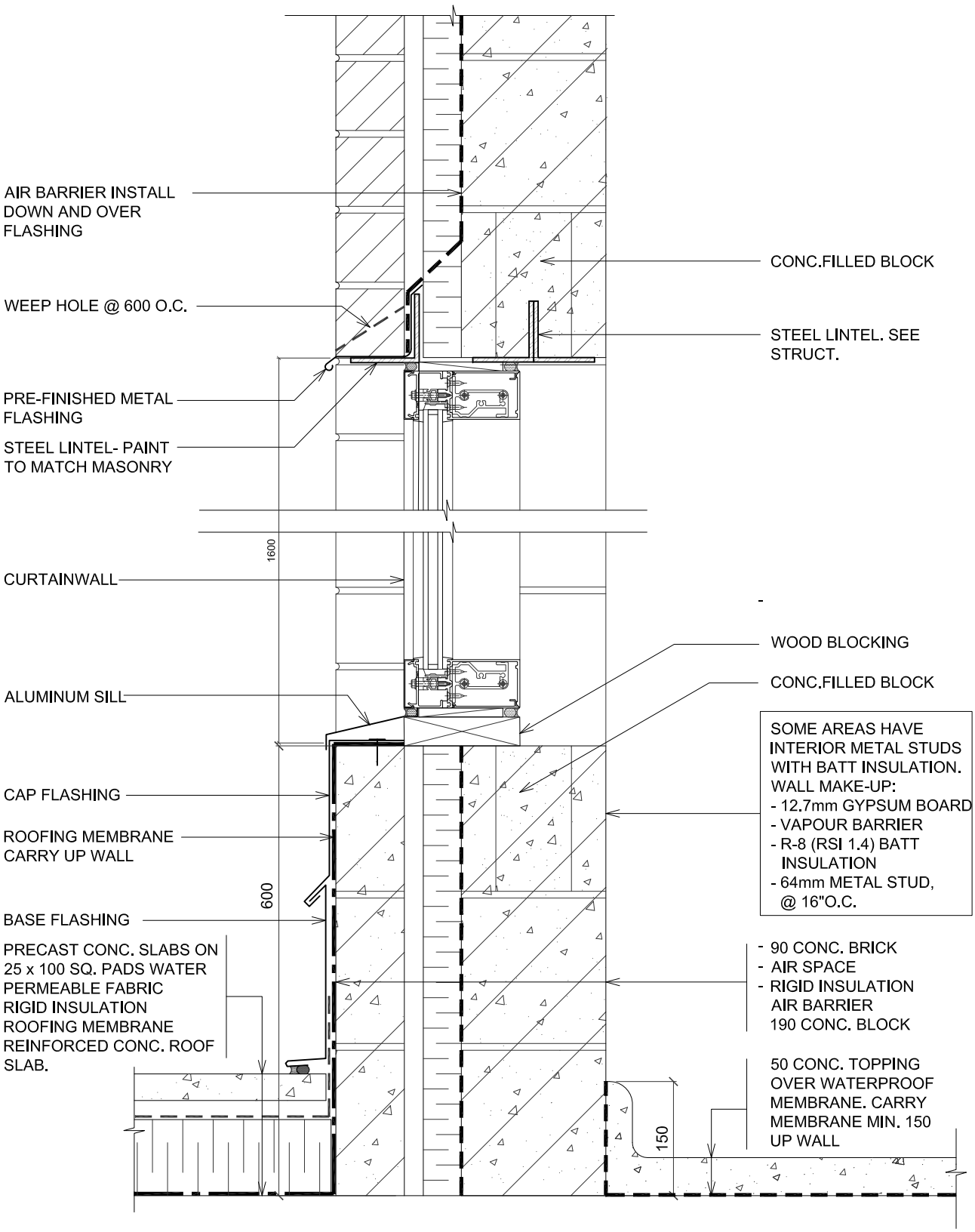
[18] Full Life Cycle Cost Analysis tables for each option are provided in Appendix C – Life Cycle Cost Analysis (LCCA)

15 APPENDIX A – PRELIMINARY DESIGN DRAWINGS

1. Building envelope (existing) details
2. Building envelope (proposed wall retrofit) details
3. Pathway 1 to 4 – single line diagrams and preliminary specifications

CUSTOMER APPROVAL Signature:_____ Date:_____ FOR SALES LOCATION USE ONLY

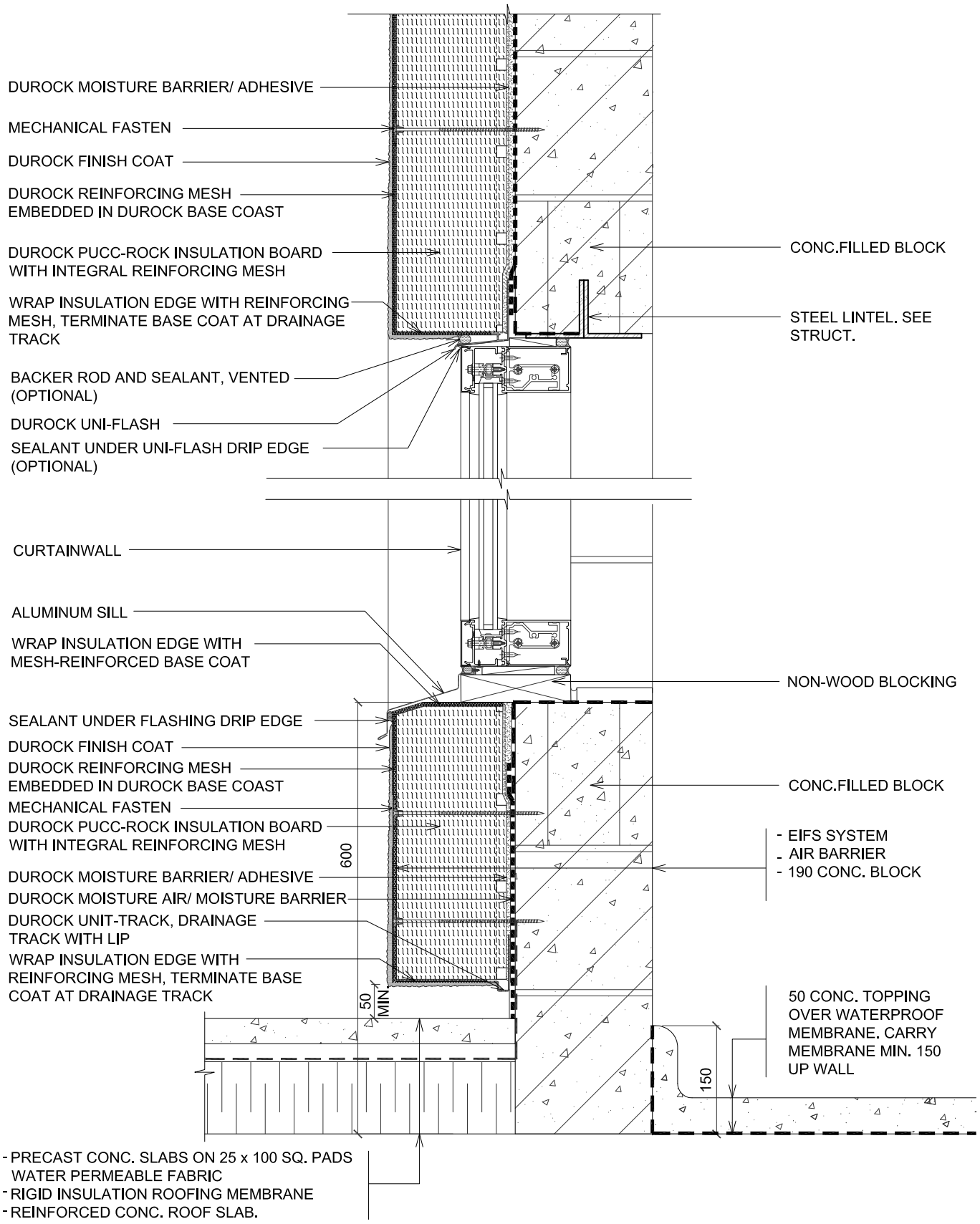
AS BUILT WALL SECTION (TYPICAL)



HALTON HILLS MUNICIPAL BUILDING		N0.	DATE	N0.	DATE
			DD MMM YYYY		
LOCATION:		01	09/ 07/ 2020		
SALES LOCATION:	PROJECT NO.				
DRAWN BY:					
	DATE:			SHEET: 1 OF 4	

CUSTOMER APPROVAL Signature:_____ Date:_____ FOR SALES LOCATION USE ONLY

EIFS WALL DETAIL (TYPICAL)



HALTON HILLS MUNICIPAL BUILDING

LOCATION:	
SALES LOCATION:	
DRAWN BY:	

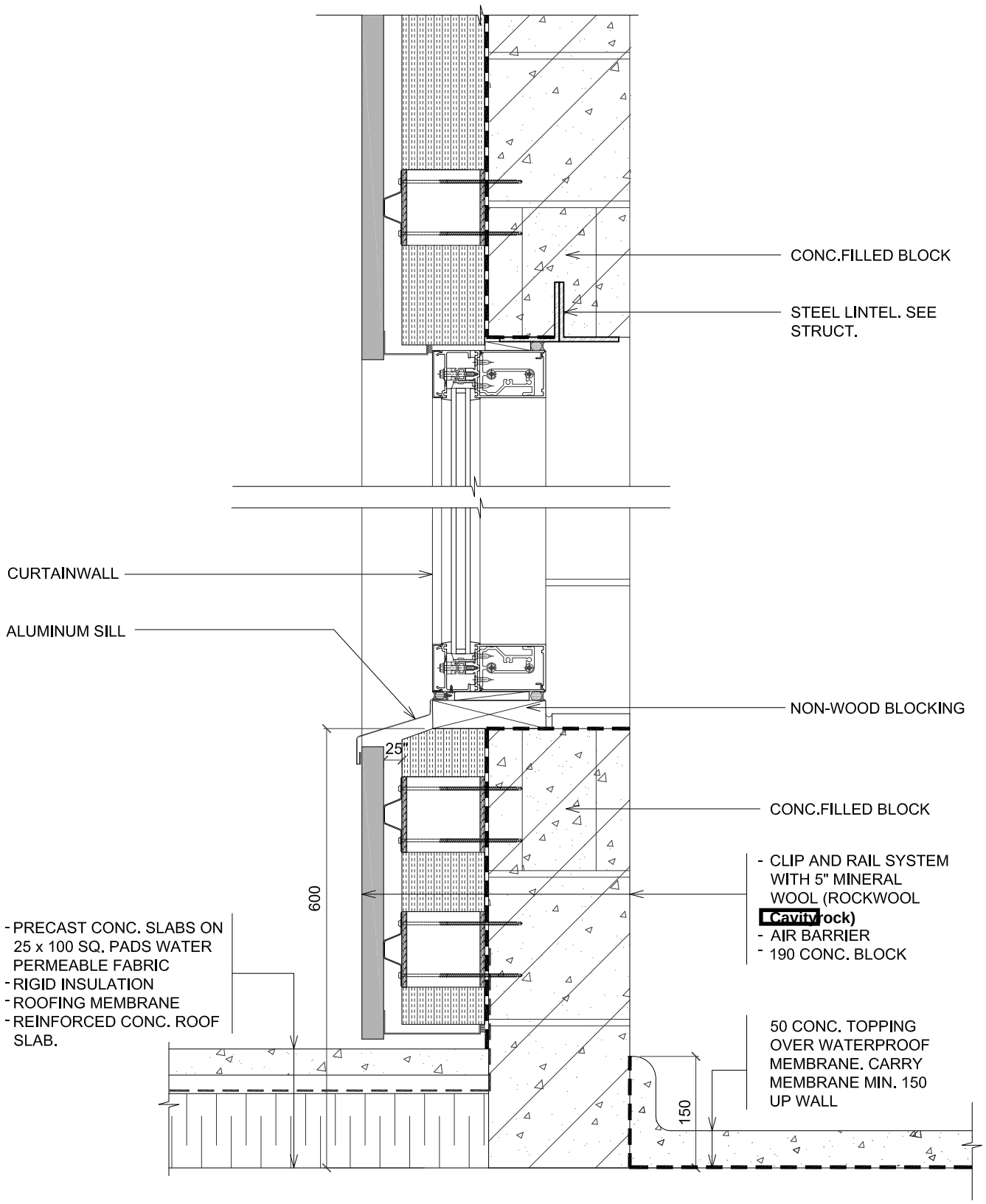
N0.	DATE	N0.	DATE
	DD MMM YYYY		
01	09/ 07/ 2020		

PROJECT NO.

DATE:

CUSTOMER APPROVAL Signature:_____ Date:_____ FOR SALES LOCATION USE ONLY

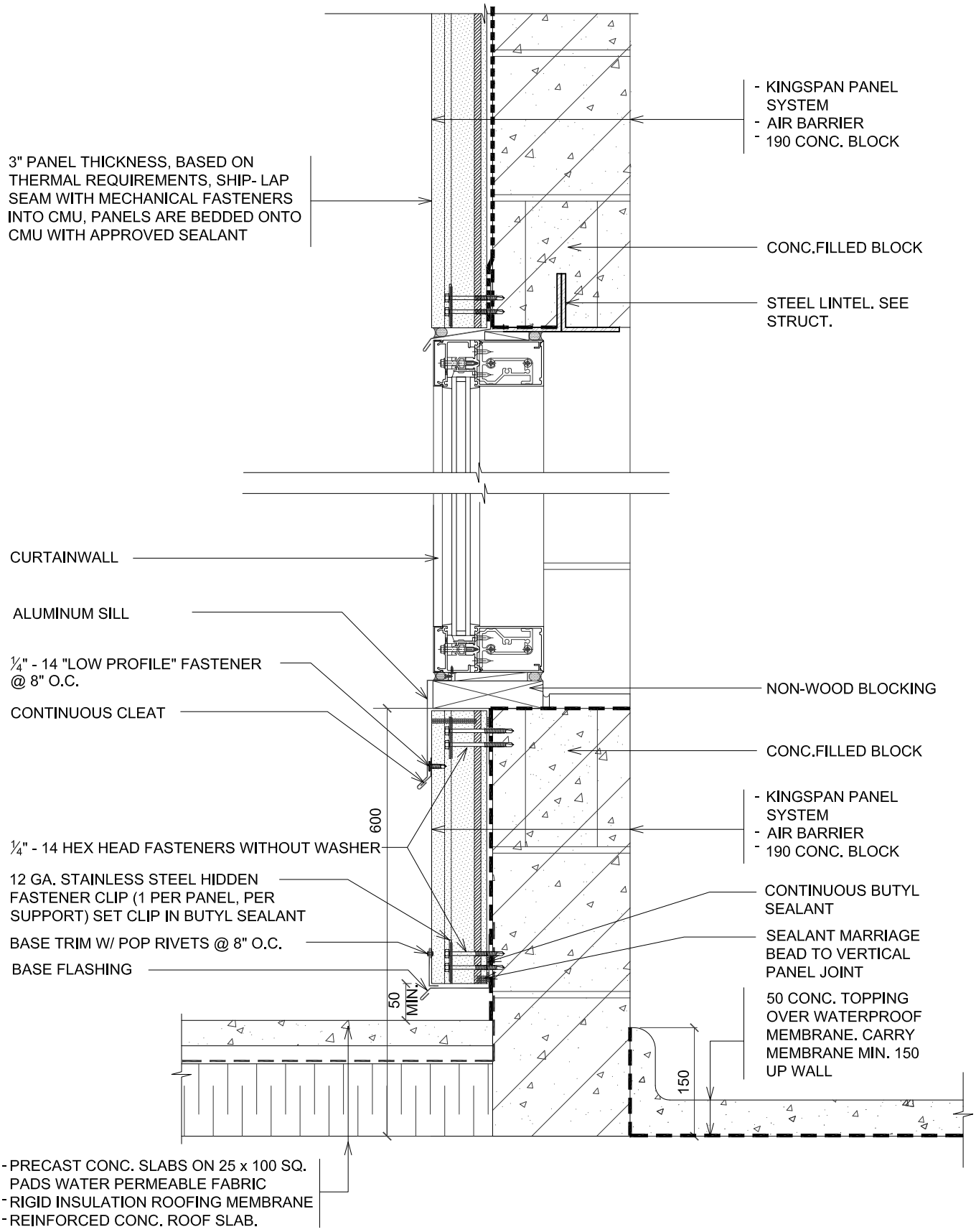
CLIP AND RAIL DETAIL WITH LIGHTWEIGHT CLADDING (TYPICAL)



HALTON HILLS MUNICIPAL BUILDING		N0.	DATE	N0.	DATE
			DD MMM YYYY		
LOCATION:		01	09/ 07/ 2020		
SALES LOCATION:	PROJECT NO.				
DRAWN BY:					
	DATE:			SHEET: 3 OF 4	

CUSTOMER APPROVAL Signature:_____ Date:_____ FOR SALES LOCATION USE ONLY

KINGSPAN INSULATED METAL PANEL WALL (TYPICAL)



HALTON HILLS MUNICIPAL BUILDING

LOCATION:	N0.	DATE	N0.	DATE
		DD MMM YYYY		
SALES LOCATION:	01	09/ 07/ 2020		
DRAWN BY:	PROJECT NO.			
	DATE:		SHEET: 4 OF 4	

Halton Hills, Ontario

Town Hall

HALTON HILLS TOWN HALL LOW CARBON DESIGN – OPTION 1

G1301-M-00

LIST OF DRAWINGS

CONTRACTOR NOTES

MECHANICAL

INTERNAT ENERGY SOLUTIONS

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

1. GENERAL SPECIFICATIONS

1.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

1.2. CARE OF SITE

1.2.1. BE RESPONSIBLE FOR THE CARE OF THE BUILDINGS. DO ALL CUTTING PATCHING, AND PAINTING REQUIRED FOR THE WORK OF THIS TRADE.
- APPLY AT LEAST ONE COAT OF CORROSION RESISTANT PRIMER TO SUPPORTS, AND EQUIPMENT FABRICATED FROM FERROUS METALS.
- TOUCH UP PAINT ALL DAMAGED EQUIPMENT WITH PRODUCTS MATCHING ORIGINAL FINISH IN QUALITY AND APPEARANCE IF APPLICABLE.
- PROVIDE FLAT BLACK PAINTING BEHIND GRILLES AND DIFFUSERS.
WORK TO BE PERFORMED BY CONTRACTOR AT THE CONTRACTOR'S EXPENSE. INSTALL TEMPORARY CAPS OR CLOSURES ON THE ENDS OF ALL PIPES, CONDUITS, ETC. TO PREVENT THE ENTRY OF DEBRIS. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT. CO-OPERATE WITH ALL OTHER TRADES.

1.2.2. ANY CORE DRILLING OF SLAB OR CONCRETE WALL WILL REQUIRE PERMISSION FROM BUILDING ENGINEER AND WILL BE X-RAYED PRIOR TO DRILLING.

1.2.3. ALL PENETRATIONS, INCLUDING SLAB PENETRATIONS, MUST BE SEALED APPROPRIATELY. FIRE STOPS ARE TO BE PROVIDED AT ALL POINTS OF PENETRATION THROUGH FIRE RATED ASSEMBLIES.

1.2.4. ENSURE ALL OPENINGS THROUGH FIRE SUPPRESSIONS DO NOT EXCEED THE MAXIMUM SIZE AT ALL CEILING OPENINGS AND MAXIMUM AND MINIMUM DIMENSIONS INDICATED IN ULC GUIDE No 40U19 FOR SERVICE PENETRATIONS ASSEMBLY AND FIRE STOPPING MATERIAL.

1.3. CODES, FEES AND CERTIFICATES

1.3.1. COMPLY WITH ALL LATEST APPLICABLE BUILDING, PLUMBING, AND ELECTRICAL CODES. USE LATEST EDITION OF CITY, PROVINCIAL AND FEDERAL REGULATIONS HAVING JURISDICTION, INCLUDING ONTARIO ELECTRICAL SAFETY CODE. IF DISCREPANCIES OCCUR USE THE MOST RESTRICTING.

1.3.2. ALL WORK SHALL BE EXECUTED, AND ALL MATERIALS SHALL CONFORM TO AND BE INSPECTED, IN STRICT ACCORDANCE WITH ALL THE LAWS, RULES, AND REGULATIONS OF THE LOCAL AND PROVINCIAL CODES AND ALL OTHER AUTHORITIES HAVING JURISDICTION.

1.3.3. THIS TRADE SHALL OBTAIN ALL NECESSARY PERMITS AND ALL NOTICES, PAY ALL FEES IN ORDER THAT THE WORK HEREINAFTER SPECIFIED MAY BE CARRIED OUT AND SHALL FURNISH ALL CERTIFICATES NECESSARY AS EVIDENCE THAT THE WORK INSTALLED CONFORMS WITH THE LAWS AND CERTIFICATES ARE ISSUED.

1.3.4. ALL CHANGES AND ALTERATIONS REQUIRED BY AN AUTHORIZED INSPECTOR OF ANY AUTHORITY HAVING JURISDICTION SHALL BE CARRIED OUT WITHOUT CHARGE OR EXPENSE TO THE OWNER.

1.3.5. ALL EQUIPMENT SUPPLIED MUST HAVE APPROVAL OF N.F.P.A., C.S.A, U.L.C., OWNER'S UNDERWRITER AND ANY OTHER AUTHORITY HAVING JURISDICTION.

2. MECHANICAL SPECIFICATIONS

2.1. EXISTING BUILDING RENOVATIONS

2.1.1. THE MECHANICAL TRADE SHALL VISIT THE SITE AND INCLUDE ALL COSTS FOR INSTALLATION REMOVAL, REVISIONS, SETTING AND RESETTING OF PIPING, DUCTS, GRILLS, DIFFUSERS, AND ALL MECHANICAL ITEMS IN GENERAL WHERE CEILINGS, WALLS, FLOORS, WINDOWS, SILLS, DUCT AND PIPE SHAFTS, ETC., ARE REVISED.

2.1.2. PERFORM ALL WORK IN THE EXISTING BUILDING INDICATED ON THE DRAWINGS, SPECIFIED HEREIN, AND AS MAY BE NECESSARY TO CARRY OUT THE WORK OF THIS CONTRACT.

2.1.3. LOCATE, RELOCATE, CONNECT AND RECONNECT ANY PIPING, DRAINS, VENTS, WATER LINES, HEATING LINES, CONTROLS, AND PIPING, DUCTWORK, OR OTHER WORK PERTAINING TO THIS TRADE PRESENTLY CONCEALED IN WALLS, PARTITIONS, OR CEILING SPACES, AND WHICH BECOME EXPOSED DURING THE RENOVATION WORK SO THAT THESE SERVICES ARE CONCEALED IN THE RENOVATED LAYOUT, AND PUT BACK INTO OPERATION.

2.1.4. ANY EQUIPMENT, ETC., TO BE REUSED SHALL BE CAREFULLY REMOVED AND STORED. ANY PIECE OF EQUIPMENT OR FITTING ACCESSORY, ETC., WHICH FORMS A PART OF THE EQUIPMENT TO BE REUSED WHICH IS LOST OR DAMAGED SHALL BE REPLACED WITH A NEW DEVICE, FITTING, ACCESSORY, ETC. AT NO COST TO THE OWNER.

2.1.5. ALL EXISTING EQUIPMENT, FIXTURES, PIPING, ETC., BEING REMOVED SHALL REMAIN THE PROPERTY OF THE BUILDING OWNER AND WILL REMAIN ON THE JOB SITE.

2.1.6. MAKE CERTAIN THAT ALL SERVICES AFFECTED BY WORK ARE CUT OFF AND PROPERLY CAPPED OR DIVERTED.

2.1.7. DO NOT INTERRUPT SERVICES TO OR WITHIN EXISTING BUILDING WITHOUT PRIOR CONSULTATION WITH OWNER.

2.2. TEMPORARY PROTECTION

2.2.1. INSTALL TEMPORARY BRACING, SHORING, AND SUPPORT FOR EXECUTION OF WORK AND PROTECTION OF PERSONS AND PROPERTY. ALWAYS INSTALL APPROPRIATE SUPPORTS AND PROTECTION, USING ACCEPTABLE METHODS TO PREVENT COLLAPSE, SETTLING, AND OTHER DAMAGES.

2.2.2. INSTALL TEMPORARY COVERINGS AND ENCLOSURES TO PREVENT DAMAGE TO EXISTING SPACES AND TO PARTS OF BUILDING THAT ARE TO REMAIN.

2.2.3. INSTALL TEMPORARY DUST ENCLOSURES TO SEPARATE CONSTRUCTION SITE FROM REST OF BUILDING. ALSO, INSTALL TEMPORARY AIR FILTERS AND DUCTWORK TO CONTAIN CONSTRUCTION DUST WITHIN CONSTRUCTION AREA.

2.3. DEMOLITION AND CUTTING

2.3.1. MECHANICAL DEMOLITION: DEMOLISH AND REMOVE EXISTING MECHANICAL CONSTRUCTION AS SHOWN ON DRAWINGS AND AS REQUIRED TO ACCOMPLISH WORK, IF APPLICABLE. WHERE NEW WORK IS ADJACENT TO EXISTING CONSTRUCTION AND WHEN EXISTING CONSTRUCTION MUST BE REPLACED, REMOVE JUST ENOUGH EXISTING CONSTRUCTION TO COMPLETE WORK UNDER CONTRACT. AT NO ADDITIONAL COST TO OWNER, REMOVE AND REPLACE EXISTING CONSTRUCTION THAT IS TO REMAIN, BUT IS DAMAGED DURING WORK.

2.3.2. CUTTING CONCRETE: CUT OPENINGS THROUGH CONCRETE BY CORE DRILLING OR SAWING. NEVER CUT OPENINGS IN CONCRETE WITH A HAMMER-DRIVEN CHISEL OR DRILL WITHOUT WRITTEN AUTHORIZATION FROM ARCHITECT.

2.3.3. OTHER WORK: NEVER ENDANGER OR DAMAGE WORK OF OTHER TRADES. IF WORK OF OTHER TRADES MUST BE ALTERED TO ACCOMMODATE MECHANICAL WORK, REVIEW PROPOSED ALTERATIONS WITH INSTALLER OF WORK AND COMPLY WITH INSTALLER'S RECOMMENDATIONS TO MINIMIZE DAMAGE. WHERE NECESSARY, ENGAGE ORIGINAL INSTALLER TO MAKE REQUIRED CHANGES.

2.3.4. CLEAN DEMOLITION AREAS AND REMOVE DEBRIS FROM SITE AT END OF EACH DAY'S WORK. TRANSPORT DEBRIS IN MANNER THAT PREVENTS SPREAD OF DUST. DO NOT PERMIT BURNING OR STORAGE OF DEBRIS AT SITE. KEEP CONSTRUCTION AREAS BROOM CLEAN. KEEP ADJACENT AREAS UNENCUMBERED AND CLEAN.

2.4. UNANTICIPATED MECHANICAL WORK

2.4.1. IF DEMOLITION WORK EXPOSES CONCEALED MECHANICAL SERVICES (SUCH AS PIPING OR DUCTS), IMMEDIATELY INFORM ENGINEER OF ADDITIONAL COST TO PROJECT TO RELOCATE, REMOVE OR ABANDON UNANTICIPATED WORK. BEGIN THIS ADDITIONAL WORK ONLY AFTER RECEIVING APPROVAL FROM OWNER FOR ADDITIONAL COSTS.

2.4.2. REMOVE OR REROUTE UNANTICIPATED MECHANICAL SERVICES UNDER DIRECTION FROM ENGINEER. RECONNECT THEM TO MAINTAIN OWNER'S OPERATIONS. ABANDON SERVICES IN PLACE WHERE THEY WILL BE CONCEALED INSIDE FLOORS AND WALLS, BUT DISCONNECT THEM FROM THEIR SOURCES AND CAP THEM IN PLACE. LEAVE NO "DEAD END" SERVICES CONCEALED IN FINISHED WORK.

2.5. CUTTING AND PATCHING

2.5.1. THIS TRADE SHALL BE RESPONSIBLE FOR ALL COSTS OF CUTTING AND PATCHING OF ANY BUILDING CONSTRUCTION MADE NECESSARY BY THE INSTALLATION OF THIS WORK AND/OR DUE TO LACK-OF-COORDINATION IN THE NEW CONSTRUCTION, EXCEPT ONLY IN SUCH INSTANCES AS MAY BE OTHERWISE ASSIGNED BY THE SPECIFICATIONS OR SHOWN ON THE DRAWINGS.

2.5.2. UNDER NO CIRCUMSTANCES SHALL ANY CUTTING OR BURNING OF THE STRUCTURAL PARTS, INCLUDING CONCRETE SLABS OF THE BUILDING, BE UNDERTAKEN WITHOUT THE WRITTEN AUTHORITY OF THE CONSULTANT.

2.5.3. ALL CUTTING AND PATCHING MUST BE CARRIED OUT BY A TRADE EXPERIENCED IN THAT PARTICULAR TYPE OF WORK, BUT THE COSTS OF SUCH WORK SHALL BE BORNE BY THE MECHANICAL TRADE.

3. ELECTRICAL SPECIFICATIONS

3.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO ALL SECTIONS AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

3.2. GENERAL ELECTRICAL NOTES

3.2.1. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST CODES AS AMENDED BY THE LOCAL MUNICIPALITY.

3.2.2. OBTAIN ALL PERMITS REQUIRED. ARRANGE FOR THE INSPECTION OF WORK BY INSPECTION AUTHORITY. PAY ALL FEES. RETAIN ALL INSPECTION CERTIFICATES. PROVIDE FINAL UNCONDITIONAL CERTIFICATE OF APPROVAL OF THE OWNER.

3.2.3. ALL WORK SHALL COMPLY STRICTLY TO THE REQUIREMENTS OF THE LATEST EDITIONS OF THE CANADIAN ELECTRICAL "CSA" CODE AS ADOPTED AND AMENDED BY PROVINCIAL REGULATIONS, AND THE BUILDING CODE. THESE CODES AND ANY ADDITIONAL REQUIREMENTS OF THE POWER UTILITY SHALL FORM AN INTEGRAL PART OF THIS SPECIFICATION. ALL EQUIPMENT SHALL BE CSA APPROVED. WHERE DRAWING CALLS FOR EQUIPMENT, WIRING OR OTHER REQUIREMENTS EXCEEDING THE MINIMUM REQUIREMENTS OF THE CODE, THE DRAWING SHALL BE FOLLOWED.

3.2.4. IN, ADDITION COMPLY WITH THE LATEST REQUIREMENTS OF THE LOCAL BUILDING CODE AND STANDARDS, THE NATIONAL BUILDING CODE AND THE FIRE COMMISSIONERS' REQUIREMENTS.

3.2.5. THE ELECTRICAL CONTRACTOR SHALL SUPPLY ALL MATERIALS AND LABOUR, EXCEPT AS OTHERWISE NOTED, TO PROVIDE A COMPLETE AND OPERATING ELECTRICAL SYSTEM AS SHOWN ON DRAWINGS.

3.2.6. BEFORE STARTING ANY WORK, SUBMIT THE REQUIRED NUMBER OF COPIES OF DRAWINGS AND SPECIFICATIONS TO THE INSPECTION AUTHORITIES AND BUILDING AND FIRE DEPARTMENTS FOR THEIR APPROVAL AND COMMENTS. ANY CHANGES REQUIRED SHALL BE COMPLIED WITH AS PART OF THIS CONTRACT, BUT THE OTHER AND CONSULTANT SHALL BE NOTIFIED IMMEDIATELY OF SUCH CHANGES. PAY ALL FEES FOR EXAMINATION OF DRAWINGS AND SPECIFICATIONS.

3.2.7. ALL ELECTRICAL EQUIPMENT MOUNTED AND CONNECTED BY ELECTRICAL CONTRACTOR, (SUPPLIED BY ELECTRICAL CONTRACTOR OR NOT) SHALL BE READILY ACCESSIBLE FOR OPERATION, MAINTENANCE, AND REPAIR.

3.2.8. ON AWARD OF CONTRACT, SUBMIT SHOP DRAWINGS FOR REVIEW FOR ALL EQUIPMENT.

3.2.9. AT COMPLETION OF WORK, PROVIDE OWNER WITH A SET OF AS-BUILT RECORD DRAWINGS. THE AS-BUILT DRAWINGS SHALL INDICATE ALL APPROVED CHANGE NOTICES AND SITE DEVIATIONS.

3.2.10. ENSURE THAT ALL ELECTRICAL EQUIPMENT SUPPLIED BY OTHER TRADES IS SUITABLE FOR THE RESPECTIVE VOLTAGE. CONFIRM POWER REQUIREMENTS OF ALL OWNER SUPPLIED EQUIPMENT.

3.2.11. ALL EQUIPMENT AND MATERIALS SHALL BE NEW AND COMMERCIAL GRADE AND BE CSA APPROVED.

3.2.12. PROVIDE TEMPORARY ELECTRICAL POWER & LIGHTING FOR THE WORK OF THE TRADES AS REQUIRED BY THE GENERAL CONTRACTOR.

3.2.13. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT.

3.2.14. CONTRACTOR IS TO ENSURE THAT ALL EQUIPMENT IS COMMISSIONED AS PER MANUFACTURER'S REQUIREMENTS.

3.2.15. CONTRACTOR SHALL CARRY OUT TESTS AND INSPECTIONS OF THE WHOLE ELECTRICAL INSTALLATION. COMMISSIONING OF THE SYSTEMS WILL BE CARRIED OUT BY THE ELECTRICAL CONTRACTOR.

3.2.16. CONTRACTOR SHALL REFER TO ALL TENDER DRAWINGS DURING THE BIDDING AND CONSTRUCTION PHASES OF THE PROJECT.

3.2.17. CONTRACTOR TO PROVIDE 3 COPIES OF OPERATION AND MAINTENANCE MANUALS FOR ALL ELECTRICAL EQUIPMENT.

3.3. GENERAL ELECTRICAL SPECIFICATIONS

3.3.1. THE ELECTRICAL CONTRACTOR SHALL COMPLETE ALL ELECTRICAL WORK IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE SPECIFICATIONS AND DRAWINGS TO THE SATISFACTION OF THE OWNER.

3.3.2. THE DRAWINGS FOR THE WORK OF THIS DIVISIONS ARE IN PART DIAGRAMMATIC, INTENDED TO CONVEY THE SCOPE OF WORK, GENERAL ARRANGEMENT AND LOCATION OF THE EQUIPMENT, APPROXIMATE SIZES AND LOCATIONS OF THE EQUIPMENT. FOLLOW THESE DRAWINGS IN EXECUTION OF THE WORK, CONSULT MECHANICAL CONSTRUCTION DRAWINGS TO BECOME FAMILIAR WITH ALL CONDITIONS RELATING TO THE INSTALLATION AND TO VERIFY SPACES IN WHICH THE WORK WILL BE INSTALLED.

3.3.3. WHENEVER DIFFERENCES OCCUR BETWEEN PLANS AND DIAGRAMS OR SCHEMATICS, AND BETWEEN THE SPECIFICATIONS AND DRAWINGS, THE MAXIMUM CONDITIONS SHALL GOVERN, AND THE TENDER SHALL BE BASED ON WHICHEVER IS THE GREATER AMOUNT.

3.3.4. KEEP A RECORD SET OF DRAWINGS ON THE SITE ON WHICH SHALL BE CLEARLY INDICATED, THE EXACT LOCATION OF ALL FEEDER RUNS, PANELS JUNCTION BOXES, PULL BOXES, ETC. TWO COPIES OF THE RECORD DRAWINGS SHALL BE SUBMITTED TO THE PROJECT MANAGER UPON COMPLETION OF THE PROJECT.

3.3.5. THE CONTRACTOR SHALL VISIT THE SITE AND EXAMINE ALL DRAWINGS CAREFULLY TO DETERMINE THE EXTENT OF WORK. EXAMINE THE SITE AND TOGETHER WITH DRAWINGS AND SPECIFICATIONS DETERMINE AND INCLUDE IN TOTAL PRICE, THE TOTAL COST OF LABOUR AND MATERIAL TO EXECUTE THE WORK.

3.3.6. NO ALLOWANCE WILL BE MADE FOR OBVIOUS CONSIDERATIONS WHICH MAY HAVE BEEN OVERLOOKED.

3.3.7. EXAMINE THE MECHANICAL AND STRUCTURAL DRAWINGS TO ENSURE THAT THE WORK OF THIS DIVISION CAN BE SUCCESSFULLY COMPLETED WITH NO INTERFERENCES OR DISCREPANCIES.

3.3.8. EXAMINE THE WORK OF THE OTHER TRADES, AS THEY AFFECT THIS DIVISION, AND REPORT IMMEDIATELY TO THE PROJECT MANAGER ANY DEFECT OR INTERFERENCE THAT MAY AFFECT THE WORK OF THIS DIVISION, OR GUARANTEE OF THIS WORK.

3.3.9. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING AND PAYING FOR ALL NECESSARY PERMITS AND INSPECTIONS AS REQUIRED OR REQUESTED BY THE AUTHORITIES HAVING JURISDICTION. ONCE THE ELECTRICAL WORK HAS BEEN COMPLETED AND ACCEPTED BY THE OWNER, THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH CERTIFICATES VERIFYING THAT THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH ALL APPLICABLE CODES, BUILDING STANDARDS, AND ALL AUTHORITIES HAVING JURISDICTION.

3.3.10. THE ELECTRICAL WORK SHALL BE CARRIED OUT AND PERFORMED WITH QUALITY WORKMANSHIP, TO THE SATISFACTION OF THE CONSULTANT, OWNER, AND PROJECT MANAGER. ANY UNSATISFACTORY WORK SHALL BE RE-DONE OR REPLACED WITHOUT EXTRA COST TO THE OWNER.

3.3.11. THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH A ONE YEAR WRITTEN WARRANTY, COMMENCING ON THE DATE OF ACCEPTANCE. THE WARRANTY SHALL COVER THE COMPLETE ELECTRICAL INSTALLATION. THE ELECTRICAL CONTRACTOR SHALL REPAIR AND/OR REPLACE ANY DEFECTS IN THE MATERIALS OR WORKMANSHIP THAT OCCUR DURING THE WARRANTY PERIOD AT A TIME CONVENIENT TO, AND AT NO EXTRA COST TO THE OWNER.

3.3.12. PROVIDE THE OWNER WITH ONE SET OF 'AS-BUILT' RECORD DRAWINGS PREPARED ON AUTOCAD R.2007 OR COMPATIBLE FORMAT, INCLUDING A COPY OF THE DRAWINGS ON CD. PROVIDE THE ENGINEER WITH ONE SET OF BLACK LINE PRINTS OF THE 'AS-BUILT' RECORD DRAWINGS. THESE DRAWINGS SHALL ONLY BE DELIVERED TO THE OWNER AND ENGINEER AFTER COMPLETION OF THE WORK AND AFTER ALL DEFICIENCIES HAVE BEEN RECORDED.

3.3.13. IN CASE EXTRA WORK OF ANY KIND IS REQUIRED, OBTAIN WRITTEN INSTRUCTIONS FROM THE PROJECT MANAGER BEFORE PROCEEDING, PAYMENT WILL BE MADE AT A FAIR AND REASONABLE RATE ONLY FOR AUTHORIZED EXTRAS. IN THE CASE OF SCOPE REDUCTIONS, THE SAME PROCEDURE SHALL APPLY AND DECREASE MADE.

3.3.14. SUBMIT SHOP DRAWINGS OF LUMINARIES, PANELBOARDS, AND OTHER MAJOR ELECTRICAL EQUIPMENT, AS THEY APPLY TO THIS PROJECT, OR AS REQUIRED BY PROJECT MANAGER. EACH SHOP DRAWING SHALL BE CHECKED AND STAMPED AS BEING CORRECTED BY THE ELECTRICAL AND GENERAL CONTRACTOR PRIOR TO SUBMISSION TO THE PROJECT MANAGER FOR REVIEW. SHOP DRAWINGS NOT STAMPED AS SUCH WILL NOT BE REVIEWED AND WILL BE RETURNED AND DESIGNATED AS "REVISE AND RESUBMIT".

3.3.15. ALL SERVICES WHICH PENETRATE THE FLOOR SLAB OR FIRE-RATED WALLS AND CEILINGS SHALL BE INSTALLED IN RIGID STEEL CONDUIT AND SHALL BE SEALED WITH AN APPROVED, NON-SHRINK, WATER PROOF AND FIRE PROOF SEALANT.

3.3.16. ALL WORK SCHEDULED AND COORDINATED TO AVOID INTERFERENCES WITH OTHER TRADES DURING AND AFTER CONSTRUCTION.

3.3.17. PROVIDE TEMPORARY ELECTRICAL POWER FOR THE WORK OF THIS DIVISION AND OTHER TRADES AS REQUIRED BY THE GENERAL CONTRACTOR OR OWNER.

3.4. SUBMITTALS

3.4.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE MATERIALS, EQUIPMENT & DEVICES.

3.5. ELECTRICAL, LIFE SAFETY, WATER & SANITARY PIPING AND FITTINGS

3.5.1. ALL FIXTURES & FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA.

4. PLUMBING

4.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

4.2. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST PLUMBING CODE AS AMENDED BY THE LOCAL MUNICIPALITY.

4.3. SUBMITTALS

4.3.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE PLUMBING MATERIALS, EQUIPMENT & DEVICES.

4.4. WATER & SANITARY PIPING AND FITTINGS

ALL FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA-B125.3

5. EXECUTION

5.1. ALL WORK SHALL MEET OR EXCEED THE LATEST REQUIREMENTS OF THE ONTARIO BUILDING CODE AND ANY LOCAL AUTHORITY HAVING JURISDICTION.

5.2. NOTIFY THE CONSULTANT OF CHANGES REQUIRED BY THE ELECTRICAL INSPECTION DEPARTMENT PRIOR TO MAKING CHANGES.

5.3. PLUG OR CAP PIPE AND FITTINGS TO KEEP OUT DEBRIS DURING CONSTRUCTION.

5.4. ALL BRANCH PIPING AND DRAIN FROM FIXTURES SHALL NOT GARDE OF NOT LESS THAN 1:50 OR AS DIRECTED BY LOCAL PLUMBING CODE.

5.5. ALL VERTICAL STACKS SHALL BE SUPPORTED AT EACH FLOOR LEVEL.

6. . TESTING AND BALANCING OF SYSTEM

6.1. ALL TESTING SHALL BE PERFORMED BY THE CONTRACTOR. TESTING SHALL BE COMPLETED BEFORE THE CONSULTANT IS NOTIFIED FOR THE SYSTEM DEMONSTRATION.

6.2. VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY ALL TERMINATIONS ARE TIGHT.

6.3. ALL FIXTURES SHALL BE TESTED TO ENSURE THAT THE WORK CORRECTLY AND ARE FLUSHING / EVACUATING AT THE CORRECT FLOW RATE.

6.4. ALL TEST CERTIFICATES TO BE INCLUDED IN MAINTENANCE MANUALS.

6.5. PROVIDE A SIGNED STATEMENT TO THE EFFECT THAT ALL TESTS FOR MECHANICAL SYSTEMS AND EQUIPMENT HAVE BEEN COMPLETELY CARRIED OUT TO THE MANUFACTURER'S RECOMMENDATIONS, AND IN ACCORDANCE WITH THE REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION.

GENERAL CONTRACTOR NOTES

1. CONTRACTOR SHALL REVIEW ALL DRAWINGS, SPECIFICATIONS, TENDER DOCUMENTS AND SITE CONDITIONS BEFORE SUBMITTING A JOB ESTIMATE FOR THIS PROJECT. ALTHOUGH A REASONABLE ATTEMPT HAS BEEN MADE TO DOCUMENT THE EXACT EXTENT OF THE EXISTING CONDITIONS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXACT SITE CONDITIONS BEFORE INSTALLATION. ANY ADDITIONAL WORK DUE TO THE SITE CONDITIONS SHALL BE INCLUDED AS PART OF THIS CONTRACT.
2. CONTRACTOR SHALL FIELD CHECK AND CONFIRM EXACT LOCATIONS, ELEVATION AND INSTALLATIONS OF ALL SERVICES FOR THIS PROJECT PRIOR TO INSTALLING ANY EQUIPMENT, PIPE WORK OR CONNECTING ANY ELECTRICAL OR WATER LINES.
3. APPROVED EQUIVALENTS OR ALTERNATIVES TO SPECIFIED PRODUCTS SHALL BE EQUAL TO THE SPECIFIED PRODUCT IN EVERY RESPECT, OPERATE AS INTENDED, MEET THE SPACE, AND CAPACITY REQUIREMENTS AS OUTLINED. ANY ALTERNATES SHALL BE SUBMITTED FOR APPROVAL BEFORE PROCUREMENT. NO ALTERNATIVE SHALL BE ACCEPTED WITHOUT PRIOR WRITTEN APPROVAL OF THE OWNER.
4. FOLLOW CHOSEN MANUFACTURER'S RECOMMENDED INSTALLATION GUIDE AND PROCEDURES FOR EQUIPMENT, SUPPLEMENTED BY THE REQUIREMENTS AND OUTLINE OF THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS AND SHALL REPORT ANY DISCREPANCIES TO CONSULTANT BEFORE PROCEEDING WITH WORK.
6. USE ONLY THE LATEST REVISED DRAWINGS AS SPECIFIED.
7. CONTRACTOR SHALL PROVIDE CONSULTANT AND PROJECT MANAGER WITH A DETAILED CONSTRUCTION SCHEDULE FOR APPROVAL BEFORE COMMENCEMENT OF ANY WORK.
8. THE CONTRACTOR SHALL INFORM CONSULTANT AND PROJECT MANAGER PRIOR TO START OF WORK ALLOWING FOR SCHEDULE AND PROCESS WITHOUT DELAY TO THE PROJECT, SHOULD IT APPEAR THAT ANY PART OF THE WORK IS NOT SUFFICIENTLY DETAILED ON THE DRAWINGS.
9. CONTRACT DOCUMENTS AND DRAWINGS ARE DIAGRAMMATIC AND NOT DRAWN TO SCALE UNLESS DETAILED OTHERWISE. THEY ESTABLISH SCOPE, MATERIAL AND INSTALLATION QUALITY AND ARE NOT DETAILED INSTALLATION INSTRUCTIONS.
10. MAKE REFERENCE TO ELECTRICAL, MECHANICAL, LIFE SAFETY AND PLUMBING DRAWINGS WHEN SETTING OUT WORK. CONSULT WITH RESPECTIVE DIVISIONS IN SETTING OUT LOCATIONS FOR EQUIPMENT SO THAT CONFLICTS ARE AVOIDED AND SYMMETRICAL AND EVEN SPACING IS MAINTAINED. JOINTLY WORK OUT ALL CONFLICTS ON SITE BEFORE FABRICATING OR INSTALLING ANY MATERIALS OR EQUIPMENT.
11. ALL EXISTING SERVICES SHALL REMAIN IN CONSTANT OPERATION. CONTRACTOR SHALL GIVE THE CONSULTANT AND OWNER FIVE WORKING DAYS WRITTEN NOTICE BEFORE ANY TEMPORARY POWER/WATER SHUTDOWNS.
12. IMMEDIATELY CUT OFF AND CAP CONCEALED SERVICES UNCOVERED DURING WORK.
13. CONTRACTOR SHALL PROVIDE COMPLETE, FULLY TESTED, AND OPERATIONAL ELECTRICAL, MECHANICAL AND PLUMBING SYSTEMS TO MEET REQUIREMENTS DESCRIBED HEREIN.
14. INSTALL EQUIPMENT IN LOCATIONS AND ROUTES SHOWN. RUN ELECTRICAL LINES WHERE SEEN FIT AND WATER LINES AS SHOWN BUT AVOID INTERFERENCE WITH OTHER SERVICES.
15. INSTALLATION MUST BE COMPLETED IN ACCORDANCE WITH APPLICABLE CODES AND ORDINANCES.
16. CONTRACTOR SHALL OBTAIN ALL PERMITS AND PAY ALL FEES APPLICABLE TO THE WORK.
17. HANDLE, STORE, AND INSTALL ALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. DO NOT STORE EQUIPMENT ON THE GROUND OR IN CONDITIONS THAT WILL DAMAGE OR COMPROMISE THE INTEGRITY OF THE PRODUCT.
18. ANY COSTS ASSOCIATED WITH MATERIAL DELIVERY OR DEBRIS REMOVAL SHALL BE THE CONTRACTORS RESPONSIBILITY. ALL DEBRIS SHALL BE COLLECTED AND REMOVED AT END OF EACH WORK DAY. CONTRACTOR SHALL EMPLOY DUST CONTROL.
19. THE INSTALLATION METHODS, FINISHING AND APPEARANCE IS SUBJECT TO THE APPROVAL OF THE CONSULTANT AND OWNER. ANY COORDINATION TIME OR ADDITIONAL MATERIALS/LABOUR REQUIRED TO ACHIEVE THE REQUIRED APPEARANCE SHALL BE INCLUDED IN THIS CONTRACT.
20. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO EXISTING SERVICES, FINISHES AND MATERIALS DUE TO THE WORK UNDER THIS CONTRACT, AND BEAR ALL COSTS INCURRED TO MAKE GOOD, REPAIR OR REPLACE SAME TO THE PROJECT MANAGER'S SATISFACTION.
21. FINAL CLEANING SHALL INCLUDE EQUIPMENT, CASES, COVERS, FLOORS, WALLS, WINDOWS, ETC. THAT HAVE BEEN AFFECTED BY THE WORK, IN READINESS FOR CLIENT'S OCCUPANCY.
22. UPON COMPLETION OF ALL WORK BY ALL TRADES, THE CONTRACTOR SHALL REMOVE ALL SURPLUS CONSTRUCTION MATERIALS, RUBBISH AND GARBAGE TO LEAVE THE PREMISES CLEAN AND SUITABLE FOR IMMEDIATE OCCUPANCY BY THE CLIENT WITHOUT THE NEED FOR FURTHER CLEANING.
23. WHERE STRUCTURAL WORK REQUIRES CUTTING AND REMOVAL, CAREFULLY EXAMINE THE WORK TO ASCERTAIN THAT THE EXTENT OF CUTTING AND REMOVAL REQUIRED IS SAFE PRIOR TO EXECUTION.

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:

GENERAL CONTRACTOR NOTES

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01

PROPOSED CONDENSING BOILER SCHEDULE			
TAG	CAPACITY (BTU/HR)	EFFICIENCY	NOTES
B-1	500,000	93%	
B-2	500,000	93%	

PROPOSED MAKE-UP AIR SCHEDULE			
TAG	CAPACITY (CFM)	EFFICIENCY	NOTES
MUA-1	4,600	90%	C/W VFD CONTROLS & ERV

PROPOSED DOMESTIC HOT WATER SCHEDULE			
TAG	CAPACITY (BTU/hr)	CAPACITY (USGAL)	EFFICIENCY
DHW-1	85,000	100	3.75 UEF

PROPOSED HEAT PUMP SCHEDULE	
TAG	MINIMUM COP
HP-1 TO HP-52	3.8 (COOLING), 4.3 (HEATING)

OPTION 1 BAS TOTAL POINTS	
POINT TYPE	QUANTITY
DO	60
AO	4
DI	63
AI	63

OPTION 1 BAS POINTS LIST

POINT NAME	POINT TYPE	POINT NO.	SYSTEM	POINT DESCRIPTION
MUA-S/S	DO	DO1	MUA	MUA START/STOP
MUA-MOD	AO	AO1	MUA	MUA MODULATION
MUA-STAT	DI	DI1	MUA	MUA STATUS
MUA-SAT	AI	AI1	MUA	MUA SUPPLY AIR TEMP
MUA-RAT	AI	A25	MUA	MUA RETURN AIR TEMP
CT-S/S	DO	DO2	CT	CT START/STOP
CT-MOD	AO	AO2	CT	CT MODULATION
CT-STAT	DI	DI2	CT	CT STATUS
CT-SWT	AI	AI2	CT	CT SUPPLY TEMP
CT-RWT	AI	AI3	CT	CT RETURN TEMP
B1-S/S	DO	DO3	B1	B1 START/STOP
B1-MOD	AO	AO3	B1	B1 MODULATION
B1-STAT	DI	DI3	B1	B1 STATUS
B1-SWT	AI	AI4	B1	B1 SUPPLY TEMP
B1-RWT	AI	AI5	B1	B1 RETURN TEMP
B1-RECIRC	DI	DI4	B1	B1 RECIRC STATUS
B2-S/S	DO	DO4	B2	B2 START/STOP
B2-MOD	AO	AO4	B2	B2 MODULATION
B2-STAT	DI	DI5	B2	B2 STATUS
B2-SWT	AI	AI6	B2	B2 SUPPLY TEMP
B2-RWT	AI	AI7	B2	B2 RETURN TEMP
B2-RECIRC	DI	DI6	B2	B2 RECIRC STATUS
P1-SS	DO	DO5	P1	P1 START/STOP
P1-STAT	DI	DI7	P1	P1 RECIRC STATUS
P2-SS	DO	DO6	P2	P2 START/STOP
P2-STAT	DI	DI8	P2	P2 RECIRC STATUS
HP-SWT	AI	AI8	HPL	HEAT PUMP LOOP SUPPLY
HP-RWT	AI	AI9	HPL	HEAT PUMP LOOP RETURN
HP-S/S 1-52	DO	DO 7 TO 59	HP	HP START/STOP FOR 52 UNITS
HP-STAT 1-52	DI	DI 9 TO 61	HP	HP STATUS FOR 52 UNITS
HP-TEMP 1-52	AI	AI 10 TO 62	HP	HP TEMP FOR 52 UNITS
BB-S/S	DO	DO60	BB	BB ON/OFF
OAT	AI	AI63	GENERAL	OUTDOOR TEMP
OCC	DI	DI62	GENERAL	OCCUPANCY
OCC	DI	DI63	GENERAL	OCCUPANCY

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
–	1	ISSUE FOR APPROVAL	2020/8/14	–

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:

EQUIPMENT SCHEDULE & BAS POINTS LIST - OPTION 1

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01

LEGEND	
SYMBOL	DESCRIPTION
	SOLAR PANELS

1 HALTON HILLS
SITE PLAN - OPTION 1

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

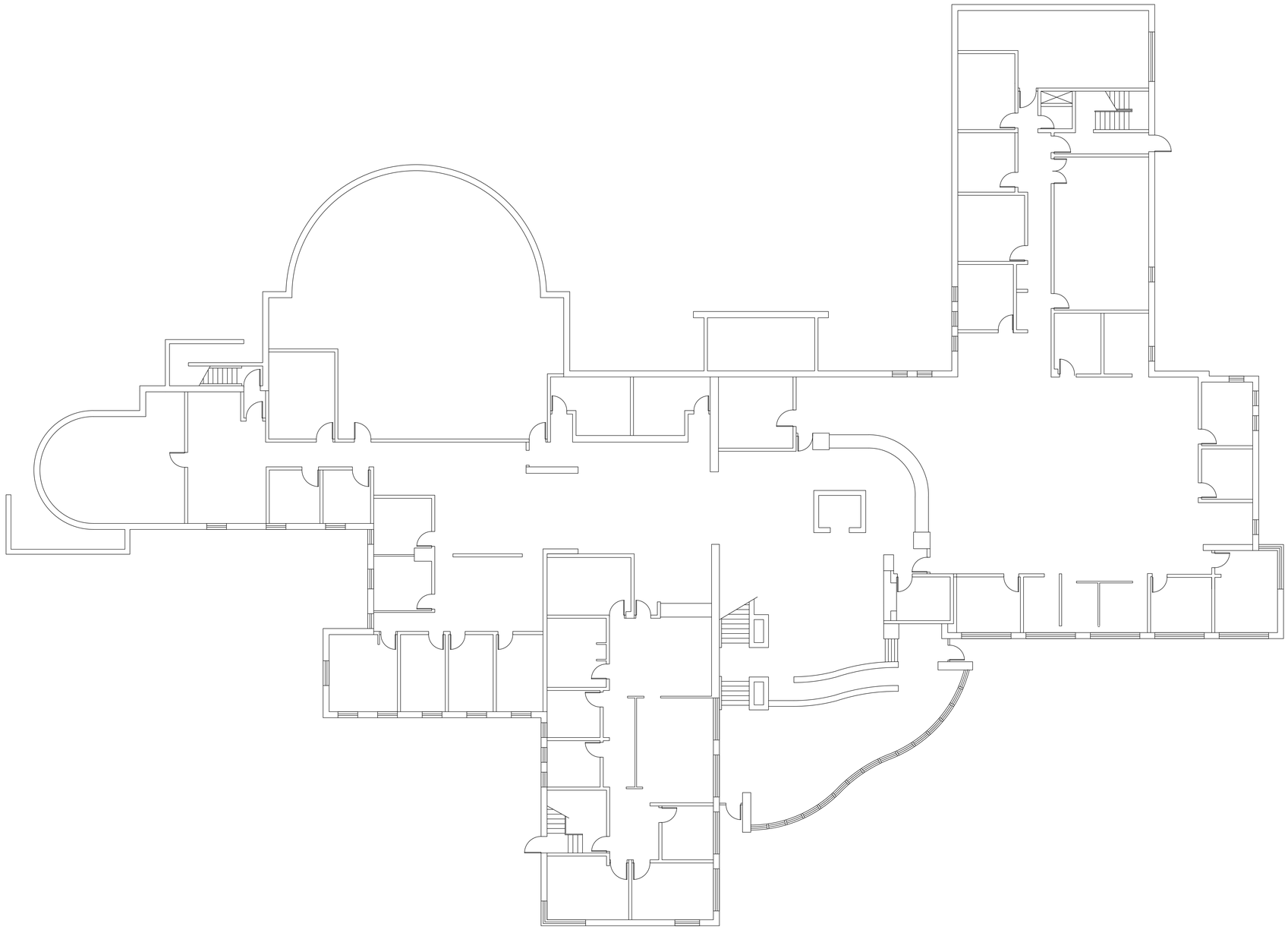
DRAWING:

HALTON HILLS SITE PLAN
OPTION 1

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-01



2 HALTON HILLS
FIRST FLOOR LAYOUT - OPTION 1

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

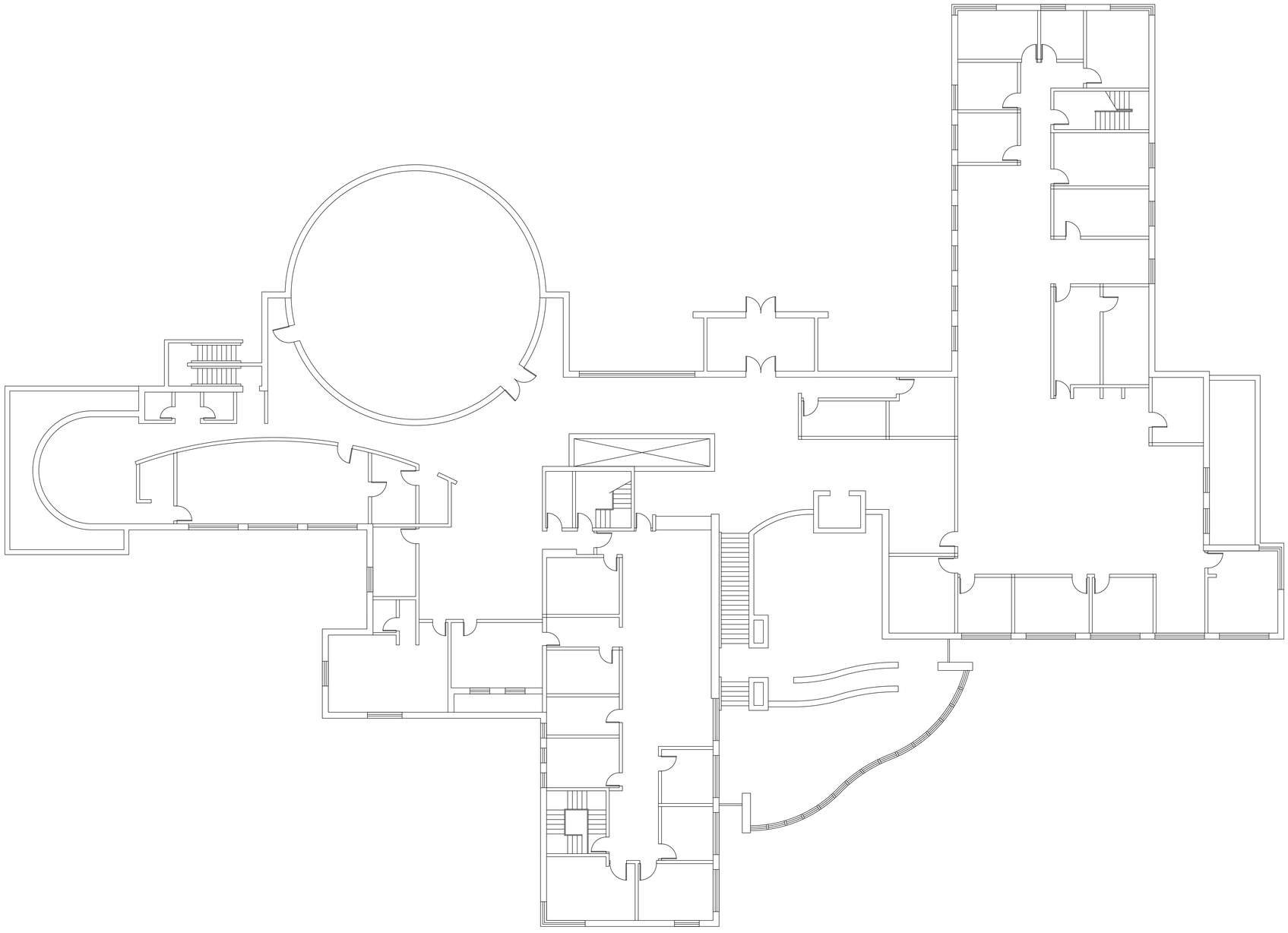
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS FIRST FLOOR LAYOUT - OPTION 1

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-02



3 HALTON HILLS
SECOND FLOOR LAYOUT - OPTION 1

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

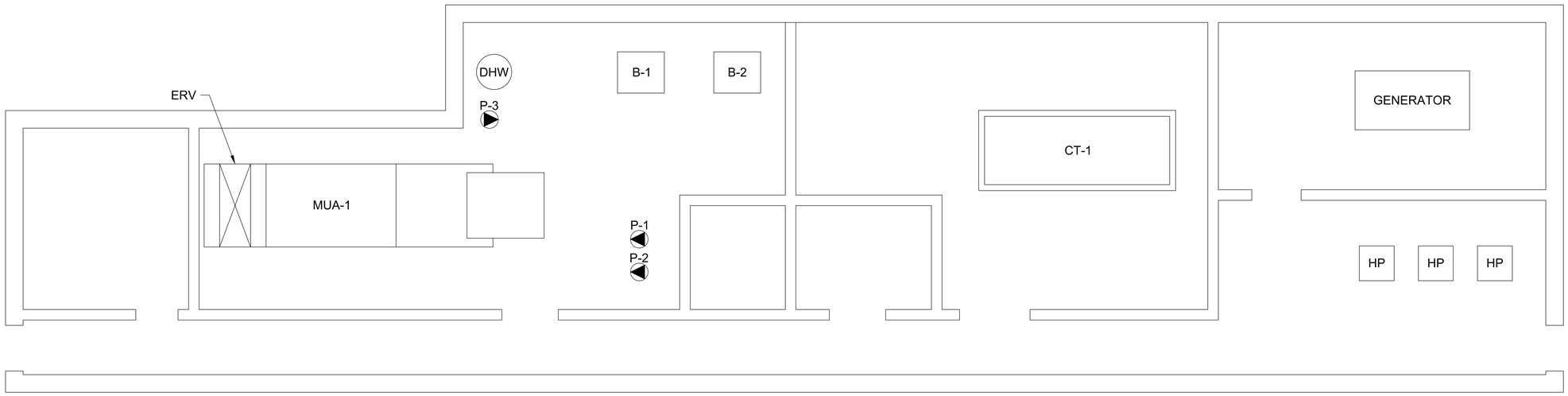
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SECOND FLOOR LAYOUT - OPTION 1

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-03



4 HALTON HILLS
PENTHOUSE LAYOUT - OPTION 1

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

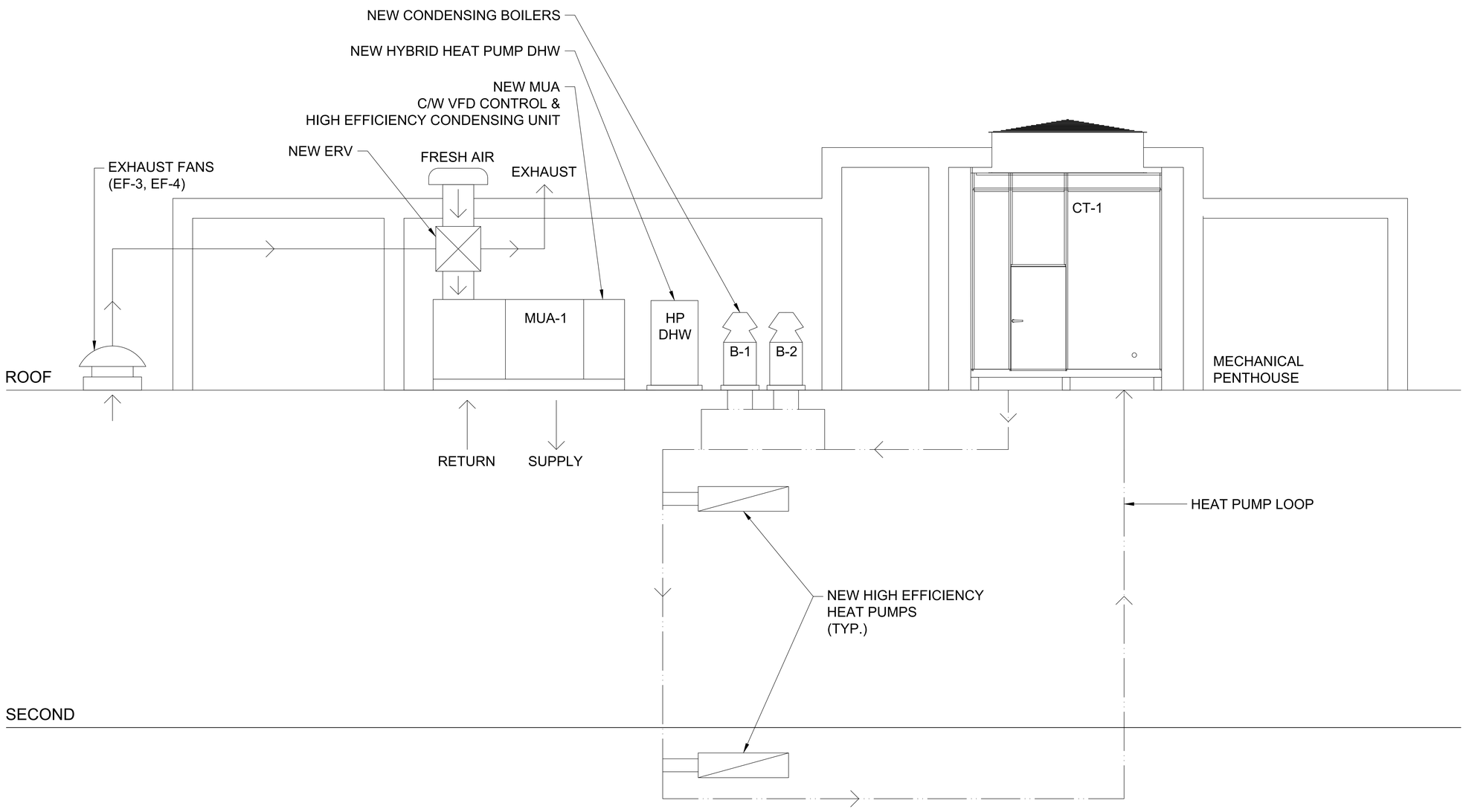
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS
PENTHOUSE LAYOUT - OPTION 1

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-04



5 HALTON HILLS
MECHANICAL SINGLE LINE DIAGRAM - OPTION 1

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS MECHANICAL SINGLE LINE DIAGRAM - OPTION 1

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-05

Halton Hills, Ontario

Town Hall

HALTON HILLS TOWN HALL LOW CARBON DESIGN - OPTION 2

G1301-M-00

LIST OF DRAWINGS

CONTRACTOR NOTES

MECHANICAL

INTERNAT ENERGY SOLUTIONS

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

1. GENERAL SPECIFICATIONS

1.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

1.2. CARE OF SITE

1.2.1. BE RESPONSIBLE FOR THE CARE OF THE BUILDINGS. DO ALL CUTTING PATCHING, AND PAINTING REQUIRED FOR THE WORK OF THIS TRADE.
- APPLY AT LEAST ONE COAT OF CORROSION RESISTANT PRIMER TO SUPPORTS, AND EQUIPMENT FABRICATED FROM FERROUS METALS.
- TOUCH UP PAINT ALL DAMAGED EQUIPMENT WITH PRODUCTS MATCHING ORIGINAL FINISH IN QUALITY AND APPEARANCE IF APPLICABLE.
- PROVIDE FLAT BLACK PAINTING BEHIND GRILLES AND DIFFUSERS.
WORK TO BE PERFORMED BY CONTRACTOR AT THE CONTRACTOR'S EXPENSE. INSTALL TEMPORARY CAPS OR CLOSURES ON THE ENDS OF ALL PIPES, CONDUITS, ETC. TO PREVENT THE ENTRY OF DEBRIS. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT. CO-OPERATE WITH ALL OTHER TRADES.

1.2.2. ANY CORE DRILLING OF SLAB OR CONCRETE WALL WILL REQUIRE PERMISSION FROM BUILDING ENGINEER AND WILL BE X-RAYED PRIOR TO DRILLING.

1.2.3. ALL PENETRATIONS, INCLUDING SLAB PENETRATIONS, MUST BE SEALED APPROPRIATELY. FIRE STOPS ARE TO BE PROVIDED AT ALL POINTS OF PENETRATION THROUGH FIRE RATED ASSEMBLIES.

1.2.4. ENSURE ALL OPENINGS THROUGH FIRE SUPPRESSIONS DO NOT EXCEED THE MAXIMUM SIZE AT ALL CEILING OPENINGS AND MAXIMUM AND MINIMUM DIMENSIONS INDICATED IN ULC GUIDE No 40U19 FOR SERVICE PENETRATIONS ASSEMBLY AND FIRE STOPPING MATERIAL.

1.3. CODES, FEES AND CERTIFICATES

1.3.1. COMPLY WITH ALL LATEST APPLICABLE BUILDING, PLUMBING, AND ELECTRICAL CODES. USE LATEST EDITION OF CITY, PROVINCIAL AND FEDERAL REGULATIONS HAVING JURISDICTION, INCLUDING ONTARIO ELECTRICAL SAFETY CODE. IF DISCREPANCIES OCCUR USE THE MOST RESTRICTING.

1.3.2. ALL WORK SHALL BE EXECUTED, AND ALL MATERIALS SHALL CONFORM TO AND BE INSPECTED, IN STRICT ACCORDANCE WITH ALL THE LAWS, RULES, AND REGULATIONS OF THE LOCAL AND PROVINCIAL CODES AND ALL OTHER AUTHORITIES HAVING JURISDICTION.

1.3.3. THIS TRADE SHALL OBTAIN ALL NECESSARY PERMITS AND ALL NOTICES, PAY ALL FEES IN ORDER THAT THE WORK HEREINAFTER SPECIFIED MAY BE CARRIED OUT AND SHALL FURNISH ALL CERTIFICATES NECESSARY AS EVIDENCE THAT THE WORK INSTALLED CONFORMS WITH THE LAWS AND CERTIFICATES ARE ISSUED.

1.3.4. ALL CHANGES AND ALTERATIONS REQUIRED BY AN AUTHORIZED INSPECTOR OF ANY AUTHORITY HAVING JURISDICTION SHALL BE CARRIED OUT WITHOUT CHARGE OR EXPENSE TO THE OWNER.

1.3.5. ALL EQUIPMENT SUPPLIED MUST HAVE APPROVAL OF N.F.P.A., C.S.A, U.L.C., OWNER'S UNDERWRITER AND ANY OTHER AUTHORITY HAVING JURISDICTION.

2. MECHANICAL SPECIFICATIONS

2.1. EXISTING BUILDING RENOVATIONS

2.1.1. THE MECHANICAL TRADE SHALL VISIT THE SITE AND INCLUDE ALL COSTS FOR INSTALLATION REMOVAL, REVISIONS, SETTING AND RESETTING OF PIPING, DUCTS, GRILLS, DIFFUSERS, AND ALL MECHANICAL ITEMS IN GENERAL WHERE CEILINGS, WALLS, FLOORS, WINDOWS, SILLS, DUCT AND PIPE SHAFTS, ETC., ARE REVISED.

2.1.2. PERFORM ALL WORK IN THE EXISTING BUILDING INDICATED ON THE DRAWINGS, SPECIFIED HEREIN, AND AS MAY BE NECESSARY TO CARRY OUT THE WORK OF THIS CONTRACT.

2.1.3. LOCATE, RELOCATE, CONNECT AND RECONNECT ANY PIPING, DRAINS, VENTS, WATER LINES, HEATING LINES, CONTROLS, AND PIPING, DUCTWORK, OR OTHER WORK PERTAINING TO THIS TRADE PRESENTLY CONCEALED IN WALLS, PARTITIONS, OR CEILING SPACES, AND WHICH BECOME EXPOSED DURING THE RENOVATION WORK SO THAT THESE SERVICES ARE CONCEALED IN THE RENOVATED LAYOUT, AND PUT BACK INTO OPERATION.

2.1.4. ANY EQUIPMENT, ETC., TO BE REUSED SHALL BE CAREFULLY REMOVED AND STORED. ANY PIECE OF EQUIPMENT OR FITTING ACCESSORY, ETC., WHICH FORMS A PART OF THE EQUIPMENT TO BE REUSED WHICH IS LOST OR DAMAGED SHALL BE REPLACED WITH A NEW DEVICE, FITTING, ACCESSORY, ETC. AT NO COST TO THE OWNER.

2.1.5. ALL EXISTING EQUIPMENT, FIXTURES, PIPING, ETC., BEING REMOVED SHALL REMAIN THE PROPERTY OF THE BUILDING OWNER AND WILL REMAIN ON THE JOB SITE.

2.1.6. MAKE CERTAIN THAT ALL SERVICES AFFECTED BY WORK ARE CUT OFF AND PROPERLY CAPPED OR DIVERTED.

2.1.7. DO NOT INTERRUPT SERVICES TO OR WITHIN EXISTING BUILDING WITHOUT PRIOR CONSULTATION WITH OWNER.

2.2. TEMPORARY PROTECTION

2.2.1. INSTALL TEMPORARY BRACING, SHORING, AND SUPPORT FOR EXECUTION OF WORK AND PROTECTION OF PERSONS AND PROPERTY. ALWAYS INSTALL APPROPRIATE SUPPORTS AND PROTECTION, USING ACCEPTABLE METHODS TO PREVENT COLLAPSE, SETTLING, AND OTHER DAMAGES.

2.2.2. INSTALL TEMPORARY COVERINGS AND ENCLOSURES TO PREVENT DAMAGE TO EXISTING SPACES AND TO PARTS OF BUILDING THAT ARE TO REMAIN.

2.2.3. INSTALL TEMPORARY DUST ENCLOSURES TO SEPARATE CONSTRUCTION SITE FROM REST OF BUILDING. ALSO, INSTALL TEMPORARY AIR FILTERS AND DUCTWORK TO CONTAIN CONSTRUCTION DUST WITHIN CONSTRUCTION AREA.

2.3. DEMOLITION AND CUTTING

2.3.1. MECHANICAL DEMOLITION: DEMOLISH AND REMOVE EXISTING MECHANICAL CONSTRUCTION AS SHOWN ON DRAWINGS AND AS REQUIRED TO ACCOMPLISH WORK, IF APPLICABLE. WHERE NEW WORK IS ADJACENT TO EXISTING CONSTRUCTION AND WHEN EXISTING CONSTRUCTION MUST BE REPLACED, REMOVE JUST ENOUGH EXISTING CONSTRUCTION TO COMPLETE WORK UNDER CONTRACT. AT NO ADDITIONAL COST TO OWNER, REMOVE AND REPLACE EXISTING CONSTRUCTION THAT IS TO REMAIN, BUT IS DAMAGED DURING WORK.

2.3.2. CUTTING CONCRETE: CUT OPENINGS THROUGH CONCRETE BY CORE DRILLING OR SAWING. NEVER CUT OPENINGS IN CONCRETE WITH A HAMMER-DRIVEN CHISEL OR DRILL WITHOUT WRITTEN AUTHORIZATION FROM ARCHITECT.

2.3.3. OTHER WORK: NEVER ENDANGER OR DAMAGE WORK OF OTHER TRADES. IF WORK OF OTHER TRADES MUST BE ALTERED TO ACCOMMODATE MECHANICAL WORK, REVIEW PROPOSED ALTERATIONS WITH INSTALLER OF WORK AND COMPLY WITH INSTALLER'S RECOMMENDATIONS TO MINIMIZE DAMAGE. WHERE NECESSARY, ENGAGE ORIGINAL INSTALLER TO MAKE REQUIRED CHANGES.

2.3.4. CLEAN DEMOLITION AREAS AND REMOVE DEBRIS FROM SITE AT END OF EACH DAY'S WORK. TRANSPORT DEBRIS IN MANNER THAT PREVENTS SPREAD OF DUST. DO NOT PERMIT BURNING OR STORAGE OF DEBRIS AT SITE. KEEP CONSTRUCTION AREAS BROOM CLEAN. KEEP ADJACENT AREAS UNENCUMBERED AND CLEAN.

2.4. UNANTICIPATED MECHANICAL WORK

2.4.1. IF DEMOLITION WORK EXPOSES CONCEALED MECHANICAL SERVICES (SUCH AS PIPING OR DUCTS), IMMEDIATELY INFORM ENGINEER OF ADDITIONAL COST TO PROJECT TO RELOCATE, REMOVE OR ABANDON UNANTICIPATED WORK. BEGIN THIS ADDITIONAL WORK ONLY AFTER RECEIVING APPROVAL FROM OWNER FOR ADDITIONAL COSTS.

2.4.2. REMOVE OR REROUTE UNANTICIPATED MECHANICAL SERVICES UNDER DIRECTION FROM ENGINEER. RECONNECT THEM TO MAINTAIN OWNER'S OPERATIONS. ABANDON SERVICES IN PLACE WHERE THEY WILL BE CONCEALED INSIDE FLOORS AND WALLS, BUT DISCONNECT THEM FROM THEIR SOURCES AND CAP THEM IN PLACE. LEAVE NO "DEAD END" SERVICES CONCEALED IN FINISHED WORK.

2.5. CUTTING AND PATCHING

2.5.1. THIS TRADE SHALL BE RESPONSIBLE FOR ALL COSTS OF CUTTING AND PATCHING OF ANY BUILDING CONSTRUCTION MADE NECESSARY BY THE INSTALLATION OF THIS WORK AND/OR DUE TO LACK-OF-COORDINATION IN THE NEW CONSTRUCTION, EXCEPT ONLY IN SUCH INSTANCES AS MAY BE OTHERWISE ASSIGNED BY THE SPECIFICATIONS OR SHOWN ON THE DRAWINGS.

2.5.2. UNDER NO CIRCUMSTANCES SHALL ANY CUTTING OR BURNING OF THE STRUCTURAL PARTS, INCLUDING CONCRETE SLABS OF THE BUILDING, BE UNDERTAKEN WITHOUT THE WRITTEN AUTHORITY OF THE CONSULTANT.

2.5.3. ALL CUTTING AND PATCHING MUST BE CARRIED OUT BY A TRADE EXPERIENCED IN THAT PARTICULAR TYPE OF WORK, BUT THE COSTS OF SUCH WORK SHALL BE BORNE BY THE MECHANICAL TRADE.

3. ELECTRICAL SPECIFICATIONS

3.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO ALL SECTIONS AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

3.2. GENERAL ELECTRICAL NOTES

3.2.1. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST CODES AS AMENDED BY THE LOCAL MUNICIPALITY.

3.2.2. OBTAIN ALL PERMITS REQUIRED. ARRANGE FOR THE INSPECTION OF WORK BY INSPECTION AUTHORITY. PAY ALL FEES. RETAIN ALL INSPECTION CERTIFICATES. PROVIDE FINAL UNCONDITIONAL CERTIFICATE OF APPROVAL OF THE OWNER.

3.2.3. ALL WORK SHALL COMPLY STRICTLY TO THE REQUIREMENTS OF THE LATEST EDITIONS OF THE CANADIAN ELECTRICAL "CSA" CODE AS ADOPTED AND AMENDED BY PROVINCIAL REGULATIONS, AND THE BUILDING CODE. THESE CODES AND ANY ADDITIONAL REQUIREMENTS OF THE POWER UTILITY SHALL FORM AN INTEGRAL PART OF THIS SPECIFICATION. ALL EQUIPMENT SHALL BE CSA APPROVED. WHERE DRAWING CALLS FOR EQUIPMENT, WIRING OR OTHER REQUIREMENTS EXCEEDING THE MINIMUM REQUIREMENTS OF THE CODE, THE DRAWING SHALL BE FOLLOWED.

3.2.4. IN, ADDITION COMPLY WITH THE LATEST REQUIREMENTS OF THE LOCAL BUILDING CODE AND STANDARDS, THE NATIONAL BUILDING CODE AND THE FIRE COMMISSIONERS' REQUIREMENTS.

3.2.5. THE ELECTRICAL CONTRACTOR SHALL SUPPLY ALL MATERIALS AND LABOUR, EXCEPT AS OTHERWISE NOTED, TO PROVIDE A COMPLETE AND OPERATING ELECTRICAL SYSTEM AS SHOWN ON DRAWINGS.

3.2.6. BEFORE STARTING ANY WORK, SUBMIT THE REQUIRED NUMBER OF COPIES OF DRAWINGS AND SPECIFICATIONS TO THE INSPECTION AUTHORITIES AND BUILDING AND FIRE DEPARTMENTS FOR THEIR APPROVAL AND COMMENTS. ANY CHANGES REQUIRED SHALL BE COMPLIED WITH AS PART OF THIS CONTRACT, BUT THE OTHER AND CONSULTANT SHALL BE NOTIFIED IMMEDIATELY OF SUCH CHANGES. PAY ALL FEES FOR EXAMINATION OF DRAWINGS AND SPECIFICATIONS.

3.2.7. ALL ELECTRICAL EQUIPMENT MOUNTED AND CONNECTED BY ELECTRICAL CONTRACTOR, (SUPPLIED BY ELECTRICAL CONTRACTOR OR NOT) SHALL BE READILY ACCESSIBLE FOR OPERATION, MAINTENANCE, AND REPAIR.

3.2.8. ON AWARD OF CONTRACT, SUBMIT SHOP DRAWINGS FOR REVIEW FOR ALL EQUIPMENT.

3.2.9. AT COMPLETION OF WORK, PROVIDE OWNER WITH A SET OF AS-BUILT RECORD DRAWINGS. THE AS-BUILT DRAWINGS SHALL INDICATE ALL APPROVED CHANGE NOTICES AND SITE DEVIATIONS.

3.2.10. ENSURE THAT ALL ELECTRICAL EQUIPMENT SUPPLIED BY OTHER TRADES IS SUITABLE FOR THE RESPECTIVE VOLTAGE. CONFIRM POWER REQUIREMENTS OF ALL OWNER SUPPLIED EQUIPMENT.

3.2.11. ALL EQUIPMENT AND MATERIALS SHALL BE NEW AND COMMERCIAL GRADE AND BE CSA APPROVED.

3.2.12. PROVIDE TEMPORARY ELECTRICAL POWER & LIGHTING FOR THE WORK OF THE TRADES AS REQUIRED BY THE GENERAL CONTRACTOR.

3.2.13. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT.

3.2.14. CONTRACTOR IS TO ENSURE THAT ALL EQUIPMENT IS COMMISSIONED AS PER MANUFACTURER'S REQUIREMENTS.

3.2.15. CONTRACTOR SHALL CARRY OUT TESTS AND INSPECTIONS OF THE WHOLE ELECTRICAL INSTALLATION. COMMISSIONING OF THE SYSTEMS WILL BE CARRIED OUT BY THE ELECTRICAL CONTRACTOR.

3.2.16. CONTRACTOR SHALL REFER TO ALL TENDER DRAWINGS DURING THE BIDDING AND CONSTRUCTION PHASES OF THE PROJECT.

3.2.17. CONTRACTOR TO PROVIDE 3 COPIES OF OPERATION AND MAINTENANCE MANUALS FOR ALL ELECTRICAL EQUIPMENT.

3.3. GENERAL ELECTRICAL SPECIFICATIONS

3.3.1. THE ELECTRICAL CONTRACTOR SHALL COMPLETE ALL ELECTRICAL WORK IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE SPECIFICATIONS AND DRAWINGS TO THE SATISFACTION OF THE OWNER.

3.3.2. THE DRAWINGS FOR THE WORK OF THIS DIVISIONS ARE IN PART DIAGRAMMATIC, INTENDED TO CONVEY THE SCOPE OF WORK, GENERAL ARRANGEMENT AND LOCATION OF THE EQUIPMENT, APPROXIMATE SIZES AND LOCATIONS OF THE EQUIPMENT. FOLLOW THESE DRAWINGS IN EXECUTION OF THE WORK, CONSULT MECHANICAL CONSTRUCTION DRAWINGS TO BECOME FAMILIAR WITH ALL CONDITIONS RELATING TO THE INSTALLATION AND TO VERIFY SPACES IN WHICH THE WORK WILL BE INSTALLED.

3.3.3. WHENEVER DIFFERENCES OCCUR BETWEEN PLANS AND DIAGRAMS OR SCHEMATICS, AND BETWEEN THE SPECIFICATIONS AND DRAWINGS, THE MAXIMUM CONDITIONS SHALL GOVERN, AND THE TENDER SHALL BE BASED ON WHICHEVER IS THE GREATER AMOUNT.

3.3.4. KEEP A RECORD SET OF DRAWINGS ON THE SITE ON WHICH SHALL BE CLEARLY INDICATED, THE EXACT LOCATION OF ALL FEEDER RUNS, PANELS JUNCTION BOXES, PULL BOXES, ETC. TWO COPIES OF THE RECORD DRAWINGS SHALL BE SUBMITTED TO THE PROJECT MANAGER UPON COMPLETION OF THE PROJECT.

3.3.5. THE CONTRACTOR SHALL VISIT THE SITE AND EXAMINE ALL DRAWINGS CAREFULLY TO DETERMINE THE EXTENT OF WORK. EXAMINE THE SITE AND TOGETHER WITH DRAWINGS AND SPECIFICATIONS DETERMINE AND INCLUDE IN TOTAL PRICE, THE TOTAL COST OF LABOUR AND MATERIAL TO EXECUTE THE WORK.

3.3.6. NO ALLOWANCE WILL BE MADE FOR OBVIOUS CONSIDERATIONS WHICH MAY HAVE BEEN OVERLOOKED.

3.3.7. EXAMINE THE MECHANICAL AND STRUCTURAL DRAWINGS TO ENSURE THAT THE WORK OF THIS DIVISION CAN BE SUCCESSFULLY COMPLETED WITH NO INTERFERENCES OR DISCREPANCIES.

3.3.8. EXAMINE THE WORK OF THE OTHER TRADES, AS THEY AFFECT THIS DIVISION, AND REPORT IMMEDIATELY TO THE PROJECT MANAGER ANY DEFECT OR INTERFERENCE THAT MAY AFFECT THE WORK OF THIS DIVISION, OR GUARANTEE OF THIS WORK.

3.3.9. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING AND PAYING FOR ALL NECESSARY PERMITS AND INSPECTIONS AS REQUIRED OR REQUESTED BY THE AUTHORITIES HAVING JURISDICTION. ONCE THE ELECTRICAL WORK HAS BEEN COMPLETED AND ACCEPTED BY THE OWNER, THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH CERTIFICATES VERIFYING THAT THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH ALL APPLICABLE CODES, BUILDING STANDARDS, AND ALL AUTHORITIES HAVING JURISDICTION.

3.3.10. THE ELECTRICAL WORK SHALL BE CARRIED OUT AND PERFORMED WITH QUALITY WORKMANSHIP, TO THE SATISFACTION OF THE CONSULTANT, OWNER, AND PROJECT MANAGER. ANY UNSATISFACTORY WORK SHALL BE RE-DONE OR REPLACED WITHOUT EXTRA COST TO THE OWNER.

3.3.11. THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH A ONE YEAR WRITTEN WARRANTY, COMMENCING ON THE DATE OF ACCEPTANCE. THE WARRANTY SHALL COVER THE COMPLETE ELECTRICAL INSTALLATION. THE ELECTRICAL CONTRACTOR SHALL REPAIR AND/OR REPLACE ANY DEFECTS IN THE MATERIALS OR WORKMANSHIP THAT OCCUR DURING THE WARRANTY PERIOD AT A TIME CONVENIENT TO, AND AT NO EXTRA COST TO THE OWNER.

3.3.12. PROVIDE THE OWNER WITH ONE SET OF 'AS-BUILT' RECORD DRAWINGS PREPARED ON AUTOCAD R.2007 OR COMPATIBLE FORMAT, INCLUDING A COPY OF THE DRAWINGS ON CD. PROVIDE THE ENGINEER WITH ONE SET OF BLACK LINE PRINTS OF THE 'AS-BUILT' RECORD DRAWINGS. THESE DRAWINGS SHALL ONLY BE DELIVERED TO THE OWNER AND ENGINEER AFTER COMPLETION OF THE WORK AND AFTER ALL DEFICIENCIES HAVE BEEN RECORDED.

3.3.13. IN CASE EXTRA WORK OF ANY KIND IS REQUIRED, OBTAIN WRITTEN INSTRUCTIONS FROM THE PROJECT MANAGER BEFORE PROCEEDING, PAYMENT WILL BE MADE AT A FAIR AND REASONABLE RATE ONLY FOR AUTHORIZED EXTRAS. IN THE CASE OF SCOPE REDUCTIONS, THE SAME PROCEDURE SHALL APPLY AND DECREASE MADE.

3.3.14. SUBMIT SHOP DRAWINGS OF LUMINARIES, PANELBOARDS, AND OTHER MAJOR ELECTRICAL EQUIPMENT, AS THEY APPLY TO THIS PROJECT, OR AS REQUIRED BY PROJECT MANAGER. EACH SHOP DRAWING SHALL BE CHECKED AND STAMPED AS BEING CORRECTED BY THE ELECTRICAL AND GENERAL CONTRACTOR PRIOR TO SUBMISSION TO THE PROJECT MANAGER FOR REVIEW. SHOP DRAWINGS NOT STAMPED AS SUCH WILL NOT BE REVIEWED AND WILL BE RETURNED AND DESIGNATED AS "REVISE AND RESUBMIT".

3.3.15. ALL SERVICES WHICH PENETRATE THE FLOOR SLAB OR FIRE-RATED WALLS AND CEILINGS SHALL BE INSTALLED IN RIGID STEEL CONDUIT AND SHALL BE SEALED WITH AN APPROVED, NON-SHRINK, WATER PROOF AND FIRE PROOF SEALANT.

3.3.16. ALL WORK SCHEDULED AND COORDINATED TO AVOID INTERFERENCES WITH OTHER TRADES DURING AND AFTER CONSTRUCTION.

3.3.17. PROVIDE TEMPORARY ELECTRICAL POWER FOR THE WORK OF THIS DIVISION AND OTHER TRADES AS REQUIRED BY THE GENERAL CONTRACTOR OR OWNER.

3.4. SUBMITTALS

3.4.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE MATERIALS, EQUIPMENT & DEVICES.

3.5. ELECTRICAL, LIFE SAFETY, WATER & SANITARY PIPING AND FITTINGS

3.5.1. ALL FIXTURES & FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA.

4. PLUMBING

4.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

4.2. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST PLUMBING CODE AS AMENDED BY THE LOCAL MUNICIPALITY.

4.3. SUBMITTALS

4.3.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE PLUMBING MATERIALS, EQUIPMENT & DEVICES.

4.4. WATER & SANITARY PIPING AND FITTINGS

ALL FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA-B125.3

5. EXECUTION

5.1. ALL WORK SHALL MEET OR EXCEED THE LATEST REQUIREMENTS OF THE ONTARIO BUILDING CODE AND ANY LOCAL AUTHORITY HAVING JURISDICTION.

5.2. NOTIFY THE CONSULTANT OF CHANGES REQUIRED BY THE ELECTRICAL INSPECTION DEPARTMENT PRIOR TO MAKING CHANGES.

5.3. PLUG OR CAP PIPE AND FITTINGS TO KEEP OUT DEBRIS DURING CONSTRUCTION.

5.4. ALL BRANCH PIPING AND DRAIN FROM FIXTURES SHALL NOT GARDE OF NOT LESS THAN 1:50 OR AS DIRECTED BY LOCAL PLUMBING CODE.

5.5. ALL VERTICAL STACKS SHALL BE SUPPORTED AT EACH FLOOR LEVEL.

6. . TESTING AND BALANCING OF SYSTEM

6.1. ALL TESTING SHALL BE PERFORMED BY THE CONTRACTOR. TESTING SHALL BE COMPLETED BEFORE THE CONSULTANT IS NOTIFIED FOR THE SYSTEM DEMONSTRATION.

6.2. VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY ALL TERMINATIONS ARE TIGHT.

6.3. ALL FIXTURES SHALL BE TESTED TO ENSURE THAT THE WORK CORRECTLY AND ARE FLUSHING / EVACUATING AT THE CORRECT FLOW RATE.

6.4. ALL TEST CERTIFICATES TO BE INCLUDED IN MAINTENANCE MANUALS.

6.5. PROVIDE A SIGNED STATEMENT TO THE EFFECT THAT ALL TESTS FOR MECHANICAL SYSTEMS AND EQUIPMENT HAVE BEEN COMPLETELY CARRIED OUT TO THE MANUFACTURER'S RECOMMENDATIONS, AND IN ACCORDANCE WITH THE REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION.

GENERAL CONTRACTOR NOTES

1. CONTRACTOR SHALL REVIEW ALL DRAWINGS, SPECIFICATIONS, TENDER DOCUMENTS AND SITE CONDITIONS BEFORE SUBMITTING A JOB ESTIMATE FOR THIS PROJECT. ALTHOUGH A REASONABLE ATTEMPT HAS BEEN MADE TO DOCUMENT THE EXACT EXTENT OF THE EXISTING CONDITIONS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXACT SITE CONDITIONS BEFORE INSTALLATION. ANY ADDITIONAL WORK DUE TO THE SITE CONDITIONS SHALL BE INCLUDED AS PART OF THIS CONTRACT.
2. CONTRACTOR SHALL FIELD CHECK AND CONFIRM EXACT LOCATIONS, ELEVATION AND INSTALLATIONS OF ALL SERVICES FOR THIS PROJECT PRIOR TO INSTALLING ANY EQUIPMENT, PIPE WORK OR CONNECTING ANY ELECTRICAL OR WATER LINES.
3. APPROVED EQUIVALENTS OR ALTERNATIVES TO SPECIFIED PRODUCTS SHALL BE EQUAL TO THE SPECIFIED PRODUCT IN EVERY RESPECT, OPERATE AS INTENDED, MEET THE SPACE, AND CAPACITY REQUIREMENTS AS OUTLINED. ANY ALTERNATES SHALL BE SUBMITTED FOR APPROVAL BEFORE PROCUREMENT. NO ALTERNATIVE SHALL BE ACCEPTED WITHOUT PRIOR WRITTEN APPROVAL OF THE OWNER.
4. FOLLOW CHOSEN MANUFACTURER'S RECOMMENDED INSTALLATION GUIDE AND PROCEDURES FOR EQUIPMENT, SUPPLEMENTED BY THE REQUIREMENTS AND OUTLINE OF THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS AND SHALL REPORT ANY DISCREPANCIES TO CONSULTANT BEFORE PROCEEDING WITH WORK.
6. USE ONLY THE LATEST REVISED DRAWINGS AS SPECIFIED.
7. CONTRACTOR SHALL PROVIDE CONSULTANT AND PROJECT MANAGER WITH A DETAILED CONSTRUCTION SCHEDULE FOR APPROVAL BEFORE COMMENCEMENT OF ANY WORK.
8. THE CONTRACTOR SHALL INFORM CONSULTANT AND PROJECT MANAGER PRIOR TO START OF WORK ALLOWING FOR SCHEDULE AND PROCESS WITHOUT DELAY TO THE PROJECT, SHOULD IT APPEAR THAT ANY PART OF THE WORK IS NOT SUFFICIENTLY DETAILED ON THE DRAWINGS.
9. CONTRACT DOCUMENTS AND DRAWINGS ARE DIAGRAMMATIC AND NOT DRAWN TO SCALE UNLESS DETAILED OTHERWISE. THEY ESTABLISH SCOPE, MATERIAL AND INSTALLATION QUALITY AND ARE NOT DETAILED INSTALLATION INSTRUCTIONS.
10. MAKE REFERENCE TO ELECTRICAL, MECHANICAL, LIFE SAFETY AND PLUMBING DRAWINGS WHEN SETTING OUT WORK. CONSULT WITH RESPECTIVE DIVISIONS IN SETTING OUT LOCATIONS FOR EQUIPMENT SO THAT CONFLICTS ARE AVOIDED AND SYMMETRICAL AND EVEN SPACING IS MAINTAINED. JOINTLY WORK OUT ALL CONFLICTS ON SITE BEFORE FABRICATING OR INSTALLING ANY MATERIALS OR EQUIPMENT.
11. ALL EXISTING SERVICES SHALL REMAIN IN CONSTANT OPERATION. CONTRACTOR SHALL GIVE THE CONSULTANT AND OWNER FIVE WORKING DAYS WRITTEN NOTICE BEFORE ANY TEMPORARY POWER/WATER SHUTDOWNS.
12. IMMEDIATELY CUT OFF AND CAP CONCEALED SERVICES UNCOVERED DURING WORK.
13. CONTRACTOR SHALL PROVIDE COMPLETE, FULLY TESTED, AND OPERATIONAL ELECTRICAL, MECHANICAL AND PLUMBING SYSTEMS TO MEET REQUIREMENTS DESCRIBED HEREIN.
14. INSTALL EQUIPMENT IN LOCATIONS AND ROUTES SHOWN. RUN ELECTRICAL LINES WHERE SEEN FIT AND WATER LINES AS SHOWN BUT AVOID INTERFERENCE WITH OTHER SERVICES.
15. INSTALLATION MUST BE COMPLETED IN ACCORDANCE WITH APPLICABLE CODES AND ORDINANCES.
16. CONTRACTOR SHALL OBTAIN ALL PERMITS AND PAY ALL FEES APPLICABLE TO THE WORK.
17. HANDLE, STORE, AND INSTALL ALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. DO NOT STORE EQUIPMENT ON THE GROUND OR IN CONDITIONS THAT WILL DAMAGE OR COMPROMISE THE INTEGRITY OF THE PRODUCT.
18. ANY COSTS ASSOCIATED WITH MATERIAL DELIVERY OR DEBRIS REMOVAL SHALL BE THE CONTRACTORS RESPONSIBILITY. ALL DEBRIS SHALL BE COLLECTED AND REMOVED AT END OF EACH WORK DAY. CONTRACTOR SHALL EMPLOY DUST CONTROL.
19. THE INSTALLATION METHODS, FINISHING AND APPEARANCE IS SUBJECT TO THE APPROVAL OF THE CONSULTANT AND OWNER. ANY COORDINATION TIME OR ADDITIONAL MATERIALS/LABOUR REQUIRED TO ACHIEVE THE REQUIRED APPEARANCE SHALL BE INCLUDED IN THIS CONTRACT.
20. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO EXISTING SERVICES, FINISHES AND MATERIALS DUE TO THE WORK UNDER THIS CONTRACT, AND BEAR ALL COSTS INCURRED TO MAKE GOOD, REPAIR OR REPLACE SAME TO THE PROJECT MANAGER'S SATISFACTION.
21. FINAL CLEANING SHALL INCLUDE EQUIPMENT, CASES, COVERS, FLOORS, WALLS, WINDOWS, ETC. THAT HAVE BEEN AFFECTED BY THE WORK, IN READINESS FOR CLIENT'S OCCUPANCY.
22. UPON COMPLETION OF ALL WORK BY ALL TRADES, THE CONTRACTOR SHALL REMOVE ALL SURPLUS CONSTRUCTION MATERIALS, RUBBISH AND GARBAGE TO LEAVE THE PREMISES CLEAN AND SUITABLE FOR IMMEDIATE OCCUPANCY BY THE CLIENT WITHOUT THE NEED FOR FURTHER CLEANING.
23. WHERE STRUCTURAL WORK REQUIRES CUTTING AND REMOVAL, CAREFULLY EXAMINE THE WORK TO ASCERTAIN THAT THE EXTENT OF CUTTING AND REMOVAL REQUIRED IS SAFE PRIOR TO EXECUTION.

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:

GENERAL CONTRACTOR NOTES

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01

PROPOSED WATER SOURCE MAKE-UP AIR SCHEDULE		
TAG	CAPACITY (CFM)	NOTES
WSHP-1	4,600	C/W VFD CONTROLS & ERV

PROPOSED DOMESTIC HOT WATER SCHEDULE			
TAG	CAPACITY (BTU/hr)	CAPACITY (USGAL)	EFFICIENCY
DHW-1	85,000	100	3.75 UEF

PROPOSED HEAT PUMP SCHEDULE	
TAG	MINIMUM COP
HP-1 TO HP-52	3.8 (COOLING), 4.3 (HEATING)

OPTION 2 BAS TOTAL POINTS	
POINT TYPE	QUANTITY
DO	60
AO	5
DI	64
AI	66

OPTION 2 BAS POINTS LIST

POINT NAME	POINT TYPE	POINT NO.	SYSTEM	POINT DESCRIPTION
WSHP-S/S	DO	DO1	WSHP	WSHP START/STOP
WSHP-MOD	AO	AO1	WSHP	WSHP MODULATION
WSHP-STAT	DI	DI1	WSHP	WSHP STATUS
WSHP-SAT	AI	AI1	WSHP	WSHP SUPPLY AIR TEMP
WSHP-RAT	AI	AI2	WSHP	WSHP RETURN AIR TEMP
CT-S/S	DO	DO1	CT	CT START/STOP
CT-MOD	AO	AO2	CT	CT MODULATION
CT-STAT	DI	DI2	CT	CT STATUS
CT-SWT	AI	AI3	CT	CT SUPPLY TEMP
CT-RWT	AI	AI4	CT	CT RETURN TEMP
B1-S/S	DO	DO2	B1	B1 START/STOP
B1-MOD	AO	AO3	B1	B1 MODULATION
B1-STAT	DI	DI3	B1	B1 STATUS
B1-SWT	AI	AI5	B1	B1 SUPPLY TEMP
B1-RWT	AI	AI6	B1	B1 RETURN TEMP
B1-RECIRC	DI	DI4	B1	B1 RECIRC STATUS
B2-S/S	DO	DO3	B2	B2 START/STOP
B2-MOD	AO	AO4	B2	B2 MODULATION
B2-STAT	DI	DI5	B2	B2 STATUS
B2-SWT	AI	AI7	B2	B2 SUPPLY TEMP
B2-RWT	AI	AI8	B2	B2 RETURN TEMP
B2-RECIRC	DI	DI6	B2	B2 RECIRC STATUS
P1-SS	DO	DO4	P1	P1 START/STOP/MODULATION
P1-STAT	DI	DI7	P1	P1 RECIRC STATUS
P2-SS	DO	DO5	P2	P2 START/STOP
P2-STAT	DI	DI8	P2	P2 START/STOP/MODULATION
GEO-S/S	DO	DO6	GEO	GEO START/STOP
GEO-MOD	AO	AO5	GEO	GEO MODULATION
GEO-STAT	DI	DI9	GEO	GEO STATUS
GEO-SWT	AI	AI9	GEO	GEO SUPPLY TEMP
GEO-RWT	AI	AI10	GEO	GEO RETURN TEMP
HP-SWT	AI	AI11	HPL	HEAT PUMP SUPPLY TEMP
HP-RWT	AI	AI12	HPL	HEAT PUMP RETURN TEMP
HP-S/S 1-52	DO	DO 7 TO 59	HP	HP START/STOP FOR 52 UNITS
HP-STAT 1-52	DI	DI 10 TO 62	HP	HP STATUS FOR 52 UNITS
HP-TEMP 1-52	AI	AI 13 TO 65	HP	HP TEMP FOR 52 UNITS
BB-S/S	DO	DO60	BB	BB ON/OFF
OAT	AI	AI66	GENERAL	OUTDOOR TEMP
OCC	DI	DI63	GENERAL	OCCUPANCY
OCC	DI	DI64	GENERAL	OCCUPANCY

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

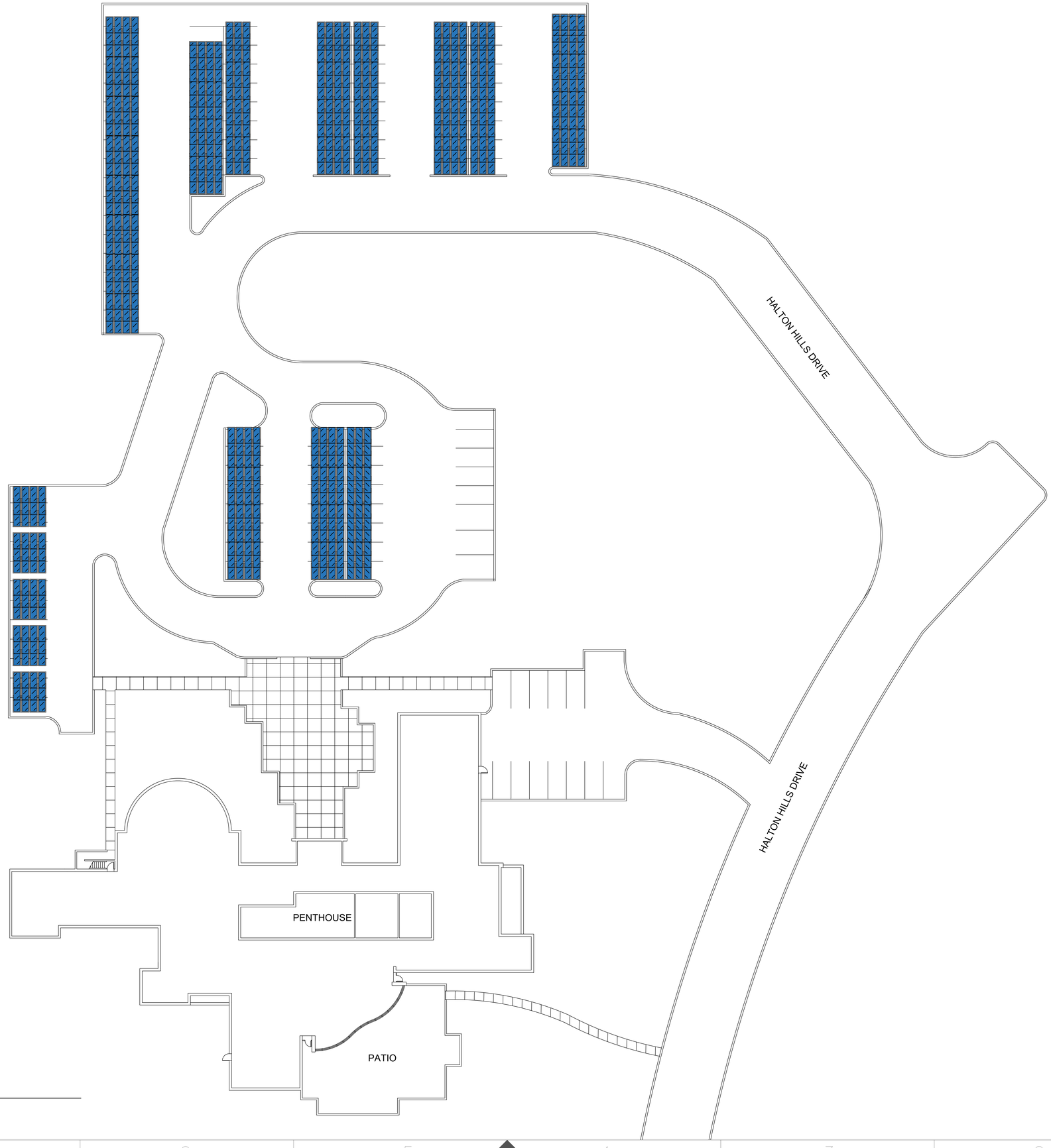
DRAWING:

EQUIPMENT SCHEDULE & BAS POINTS LIST - OPTION 2

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01



LEGEND	
SYMBOL	DESCRIPTION
	SOLAR PANELS

1 HALTON HILLS
SITE PLAN - OPTION 2

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

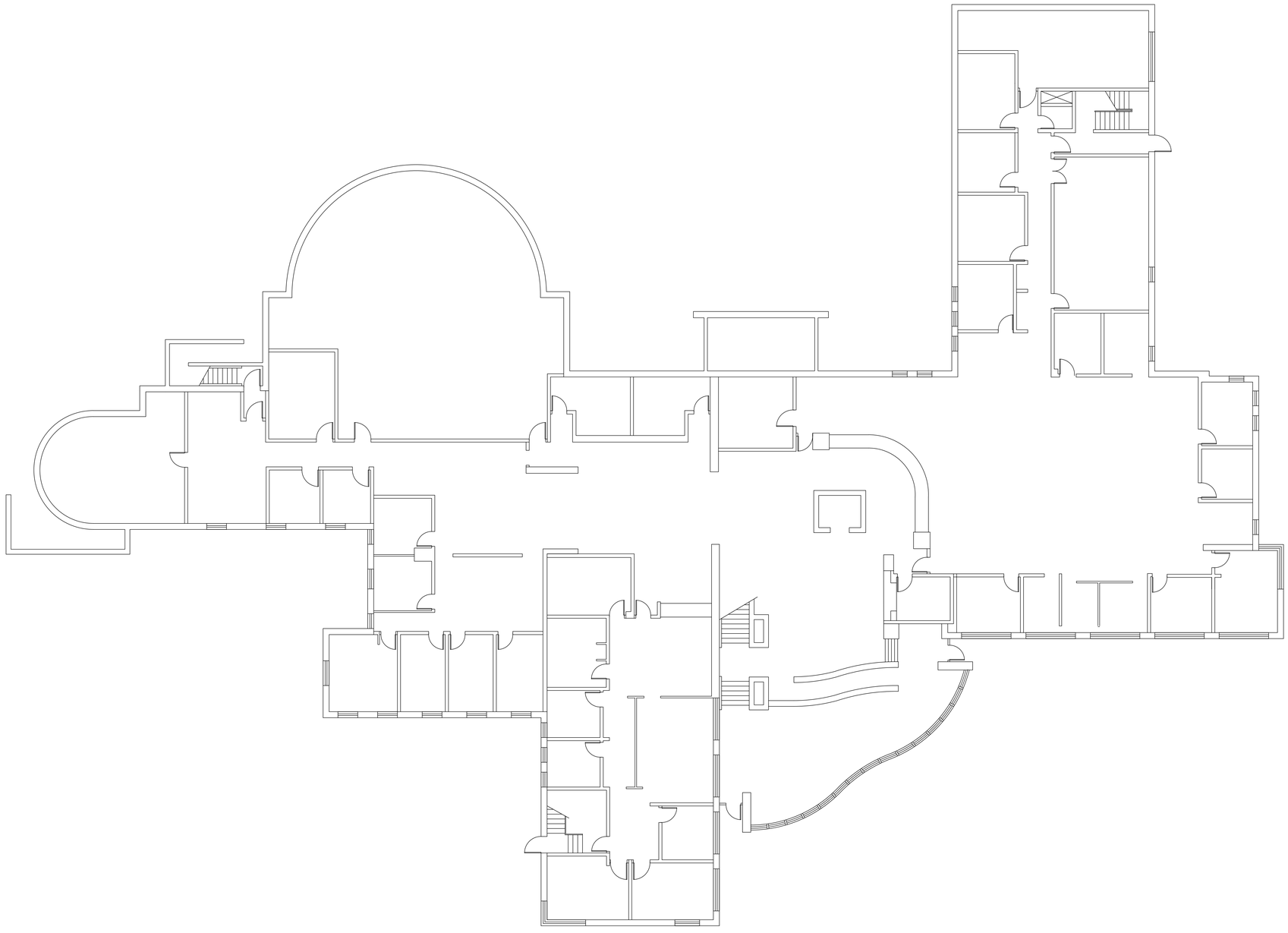
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SITE PLAN
OPTION 2

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-01



2 HALTON HILLS
FIRST FLOOR LAYOUT - OPTION 2

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

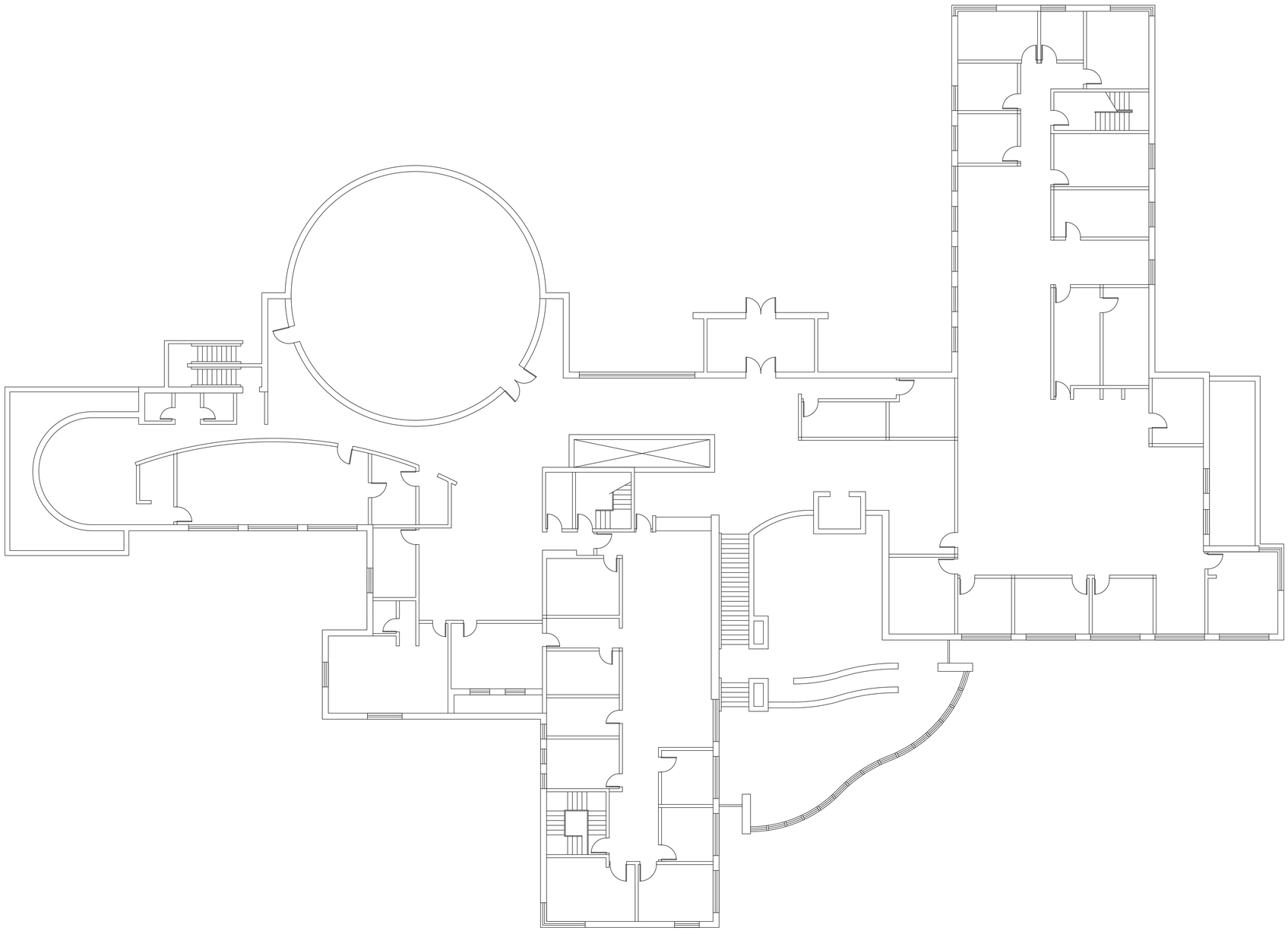
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS FIRST FLOOR
LAYOUT - OPTION 2

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-02



3 HALTON HILLS
SECOND FLOOR LAYOUT - OPTION 2

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

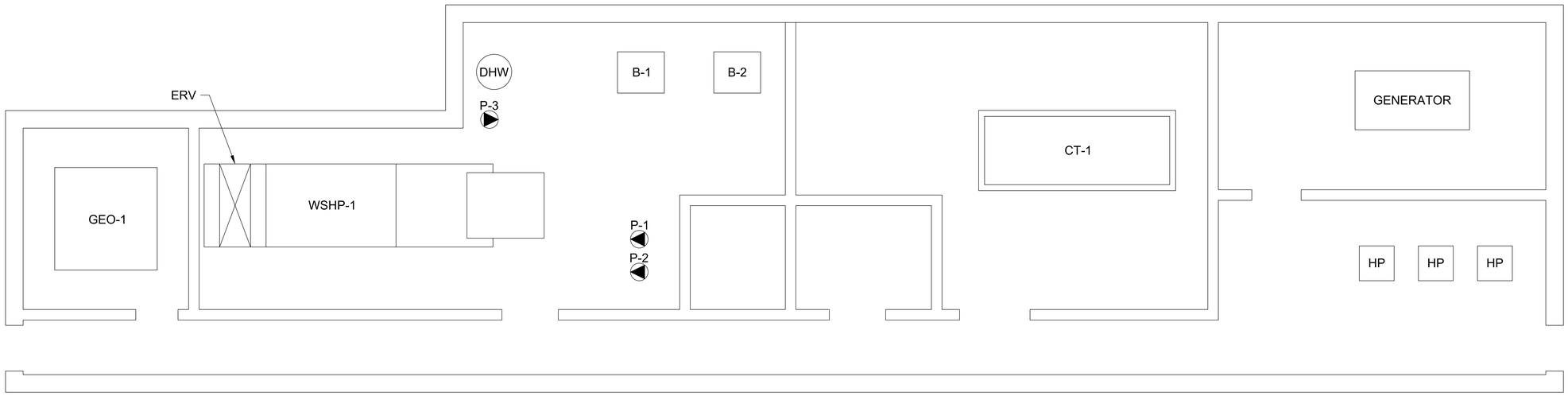
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SECOND FLOOR LAYOUT - OPTION 2

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-03



4 HALTON HILLS
PENTHOUSE LAYOUT - OPTION 2

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

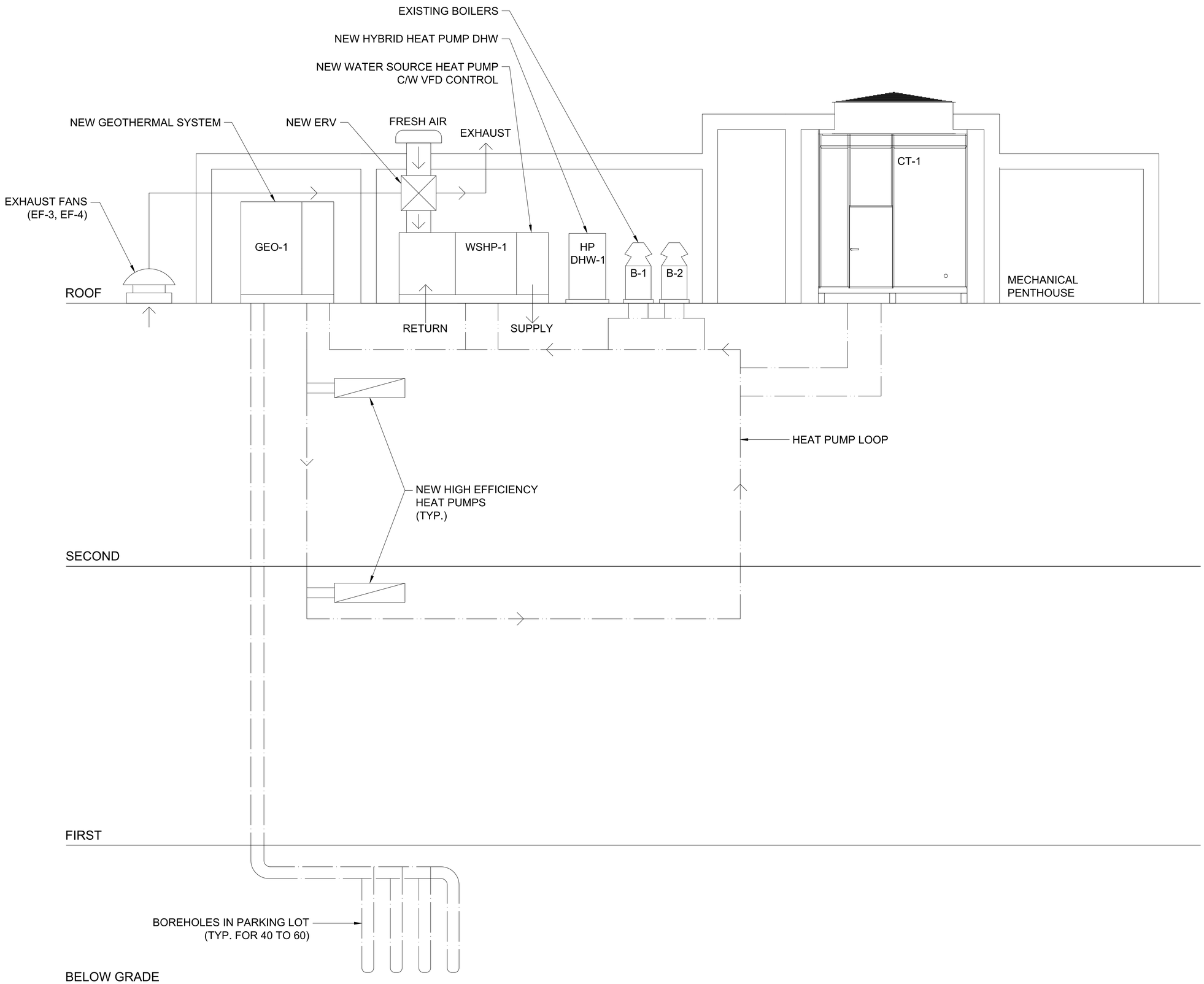
DRAWING:

HALTON HILLS
PENTHOUSE LAYOUT - OPTION 2

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-04



5 HALTON HILLS
MECHANICAL SINGLE LINE DIAGRAM - OPTION 2

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
–	1	ISSUE FOR APPROVAL	2020/8/14	–

STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS MECHANICAL SINGLE LINE DIAGRAM - OPTION 2

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-05

Halton Hills, Ontario

Town Hall

HALTON HILLS TOWN HALL LOW CARBON DESIGN – OPTION 3

G1301-M-00

LIST OF DRAWINGS

CONTRACTOR NOTES

MECHANICAL

INTERNAT ENERGY SOLUTIONS

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

1. GENERAL SPECIFICATIONS

1.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

1.2. CARE OF SITE

1.2.1. BE RESPONSIBLE FOR THE CARE OF THE BUILDINGS. DO ALL CUTTING PATCHING, AND PAINTING REQUIRED FOR THE WORK OF THIS TRADE.
- APPLY AT LEAST ONE COAT OF CORROSION RESISTANT PRIMER TO SUPPORTS, AND EQUIPMENT FABRICATED FROM FERROUS METALS.
- TOUCH UP PAINT ALL DAMAGED EQUIPMENT WITH PRODUCTS MATCHING ORIGINAL FINISH IN QUALITY AND APPEARANCE IF APPLICABLE.
- PROVIDE FLAT BLACK PAINTING BEHIND GRILLES AND DIFFUSERS.
WORK TO BE PERFORMED BY CONTRACTOR AT THE CONTRACTOR'S EXPENSE. INSTALL TEMPORARY CAPS OR CLOSURES ON THE ENDS OF ALL PIPES, CONDUITS, ETC. TO PREVENT THE ENTRY OF DEBRIS. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT. CO-OPERATE WITH ALL OTHER TRADES.

1.2.2. ANY CORE DRILLING OF SLAB OR CONCRETE WALL WILL REQUIRE PERMISSION FROM BUILDING ENGINEER AND WILL BE X-RAYED PRIOR TO DRILLING.

1.2.3. ALL PENETRATIONS, INCLUDING SLAB PENETRATIONS, MUST BE SEALED APPROPRIATELY. FIRE STOPS ARE TO BE PROVIDED AT ALL POINTS OF PENETRATION THROUGH FIRE RATED ASSEMBLIES.

1.2.4. ENSURE ALL OPENINGS THROUGH FIRE SUPPRESSIONS DO NOT EXCEED THE MAXIMUM SIZE AT ALL CEILING OPENINGS AND MAXIMUM AND MINIMUM DIMENSIONS INDICATED IN ULC GUIDE No 40U19 FOR SERVICE PENETRATIONS ASSEMBLY AND FIRE STOPPING MATERIAL.

1.3. CODES, FEES AND CERTIFICATES

1.3.1. COMPLY WITH ALL LATEST APPLICABLE BUILDING, PLUMBING, AND ELECTRICAL CODES. USE LATEST EDITION OF CITY, PROVINCIAL AND FEDERAL REGULATIONS HAVING JURISDICTION, INCLUDING ONTARIO ELECTRICAL SAFETY CODE. IF DISCREPANCIES OCCUR USE THE MOST RESTRICTING.

1.3.2. ALL WORK SHALL BE EXECUTED, AND ALL MATERIALS SHALL CONFORM TO AND BE INSPECTED, IN STRICT ACCORDANCE WITH ALL THE LAWS, RULES, AND REGULATIONS OF THE LOCAL AND PROVINCIAL CODES AND ALL OTHER AUTHORITIES HAVING JURISDICTION.

1.3.3. THIS TRADE SHALL OBTAIN ALL NECESSARY PERMITS AND ALL NOTICES, PAY ALL FEES IN ORDER THAT THE WORK HEREINAFTER SPECIFIED MAY BE CARRIED OUT AND SHALL FURNISH ALL CERTIFICATES NECESSARY AS EVIDENCE THAT THE WORK INSTALLED CONFORMS WITH THE LAWS AND CERTIFICATES ARE ISSUED.

1.3.4. ALL CHANGES AND ALTERATIONS REQUIRED BY AN AUTHORIZED INSPECTOR OF ANY AUTHORITY HAVING JURISDICTION SHALL BE CARRIED OUT WITHOUT CHARGE OR EXPENSE TO THE OWNER.

1.3.5. ALL EQUIPMENT SUPPLIED MUST HAVE APPROVAL OF N.F.P.A., C.S.A, U.L.C., OWNER'S UNDERWRITER AND ANY OTHER AUTHORITY HAVING JURISDICTION.

2. MECHANICAL SPECIFICATIONS

2.1. EXISTING BUILDING RENOVATIONS

2.1.1. THE MECHANICAL TRADE SHALL VISIT THE SITE AND INCLUDE ALL COSTS FOR INSTALLATION REMOVAL, REVISIONS, SETTING AND RESETTING OF PIPING, DUCTS, GRILLS, DIFFUSERS, AND ALL MECHANICAL ITEMS IN GENERAL WHERE CEILINGS, WALLS, FLOORS, WINDOWS, SILLS, DUCT AND PIPE SHAFTS, ETC., ARE REVISED.

2.1.2. PERFORM ALL WORK IN THE EXISTING BUILDING INDICATED ON THE DRAWINGS, SPECIFIED HEREIN, AND AS MAY BE NECESSARY TO CARRY OUT THE WORK OF THIS CONTRACT.

2.1.3. LOCATE, RELOCATE, CONNECT AND RECONNECT ANY PIPING, DRAINS, VENTS, WATER LINES, HEATING LINES, CONTROLS, AND PIPING, DUCTWORK, OR OTHER WORK PERTAINING TO THIS TRADE PRESENTLY CONCEALED IN WALLS, PARTITIONS, OR CEILING SPACES, AND WHICH BECOME EXPOSED DURING THE RENOVATION WORK SO THAT THESE SERVICES ARE CONCEALED IN THE RENOVATED LAYOUT, AND PUT BACK INTO OPERATION.

2.1.4. ANY EQUIPMENT, ETC., TO BE REUSED SHALL BE CAREFULLY REMOVED AND STORED. ANY PIECE OF EQUIPMENT OR FITTING ACCESSORY, ETC., WHICH FORMS A PART OF THE EQUIPMENT TO BE REUSED WHICH IS LOST OR DAMAGED SHALL BE REPLACED WITH A NEW DEVICE, FITTING, ACCESSORY, ETC. AT NO COST TO THE OWNER.

2.1.5. ALL EXISTING EQUIPMENT, FIXTURES, PIPING, ETC., BEING REMOVED SHALL REMAIN THE PROPERTY OF THE BUILDING OWNER AND WILL REMAIN ON THE JOB SITE.

2.1.6. MAKE CERTAIN THAT ALL SERVICES AFFECTED BY WORK ARE CUT OFF AND PROPERLY CAPPED OR DIVERTED.

2.1.7. DO NOT INTERRUPT SERVICES TO OR WITHIN EXISTING BUILDING WITHOUT PRIOR CONSULTATION WITH OWNER.

2.2. TEMPORARY PROTECTION

2.2.1. INSTALL TEMPORARY BRACING, SHORING, AND SUPPORT FOR EXECUTION OF WORK AND PROTECTION OF PERSONS AND PROPERTY. ALWAYS INSTALL APPROPRIATE SUPPORTS AND PROTECTION, USING ACCEPTABLE METHODS TO PREVENT COLLAPSE, SETTLING, AND OTHER DAMAGES.

2.2.2. INSTALL TEMPORARY COVERINGS AND ENCLOSURES TO PREVENT DAMAGE TO EXISTING SPACES AND TO PARTS OF BUILDING THAT ARE TO REMAIN.

2.2.3. INSTALL TEMPORARY DUST ENCLOSURES TO SEPARATE CONSTRUCTION SITE FROM REST OF BUILDING. ALSO, INSTALL TEMPORARY AIR FILTERS AND DUCTWORK TO CONTAIN CONSTRUCTION DUST WITHIN CONSTRUCTION AREA.

2.3. DEMOLITION AND CUTTING

2.3.1. MECHANICAL DEMOLITION: DEMOLISH AND REMOVE EXISTING MECHANICAL CONSTRUCTION AS SHOWN ON DRAWINGS AND AS REQUIRED TO ACCOMPLISH WORK, IF APPLICABLE. WHERE NEW WORK IS ADJACENT TO EXISTING CONSTRUCTION AND WHEN EXISTING CONSTRUCTION MUST BE REPLACED, REMOVE JUST ENOUGH EXISTING CONSTRUCTION TO COMPLETE WORK UNDER CONTRACT. AT NO ADDITIONAL COST TO OWNER, REMOVE AND REPLACE EXISTING CONSTRUCTION THAT IS TO REMAIN, BUT IS DAMAGED DURING WORK.

2.3.2. CUTTING CONCRETE: CUT OPENINGS THROUGH CONCRETE BY CORE DRILLING OR SAWING. NEVER CUT OPENINGS IN CONCRETE WITH A HAMMER-DRIVEN CHISEL OR DRILL WITHOUT WRITTEN AUTHORIZATION FROM ARCHITECT.

2.3.3. OTHER WORK: NEVER ENDANGER OR DAMAGE WORK OF OTHER TRADES. IF WORK OF OTHER TRADES MUST BE ALTERED TO ACCOMMODATE MECHANICAL WORK, REVIEW PROPOSED ALTERATIONS WITH INSTALLER OF WORK AND COMPLY WITH INSTALLER'S RECOMMENDATIONS TO MINIMIZE DAMAGE. WHERE NECESSARY, ENGAGE ORIGINAL INSTALLER TO MAKE REQUIRED CHANGES.

2.3.4. CLEAN DEMOLITION AREAS AND REMOVE DEBRIS FROM SITE AT END OF EACH DAY'S WORK. TRANSPORT DEBRIS IN MANNER THAT PREVENTS SPREAD OF DUST. DO NOT PERMIT BURNING OR STORAGE OF DEBRIS AT SITE. KEEP CONSTRUCTION AREAS BROOM CLEAN. KEEP ADJACENT AREAS UNENCUMBERED AND CLEAN.

2.4. UNANTICIPATED MECHANICAL WORK

2.4.1. IF DEMOLITION WORK EXPOSES CONCEALED MECHANICAL SERVICES (SUCH AS PIPING OR DUCTS), IMMEDIATELY INFORM ENGINEER OF ADDITIONAL COST TO PROJECT TO RELOCATE, REMOVE OR ABANDON UNANTICIPATED WORK. BEGIN THIS ADDITIONAL WORK ONLY AFTER RECEIVING APPROVAL FROM OWNER FOR ADDITIONAL COSTS.

2.4.2. REMOVE OR REROUTE UNANTICIPATED MECHANICAL SERVICES UNDER DIRECTION FROM ENGINEER. RECONNECT THEM TO MAINTAIN OWNER'S OPERATIONS. ABANDON SERVICES IN PLACE WHERE THEY WILL BE CONCEALED INSIDE FLOORS AND WALLS, BUT DISCONNECT THEM FROM THEIR SOURCES AND CAP THEM IN PLACE. LEAVE NO "DEAD END" SERVICES CONCEALED IN FINISHED WORK.

2.5. CUTTING AND PATCHING

2.5.1. THIS TRADE SHALL BE RESPONSIBLE FOR ALL COSTS OF CUTTING AND PATCHING OF ANY BUILDING CONSTRUCTION MADE NECESSARY BY THE INSTALLATION OF THIS WORK AND/OR DUE TO LACK-OF-COORDINATION IN THE NEW CONSTRUCTION, EXCEPT ONLY IN SUCH INSTANCES AS MAY BE OTHERWISE ASSIGNED BY THE SPECIFICATIONS OR SHOWN ON THE DRAWINGS.

2.5.2. UNDER NO CIRCUMSTANCES SHALL ANY CUTTING OR BURNING OF THE STRUCTURAL PARTS, INCLUDING CONCRETE SLABS OF THE BUILDING, BE UNDERTAKEN WITHOUT THE WRITTEN AUTHORITY OF THE CONSULTANT.

2.5.3. ALL CUTTING AND PATCHING MUST BE CARRIED OUT BY A TRADE EXPERIENCED IN THAT PARTICULAR TYPE OF WORK, BUT THE COSTS OF SUCH WORK SHALL BE BORNE BY THE MECHANICAL TRADE.

3. ELECTRICAL SPECIFICATIONS

3.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO ALL SECTIONS AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

3.2. GENERAL ELECTRICAL NOTES

3.2.1. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST CODES AS AMENDED BY THE LOCAL MUNICIPALITY.

3.2.2. OBTAIN ALL PERMITS REQUIRED. ARRANGE FOR THE INSPECTION OF WORK BY INSPECTION AUTHORITY. PAY ALL FEES. RETAIN ALL INSPECTION CERTIFICATES. PROVIDE FINAL UNCONDITIONAL CERTIFICATE OF APPROVAL OF THE OWNER.

3.2.3. ALL WORK SHALL COMPLY STRICTLY TO THE REQUIREMENTS OF THE LATEST EDITIONS OF THE CANADIAN ELECTRICAL "CSA" CODE AS ADOPTED AND AMENDED BY PROVINCIAL REGULATIONS, AND THE BUILDING CODE. THESE CODES AND ANY ADDITIONAL REQUIREMENTS OF THE POWER UTILITY SHALL FORM AN INTEGRAL PART OF THIS SPECIFICATION. ALL EQUIPMENT SHALL BE CSA APPROVED. WHERE DRAWING CALLS FOR EQUIPMENT, WIRING OR OTHER REQUIREMENTS EXCEEDING THE MINIMUM REQUIREMENTS OF THE CODE, THE DRAWING SHALL BE FOLLOWED.

3.2.4. IN, ADDITION COMPLY WITH THE LATEST REQUIREMENTS OF THE LOCAL BUILDING CODE AND STANDARDS, THE NATIONAL BUILDING CODE AND THE FIRE COMMISSIONERS' REQUIREMENTS.

3.2.5. THE ELECTRICAL CONTRACTOR SHALL SUPPLY ALL MATERIALS AND LABOUR, EXCEPT AS OTHERWISE NOTED, TO PROVIDE A COMPLETE AND OPERATING ELECTRICAL SYSTEM AS SHOWN ON DRAWINGS.

3.2.6. BEFORE STARTING ANY WORK, SUBMIT THE REQUIRED NUMBER OF COPIES OF DRAWINGS AND SPECIFICATIONS TO THE INSPECTION AUTHORITIES AND BUILDING AND FIRE DEPARTMENTS FOR THEIR APPROVAL AND COMMENTS. ANY CHANGES REQUIRED SHALL BE COMPLIED WITH AS PART OF THIS CONTRACT, BUT THE OTHER AND CONSULTANT SHALL BE NOTIFIED IMMEDIATELY OF SUCH CHANGES. PAY ALL FEES FOR EXAMINATION OF DRAWINGS AND SPECIFICATIONS.

3.2.7. ALL ELECTRICAL EQUIPMENT MOUNTED AND CONNECTED BY ELECTRICAL CONTRACTOR, (SUPPLIED BY ELECTRICAL CONTRACTOR OR NOT) SHALL BE READILY ACCESSIBLE FOR OPERATION, MAINTENANCE, AND REPAIR.

3.2.8. ON AWARD OF CONTRACT, SUBMIT SHOP DRAWINGS FOR REVIEW FOR ALL EQUIPMENT.

3.2.9. AT COMPLETION OF WORK, PROVIDE OWNER WITH A SET OF AS-BUILT RECORD DRAWINGS. THE AS-BUILT DRAWINGS SHALL INDICATE ALL APPROVED CHANGE NOTICES AND SITE DEVIATIONS.

3.2.10. ENSURE THAT ALL ELECTRICAL EQUIPMENT SUPPLIED BY OTHER TRADES IS SUITABLE FOR THE RESPECTIVE VOLTAGE. CONFIRM POWER REQUIREMENTS OF ALL OWNER SUPPLIED EQUIPMENT.

3.2.11. ALL EQUIPMENT AND MATERIALS SHALL BE NEW AND COMMERCIAL GRADE AND BE CSA APPROVED.

3.2.12. PROVIDE TEMPORARY ELECTRICAL POWER & LIGHTING FOR THE WORK OF THE TRADES AS REQUIRED BY THE GENERAL CONTRACTOR.

3.2.13. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT.

3.2.14. CONTRACTOR IS TO ENSURE THAT ALL EQUIPMENT IS COMMISSIONED AS PER MANUFACTURER'S REQUIREMENTS.

3.2.15. CONTRACTOR SHALL CARRY OUT TESTS AND INSPECTIONS OF THE WHOLE ELECTRICAL INSTALLATION. COMMISSIONING OF THE SYSTEMS WILL BE CARRIED OUT BY THE ELECTRICAL CONTRACTOR.

3.2.16. CONTRACTOR SHALL REFER TO ALL TENDER DRAWINGS DURING THE BIDDING AND CONSTRUCTION PHASES OF THE PROJECT.

3.2.17. CONTRACTOR TO PROVIDE 3 COPIES OF OPERATION AND MAINTENANCE MANUALS FOR ALL ELECTRICAL EQUIPMENT.

3.3. GENERAL ELECTRICAL SPECIFICATIONS

3.3.1. THE ELECTRICAL CONTRACTOR SHALL COMPLETE ALL ELECTRICAL WORK IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE SPECIFICATIONS AND DRAWINGS TO THE SATISFACTION OF THE OWNER.

3.3.2. THE DRAWINGS FOR THE WORK OF THIS DIVISIONS ARE IN PART DIAGRAMMATIC, INTENDED TO CONVEY THE SCOPE OF WORK, GENERAL ARRANGEMENT AND LOCATION OF THE EQUIPMENT, APPROXIMATE SIZES AND LOCATIONS OF THE EQUIPMENT. FOLLOW THESE DRAWINGS IN EXECUTION OF THE WORK, CONSULT MECHANICAL CONSTRUCTION DRAWINGS TO BECOME FAMILIAR WITH ALL CONDITIONS RELATING TO THE INSTALLATION AND TO VERIFY SPACES IN WHICH THE WORK WILL BE INSTALLED.

3.3.3. WHENEVER DIFFERENCES OCCUR BETWEEN PLANS AND DIAGRAMS OR SCHEMATICS, AND BETWEEN THE SPECIFICATIONS AND DRAWINGS, THE MAXIMUM CONDITIONS SHALL GOVERN, AND THE TENDER SHALL BE BASED ON WHICHEVER IS THE GREATER AMOUNT.

3.3.4. KEEP A RECORD SET OF DRAWINGS ON THE SITE ON WHICH SHALL BE CLEARLY INDICATED, THE EXACT LOCATION OF ALL FEEDER RUNS, PANELS JUNCTION BOXES, PULL BOXES, ETC. TWO COPIES OF THE RECORD DRAWINGS SHALL BE SUBMITTED TO THE PROJECT MANAGER UPON COMPLETION OF THE PROJECT.

3.3.5. THE CONTRACTOR SHALL VISIT THE SITE AND EXAMINE ALL DRAWINGS CAREFULLY TO DETERMINE THE EXTENT OF WORK. EXAMINE THE SITE AND TOGETHER WITH DRAWINGS AND SPECIFICATIONS DETERMINE AND INCLUDE IN TOTAL PRICE, THE TOTAL COST OF LABOUR AND MATERIAL TO EXECUTE THE WORK.

3.3.6. NO ALLOWANCE WILL BE MADE FOR OBVIOUS CONSIDERATIONS WHICH MAY HAVE BEEN OVERLOOKED.

3.3.7. EXAMINE THE MECHANICAL AND STRUCTURAL DRAWINGS TO ENSURE THAT THE WORK OF THIS DIVISION CAN BE SUCCESSFULLY COMPLETED WITH NO INTERFERENCES OR DISCREPANCIES.

3.3.8. EXAMINE THE WORK OF THE OTHER TRADES, AS THEY AFFECT THIS DIVISION, AND REPORT IMMEDIATELY TO THE PROJECT MANAGER ANY DEFECT OR INTERFERENCE THAT MAY AFFECT THE WORK OF THIS DIVISION, OR GUARANTEE OF THIS WORK.

3.3.9. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING AND PAYING FOR ALL NECESSARY PERMITS AND INSPECTIONS AS REQUIRED OR REQUESTED BY THE AUTHORITIES HAVING JURISDICTION. ONCE THE ELECTRICAL WORK HAS BEEN COMPLETED AND ACCEPTED BY THE OWNER, THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH CERTIFICATES VERIFYING THAT THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH ALL APPLICABLE CODES, BUILDING STANDARDS, AND ALL AUTHORITIES HAVING JURISDICTION.

3.3.10. THE ELECTRICAL WORK SHALL BE CARRIED OUT AND PERFORMED WITH QUALITY WORKMANSHIP, TO THE SATISFACTION OF THE CONSULTANT, OWNER, AND PROJECT MANAGER. ANY UNSATISFACTORY WORK SHALL BE RE-DONE OR REPLACED WITHOUT EXTRA COST TO THE OWNER.

3.3.11. THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH A ONE YEAR WRITTEN WARRANTY, COMMENCING ON THE DATE OF ACCEPTANCE. THE WARRANTY SHALL COVER THE COMPLETE ELECTRICAL INSTALLATION. THE ELECTRICAL CONTRACTOR SHALL REPAIR AND/OR REPLACE ANY DEFECTS IN THE MATERIALS OR WORKMANSHIP THAT OCCUR DURING THE WARRANTY PERIOD AT A TIME CONVENIENT TO, AND AT NO EXTRA COST TO THE OWNER.

3.3.12. PROVIDE THE OWNER WITH ONE SET OF 'AS-BUILT' RECORD DRAWINGS PREPARED ON AUTOCAD R.2007 OR COMPATIBLE FORMAT, INCLUDING A COPY OF THE DRAWINGS ON CD. PROVIDE THE ENGINEER WITH ONE SET OF BLACK LINE PRINTS OF THE 'AS-BUILT' RECORD DRAWINGS. THESE DRAWINGS SHALL ONLY BE DELIVERED TO THE OWNER AND ENGINEER AFTER COMPLETION OF THE WORK AND AFTER ALL DEFICIENCIES HAVE BEEN RECORDED.

3.3.13. IN CASE EXTRA WORK OF ANY KIND IS REQUIRED, OBTAIN WRITTEN INSTRUCTIONS FROM THE PROJECT MANAGER BEFORE PROCEEDING, PAYMENT WILL BE MADE AT A FAIR AND REASONABLE RATE ONLY FOR AUTHORIZED EXTRAS. IN THE CASE OF SCOPE REDUCTIONS, THE SAME PROCEDURE SHALL APPLY AND DECREASE MADE.

3.3.14. SUBMIT SHOP DRAWINGS OF LUMINARIES, PANELBOARDS, AND OTHER MAJOR ELECTRICAL EQUIPMENT, AS THEY APPLY TO THIS PROJECT, OR AS REQUIRED BY PROJECT MANAGER. EACH SHOP DRAWING SHALL BE CHECKED AND STAMPED AS BEING CORRECTED BY THE ELECTRICAL AND GENERAL CONTRACTOR PRIOR TO SUBMISSION TO THE PROJECT MANAGER FOR REVIEW. SHOP DRAWINGS NOT STAMPED AS SUCH WILL NOT BE REVIEWED AND WILL BE RETURNED AND DESIGNATED AS "REVISE AND RESUBMIT".

3.3.15. ALL SERVICES WHICH PENETRATE THE FLOOR SLAB OR FIRE-RATED WALLS AND CEILINGS SHALL BE INSTALLED IN RIGID STEEL CONDUIT AND SHALL BE SEALED WITH AN APPROVED, NON-SHRINK, WATER PROOF AND FIRE PROOF SEALANT.

3.3.16. ALL WORK SCHEDULED AND COORDINATED TO AVOID INTERFERENCES WITH OTHER TRADES DURING AND AFTER CONSTRUCTION.

3.3.17. PROVIDE TEMPORARY ELECTRICAL POWER FOR THE WORK OF THIS DIVISION AND OTHER TRADES AS REQUIRED BY THE GENERAL CONTRACTOR OR OWNER.

3.4. SUBMITTALS

3.4.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE MATERIALS, EQUIPMENT & DEVICES.

3.5. ELECTRICAL, LIFE SAFETY, WATER & SANITARY PIPING AND FITTINGS

3.5.1. ALL FIXTURES & FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA.

4. PLUMBING

4.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

4.2. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST PLUMBING CODE AS AMENDED BY THE LOCAL MUNICIPALITY.

4.3. SUBMITTALS

4.3.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE PLUMBING MATERIALS, EQUIPMENT & DEVICES.

4.4. WATER & SANITARY PIPING AND FITTINGS

ALL FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA-B125.3

5. EXECUTION

5.1. ALL WORK SHALL MEET OR EXCEED THE LATEST REQUIREMENTS OF THE ONTARIO BUILDING CODE AND ANY LOCAL AUTHORITY HAVING JURISDICTION.

5.2. NOTIFY THE CONSULTANT OF CHANGES REQUIRED BY THE ELECTRICAL INSPECTION DEPARTMENT PRIOR TO MAKING CHANGES.

5.3. PLUG OR CAP PIPE AND FITTINGS TO KEEP OUT DEBRIS DURING CONSTRUCTION.

5.4. ALL BRANCH PIPING AND DRAIN FROM FIXTURES SHALL NOT GARDE OF NOT LESS THAN 1:50 OR AS DIRECTED BY LOCAL PLUMBING CODE.

5.5. ALL VERTICAL STACKS SHALL BE SUPPORTED AT EACH FLOOR LEVEL.

6. . TESTING AND BALANCING OF SYSTEM

6.1. ALL TESTING SHALL BE PERFORMED BY THE CONTRACTOR. TESTING SHALL BE COMPLETED BEFORE THE CONSULTANT IS NOTIFIED FOR THE SYSTEM DEMONSTRATION.

6.2. VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY ALL TERMINATIONS ARE TIGHT.

6.3. ALL FIXTURES SHALL BE TESTED TO ENSURE THAT THE WORK CORRECTLY AND ARE FLUSHING / EVACUATING AT THE CORRECT FLOW RATE.

6.4. ALL TEST CERTIFICATES TO BE INCLUDED IN MAINTENANCE MANUALS.

6.5. PROVIDE A SIGNED STATEMENT TO THE EFFECT THAT ALL TESTS FOR MECHANICAL SYSTEMS AND EQUIPMENT HAVE BEEN COMPLETELY CARRIED OUT TO THE MANUFACTURER'S RECOMMENDATIONS, AND IN ACCORDANCE WITH THE REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION.

GENERAL CONTRACTOR NOTES

1. CONTRACTOR SHALL REVIEW ALL DRAWINGS, SPECIFICATIONS, TENDER DOCUMENTS AND SITE CONDITIONS BEFORE SUBMITTING A JOB ESTIMATE FOR THIS PROJECT. ALTHOUGH A REASONABLE ATTEMPT HAS BEEN MADE TO DOCUMENT THE EXACT EXTENT OF THE EXISTING CONDITIONS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXACT SITE CONDITIONS BEFORE INSTALLATION. ANY ADDITIONAL WORK DUE TO THE SITE CONDITIONS SHALL BE INCLUDED AS PART OF THIS CONTRACT.
2. CONTRACTOR SHALL FIELD CHECK AND CONFIRM EXACT LOCATIONS, ELEVATION AND INSTALLATIONS OF ALL SERVICES FOR THIS PROJECT PRIOR TO INSTALLING ANY EQUIPMENT, PIPE WORK OR CONNECTING ANY ELECTRICAL OR WATER LINES.
3. APPROVED EQUIVALENTS OR ALTERNATIVES TO SPECIFIED PRODUCTS SHALL BE EQUAL TO THE SPECIFIED PRODUCT IN EVERY RESPECT, OPERATE AS INTENDED, MEET THE SPACE, AND CAPACITY REQUIREMENTS AS OUTLINED. ANY ALTERNATES SHALL BE SUBMITTED FOR APPROVAL BEFORE PROCUREMENT. NO ALTERNATIVE SHALL BE ACCEPTED WITHOUT PRIOR WRITTEN APPROVAL OF THE OWNER.
4. FOLLOW CHOSEN MANUFACTURER'S RECOMMENDED INSTALLATION GUIDE AND PROCEDURES FOR EQUIPMENT, SUPPLEMENTED BY THE REQUIREMENTS AND OUTLINE OF THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS AND SHALL REPORT ANY DISCREPANCIES TO CONSULTANT BEFORE PROCEEDING WITH WORK.
6. USE ONLY THE LATEST REVISED DRAWINGS AS SPECIFIED.
7. CONTRACTOR SHALL PROVIDE CONSULTANT AND PROJECT MANAGER WITH A DETAILED CONSTRUCTION SCHEDULE FOR APPROVAL BEFORE COMMENCEMENT OF ANY WORK.
8. THE CONTRACTOR SHALL INFORM CONSULTANT AND PROJECT MANAGER PRIOR TO START OF WORK ALLOWING FOR SCHEDULE AND PROCESS WITHOUT DELAY TO THE PROJECT, SHOULD IT APPEAR THAT ANY PART OF THE WORK IS NOT SUFFICIENTLY DETAILED ON THE DRAWINGS.
9. CONTRACT DOCUMENTS AND DRAWINGS ARE DIAGRAMMATIC AND NOT DRAWN TO SCALE UNLESS DETAILED OTHERWISE. THEY ESTABLISH SCOPE, MATERIAL AND INSTALLATION QUALITY AND ARE NOT DETAILED INSTALLATION INSTRUCTIONS.
10. MAKE REFERENCE TO ELECTRICAL, MECHANICAL, LIFE SAFETY AND PLUMBING DRAWINGS WHEN SETTING OUT WORK. CONSULT WITH RESPECTIVE DIVISIONS IN SETTING OUT LOCATIONS FOR EQUIPMENT SO THAT CONFLICTS ARE AVOIDED AND SYMMETRICAL AND EVEN SPACING IS MAINTAINED. JOINTLY WORK OUT ALL CONFLICTS ON SITE BEFORE FABRICATING OR INSTALLING ANY MATERIALS OR EQUIPMENT.
11. ALL EXISTING SERVICES SHALL REMAIN IN CONSTANT OPERATION. CONTRACTOR SHALL GIVE THE CONSULTANT AND OWNER FIVE WORKING DAYS WRITTEN NOTICE BEFORE ANY TEMPORARY POWER/WATER SHUTDOWNS.
12. IMMEDIATELY CUT OFF AND CAP CONCEALED SERVICES UNCOVERED DURING WORK.
13. CONTRACTOR SHALL PROVIDE COMPLETE, FULLY TESTED, AND OPERATIONAL ELECTRICAL, MECHANICAL AND PLUMBING SYSTEMS TO MEET REQUIREMENTS DESCRIBED HEREIN.
14. INSTALL EQUIPMENT IN LOCATIONS AND ROUTES SHOWN. RUN ELECTRICAL LINES WHERE SEEN FIT AND WATER LINES AS SHOWN BUT AVOID INTERFERENCE WITH OTHER SERVICES.
15. INSTALLATION MUST BE COMPLETED IN ACCORDANCE WITH APPLICABLE CODES AND ORDINANCES.
16. CONTRACTOR SHALL OBTAIN ALL PERMITS AND PAY ALL FEES APPLICABLE TO THE WORK.
17. HANDLE, STORE, AND INSTALL ALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. DO NOT STORE EQUIPMENT ON THE GROUND OR IN CONDITIONS THAT WILL DAMAGE OR COMPROMISE THE INTEGRITY OF THE PRODUCT.
18. ANY COSTS ASSOCIATED WITH MATERIAL DELIVERY OR DEBRIS REMOVAL SHALL BE THE CONTRACTORS RESPONSIBILITY. ALL DEBRIS SHALL BE COLLECTED AND REMOVED AT END OF EACH WORK DAY. CONTRACTOR SHALL EMPLOY DUST CONTROL.
19. THE INSTALLATION METHODS, FINISHING AND APPEARANCE IS SUBJECT TO THE APPROVAL OF THE CONSULTANT AND OWNER. ANY COORDINATION TIME OR ADDITIONAL MATERIALS/LABOUR REQUIRED TO ACHIEVE THE REQUIRED APPEARANCE SHALL BE INCLUDED IN THIS CONTRACT.
20. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO EXISTING SERVICES, FINISHES AND MATERIALS DUE TO THE WORK UNDER THIS CONTRACT, AND BEAR ALL COSTS INCURRED TO MAKE GOOD, REPAIR OR REPLACE SAME TO THE PROJECT MANAGER'S SATISFACTION.
21. FINAL CLEANING SHALL INCLUDE EQUIPMENT, CASES, COVERS, FLOORS, WALLS, WINDOWS, ETC. THAT HAVE BEEN AFFECTED BY THE WORK, IN READINESS FOR CLIENT'S OCCUPANCY.
22. UPON COMPLETION OF ALL WORK BY ALL TRADES, THE CONTRACTOR SHALL REMOVE ALL SURPLUS CONSTRUCTION MATERIALS, RUBBISH AND GARBAGE TO LEAVE THE PREMISES CLEAN AND SUITABLE FOR IMMEDIATE OCCUPANCY BY THE CLIENT WITHOUT THE NEED FOR FURTHER CLEANING.
23. WHERE STRUCTURAL WORK REQUIRES CUTTING AND REMOVAL, CAREFULLY EXAMINE THE WORK TO ASCERTAIN THAT THE EXTENT OF CUTTING AND REMOVAL REQUIRED IS SAFE PRIOR TO EXECUTION.

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:

GENERAL CONTRACTOR NOTES

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01

PROPOSED AIR SOURCE VRF SCHEDULE	
TAG	MINIMUM COP
VRF-1	2.73 (COOLING), 3.2 (HEATING)

PROPOSED AIR SOURCE HEAT PUMP SCHEDULE		
TAG	CAPACITY (CFM)	NOTES
ASHP-1	4,600	C/W VFD CONTROLS & ERV

PROPOSED DOMESTIC HOT WATER SCHEDULE			
TAG	CAPACITY (BTU/hr)	CAPACITY (USGAL)	EFFICIENCY
DHW-1	85,000	100	3.75 UEF

OPTION 3 BAS TOTAL POINTS	
POINT TYPE	QUANTITY
DO	56
AO	2
DI	57
AI	58

OPTION 3 BAS POINTS LIST

POINT NAME	POINT TYPE	POINT NO.	SYSTEM	POINT DESCRIPTION
ASHP-S/S	DO	DO1	ASHP	ASHP START/STOP
ASHP-MOD	AO	AO1	ASHP	ASHP MODULATION
ASHP-STAT	DI	DI1	ASHP	ASHP STATUS
ASHP-SAT	AI	AI1	ASHP	ASHP SUPPLY AIR TEMP
ASHP-RAT	AI	AI2	ASHP	ASHP RETURN AIR TEMP
VRF-S/S	DO	DO2	VRF	VRF START/STOP
VRF-MOD	AO	AO2	VRF	VRF MODULATION
VRF-STAT	DI	DI2	VRF	VRF STATUS
VRF-S	AI	AI3	VRF	VRF LOOP SUPPLY STATUS
VRF-R	AI	AI4	VRF	VRF LOOP RETURN STATUS
VRFI-S/S 1-52	DO	DO 3 TO 55	VRFIT	VRF INDOOR TERMINAL START/STOP FOR 52 UNITS
VRFI-STAT 1-52	DI	DI 3 TO 55	VRFIT	VRF INDOOR TERMINAL STATUS FOR 52 UNITS
VRFI-TEMP 1-52	AI	AI 5 TO 57	VRFIT	VRF INDOOR TERMINAL TEMP FOR 52 UNITS
BB-S/S	DO	DO56	BB	BB ON/OFF
OAT	AI	AI58	GENERAL	OUTDOOR TEMP
OCC	DI	DI56	GENERAL	OCCUPANCY
OCC	DI	DI57	GENERAL	OCCUPANCY

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
–	1	ISSUE FOR APPROVAL	2020/8/14	–

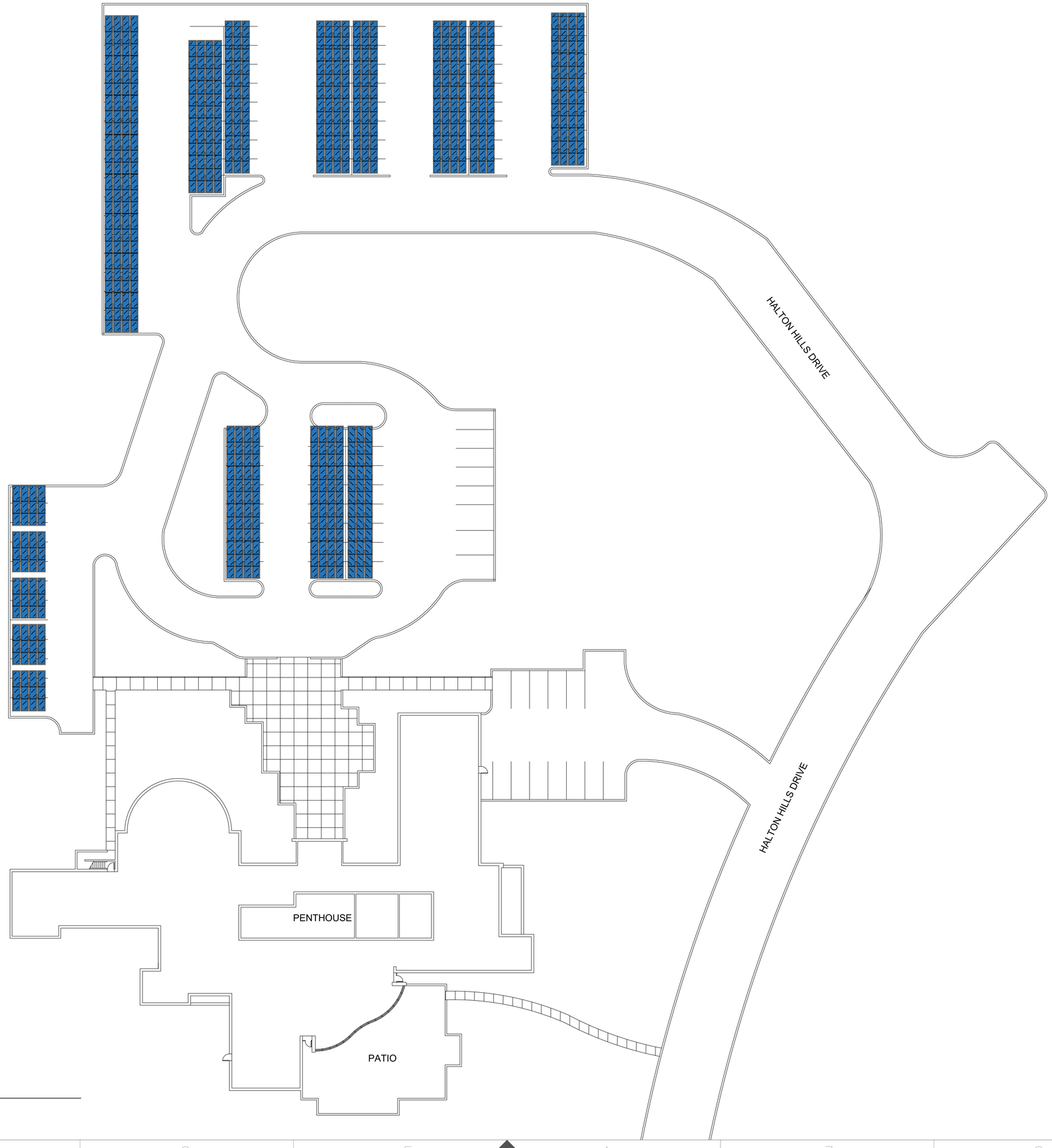
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
EQUIPMENT SCHEDULE & BAS POINTS LIST - OPTION 3

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01



LEGEND	
SYMBOL	DESCRIPTION
	SOLAR PANELS

1 HALTON HILLS
SITE PLAN - OPTION 3

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

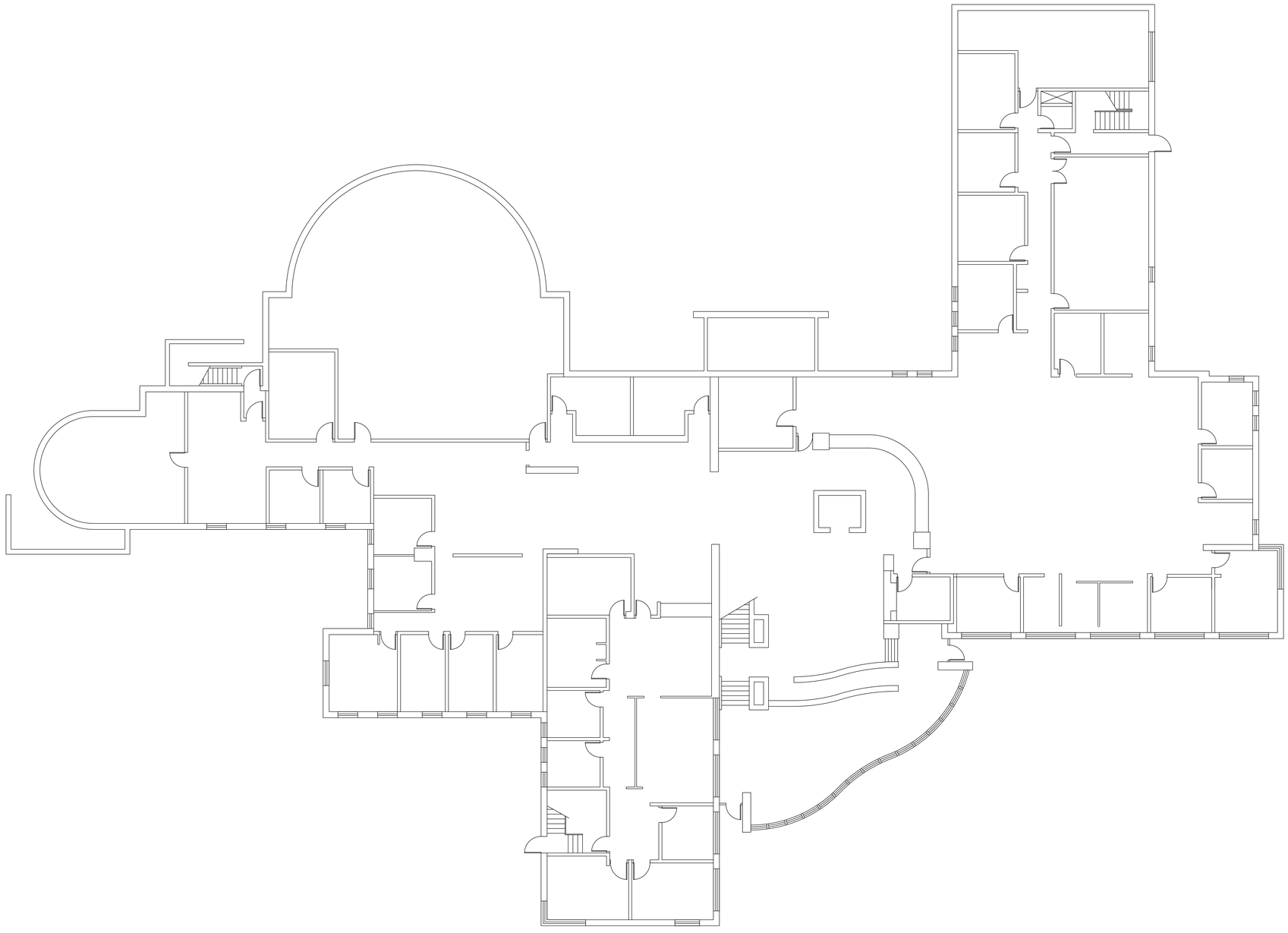
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SITE PLAN
OPTION 3

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-01



2 HALTON HILLS
FIRST FLOOR LAYOUT - OPTION 3

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

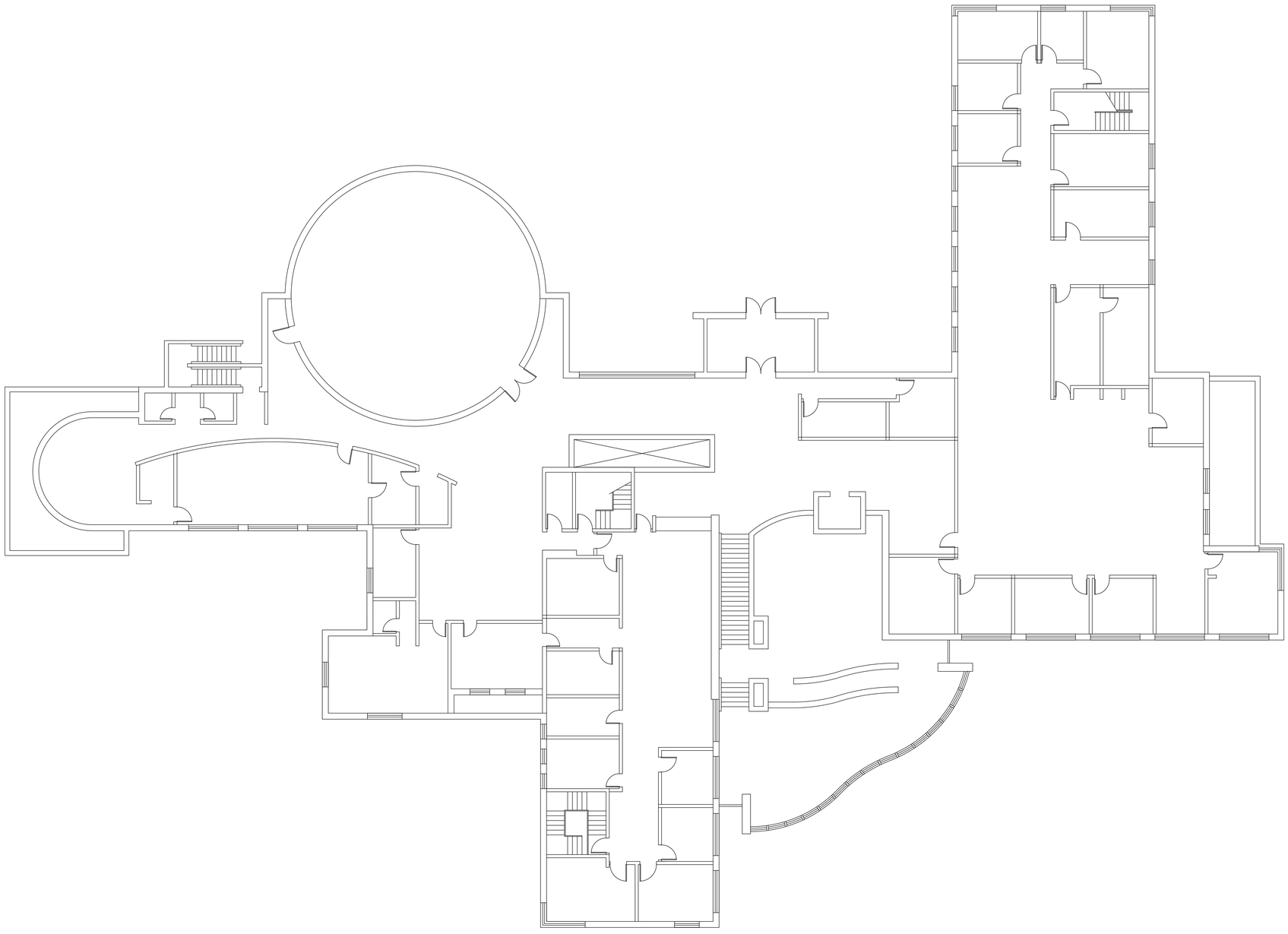
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS FIRST FLOOR
LAYOUT - OPTION 3

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-02



3 HALTON HILLS
SECOND FLOOR LAYOUT - OPTION 3

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

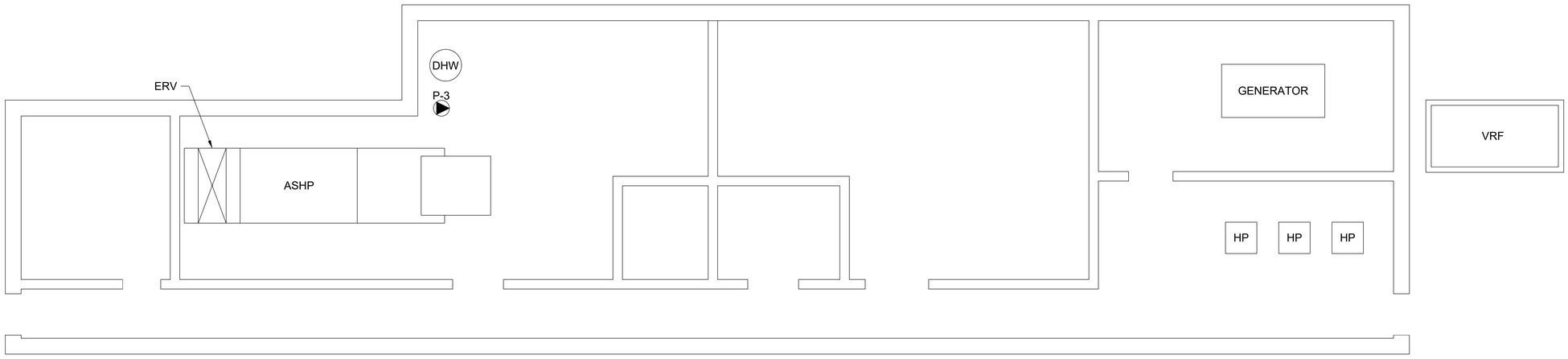
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SECOND FLOOR LAYOUT - OPTION 3

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-03



4 HALTON HILLS
PENTHOUSE LAYOUT - OPTION 3

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

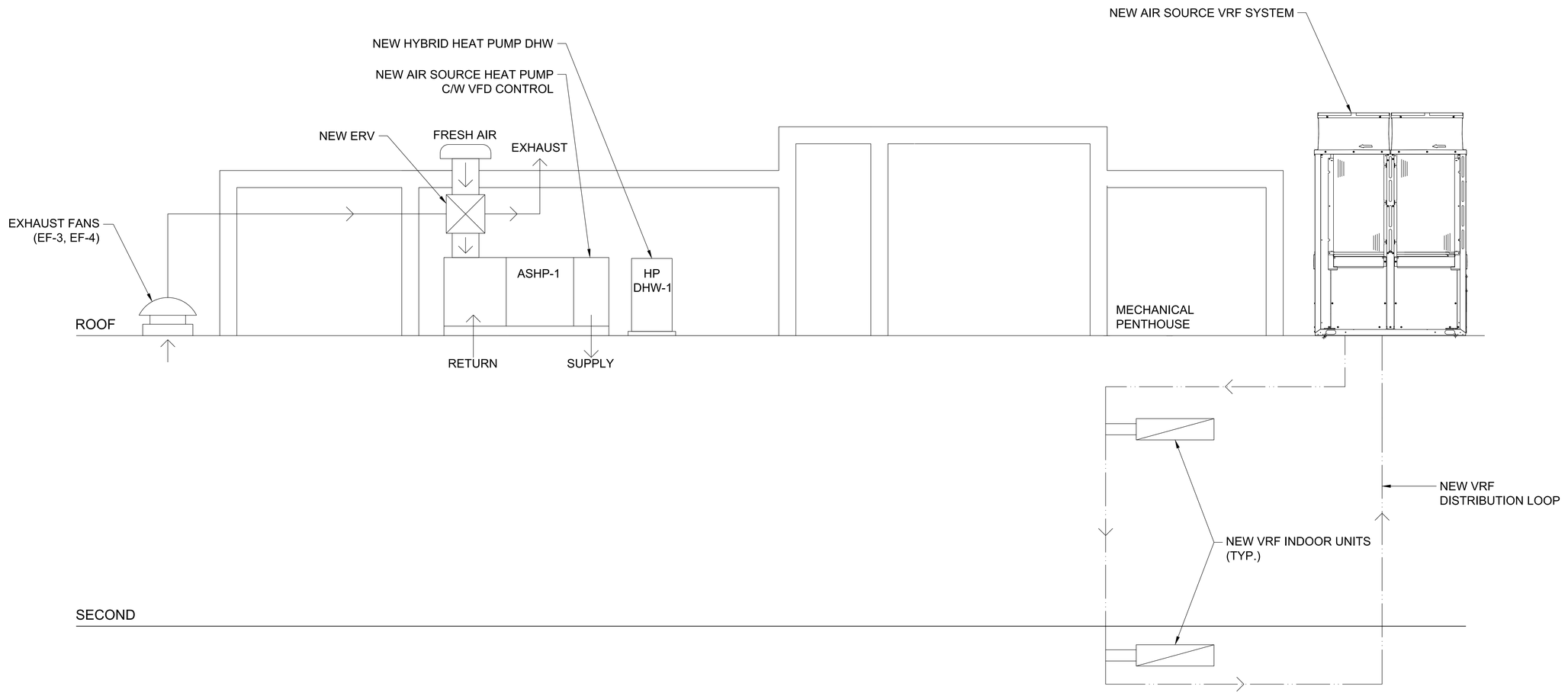
DRAWING:

HALTON HILLS
PENTHOUSE LAYOUT - OPTION 3

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-04



5 HALTON HILLS
MECHANICAL SINGLE LINE DIAGRAM - OPTION 3

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS MECHANICAL SINGLE LINE DIAGRAM - OPTION 3

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-05

Halton Hills, Ontario

Town Hall

HALTON HILLS TOWN HALL LOW CARBON DESIGN – OPTION 4

G1301-M-00

LIST OF DRAWINGS

CONTRACTOR NOTES

MECHANICAL

INTERNAT ENERGY SOLUTIONS

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

1. GENERAL SPECIFICATIONS

1.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

1.2. CARE OF SITE

1.2.1. BE RESPONSIBLE FOR THE CARE OF THE BUILDINGS. DO ALL CUTTING PATCHING, AND PAINTING REQUIRED FOR THE WORK OF THIS TRADE.
- APPLY AT LEAST ONE COAT OF CORROSION RESISTANT PRIMER TO SUPPORTS, AND EQUIPMENT FABRICATED FROM FERROUS METALS.
- TOUCH UP PAINT ALL DAMAGED EQUIPMENT WITH PRODUCTS MATCHING ORIGINAL FINISH IN QUALITY AND APPEARANCE IF APPLICABLE.
- PROVIDE FLAT BLACK PAINTING BEHIND GRILLES AND DIFFUSERS.
WORK TO BE PERFORMED BY CONTRACTOR AT THE CONTRACTOR'S EXPENSE. INSTALL TEMPORARY CAPS OR CLOSURES ON THE ENDS OF ALL PIPES, CONDUITS, ETC. TO PREVENT THE ENTRY OF DEBRIS. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT. CO-OPERATE WITH ALL OTHER TRADES.

1.2.2. ANY CORE DRILLING OF SLAB OR CONCRETE WALL WILL REQUIRE PERMISSION FROM BUILDING ENGINEER AND WILL BE X-RAYED PRIOR TO DRILLING.

1.2.3. ALL PENETRATIONS, INCLUDING SLAB PENETRATIONS, MUST BE SEALED APPROPRIATELY. FIRE STOPS ARE TO BE PROVIDED AT ALL POINTS OF PENETRATION THROUGH FIRE RATED ASSEMBLIES.

1.2.4. ENSURE ALL OPENINGS THROUGH FIRE SUPPRESSIONS DO NOT EXCEED THE MAXIMUM SIZE AT ALL CEILING OPENINGS AND MAXIMUM AND MINIMUM DIMENSIONS INDICATED IN ULC GUIDE No 40U19 FOR SERVICE PENETRATIONS ASSEMBLY AND FIRE STOPPING MATERIAL.

1.3. CODES, FEES AND CERTIFICATES

1.3.1. COMPLY WITH ALL LATEST APPLICABLE BUILDING, PLUMBING, AND ELECTRICAL CODES. USE LATEST EDITION OF CITY, PROVINCIAL AND FEDERAL REGULATIONS HAVING JURISDICTION, INCLUDING ONTARIO ELECTRICAL SAFETY CODE. IF DISCREPANCIES OCCUR USE THE MOST RESTRICTING.

1.3.2. ALL WORK SHALL BE EXECUTED, AND ALL MATERIALS SHALL CONFORM TO AND BE INSPECTED, IN STRICT ACCORDANCE WITH ALL THE LAWS, RULES, AND REGULATIONS OF THE LOCAL AND PROVINCIAL CODES AND ALL OTHER AUTHORITIES HAVING JURISDICTION.

1.3.3. THIS TRADE SHALL OBTAIN ALL NECESSARY PERMITS AND ALL NOTICES, PAY ALL FEES IN ORDER THAT THE WORK HEREINAFTER SPECIFIED MAY BE CARRIED OUT AND SHALL FURNISH ALL CERTIFICATES NECESSARY AS EVIDENCE THAT THE WORK INSTALLED CONFORMS WITH THE LAWS AND CERTIFICATES ARE ISSUED.

1.3.4. ALL CHANGES AND ALTERATIONS REQUIRED BY AN AUTHORIZED INSPECTOR OF ANY AUTHORITY HAVING JURISDICTION SHALL BE CARRIED OUT WITHOUT CHARGE OR EXPENSE TO THE OWNER.

1.3.5. ALL EQUIPMENT SUPPLIED MUST HAVE APPROVAL OF N.F.P.A., C.S.A, U.L.C., OWNER'S UNDERWRITER AND ANY OTHER AUTHORITY HAVING JURISDICTION.

2. MECHANICAL SPECIFICATIONS

2.1. EXISTING BUILDING RENOVATIONS

2.1.1. THE MECHANICAL TRADE SHALL VISIT THE SITE AND INCLUDE ALL COSTS FOR INSTALLATION REMOVAL, REVISIONS, SETTING AND RESETTING OF PIPING, DUCTS, GRILLS, DIFFUSERS, AND ALL MECHANICAL ITEMS IN GENERAL WHERE CEILINGS, WALLS, FLOORS, WINDOWS, SILLS, DUCT AND PIPE SHAFTS, ETC., ARE REVISED.

2.1.2. PERFORM ALL WORK IN THE EXISTING BUILDING INDICATED ON THE DRAWINGS, SPECIFIED HEREIN, AND AS MAY BE NECESSARY TO CARRY OUT THE WORK OF THIS CONTRACT.

2.1.3. LOCATE, RELOCATE, CONNECT AND RECONNECT ANY PIPING, DRAINS, VENTS, WATER LINES, HEATING LINES, CONTROLS, AND PIPING, DUCTWORK, OR OTHER WORK PERTAINING TO THIS TRADE PRESENTLY CONCEALED IN WALLS, PARTITIONS, OR CEILING SPACES, AND WHICH BECOME EXPOSED DURING THE RENOVATION WORK SO THAT THESE SERVICES ARE CONCEALED IN THE RENOVATED LAYOUT, AND PUT BACK INTO OPERATION.

2.1.4. ANY EQUIPMENT, ETC., TO BE REUSED SHALL BE CAREFULLY REMOVED AND STORED. ANY PIECE OF EQUIPMENT OR FITTING ACCESSORY, ETC., WHICH FORMS A PART OF THE EQUIPMENT TO BE REUSED WHICH IS LOST OR DAMAGED SHALL BE REPLACED WITH A NEW DEVICE, FITTING, ACCESSORY, ETC. AT NO COST TO THE OWNER.

2.1.5. ALL EXISTING EQUIPMENT, FIXTURES, PIPING, ETC., BEING REMOVED SHALL REMAIN THE PROPERTY OF THE BUILDING OWNER AND WILL REMAIN ON THE JOB SITE.

2.1.6. MAKE CERTAIN THAT ALL SERVICES AFFECTED BY WORK ARE CUT OFF AND PROPERLY CAPPED OR DIVERTED.

2.1.7. DO NOT INTERRUPT SERVICES TO OR WITHIN EXISTING BUILDING WITHOUT PRIOR CONSULTATION WITH OWNER.

2.2. TEMPORARY PROTECTION

2.2.1. INSTALL TEMPORARY BRACING, SHORING, AND SUPPORT FOR EXECUTION OF WORK AND PROTECTION OF PERSONS AND PROPERTY. ALWAYS INSTALL APPROPRIATE SUPPORTS AND PROTECTION, USING ACCEPTABLE METHODS TO PREVENT COLLAPSE, SETTLING, AND OTHER DAMAGES.

2.2.2. INSTALL TEMPORARY COVERINGS AND ENCLOSURES TO PREVENT DAMAGE TO EXISTING SPACES AND TO PARTS OF BUILDING THAT ARE TO REMAIN.

2.2.3. INSTALL TEMPORARY DUST ENCLOSURES TO SEPARATE CONSTRUCTION SITE FROM REST OF BUILDING. ALSO, INSTALL TEMPORARY AIR FILTERS AND DUCTWORK TO CONTAIN CONSTRUCTION DUST WITHIN CONSTRUCTION AREA.

2.3. DEMOLITION AND CUTTING

2.3.1. MECHANICAL DEMOLITION: DEMOLISH AND REMOVE EXISTING MECHANICAL CONSTRUCTION AS SHOWN ON DRAWINGS AND AS REQUIRED TO ACCOMPLISH WORK, IF APPLICABLE. WHERE NEW WORK IS ADJACENT TO EXISTING CONSTRUCTION AND WHEN EXISTING CONSTRUCTION MUST BE REPLACED, REMOVE JUST ENOUGH EXISTING CONSTRUCTION TO COMPLETE WORK UNDER CONTRACT. AT NO ADDITIONAL COST TO OWNER, REMOVE AND REPLACE EXISTING CONSTRUCTION THAT IS TO REMAIN, BUT IS DAMAGED DURING WORK.

2.3.2. CUTTING CONCRETE: CUT OPENINGS THROUGH CONCRETE BY CORE DRILLING OR SAWING. NEVER CUT OPENINGS IN CONCRETE WITH A HAMMER-DRIVEN CHISEL OR DRILL WITHOUT WRITTEN AUTHORIZATION FROM ARCHITECT.

2.3.3. OTHER WORK: NEVER ENDANGER OR DAMAGE WORK OF OTHER TRADES. IF WORK OF OTHER TRADES MUST BE ALTERED TO ACCOMMODATE MECHANICAL WORK, REVIEW PROPOSED ALTERATIONS WITH INSTALLER OF WORK AND COMPLY WITH INSTALLER'S RECOMMENDATIONS TO MINIMIZE DAMAGE. WHERE NECESSARY, ENGAGE ORIGINAL INSTALLER TO MAKE REQUIRED CHANGES.

2.3.4. CLEAN DEMOLITION AREAS AND REMOVE DEBRIS FROM SITE AT END OF EACH DAY'S WORK. TRANSPORT DEBRIS IN MANNER THAT PREVENTS SPREAD OF DUST. DO NOT PERMIT BURNING OR STORAGE OF DEBRIS AT SITE. KEEP CONSTRUCTION AREAS BROOM CLEAN. KEEP ADJACENT AREAS UNENCUMBERED AND CLEAN.

2.4. UNANTICIPATED MECHANICAL WORK

2.4.1. IF DEMOLITION WORK EXPOSES CONCEALED MECHANICAL SERVICES (SUCH AS PIPING OR DUCTS), IMMEDIATELY INFORM ENGINEER OF ADDITIONAL COST TO PROJECT TO RELOCATE, REMOVE OR ABANDON UNANTICIPATED WORK. BEGIN THIS ADDITIONAL WORK ONLY AFTER RECEIVING APPROVAL FROM OWNER FOR ADDITIONAL COSTS.

2.4.2. REMOVE OR REROUTE UNANTICIPATED MECHANICAL SERVICES UNDER DIRECTION FROM ENGINEER. RECONNECT THEM TO MAINTAIN OWNER'S OPERATIONS. ABANDON SERVICES IN PLACE WHERE THEY WILL BE CONCEALED INSIDE FLOORS AND WALLS, BUT DISCONNECT THEM FROM THEIR SOURCES AND CAP THEM IN PLACE. LEAVE NO "DEAD END" SERVICES CONCEALED IN FINISHED WORK.

2.5. CUTTING AND PATCHING

2.5.1. THIS TRADE SHALL BE RESPONSIBLE FOR ALL COSTS OF CUTTING AND PATCHING OF ANY BUILDING CONSTRUCTION MADE NECESSARY BY THE INSTALLATION OF THIS WORK AND/OR DUE TO LACK-OF-COORDINATION IN THE NEW CONSTRUCTION, EXCEPT ONLY IN SUCH INSTANCES AS MAY BE OTHERWISE ASSIGNED BY THE SPECIFICATIONS OR SHOWN ON THE DRAWINGS.

2.5.2. UNDER NO CIRCUMSTANCES SHALL ANY CUTTING OR BURNING OF THE STRUCTURAL PARTS, INCLUDING CONCRETE SLABS OF THE BUILDING, BE UNDERTAKEN WITHOUT THE WRITTEN AUTHORITY OF THE CONSULTANT.

2.5.3. ALL CUTTING AND PATCHING MUST BE CARRIED OUT BY A TRADE EXPERIENCED IN THAT PARTICULAR TYPE OF WORK, BUT THE COSTS OF SUCH WORK SHALL BE BORNE BY THE MECHANICAL TRADE.

3. ELECTRICAL SPECIFICATIONS

3.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO ALL SECTIONS AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

3.2. GENERAL ELECTRICAL NOTES

3.2.1. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST CODES AS AMENDED BY THE LOCAL MUNICIPALITY.

3.2.2. OBTAIN ALL PERMITS REQUIRED. ARRANGE FOR THE INSPECTION OF WORK BY INSPECTION AUTHORITY. PAY ALL FEES. RETAIN ALL INSPECTION CERTIFICATES. PROVIDE FINAL UNCONDITIONAL CERTIFICATE OF APPROVAL OF THE OWNER.

3.2.3. ALL WORK SHALL COMPLY STRICTLY TO THE REQUIREMENTS OF THE LATEST EDITIONS OF THE CANADIAN ELECTRICAL "CSA" CODE AS ADOPTED AND AMENDED BY PROVINCIAL REGULATIONS, AND THE BUILDING CODE. THESE CODES AND ANY ADDITIONAL REQUIREMENTS OF THE POWER UTILITY SHALL FORM AN INTEGRAL PART OF THIS SPECIFICATION. ALL EQUIPMENT SHALL BE CSA APPROVED. WHERE DRAWING CALLS FOR EQUIPMENT, WIRING OR OTHER REQUIREMENTS EXCEEDING THE MINIMUM REQUIREMENTS OF THE CODE, THE DRAWING SHALL BE FOLLOWED.

3.2.4. IN, ADDITION COMPLY WITH THE LATEST REQUIREMENTS OF THE LOCAL BUILDING CODE AND STANDARDS, THE NATIONAL BUILDING CODE AND THE FIRE COMMISSIONERS' REQUIREMENTS.

3.2.5. THE ELECTRICAL CONTRACTOR SHALL SUPPLY ALL MATERIALS AND LABOUR, EXCEPT AS OTHERWISE NOTED, TO PROVIDE A COMPLETE AND OPERATING ELECTRICAL SYSTEM AS SHOWN ON DRAWINGS.

3.2.6. BEFORE STARTING ANY WORK, SUBMIT THE REQUIRED NUMBER OF COPIES OF DRAWINGS AND SPECIFICATIONS TO THE INSPECTION AUTHORITIES AND BUILDING AND FIRE DEPARTMENTS FOR THEIR APPROVAL AND COMMENTS. ANY CHANGES REQUIRED SHALL BE COMPLIED WITH AS PART OF THIS CONTRACT, BUT THE OTHER AND CONSULTANT SHALL BE NOTIFIED IMMEDIATELY OF SUCH CHANGES. PAY ALL FEES FOR EXAMINATION OF DRAWINGS AND SPECIFICATIONS.

3.2.7. ALL ELECTRICAL EQUIPMENT MOUNTED AND CONNECTED BY ELECTRICAL CONTRACTOR, (SUPPLIED BY ELECTRICAL CONTRACTOR OR NOT) SHALL BE READILY ACCESSIBLE FOR OPERATION, MAINTENANCE, AND REPAIR.

3.2.8. ON AWARD OF CONTRACT, SUBMIT SHOP DRAWINGS FOR REVIEW FOR ALL EQUIPMENT.

3.2.9. AT COMPLETION OF WORK, PROVIDE OWNER WITH A SET OF AS-BUILT RECORD DRAWINGS. THE AS-BUILT DRAWINGS SHALL INDICATE ALL APPROVED CHANGE NOTICES AND SITE DEVIATIONS.

3.2.10. ENSURE THAT ALL ELECTRICAL EQUIPMENT SUPPLIED BY OTHER TRADES IS SUITABLE FOR THE RESPECTIVE VOLTAGE. CONFIRM POWER REQUIREMENTS OF ALL OWNER SUPPLIED EQUIPMENT.

3.2.11. ALL EQUIPMENT AND MATERIALS SHALL BE NEW AND COMMERCIAL GRADE AND BE CSA APPROVED.

3.2.12. PROVIDE TEMPORARY ELECTRICAL POWER & LIGHTING FOR THE WORK OF THE TRADES AS REQUIRED BY THE GENERAL CONTRACTOR.

3.2.13. CLEAN UP ALL DEBRIS DAILY AND REMOVE FROM FROM THE SITE ON OR BEFORE COMPLETION OF THE CONTRACT.

3.2.14. CONTRACTOR IS TO ENSURE THAT ALL EQUIPMENT IS COMMISSIONED AS PER MANUFACTURER'S REQUIREMENTS.

3.2.15. CONTRACTOR SHALL CARRY OUT TESTS AND INSPECTIONS OF THE WHOLE ELECTRICAL INSTALLATION. COMMISSIONING OF THE SYSTEMS WILL BE CARRIED OUT BY THE ELECTRICAL CONTRACTOR.

3.2.16. CONTRACTOR SHALL REFER TO ALL TENDER DRAWINGS DURING THE BIDDING AND CONSTRUCTION PHASES OF THE PROJECT.

3.2.17. CONTRACTOR TO PROVIDE 3 COPIES OF OPERATION AND MAINTENANCE MANUALS FOR ALL ELECTRICAL EQUIPMENT.

3.3. GENERAL ELECTRICAL SPECIFICATIONS

3.3.1. THE ELECTRICAL CONTRACTOR SHALL COMPLETE ALL ELECTRICAL WORK IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE SPECIFICATIONS AND DRAWINGS TO THE SATISFACTION OF THE OWNER.

3.3.2. THE DRAWINGS FOR THE WORK OF THIS DIVISIONS ARE IN PART DIAGRAMMATIC, INTENDED TO CONVEY THE SCOPE OF WORK, GENERAL ARRANGEMENT AND LOCATION OF THE EQUIPMENT, APPROXIMATE SIZES AND LOCATIONS OF THE EQUIPMENT. FOLLOW THESE DRAWINGS IN EXECUTION OF THE WORK, CONSULT MECHANICAL CONSTRUCTION DRAWINGS TO BECOME FAMILIAR WITH ALL CONDITIONS RELATING TO THE INSTALLATION AND TO VERIFY SPACES IN WHICH THE WORK WILL BE INSTALLED.

3.3.3. WHENEVER DIFFERENCES OCCUR BETWEEN PLANS AND DIAGRAMS OR SCHEMATICS, AND BETWEEN THE SPECIFICATIONS AND DRAWINGS, THE MAXIMUM CONDITIONS SHALL GOVERN, AND THE TENDER SHALL BE BASED ON WHICHEVER IS THE GREATER AMOUNT.

3.3.4. KEEP A RECORD SET OF DRAWINGS ON THE SITE ON WHICH SHALL BE CLEARLY INDICATED, THE EXACT LOCATION OF ALL FEEDER RUNS, PANELS JUNCTION BOXES, PULL BOXES, ETC. TWO COPIES OF THE RECORD DRAWINGS SHALL BE SUBMITTED TO THE PROJECT MANAGER UPON COMPLETION OF THE PROJECT.

3.3.5. THE CONTRACTOR SHALL VISIT THE SITE AND EXAMINE ALL DRAWINGS CAREFULLY TO DETERMINE THE EXTENT OF WORK. EXAMINE THE SITE AND TOGETHER WITH DRAWINGS AND SPECIFICATIONS DETERMINE AND INCLUDE IN TOTAL PRICE, THE TOTAL COST OF LABOUR AND MATERIAL TO EXECUTE THE WORK.

3.3.6. NO ALLOWANCE WILL BE MADE FOR OBVIOUS CONSIDERATIONS WHICH MAY HAVE BEEN OVERLOOKED.

3.3.7. EXAMINE THE MECHANICAL AND STRUCTURAL DRAWINGS TO ENSURE THAT THE WORK OF THIS DIVISION CAN BE SUCCESSFULLY COMPLETED WITH NO INTERFERENCES OR DISCREPANCIES.

3.3.8. EXAMINE THE WORK OF THE OTHER TRADES, AS THEY AFFECT THIS DIVISION, AND REPORT IMMEDIATELY TO THE PROJECT MANAGER ANY DEFECT OR INTERFERENCE THAT MAY AFFECT THE WORK OF THIS DIVISION, OR GUARANTEE OF THIS WORK.

3.3.9. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING AND PAYING FOR ALL NECESSARY PERMITS AND INSPECTIONS AS REQUIRED OR REQUESTED BY THE AUTHORITIES HAVING JURISDICTION. ONCE THE ELECTRICAL WORK HAS BEEN COMPLETED AND ACCEPTED BY THE OWNER, THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH CERTIFICATES VERIFYING THAT THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH ALL APPLICABLE CODES, BUILDING STANDARDS, AND ALL AUTHORITIES HAVING JURISDICTION.

3.3.10. THE ELECTRICAL WORK SHALL BE CARRIED OUT AND PERFORMED WITH QUALITY WORKMANSHIP, TO THE SATISFACTION OF THE CONSULTANT, OWNER, AND PROJECT MANAGER. ANY UNSATISFACTORY WORK SHALL BE RE-DONE OR REPLACED WITHOUT EXTRA COST TO THE OWNER.

3.3.11. THE ELECTRICAL CONTRACTOR SHALL PROVIDE THE OWNER WITH A ONE YEAR WRITTEN WARRANTY, COMMENCING ON THE DATE OF ACCEPTANCE. THE WARRANTY SHALL COVER THE COMPLETE ELECTRICAL INSTALLATION. THE ELECTRICAL CONTRACTOR SHALL REPAIR AND/OR REPLACE ANY DEFECTS IN THE MATERIALS OR WORKMANSHIP THAT OCCUR DURING THE WARRANTY PERIOD AT A TIME CONVENIENT TO, AND AT NO EXTRA COST TO THE OWNER.

3.3.12. PROVIDE THE OWNER WITH ONE SET OF 'AS-BUILT' RECORD DRAWINGS PREPARED ON AUTOCAD R.2007 OR COMPATIBLE FORMAT, INCLUDING A COPY OF THE DRAWINGS ON CD. PROVIDE THE ENGINEER WITH ONE SET OF BLACK LINE PRINTS OF THE 'AS-BUILT' RECORD DRAWINGS. THESE DRAWINGS SHALL ONLY BE DELIVERED TO THE OWNER AND ENGINEER AFTER COMPLETION OF THE WORK AND AFTER ALL DEFICIENCIES HAVE BEEN RECORDED.

3.3.13. IN CASE EXTRA WORK OF ANY KIND IS REQUIRED, OBTAIN WRITTEN INSTRUCTIONS FROM THE PROJECT MANAGER BEFORE PROCEEDING, PAYMENT WILL BE MADE AT A FAIR AND REASONABLE RATE ONLY FOR AUTHORIZED EXTRAS. IN THE CASE OF SCOPE REDUCTIONS, THE SAME PROCEDURE SHALL APPLY AND DECREASE MADE.

3.3.14. SUBMIT SHOP DRAWINGS OF LUMINARIES, PANELBOARDS, AND OTHER MAJOR ELECTRICAL EQUIPMENT, AS THEY APPLY TO THIS PROJECT, OR AS REQUIRED BY PROJECT MANAGER. EACH SHOP DRAWING SHALL BE CHECKED AND STAMPED AS BEING CORRECTED BY THE ELECTRICAL AND GENERAL CONTRACTOR PRIOR TO SUBMISSION TO THE PROJECT MANAGER FOR REVIEW. SHOP DRAWINGS NOT STAMPED AS SUCH WILL NOT BE REVIEWED AND WILL BE RETURNED AND DESIGNATED AS "REVISE AND RESUBMIT".

3.3.15. ALL SERVICES WHICH PENETRATE THE FLOOR SLAB OR FIRE-RATED WALLS AND CEILINGS SHALL BE INSTALLED IN RIGID STEEL CONDUIT AND SHALL BE SEALED WITH AN APPROVED, NON-SHRINK, WATER PROOF AND FIRE PROOF SEALANT.

3.3.16. ALL WORK SCHEDULED AND COORDINATED TO AVOID INTERFERENCES WITH OTHER TRADES DURING AND AFTER CONSTRUCTION.

3.3.17. PROVIDE TEMPORARY ELECTRICAL POWER FOR THE WORK OF THIS DIVISION AND OTHER TRADES AS REQUIRED BY THE GENERAL CONTRACTOR OR OWNER.

3.4. SUBMITTALS

3.4.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE MATERIALS, EQUIPMENT & DEVICES.

3.5. ELECTRICAL, LIFE SAFETY, WATER & SANITARY PIPING AND FITTINGS

3.5.1. ALL FIXTURES & FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA.

4. PLUMBING

4.1. THE INSTRUCTIONS TO BIDDERS, CONSTRUCTION CONTRACTORS AND SUB-CONTRACTORS SHALL APPLY TO THE MECHANICAL SECTION AS IF WRITTEN IN FULL HEREIN. THE CONTRACTOR MUST SUPPLY AND INSTALL ALL EQUIPMENT, MATERIALS, LABOUR AND TOOLS, NECESSARY TO COMPLETE ALL SYSTEMS SHOWN ON THE DRAWINGS - RENDERING A COMPLETE AND OPERATING INSTALLATION.

4.2. ALL MATERIALS, EQUIPMENT, AND SYSTEMS MUST COMPLY WITH THE LATEST PLUMBING CODE AS AMENDED BY THE LOCAL MUNICIPALITY.

4.3. SUBMITTALS

4.3.1. PROVIDE DETAILED SHOP DRAWINGS, MAINTENANCE DATA AND OPERATING INSTRUCTIONS FOR ALL THE PLUMBING MATERIALS, EQUIPMENT & DEVICES.

4.4. WATER & SANITARY PIPING AND FITTINGS

ALL FITTINGS MANUFACTURED IN ACCORDANCE WITH CAN/CSA-B125.3

5. EXECUTION

5.1. ALL WORK SHALL MEET OR EXCEED THE LATEST REQUIREMENTS OF THE ONTARIO BUILDING CODE AND ANY LOCAL AUTHORITY HAVING JURISDICTION.

5.2. NOTIFY THE CONSULTANT OF CHANGES REQUIRED BY THE ELECTRICAL INSPECTION DEPARTMENT PRIOR TO MAKING CHANGES.

5.3. PLUG OR CAP PIPE AND FITTINGS TO KEEP OUT DEBRIS DURING CONSTRUCTION.

5.4. ALL BRANCH PIPING AND DRAIN FROM FIXTURES SHALL NOT GARDE OF NOT LESS THAN 1:50 OR AS DIRECTED BY LOCAL PLUMBING CODE.

5.5. ALL VERTICAL STACKS SHALL BE SUPPORTED AT EACH FLOOR LEVEL.

6. . TESTING AND BALANCING OF SYSTEM

6.1. ALL TESTING SHALL BE PERFORMED BY THE CONTRACTOR. TESTING SHALL BE COMPLETED BEFORE THE CONSULTANT IS NOTIFIED FOR THE SYSTEM DEMONSTRATION.

6.2. VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY ALL TERMINATIONS ARE TIGHT.

6.3. ALL FIXTURES SHALL BE TESTED TO ENSURE THAT THE WORK CORRECTLY AND ARE FLUSHING / EVACUATING AT THE CORRECT FLOW RATE.

6.4. ALL TEST CERTIFICATES TO BE INCLUDED IN MAINTENANCE MANUALS.

6.5. PROVIDE A SIGNED STATEMENT TO THE EFFECT THAT ALL TESTS FOR MECHANICAL SYSTEMS AND EQUIPMENT HAVE BEEN COMPLETELY CARRIED OUT TO THE MANUFACTURER'S RECOMMENDATIONS, AND IN ACCORDANCE WITH THE REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION.

GENERAL CONTRACTOR NOTES

1. CONTRACTOR SHALL REVIEW ALL DRAWINGS, SPECIFICATIONS, TENDER DOCUMENTS AND SITE CONDITIONS BEFORE SUBMITTING A JOB ESTIMATE FOR THIS PROJECT. ALTHOUGH A REASONABLE ATTEMPT HAS BEEN MADE TO DOCUMENT THE EXACT EXTENT OF THE EXISTING CONDITIONS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXACT SITE CONDITIONS BEFORE INSTALLATION. ANY ADDITIONAL WORK DUE TO THE SITE CONDITIONS SHALL BE INCLUDED AS PART OF THIS CONTRACT.
2. CONTRACTOR SHALL FIELD CHECK AND CONFIRM EXACT LOCATIONS, ELEVATION AND INSTALLATIONS OF ALL SERVICES FOR THIS PROJECT PRIOR TO INSTALLING ANY EQUIPMENT, PIPE WORK OR CONNECTING ANY ELECTRICAL OR WATER LINES.
3. APPROVED EQUIVALENTS OR ALTERNATIVES TO SPECIFIED PRODUCTS SHALL BE EQUAL TO THE SPECIFIED PRODUCT IN EVERY RESPECT, OPERATE AS INTENDED, MEET THE SPACE, AND CAPACITY REQUIREMENTS AS OUTLINED. ANY ALTERNATES SHALL BE SUBMITTED FOR APPROVAL BEFORE PROCUREMENT. NO ALTERNATIVE SHALL BE ACCEPTED WITHOUT PRIOR WRITTEN APPROVAL OF THE OWNER.
4. FOLLOW CHOSEN MANUFACTURER'S RECOMMENDED INSTALLATION GUIDE AND PROCEDURES FOR EQUIPMENT, SUPPLEMENTED BY THE REQUIREMENTS AND OUTLINE OF THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS AND SHALL REPORT ANY DISCREPANCIES TO CONSULTANT BEFORE PROCEEDING WITH WORK.
6. USE ONLY THE LATEST REVISED DRAWINGS AS SPECIFIED.
7. CONTRACTOR SHALL PROVIDE CONSULTANT AND PROJECT MANAGER WITH A DETAILED CONSTRUCTION SCHEDULE FOR APPROVAL BEFORE COMMENCEMENT OF ANY WORK.
8. THE CONTRACTOR SHALL INFORM CONSULTANT AND PROJECT MANAGER PRIOR TO START OF WORK ALLOWING FOR SCHEDULE AND PROCESS WITHOUT DELAY TO THE PROJECT, SHOULD IT APPEAR THAT ANY PART OF THE WORK IS NOT SUFFICIENTLY DETAILED ON THE DRAWINGS.
9. CONTRACT DOCUMENTS AND DRAWINGS ARE DIAGRAMMATIC AND NOT DRAWN TO SCALE UNLESS DETAILED OTHERWISE. THEY ESTABLISH SCOPE, MATERIAL AND INSTALLATION QUALITY AND ARE NOT DETAILED INSTALLATION INSTRUCTIONS.
10. MAKE REFERENCE TO ELECTRICAL, MECHANICAL, LIFE SAFETY AND PLUMBING DRAWINGS WHEN SETTING OUT WORK. CONSULT WITH RESPECTIVE DIVISIONS IN SETTING OUT LOCATIONS FOR EQUIPMENT SO THAT CONFLICTS ARE AVOIDED AND SYMMETRICAL AND EVEN SPACING IS MAINTAINED. JOINTLY WORK OUT ALL CONFLICTS ON SITE BEFORE FABRICATING OR INSTALLING ANY MATERIALS OR EQUIPMENT.
11. ALL EXISTING SERVICES SHALL REMAIN IN CONSTANT OPERATION. CONTRACTOR SHALL GIVE THE CONSULTANT AND OWNER FIVE WORKING DAYS WRITTEN NOTICE BEFORE ANY TEMPORARY POWER/WATER SHUTDOWNS.
12. IMMEDIATELY CUT OFF AND CAP CONCEALED SERVICES UNCOVERED DURING WORK.
13. CONTRACTOR SHALL PROVIDE COMPLETE, FULLY TESTED, AND OPERATIONAL ELECTRICAL, MECHANICAL AND PLUMBING SYSTEMS TO MEET REQUIREMENTS DESCRIBED HEREIN.
14. INSTALL EQUIPMENT IN LOCATIONS AND ROUTES SHOWN. RUN ELECTRICAL LINES WHERE SEEN FIT AND WATER LINES AS SHOWN BUT AVOID INTERFERENCE WITH OTHER SERVICES.
15. INSTALLATION MUST BE COMPLETED IN ACCORDANCE WITH APPLICABLE CODES AND ORDINANCES.
16. CONTRACTOR SHALL OBTAIN ALL PERMITS AND PAY ALL FEES APPLICABLE TO THE WORK.
17. HANDLE, STORE, AND INSTALL ALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. DO NOT STORE EQUIPMENT ON THE GROUND OR IN CONDITIONS THAT WILL DAMAGE OR COMPROMISE THE INTEGRITY OF THE PRODUCT.
18. ANY COSTS ASSOCIATED WITH MATERIAL DELIVERY OR DEBRIS REMOVAL SHALL BE THE CONTRACTORS RESPONSIBILITY. ALL DEBRIS SHALL BE COLLECTED AND REMOVED AT END OF EACH WORK DAY. CONTRACTOR SHALL EMPLOY DUST CONTROL.
19. THE INSTALLATION METHODS, FINISHING AND APPEARANCE IS SUBJECT TO THE APPROVAL OF THE CONSULTANT AND OWNER. ANY COORDINATION TIME OR ADDITIONAL MATERIALS/LABOUR REQUIRED TO ACHIEVE THE REQUIRED APPEARANCE SHALL BE INCLUDED IN THIS CONTRACT.
20. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO EXISTING SERVICES, FINISHES AND MATERIALS DUE TO THE WORK UNDER THIS CONTRACT, AND BEAR ALL COSTS INCURRED TO MAKE GOOD, REPAIR OR REPLACE SAME TO THE PROJECT MANAGER'S SATISFACTION.
21. FINAL CLEANING SHALL INCLUDE EQUIPMENT, CASES, COVERS, FLOORS, WALLS, WINDOWS, ETC. THAT HAVE BEEN AFFECTED BY THE WORK, IN READINESS FOR CLIENT'S OCCUPANCY.
22. UPON COMPLETION OF ALL WORK BY ALL TRADES, THE CONTRACTOR SHALL REMOVE ALL SURPLUS CONSTRUCTION MATERIALS, RUBBISH AND GARBAGE TO LEAVE THE PREMISES CLEAN AND SUITABLE FOR IMMEDIATE OCCUPANCY BY THE CLIENT WITHOUT THE NEED FOR FURTHER CLEANING.
23. WHERE STRUCTURAL WORK REQUIRES CUTTING AND REMOVAL, CAREFULLY EXAMINE THE WORK TO ASCERTAIN THAT THE EXTENT OF CUTTING AND REMOVAL REQUIRED IS SAFE PRIOR TO EXECUTION.

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:

GENERAL CONTRACTOR NOTES

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01

PROPOSED WATER SOURCE VRF SCHEDULE	
TAG	MINIMUM COP
VRF-1	2.73 (COOLING), 3.2 (HEATING)

PROPOSED WATER SOURCE HEAT PUMP SCHEDULE		
TAG	CAPACITY (CFM)	NOTES
WSHP-1	4,600	C/W VFD CONTROLS & ERV

PROPOSED DOMESTIC HOT WATER SCHEDULE			
TAG	CAPACITY (BTU/hr)	CAPACITY (USGAL)	EFFICIENCY
DHW-1	85,000	100	3.75 UEF

OPTION 4 BAS TOTAL POINTS	
POINT TYPE	QUANTITY
DO	57
AO	3
DI	58
AI	60

OPTION 4 BAS POINTS LIST

POINT NAME	POINT TYPE	POINT NO.	SYSTEM	POINT DESCRIPTION
WSHP-S/S	DO	DO1	WSHP	WSHP START/STOP
WSHP-MOD	AO	AO1	WSHP	WSHP MODULATION
WSHP-STAT	DI	DI1	WSHP	WSHP STATUS
WSHP-SAT	AI	AI1	WSHP	WSHP SUPPLY AIR TEMP
WSHP-RAT	AI	AI2	WSHP	WSHP RETURN AIR TEMP
VRF-S/S	DO	DO2	VRF	VRF START/STOP
VRF-MOD	AO	AO2	VRF	VRF MODULATION
VRF-STAT	DI	DI2	VRF	VRF STATUS
VRF-S	AI	AI3	VRF	VRF LOOP SUPPLY STATUS
VRF-R	AI	AI4	VRF	VRF LOOP RETURN STATUS
VRF-GEO-S/S	DO	DO3	GEO	GEO START/STOP
VRF-GEO-MOD	AO	AO3	GEO	GEO MODULATION
VRF-GEO-STAT	DI	DI3	GEO	GEO STATUS
VRF-GEOSWT	AI	AI5	GEO	VRF GEO LOOP SUPPLY TEMP
VRF-GEORWT	AI	AI6	GEO	VRF GEO LOOP RETURN TEMP
VRFI-S/S 1-52	DO	DO 4 TO 56	VRFIT	VRF INDOOR TERMINAL START/STOP FOR 52 UNITS
VRFI-STAT 1-52	DI	DI 4 TO 56	VRFIT	VRF INDOOR TERMINAL STATUS FOR 52 UNITS
VRFI-TEMP 1-52	AI	AI 7 TO 59	VRFIT	VRF INDOOR TERMINAL TEMP FOR 52 UNITS
BB-S/S	DO	57	BB	BB ON/OFF
OAT	AI	AI60	GENERAL	OUTDOOR TEMP
OCC	DI	DI57	GENERAL	OCCUPANCY
OCC	DI	DI58	GENERAL	OCCUPANCY

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

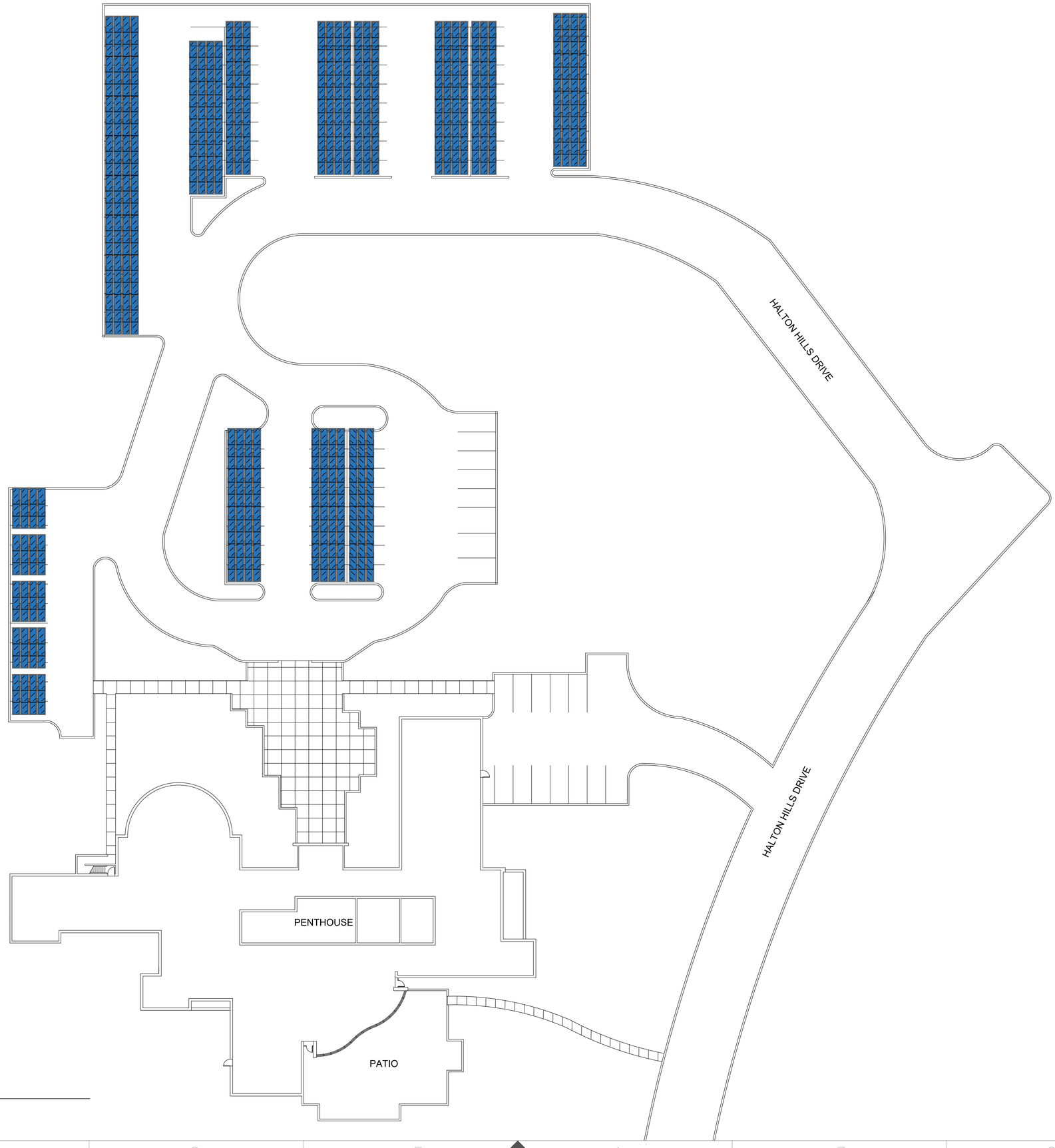
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
EQUIPMENT SCHEDULE & BAS POINTS LIST - OPTION 4

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	N-01



LEGEND	
SYMBOL	DESCRIPTION
	SOLAR PANELS

1 HALTON HILLS
SITE PLAN - OPTION 4

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
–	1	ISSUE FOR APPROVAL	2020/8/14	–

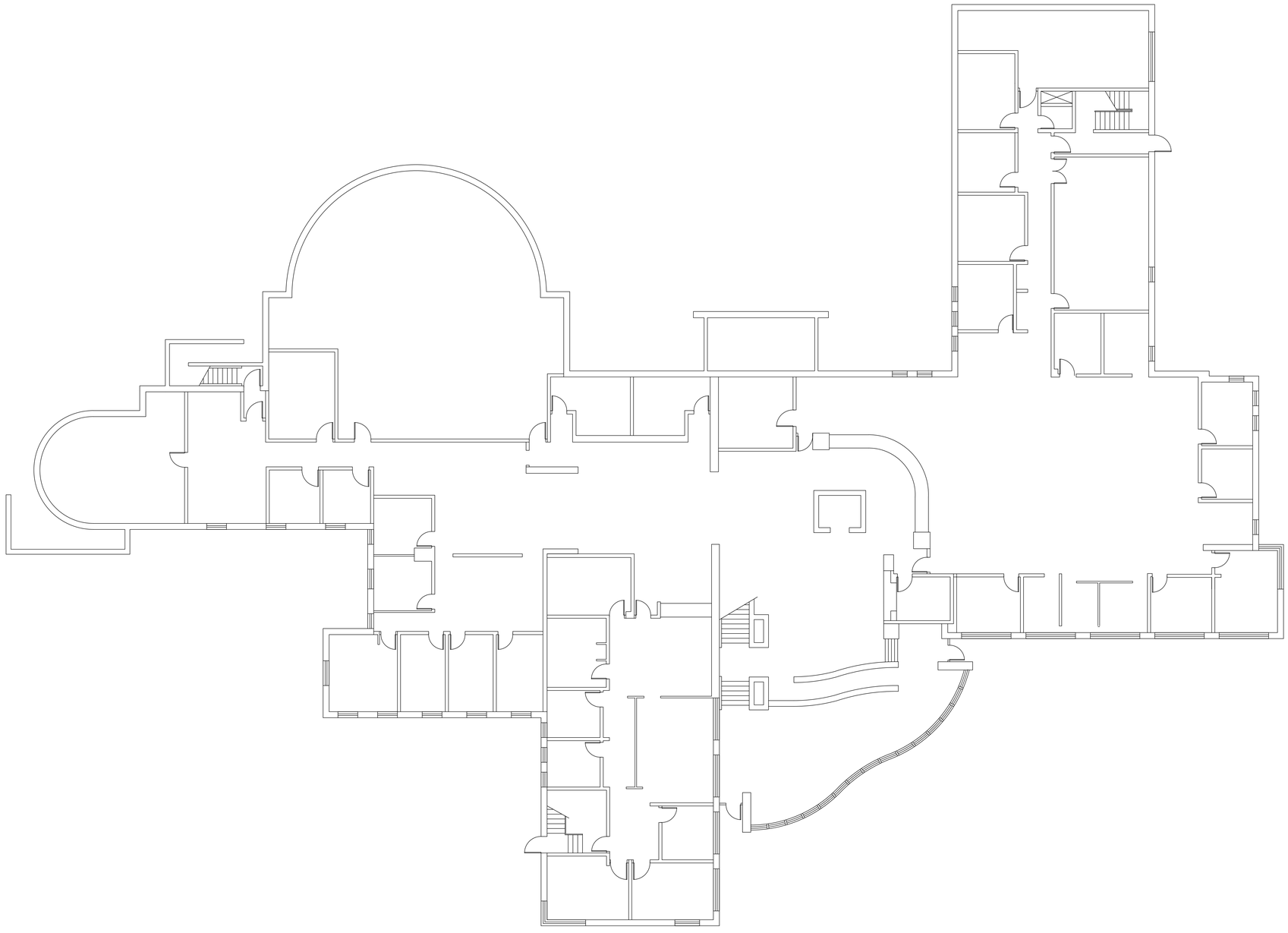
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SITE PLAN
OPTION 4

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-01



2 HALTON HILLS
FIRST FLOOR LAYOUT - OPTION 4

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

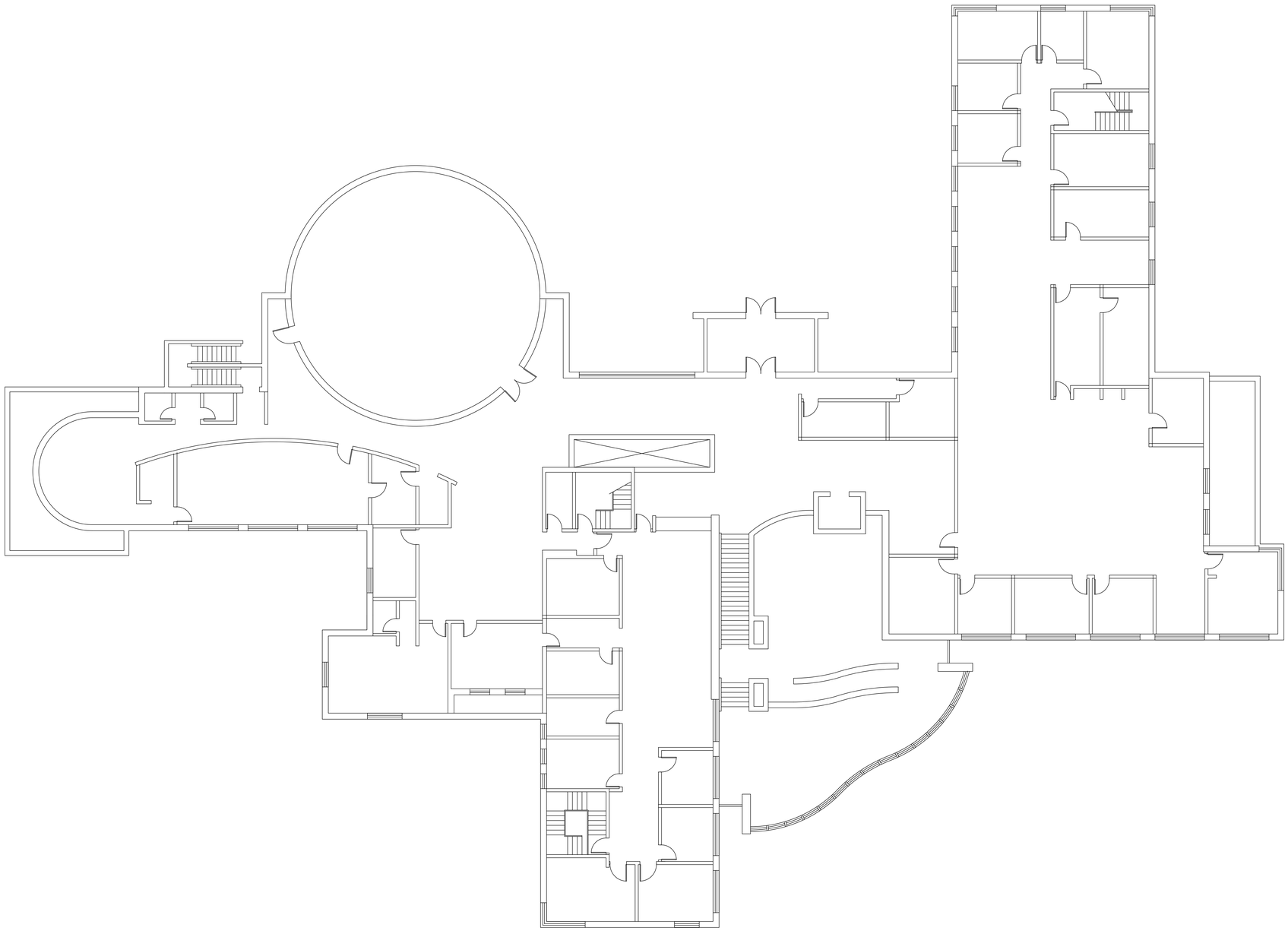
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS FIRST FLOOR
LAYOUT - OPTION 4

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-02



3 HALTON HILLS
SECOND FLOOR LAYOUT - OPTION 4

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

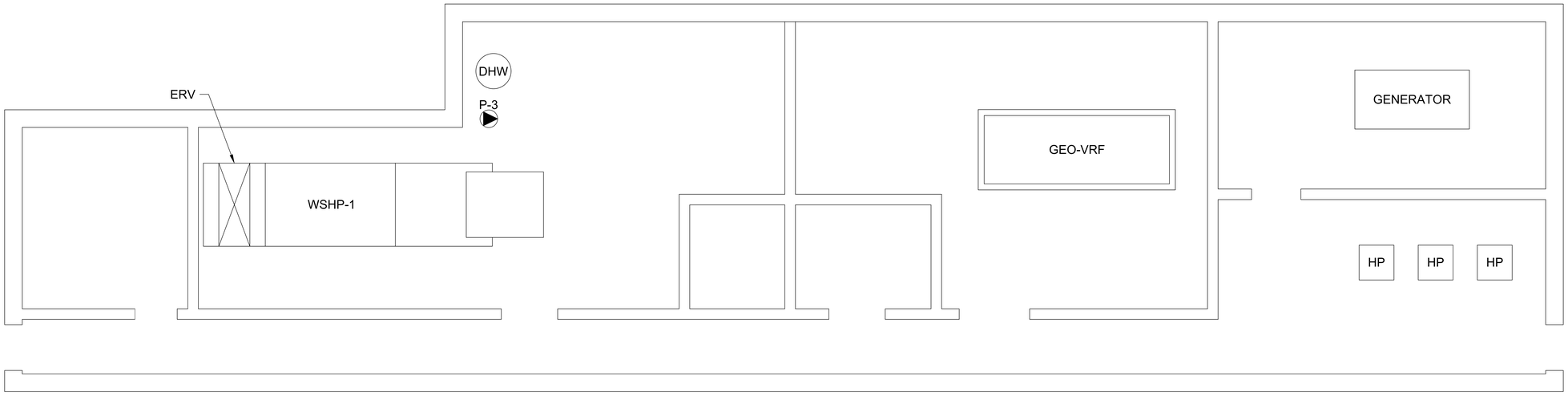
STAMP:

PROJECT:
1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS SECOND FLOOR LAYOUT - OPTION 4

INTERNAT ENERGY SOLUTIONS
Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-03



4 HALTON HILLS
PENTHOUSE LAYOUT - OPTION 4

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
--	1	ISSUE FOR APPROVAL	2020/8/14	--

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

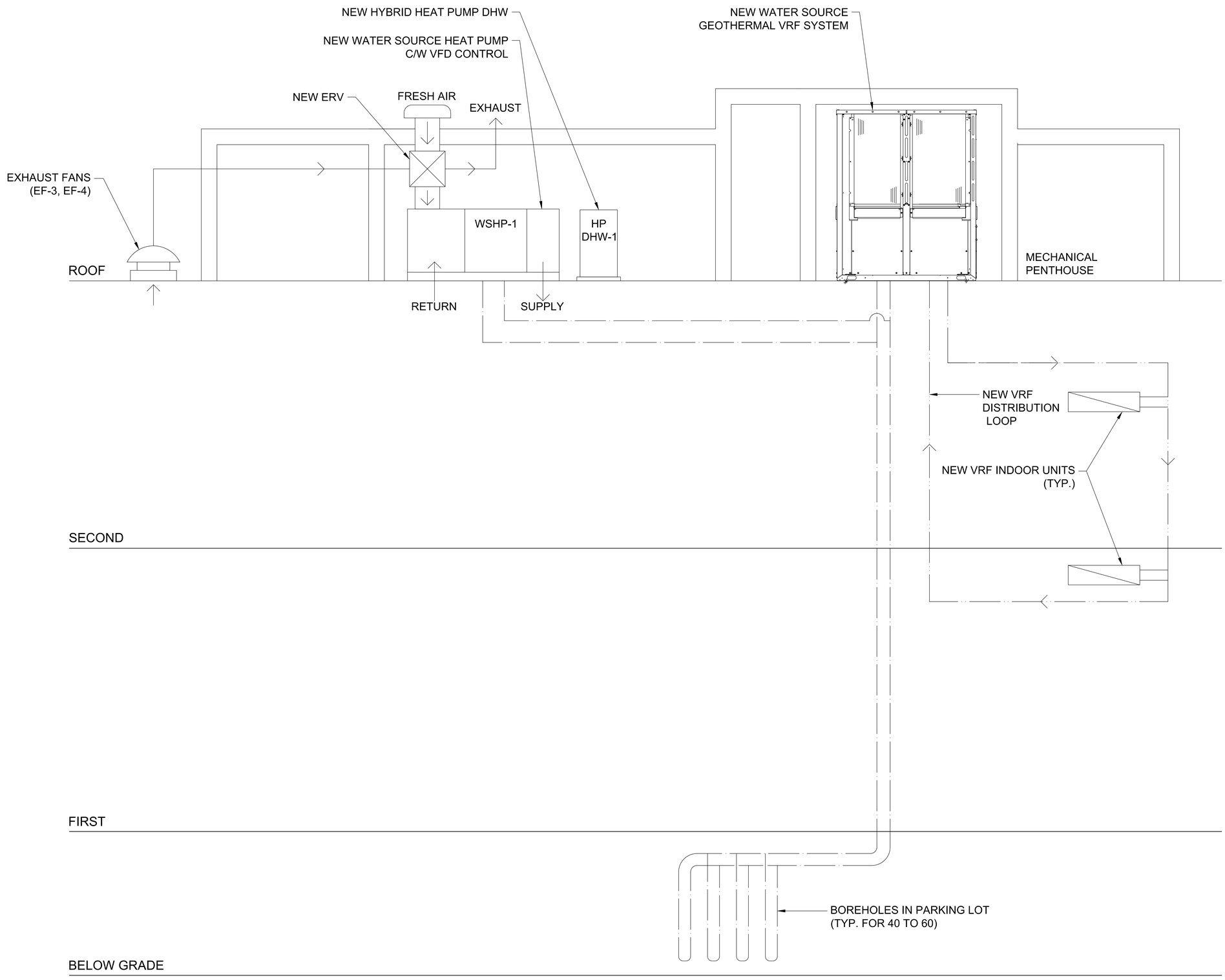
DRAWING:

HALTON HILLS
PENTHOUSE LAYOUT - OPTION 4

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-04



5 HALTON HILLS
MECHANICAL SINGLE LINE DIAGRAM - OPTION 4

GENERAL NOTES:

CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON THE PROJECT.

CONTRACTOR TO REPORT ANY DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

DRAWINGS ARE NOT TO BE SCALED.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
–	1	ISSUE FOR APPROVAL	2020/8/14	–

STAMP:

PROJECT:

1 HALTON HILLS DRIVE
HALTON HILLS, ONTARIO

DRAWING:
HALTON HILLS MECHANICAL SINGLE LINE DIAGRAM - OPTION 4

INTERNAT ENERGY SOLUTIONS

Internat Energy Solutions Canada
425 Adelaide St W #202, Toronto, ON M5V 3C1
(416) 628-4658

SCALE:	-
DRAWN BY:	A.L.
CHECKED:	L.N.
PROJECT No.:	G1301-M-00
DATE:	August 14, 2020
DRAWING No.:	M-05

16 APPENDIX B – THIRD PARTY REPORTS AND ANALYSIS

1. Structural gap load analysis (Art Engineering Inc.)
2. Hygrothermal analysis – exterior wall retrofit options (Rockwool)

art engineering inc.
171 Walgreen Road • Carp • Ontario • K0A 1L0 • Canada
(613) 836-0632 • Fax: (613) 836-1226
www.artengineering.ca

HALTON HILLS TOWN HALL
1 Halton Hills Drive, Georgetown, Ontario, L7G 5G2

Structural Analysis to Determine Gap Loading for Photovoltaic Panel Installation

Project No. 5129
Revision No. 00
August 20, 2020

Prepared by: Gabriel Doucette
B.A.S.c.

Approved by: Timothy Berg
P. Eng.

Prepared for: Internat Energy Solutions Canada

Document Revision Index

Revision	Date	Description of Changes
00	August 20, 2020	Initial version

Table of Contents

Appendices:

1.0 Introduction

ART Engineering Inc. (AEI) has been retained by Internat Energy Solutions Canada to perform a structural analysis of the Halton Hills Town Hall, located in Georgetown, Ontario, to determine if the existing building is capable of supporting the additional superimposed loads from the proposed photovoltaic panel installation, and provide "gap loadings" for the roof outlining residual load carrying capacity.

2.0 Background

Halton Hills Town Hall is located at 1 Halton Hills Drive in Georgetown Ontario and consists of a two-storey reinforced concrete structure with infill steel framing, constructed circa 1987. The building has a footprint of approximately 1960 m^2 [21,000 ft^2].

3.0 Project Documentation

The following documentation was provided to AEI for review:

- As-built structural drawings, prepared by James S.F. MA & Associated Ltd. Consulting Engineers, dated August 31, 1987, drawing numbers 1-8;
- As-built architectural drawings, prepared by C.A. Ventin Architects, dated August 31, 1987, drawing numbers 1-28.

4.0 Limitations

The gap loads provided in this report are a result of an analysis of the structure based on the as-built drawings provided. The following limitations and assumptions apply to the structural analysis performed by AEI:

- The conditions shown on the drawings provided are accurate and representative of the current site conditions. Investigative work is required to confirm this assumption prior to the photovoltaic panel installation. Any deviations from the conditions shown on the drawings may affect the gap loads provided;
- All existing concrete is assumed to have a minimum compressive strength of 25 MPa, with a maximum aggregate size of 20 mm, and reinforced with deformed bars with a minimum yield strength of 400 MPa. Verification of the existing concrete compressive strength is required prior to installation of the photovoltaic panels;
- All existing structural steel is assumed to be CSA G40.12 and have a minimum yield strength of 300 MPa. Verification of the existing structural steel yield strength is required prior to installation of the photovoltaic panels;
- Reinforcement in concrete beams and slabs is assumed to have a cover of 20 mm;
- The analysis assumes that no major deficiencies or deterioration are present within the structural members;
- The analysis was completed for gravity load effects only.

5.0 Structural Analysis

The structural analysis was performed in accordance with the requirements of the 2012 Ontario Building Code (amended 2020), CSA A23.3-19, Design of Concrete Structures, and CSA S16-19, Design of Steel Structures and the as-built structural drawings provided.

A structural model was prepared using ETABS, a finite element modelling and structural analysis program. A linear static analysis was performed using cracked section properties to simulate the stress

redistribution within the structure. The resulting gap loads determined from the structural analysis are provided in Appendix A. Screenshots from the analysis are attached in Appendix B.

6.0 Discussion

The gap loads provided are based on the assumptions and limitations described herein. It is important to note that the gap loads shown are also subject to the final proposed solar panel installation, as certain configurations are subject to further additional snow accumulation.

To increase the gap loading where shown, or to provide a gap load where the results of the analysis do not currently allow, the following two options have been explored:

Option 1: Reinforcing of the existing structural elements as required to provide the desired gap load, and;
Option 2: Removal of the existing roof ballast to offset the weight of the solar panel installation.

Option 1 entails strengthening the existing structural elements where required to provide the desired gap load. As indicated in Appendix A, concrete beams and slabs locally govern the capacity of the existing roof structure. Additional flexural strengthening where noted could be provided in the form of fibre-reinforced polymer (FRP) reinforcement applied to the faces of the concrete beam and slab elements. Shear reinforcement may also be provided in the form of FRP reinforcement applied to the sides of concrete beam elements. An alternative cost-effective shear strengthening approach utilizing mechanically fastened or chemically bonded steel plates applied to the faces of the beam elements is also feasible.

Option 2 would include reducing the roof dead load on the roof by removing the existing ballast to offset the weight of the solar panel installation. The feasibility of this option would need to be assessed from a building science perspective prior to implementation. Further investigative work would be required to verify the weight of the current roof assembly prior to proceeding with this alternative. It is important to note that this approach will not be a possible across the entire roof area, as certain portions of the roof structure do not meet current code requirements. Accordingly, if this is the preferred approach, each area of the roof will be treated on a case-by-case basis.

Alternatively, a combination of the two approaches may be utilized.

7.0 Conclusion and Recommendations

AEI has conducted a structural analysis considering gravity loads on the existing structure, and has determined the following:

The structure has some residual load capacity which would allow for the installation of photovoltaic panels on certain portions of the roof, however other areas of the roof do not meet current code requirements, and as such no gap loads have been provided in these locations.

The areas of the roof where no gap loads have been provided are governed predominately by the shear capacity of the concrete beams, and the flexural capacity of the concrete slabs. In order to provide a gap load where the analysis does not currently allow, structural elements may be reinforced with FRP reinforcing to provide the desired gap load. As an alternative, the roof dead load may be decreased by removing the existing ballast to offset the weight of the solar panel installation, provided that this option is found to be feasible from a building science perspective.

We trust that that above satisfies your requirements. Should you have any further questions, please do not hesitate to contact our office at (613) 836-0632.

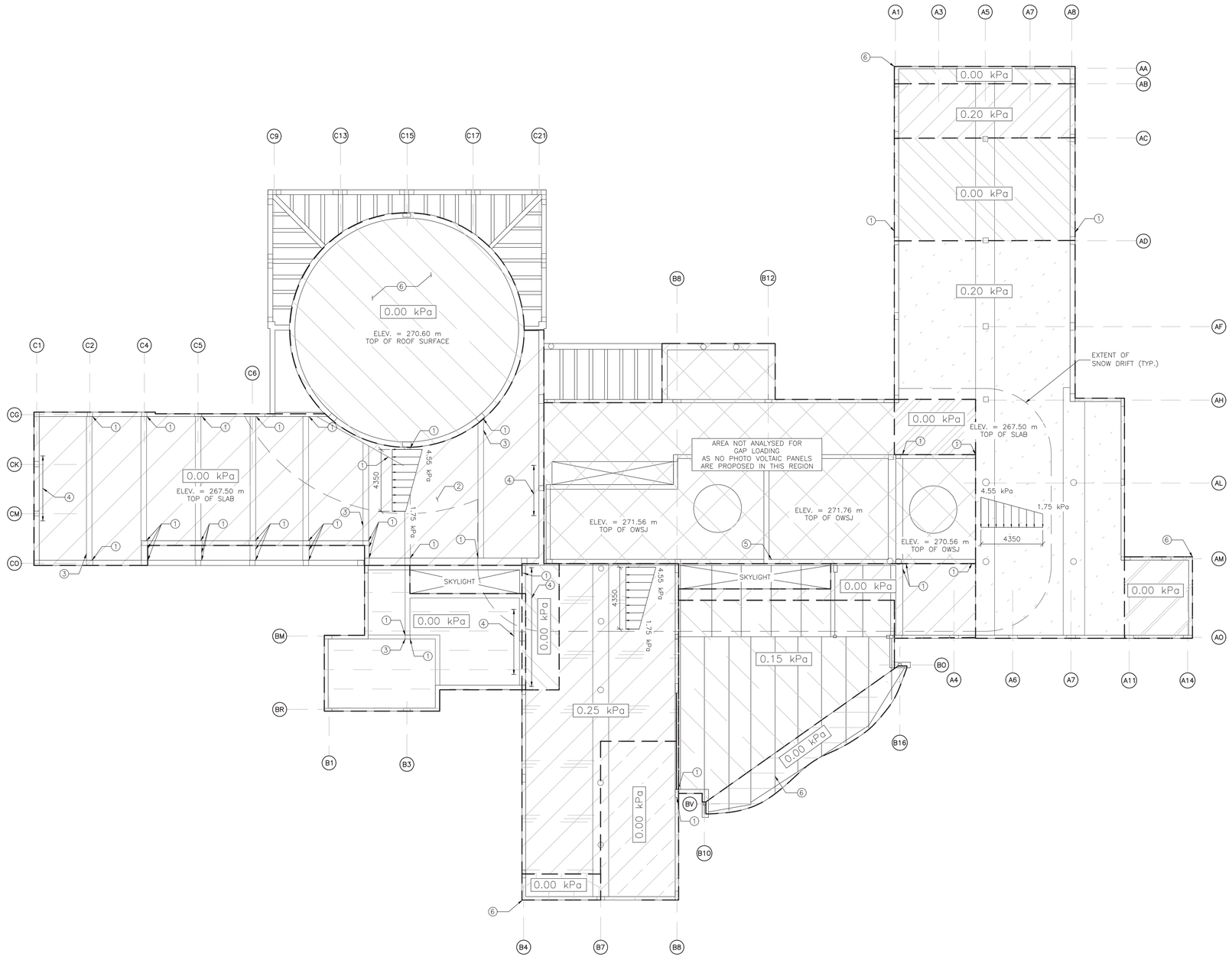
Approved by:
Timothy Berg
P. Eng.

Prepared by:
Gabriel Doucette
B.A.S.c.

Appendix A: Gap Loading Plan Layout

STRUCTURAL REINFORCING REQUIRED TO INCREASE GAP LOAD:

1. REINFORCE CONCRETE BEAM TO INCREASE SHEAR CAPACITY.
2. REINFORCE CONCRETE SLAB TO INCREASE POSITIVE BENDING FLEXURAL RESISTANCE.
3. REINFORCE CONCRETE BEAM TO INCREASE NEGATIVE BENDING FLEXURAL RESISTANCE AT SUPPORT.
4. REINFORCE CONCRETE SLAB TO INCREASE NEGATIVE BENDING FLEXURAL RESISTANCE AT SUPPORT.
5. REINFORCE CONCRETE BEAM TO INCREASE POSITIVE BENDING FLEXURAL RESISTANCE.
6. STRUCTURAL DRAWINGS PROVIDE INSUFFICIENT DETAIL TO QUANTIFY RESIDUAL CAPACITY AT THIS LOCATION, FURTHER INVESTIGATIVE WORK REQUIRED.



1 / SA-1 ROOF PLAN
1:150

client

INTERNAT ENERGY SOLUTIONS

project

HALTON HILLS TOWN HALL
GAP LOADING FOR
PHOTOVOLTAIC PANEL
INSTALLATION

1 HALTON HILLS DRIVE
GEORGETOWN ON, L7G 5G2

art engineering inc.
171 Walgreen Road
Carp - Ontario - K0A 1L0 - Canada
(613) 836-0632 - Fax: (613) 836-1226
www.artengineering.ca

A / B — A detail no. no. de détail; B location drawing no. sur dessin no.

scale 1:150

revisions		date
0.	FOR CLIENT'S REVIEW	20-08-20

drawing

ROOF PLAN
&
GAP LOADING

stamp

date	project number	drawing number
August 20, 2020	5129	SA-1

Appendix B: Screenshots of FEM Structural Model

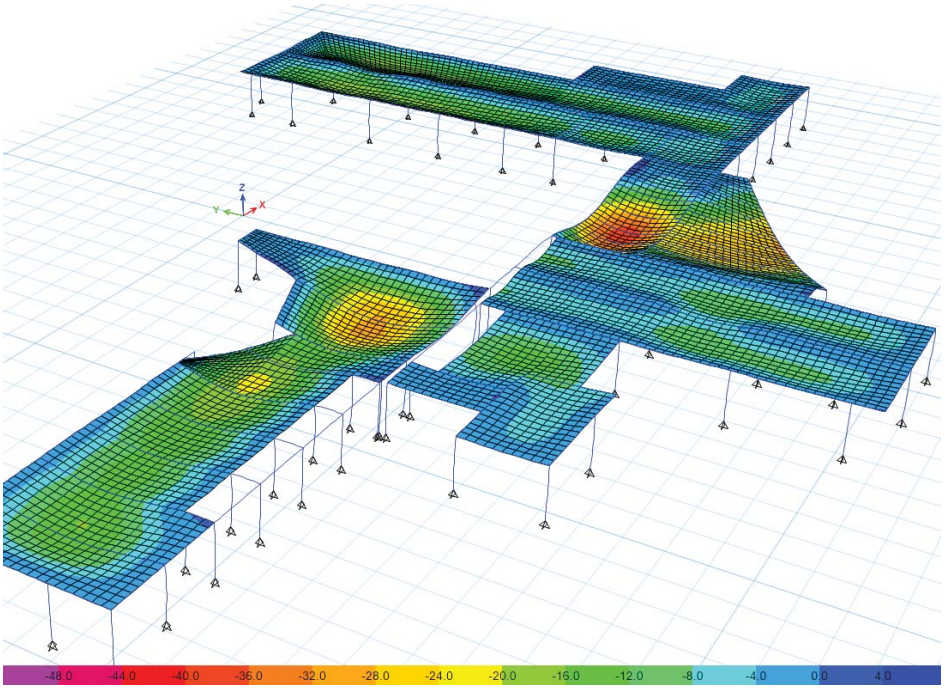


Figure 1: Roof Structure Deflection at serviceability limit state (mm)

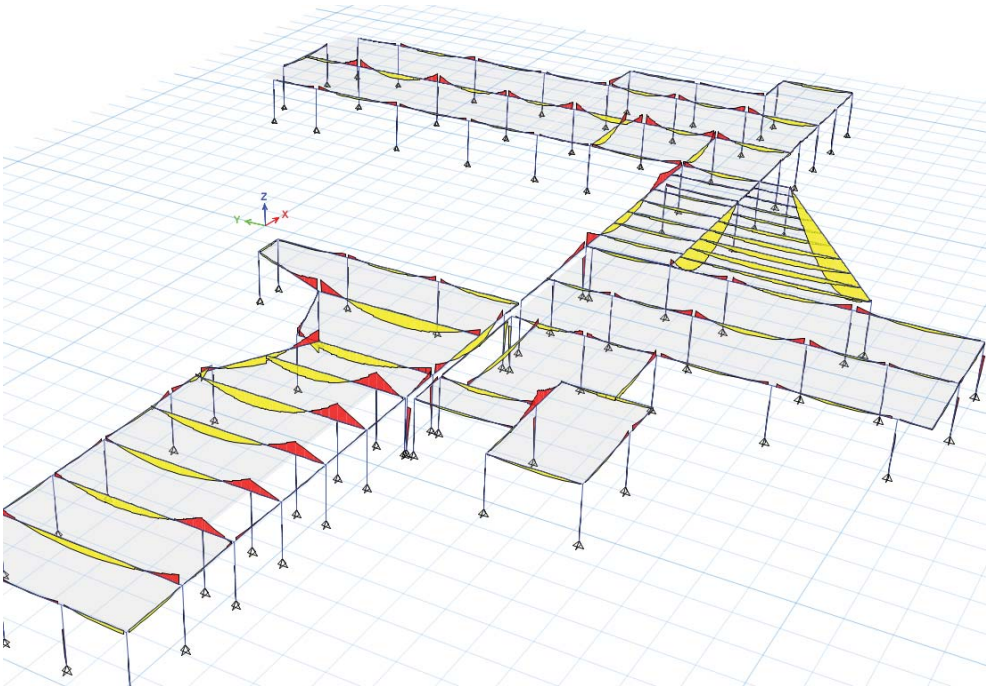


Figure 2: Roof beam flexural bending moment forces at ultimate limit state (kN•m)

Building Science Report

Date: July 17, 2020

Project No: RBS2020-100
Version: 1.0

Project Name: Halton Hills Municipal Building
Project Location: 1 Halton Hills Dr., Georgetown, ON L7G 5G2, Canada
Primary Contact: Dave PETERSEN - Outside In Design + Build

Contact: Ryan FOSTER
Author: Antoine HABELLION
Reviewer: Vincent CHIU

The information provided within this document is for illustration purposes only. Actual results may vary as ROCKWOOL™ has no control over the final design, workmanship, necessary materials or applicable conditions which can impact predicted performance. As a result, the information contained herein provides no performance warranty as to any specific end use application of ROCKWOOL™ products.

Analysis of four typical exterior walls

U-factor determination

Three-dimensional heat transfer simulations were conducted using HEAT3 8.02 on four typical exterior walls, based on the details and description provided by Outside In Design + Build and our understanding of the project.

The purpose of the simulations was to determine the overall thermal transmittance of the assemblies. The inputs, assumptions and results of the simulations are summarized herein.

A. Input and Assumptions

HEAT3 is a PC-program designed to perform three-dimensional steady-state heat conduction modelling where the heat equation is solved with explicit forward finite differences. The program, created by Lund University and edited by BLOCON, is well benchmarked for determining heat conduction through thermal bridging and heat loss through assemblies which two-dimensional tools cannot accurately analyse.

The simulations were performed with an interior temperature of 20°C / 68°F and an exterior temperature of -10°C / 14°F, which were selected based on our understanding of the project. The surface film resistances in the analysis were based on Chapter 26, Table 10 Surface film coefficients/resistances from 2017 ASHRAE Handbook of Fundamentals:

- 0.12 m^2.k/W / 0.68 ft^2·°F·hr/BTU on the vertical interior side,
- 0.03 m^2.k/W / 0.17 ft^2·°F·hr/BTU on the exterior side.

Based on our understanding of the project, the assemblies were constructed using the following materials along with their respective thermal conductivities λ or thermal resistances (SI units):

- Gypsum (λ=0.1603 W/m.K),
- Steel, galvanized (λ=62.0000 W/m.K),
- Concrete masonry unit, solid grouted, 115 pcf (λ=0.5961 W/m.K),
- Fiberglass batt (λ=0.0451 W/m.K),
- Extruded Polystyrene (XPS) (λ=0.0288 W/m.K),
- PUCC-ROCK EIFS system (λ=0.0361 W/m.K),
- ROCKWOOL CAVITYROCK® (λ=0.0335 W/m.K),

- Fiberglass clip (λ=0.3000 W/m.K),
- Insulated metal panel (λ=0.0200 W/m.K).

The material properties used in the simulations performed are based on the materials listed above. Any material not indicated to us in the documentation provided has been selected based on our experience with the materials used for similar projects. In addition, these material properties are based on the properties listed in the standard HEAT3 library file, except for ROCKWOOL CAVITYROCK® which was simulated using properties obtained from the manufacturer's published written datasheet.

B. Assemblies description

As-built wall → R-8.0 + R-10.0ci
- 3-5/8" concrete brick,
- 1.0" air cavity b/w masonry ties @ 16.0" x 16.0" o.c.,
- 2.0" extruded polystyrene (XPS) b/w masonry ties @ 16.0" x 16.0" o.c.,
- Water-resistive barrier,
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt b/w 18-gauge steel studs @ 16.0" o.c.,
- ½" gypsum board.

EIFS wall → R-8.0 + R-20.0ci
- 5.0" PUCC-ROCK EIFS system by DuROCK, fastened with #12 galvanized-steel screws @ 16.0" x 12.0" o.c.,
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt b/w 18-gauge steel studs @ 16.0" o.c.,
- ½" gypsum board.

Clip and rail system wall → R-8.0 + R-21.5ci
- Metal panel,
- 1.0" air cavity b/w horizonal hat channels @ 36.0" o.c.,
- 5.0" ROCKWOOL CAVITYROCK® b/w CASCADIA clips® @ 16.0" x 36.0" o.c.,
- Water-resistive barrier,
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt b/w 18-gauge steel studs @ 16.0" o.c.,
- ½" gypsum board.

Insulated metal panel wall → R-8.0 + R-21.6ci
- 3.0" insulated metal panel,
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt b/w 18-gauge steel studs @ 16.0" o.c.,
- ½" gypsum board.

Assumptions and limitations:
- The exterior veneer, ventilated cladding and air cavity were not included in the models as they were assumed to reach the steady state exterior temperature, due to the ventilation. Any actual added thermal performance can be assumed as a bonus.
- The galvanized-steel masonry ties were modelled as per the RODENHOUSE POS-I-Ties®.

- The CASCADIA clip® was modelled based off the documentation available online on the Cascadia Windows website and was assumed to be fastened with two #14 galvanized steel fasteners.
- Spacing and type of ties, clips and fasteners were based on our understanding of the project and experience. Further structural integrity analysis should be validated by a structural engineer to ensure compliance with loads specific to the project location.
- The water-resistive barrier, which was assumed to have a negligible impact on the thermal performance of the assemblies, was not included in the models.
- The insulation pins were not included in the model as their effect on the overall thermal performance of the assemblies was assumed negligible.
- The modeling was performed for the clear area of the walls (center-of-walls) and did not account for additional framing such as floors and partition walls or penetrations such as windows and doors.

C. Results summary

	Nominal thermal resistance	Effective thermal resistance	U-factor	Reduction
	R [ft².°F·hr/BTU]	**R [ft².°F·hr/BTU]**	**[BTU/ft².°F·hr]**	**%**
As-built wall → R-8.0 + R-10.0ci	21.23	16.43	0.061	22.6%
EIFS wall → R-8.0 + R-20.0ci	31.16	25.47	0.039	18.3%
Clip and rail system wall → R-8.0 + R-21.5ci	32.70	25.99	0.038	20.5%
Insulated metal panel wall → R-8.0 + R-21.6ci	32.76	29.10	0.034	11.2%

Moisture analysis

A hygrothermal analysis was conducted on two typical exterior walls, as described in the first part of this report and based on the details and description provided by Outside In Design + Build and our understanding of the project, to determine the assembly's performance and identify potential risks of moisture related issues. The modelling was conducted using WUFI Pro hygrothermal modelling software version 6.4.

Note that *Insulated metal panel* wall is not presented in the following of this report as it was expected to show similar or better results than *As-built wall*.

The climate data from Toronto, ON – ASHRAE Year 2 – from Oak Ridge National Laboratory, TN, USA was used as the exterior conditions; a relative humidity of 45% ±15 and a temperature of 22.5ºF ± 2.5 were considered for the interior conditions, as per the information provided by Gensler and our understanding of the project.

Except for ROCKWOOL CAVITYROCK® which was true to the exact material, as tested by Fraunhofer, the material properties are based on the existing WUFI material database. Additionally, it should be noted that the insulation levels in the models do not reflect thermal performance losses caused by the studs, ties, clips and fasteners.

80% relative humidity and 68°F were considered as initial conditions for all the components of the assemblies with their respective moisture content in these conditions.

A. Assemblies description

The rain load was calculated in accordance with ASHRAE Standard 160. Therefore, the wall assemblies, below a low-slope roof, were set at a height below 33ft. with medium exposure and the short-wave radiation absorptivity was set to 0.6 to represent a concrete brick and the weathered stucco and 0.54 to represent the metal panel. Finally, the long-wave radiation absorptivity was set at 0.9 and the cloud index at 0.65 (representative of Toronto).

<u>As-built wall</u>
- 3-5/8" concrete brick,
- 1.0" air cavity (w/ ties not included in the model),
- 2.0" extruded polystyrene (XPS) (w/ ties not included in the model),
- Water-resistive barrier (0.26 perm – ASTM E-96, Method B),
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt (b/w studs not included in the model),
- ½" gypsum board with latex paint or water vapor semi-permeable finish (7.0 perms).

<u>EIFS wall</u>
- 0.1" acrylic stucco,
- Water-resistive barrier (1.0 perm),
- 7-½" concrete masonry unit,
- 2-½" fiberglass batt (b/w studs not included in the model),
- ½" gypsum board with latex paint or water vapor semi-permeable finish (7.0 perms).

<u>Clip and rail system wall</u>
- Metal panel,
- 1.0" air cavity (b/w hat channels not included in the model),

- 5.0” ROCKWOOL CAVITYROCK® (b/w clips not included in the model),
- Water-resistive barrier (0.26 perm – ASTM E-96, Method B),
- 7-½” concrete masonry unit,
- 2-½” fiberglass batt (b/w studs not included in the model),
- ½” gypsum board with latex paint or water vapor semi-permeable finish (7.0 perms).

The assemblies were first modelled as perfects system and then with rain leakage. The discussion graphs that follow show the results with 1% of rain penetrating the brick veneer, the EIFS finish or behind the cladding and the insulation and reaching the surface of the water-resistive barrier, and 1% of this 1% penetrating behind the insulation and the water-resistive barrier and reaching the surface of the sheathing, representative of a hole in the membrane around a fastener for instance.

To represent the worst-case scenario in the Toronto climate, the North-East orientation was chosen as the main orientation for the analysis as it received the highest rain load combined with the lowest sun exposure.

It should be noted that these results should be used for relative analysis. Most of the materials used in the analysis are generic materials existing in the WUFI database. Actual characteristics and performance may differ based on the choice, conditions and installation of the final products.

B. Performance criteria

With these types of assemblies which have split insulation between the interior and the exterior, there is the potential for condensation to occur on the interior side of the concrete blocks as it could represent the first cold layer and therefore condensing surface within the assemblies in winter. It is imperative to ensure drying potential throughout the assemblies.

Therefore, to assess their performance, the following thresholds have been identified, in accordance with ASHRAE Standard 160-2009 – Criteria for moisture-control design analysis in Buildings:

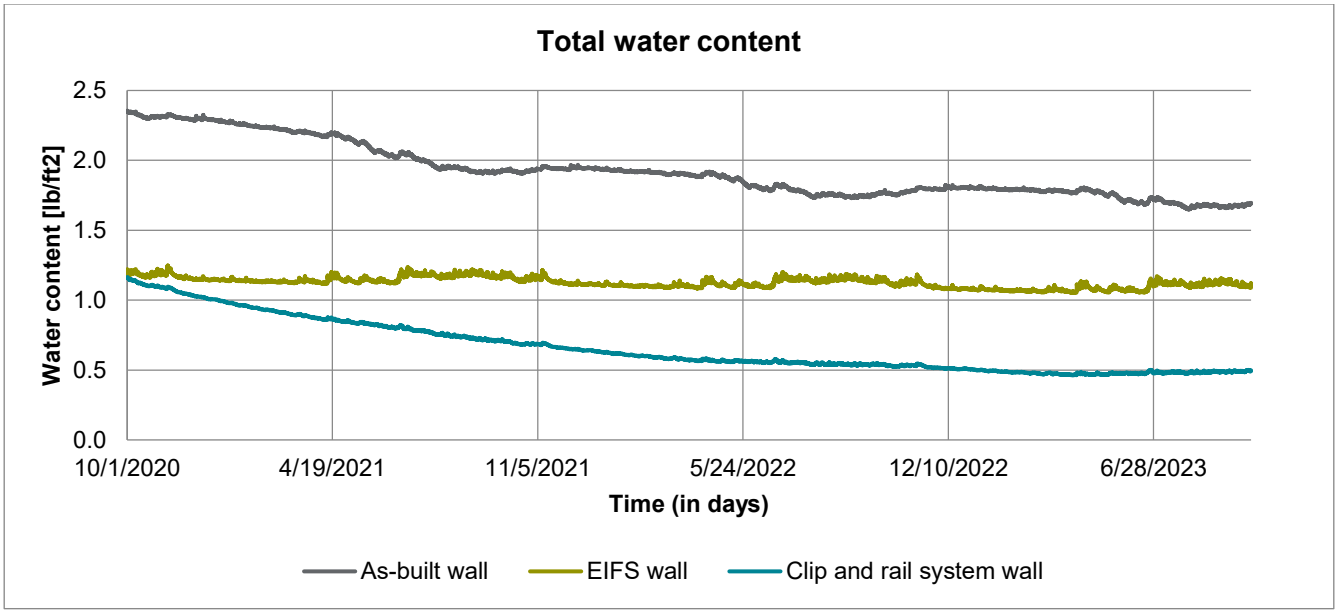
- The overall assembly should demonstrate drying and/or equilibrium. Increasing yearly levels of moisture denote a wall assembly at higher risk,
- The relative humidity on the interior face of the concrete blocks should not exceed 80% on average for a period of 30 days or more when the 30-day running average surface temperature is between 41°F and 104°F (mold growth performance criteria 1),
- The relative humidity at the surface of all the other layers should remain below 80%.

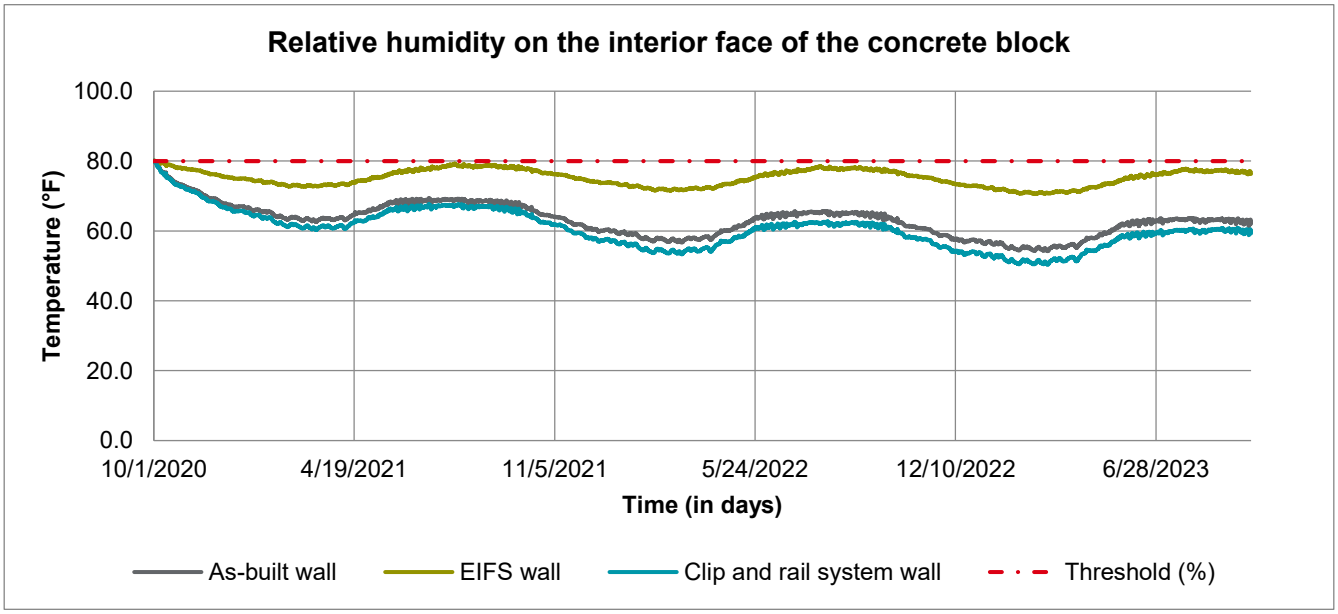
C. Discussion

For all three walls, the total water content reaches equilibrium over time. In addition, the relative humidity levels and moisture content remain below the thresholds. These results do not indicate a potential risk for moisture related issues. This was expected due to the ratio of exterior to total insulation R-values and the high drying potential of the assemblies using vapor permeable stone wool insulation.

Finally, it should be noted that air and rain leakages at windows and sealed joints are critical with these types of enclosures and that the air and water tightness of the assembly should require special attention during construction.

Date: July 17, 2020





Appendix: ROCKWOOL Specification Sheet

ROCKWOOL CAVITYROCK®
https://cdn01.rockwool.com/siteassets/o2-rockwool/documentation/specifications/commercial/cavityrock-072113-guidespec-us-en.pdf?f=20180430101223

17 APPENDIX C – LIFE CYCLE COST ANALYSIS (LCCA)

1. Pathway 1 LCCA
2. Pathway 2 LCCA
3. Pathway 3 LCCA
4. Pathway 4 LCCA

LIFE CYCLE COST ANALYSIS - Pathway 1

Assumptions

Utility Rates (2020)		Utility Savings	
Electricity	$ 0.1907	Electricity	108,265
Natural Gas	$ 0.2559	Natural Gas	13,914

Discount Rate	2.5%																			
Escalation Rates	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electricity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%
NG	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%

Life Cycle Costs

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Investment	-$3,220,900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Incentive/Rebate	$ -	$424,274	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Certification Cost	$ -	-$5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M Costs	$ -	$ -	$ -	$ -	$ -	-$241	$ -	-$7,657	$ -	$ -	-$46,949	$ -	$ -	$ -	-$7,657	$ -	$ -	$ -	$ -	$ -	-$241
Replacement Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$25,000	$ -	$ -	$ -	$ -	-$17,500	$ -	$ -	$ -	$ -	$ -
Residual value	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$271,332
Electricity Savings (kWh)	-	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265	108,265
NG Savings (m3)	-	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914	13,914
Carbon Offsets	-	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593	-$593
Renewable Energy Generation (kWh)	-	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918
Renewable Energy Credit ($)	$ -	$77,425	$81,993	$86,831	$91,954	$97,379	$103,124	$109,208	$115,652	$122,475	$129,701	$137,354	$145,457	$154,039	$163,128	$172,752	$182,945	$193,738	$205,169	$217,274	$230,093
Annual Utility Savings	$ -	$40,958	$43,205	$45,582	$48,095	$50,753	$53,564	$56,537	$59,682	$63,009	$66,528	$70,251	$74,190	$78,356	$82,765	$87,429	$92,364	$97,585	$103,111	$108,957	$115,144
Present value	-$3,220,900	$537,064	$124,605	$131,819	$139,455	$147,297	$156,095	$157,496	$174,741	$184,891	$123,687	$207,012	$219,054	$231,803	$237,643	$242,088	$274,715	$290,731	$307,687	$325,638	$615,735

PROJECT NPV $422,238 **IRR** 3.7%

LIFE CYCLE COST ANALYSIS - Pathway 2

Assumptions

Utility Rates (2020)		Utility Savings	
Electricity	$ 0.1907	Electricity	52,300
Natural Gas	$ 0.2559	Natural Gas	27,512

Discount Rate	2.5%																			
Escalation Rates	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electricity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%
NG	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%

Life Cycle Costs

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Investment	-$3,559,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Incentive/Rebate	$ -	$459,028	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Certification Cost	$ -	-$5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M Costs	$ -	$ -	$ -	$ -	$ -	-$241	$ -	$ -	$ -	$ -	-$38,818	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$25,000	$ -	$ -	$ -	$ -	-$17,500	$ -	$ -	$ -	$ -	$ -
Residual value	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$685,827
Electricity Savings (kWh)	-	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300	52,300
NG Savings (m3)	-	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512
Carbon Offsets	-	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116	-$116
Renewable Energy Generation (kWh)	-	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918
Renewable Energy Credit ($)	$ -	$77,425	$81,993	$86,831	$91,954	$97,379	$103,124	$109,208	$115,652	$122,475	$129,701	$137,354	$145,457	$154,039	$163,128	$172,752	$182,945	$193,738	$205,169	$217,274	$230,093
Annual Utility Savings	$ -	$26,271	$27,486	$28,767	$30,116	$31,537	$33,036	$34,615	$36,281	$38,037	$39,889	$41,842	$43,903	$46,077	$48,371	$50,792	$53,347	$56,044	$58,891	$61,897	$65,071
Present value	-$3,559,200	$557,608	$109,363	$115,481	$121,953	$128,559	$136,044	$143,708	$151,816	$160,396	$105,656	$179,080	$189,244	$200,000	$211,383	$205,928	$236,176	$249,666	$263,944	$279,055	$980,875

PROJECT NPV **-$25,697** **IRR** **2.4%**

LIFE CYCLE COST ANALYSIS - Pathway 3

Assumptions

Utility Rates (2020)		Utility Savings	
Electricity	$ 0.1907	Electricity	31,610
Natural Gas	$ 0.2559	Natural Gas	27,512

Discount Rate	2.5%																			
Escalation Rates	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electricity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%
NG	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%

Life Cycle Costs

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Investment	-$3,311,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Incentive/Rebate	$ -	$425,377	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Certification Cost	$ -	-$5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M Costs	$ -	$ -	$ -	$ -	$ -	-$241	$ -	$ -	$ -	$ -	-$45,840	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$25,000	$ -	$ -	$ -	$ -	-$17,500	$ -	$ -	$ -	$ -	$ -
Residual value	$131,292	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$532,493
Electricity Savings (kWh)	-	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610	31,610
NG Savings (m3)	-	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512
Carbon Offsets	-	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125	-$125
Renewable Energy Generation (kWh)	-	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918
Renewable Energy Credit ($)	$ -	$77,425	$81,993	$86,831	$91,954	$97,379	$103,124	$109,208	$115,652	$122,475	$129,701	$137,354	$145,457	$154,039	$163,128	$172,752	$182,945	$193,738	$205,169	$217,274	$230,093
Annual Utility Savings	$ -	$19,273	$20,076	$20,919	$21,805	$22,736	$23,715	$24,745	$25,828	$26,967	$28,166	$29,428	$30,756	$32,155	$33,627	$35,178	$36,812	$38,534	$40,348	$42,260	$44,275
Present value	-$3,180,208	$516,950	$101,944	$107,624	$113,633	$119,749	$126,714	$133,828	$141,355	$149,317	$86,902	$166,657	$176,089	$186,069	$196,630	$190,306	$219,632	$232,147	$245,392	$259,408	$806,736

PROJECT NPV $30,383 **IRR** 2.6%

LIFE CYCLE COST ANALYSIS - Pathway 4

Assumptions

Utility Rates (2020)		Utility Savings	
Electricity	$ 0.1907	Electricity	71,604
Natural Gas	$ 0.2559	Natural Gas	27,512

Discount Rate	2.5%																			
Escalation Rates	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electricity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%
NG	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%

Life Cycle Costs

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Investment	-$3,815,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Incentive/Rebate	$ -	$493,586	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Certification Cost	$ -	-$5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M Costs	$ -	$ -	$ -	$ -	$ -	-$241	$ -	$ -	$ -	$ -	-$45,840	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$25,000	$ -	$ -	$ -	$ -	-$17,500	$ -	$ -	$ -	$ -	$ -
Residual value	$131,292	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$697,493
Electricity Savings (kWh)	-	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604	71,604
NG Savings (m3)	-	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512	27,512
Carbon Offsets	-	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108	-$108
Renewable Energy Generation (kWh)	-	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918	228,918
Renewable Energy Credit ($)	$ -	$77,425	$81,993	$86,831	$91,954	$97,379	$103,124	$109,208	$115,652	$122,475	$129,701	$137,354	$145,457	$154,039	$163,128	$172,752	$182,945	$193,738	$205,169	$217,274	$230,093
Annual Utility Savings	$ -	$32,800	$34,401	$36,089	$37,870	$39,749	$41,732	$43,825	$46,033	$48,365	$50,826	$53,425	$56,169	$59,067	$62,127	$65,360	$68,774	$72,381	$76,192	$80,219	$84,474
Present value	-$3,683,808	$598,703	$116,286	$122,811	$129,715	$136,779	$144,748	$152,925	$161,577	$170,732	$109,579	$190,670	$201,518	$212,998	$225,147	$220,504	$251,611	$266,012	$281,253	$297,385	$1,011,953

PROJECT NPV $59,818 **IRR** 2.7%

18 APPENDIX D – COST ESTIMATE REPORTS (CLASS C)

1. Pathway 1 cost estimate
2. Pathway 2 cost estimate
3. Pathway 3 cost estimate
4. Pathway 4 cost estimate
5. Exterior wall retrofit (EIFS) cost estimate
6. Exterior wall retrofit (Clip and Rail) cost estimate
7. Exterior wall retrofit (IMP) cost estimate

Alpha Cost Consultants

www.alphacostcon.com

LOW CARBON FEASIBILITY STUDY

CLASS "C" COST ESTIMATES REV.0.0

TOWN HALL HALTON HILLS

1 HALTON HILLS DRIVE, GEORGETOWN

PREPARED FOR :

INTERNAT ENERGY SOLUTIONS

Alpha Cost Consultants Inc.

COST CONSULTANTS I QUANTITY SURVEYORS

510 Rowntree Dairy Road, Unit 3B, Woodbridge, ON, L4L 8H2
Phone: 416-855-2414
Email: info@alphacostcon.com , www.alphacostcon.com

August 17, 2020 **Project # 20021**

Internat Energy Solutions Canada
425 Adelaide Street West #202
Toronto, ON, M5V 3C1
Ph-416-628-4658

Kind Attn: **Matthew Hudson, P.Eng., MBsc.**
Building Scientist

Reference - **Town Hall Halton Hills Low Carbon Renewal Feasibility Study - Class "C" Cost Estimates**

Dear Matthew,

Please find Class “C” Cost Estimates for above noted project .

These estimates are prepared based on drawings and information provided by Internat Energy Solutions Canada Inc. received on July 22nd. Design drawings as prepared by Internat Energy Solutions Canada Inc.

These estimates are meant to be indicative of the fair market value for upgrades to building envelope, mechanical HVAC system and electrical systems to meet low/ zero carbon code to Town Hall building located in Georgetown. Our estimates are not intended to be the prediction of the lowest bid amount (tenders) received rather should be representative of the median bid amount (tender) received.

We recommend that the owner and the design team carefully review the cost estimate report, including line item descriptions, unit price clarifications, exclusions, inclusions, assumptions, contingencies, escalation and mark-ups.

Please contact undersigned for any clarifications and questions on contents included.

Warm Regards,

Sanjay Verma PQS, MRICS, B.Eng.
Partner
Alpha Cost Consultants Inc.
Encl: (Feasibility Study Stage Class "C" Cost Estimates Rev.0.0, August 17, 2020)

TABLE OF CONTENTS	PAGE

1. PROJECT INFORMATION

1.1 Project Type and Location

This project scope consists of upgrades to building envelope, HVAC and electrical system to meet Low/ Zero Carbon requirements as follows.

Pathway 1

Optimize Existing Building System - ZCB certification

Pathway 2

Geothermal System Retrofit - ZCB certification

Pathway 3

Variable Refrigerant Flow (VRF- Air Source) System Retrofit - ZCB certification

Pathway 4

Variable Refrigerant Flow (VRF- Water Source- Geothermal) System Retrofit - ZCB certification

1.2 Project Building Class

Canadian Institute of Quantity Surveyors (CIQS) building class for this project is
Category 5 / 5.5 City Hall Building

1.3 Project Delivery Method

Project will be tendered with standard stipulated sum contract method.

2. ESTIMATE METHODOLOGY

2.1 Estimate Class

These Class "C" Cost Estimates are intended to establish an indicative estimate of the hard construction costs based on the level of design information including floor plans, programme areas, design memorandum, test reports, site plans and other project specific requirements provided. This prepared estimate is our opinion on total hard construction cost of this project is based on current industry and market value for this type of project located in **Georgetown, ON.**

The accuracy of estimate is based on the documentation & level of information provided and design stage is intended to be +/- 5 to 20%. This is based on standard industry guidelines derived from the Federal Government definition of Estimate Class A/ B/ C/ D. Design contingency and construction contingency (post contract) has been included as % of total costs.

2.2 Quantity Take-Offs

Based on the project design information available at this time, we have measured quantities in accordance with CIQS elemental method of measurement, to establish a bill of material required for construction where possible and; applied our technical skills & expertise to bridge necessary design gaps to establish cost of associated elements; based on experience with project of similar nature and type.

2.3 Unit Rates

The unit rates developed for our estimate include material, labour, equipment, tools and contractor's overhead and profit specific to **Georgetown, ON.**

The unit rates for each of the elements are developed specifically based on current industry median costs for the type of design, construction, and materials specified.

2.4 Cost Base

The site specific cost for this estimate is to project location is **1 Halton Hills Drive, Georgetown, ON.**

Pricing is based on competitive tender results with a minimum of four bid submissions at each major trade level. Tenders receiving less submissions (occasionally three) historically tend to have a much higher risk of an overrun in cost when compared to the budget established in an estimate. Pre-qualification list for contractors may often incur additional financial costs subsequent to reduced level of competitiveness.

2.5 General Requirements and Fees

The General Requirements and Fees for the Contractor are included as a percentage of the hard construction cost. These costs include supervision and labour, access to the site, site accommodations, site protection, temporary utilities, clean up, equipment, and other miscellaneous project requirements.

2.6 Bonding and Insurance

We have included the median estimated costs for 50% performance and 50% labour & material. These are the standard bonding requirements commonly requested by the owner.

The estimate includes an allowance for general liability and builder's risk insurance based on an average cost per $1,000 of estimated hard construction costs. The actual insurance costs would be subjected to the insurance requirements.

2.7 Soft Costs

The estimated soft costs have been **excluded** from this estimate.

These costs include items traditionally funded by the owner and separate from the hard construction costs which would be applicable to the contractor. The soft costs include items such as consultant fees; disbursements; project management fees; independent inspection and testing; legal fees; permits and development charges; operational and moving expenses; financing and loan fees; owner supplied fixtures, and equipment; and Harmonized Sales Tax.

We recommend owner and design team to consider these costs to establish a complete construction budget for this project.

2.8 Taxes

No provision has been made for the HST. We recommend that owner make separate provisions for HST to project cost estimate.

2.9 Design Documents

Following is the list of design documents provided.

Reference	Document Description	Revision Date
Document	Design Overview Pathway # 1, 2 , 3 & 4	August 6, 2020
Drawings	Mechanical Plans - Pathway 1, 2, 3 & 4 (32 sheets)	June 23, 2020
Drawings	Existing Building Drawings : Architectural (27 sheets) + Mechanical (8 sheets + 2 sprinklers) + Electrical (7 sheets)	August 31, 1987
Document	Level II Energy Audit Report (Lot)	August 23, 2013

3. CONTINGENCIES

3.1 Design and Pricing Contingency

A design contingency and pricing contingency of **7%** has been included as % of total costs.

The design contingency is an allowance to cover probable cost associated to bridge the minor design gap at this design stage and anticipated to reduce with design advancement of the project during remaining design stage.

3.2 Escalation

Our estimate is based on **3rd Quarter 2020 construction values**. We have excluded for escalation to any future date for construction .

3.3 Construction Contingency (Post Contract Changes)

Construction contingency for post contract changes that may occur after the project is tendered to cover the cost of anticipated change orders, has been included as **10%** of total construction cost.

It is recommended that owner and design team carefully consider this allowance and include in program budget.

4. LIMITATIONS OF THE REPORT

4.1 Probable Costs

Alpha Cost Consultants Inc. cannot control the cost of construction or competitive bidding and market conditions. This opinion of probable cost of construction is based on our experience, qualifications, and best judgement with the construction industry. **Alpha Cost Consultants Inc.** cannot guarantee that proposals or actual construction costs will not vary from this or subsequent estimates.

Alpha Cost Consultants Inc. has prepared this report based on CIQS guidelines and standard industry accepted practices and principles.

4.2 Report use

This report has been prepared for use of owner; any duplication or transfer to third party will require consent from **Alpha Cost Consultants Inc.**

Alpha Cost Consultant Inc. recommends that the owner and design team carefully review the report including inclusions, exclusions, assumptions and notify **Alpha Cost Consultant Inc.** for any deviations including errors and omissions within 30 days of receipt of this report.

4.3 Canadian Anti Spam Legislation (CASL)

We comply with CASL requirements for providing our services. By receiving this report in electronic format via email you provide consent for email correspondence.

If you wish not to receive any email please notify us so we can unsubscribe you from future electronic correspondence list.

4.4 COVID 19 Implication:

Our estimated cost does not account any market uncertainties and implications arising due to COVID 19 to construction industry.

5. SCOPE CLARIFICATIONS

5.1 Assumptions

Architectural / Structural:

- Various assumptions were made based on the design information available and our experience with projects of a similar nature.
- Our estimate is based on working during normal hours.
- Work to be performed by **union labour.**
- New windows will be installed at existing openings.
- Existing kitchen / cafeteria appliances will be replaced with new Energy Star rated.
- Please refer to the specific items within the estimate for the detailed assumptions made.

Mechanical:

- New BAS will be provided based on direct digital controls (DDC) system.
- Please refer to other scope specific assumptions within estimate.

Electrical:

- Existing interior light fixtures will be replaced with new LED type.
- Please refer to other scope specific assumptions within estimate.

5.2 Exclusions

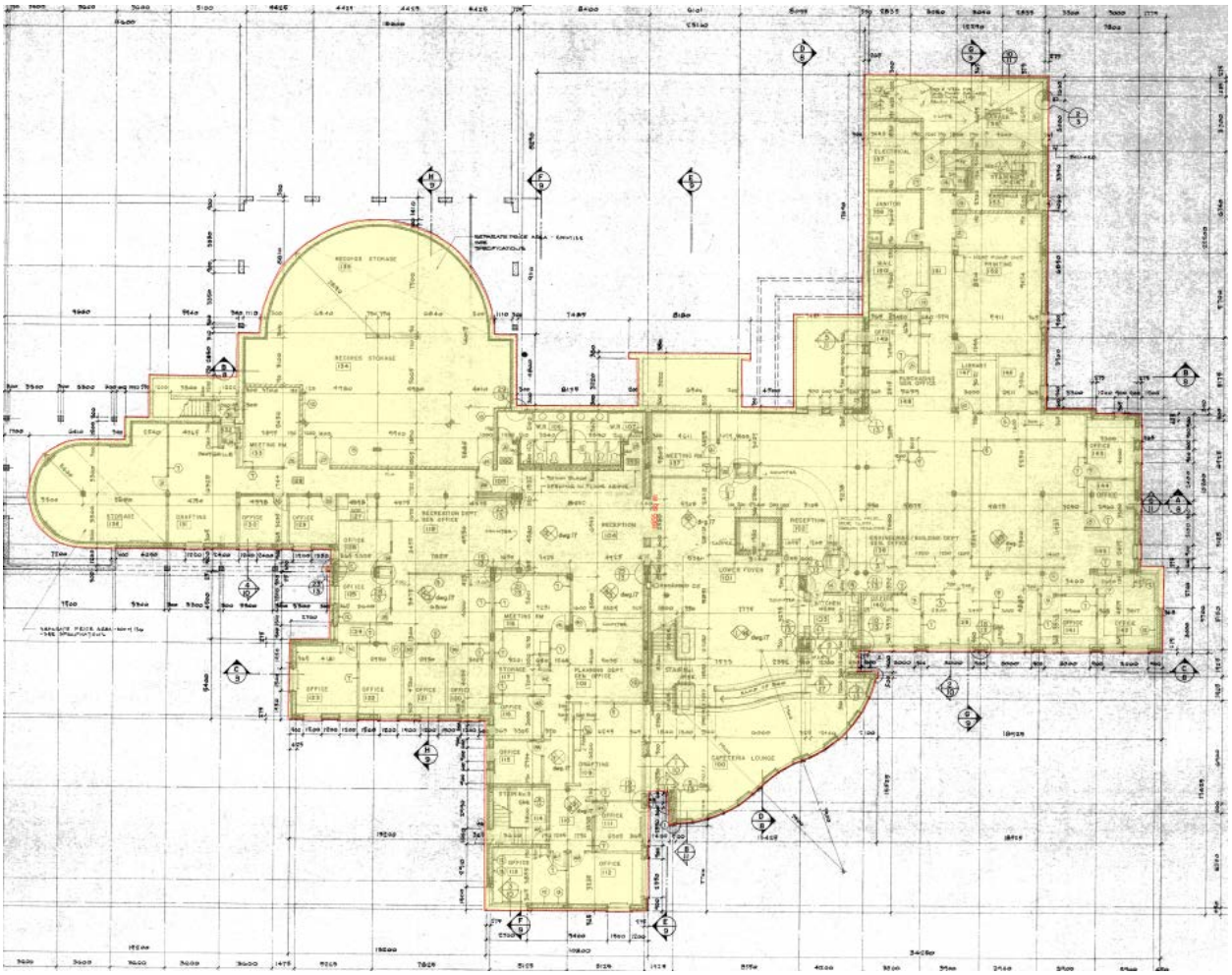
- Harmonized Sales Tax (HST)
- Project soft costs such as consultant's fees, land acquisition charges, legal fees etc.
- Accelerated or prolonged construction schedule.
- Sole sourced equipment or systems.
- Site development or site servicing works.
- Asbestos abatement.
- Photocopiers, water fountains, data/server racks etc.
- COID 19 implications.

6. BUILDING AREA

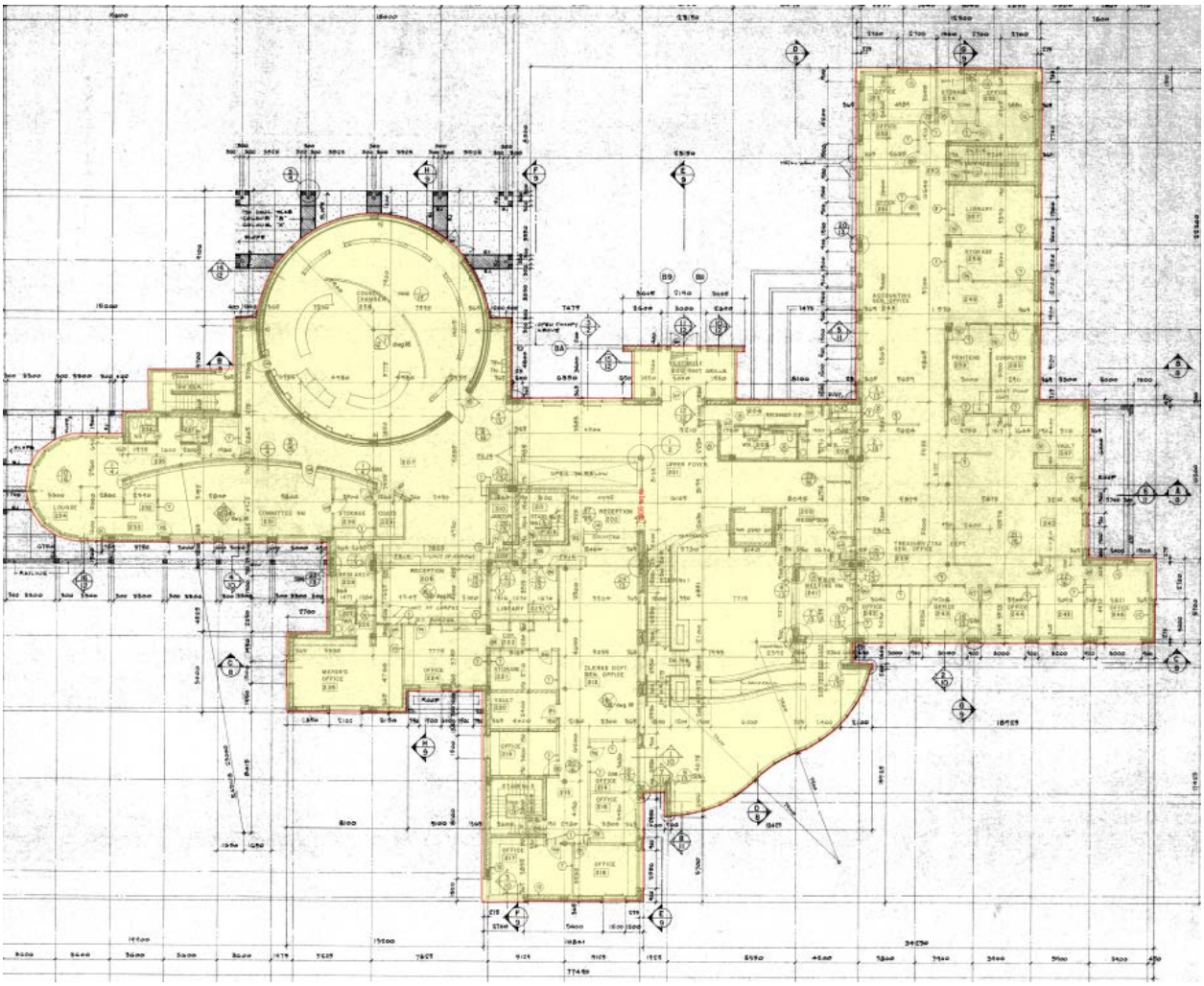
The following usable floor area of construction has been noted from RFP documents .The area is reported for general information for unit cost reference and reporting purpose only.

6.1 Summary of Usable Floor Area

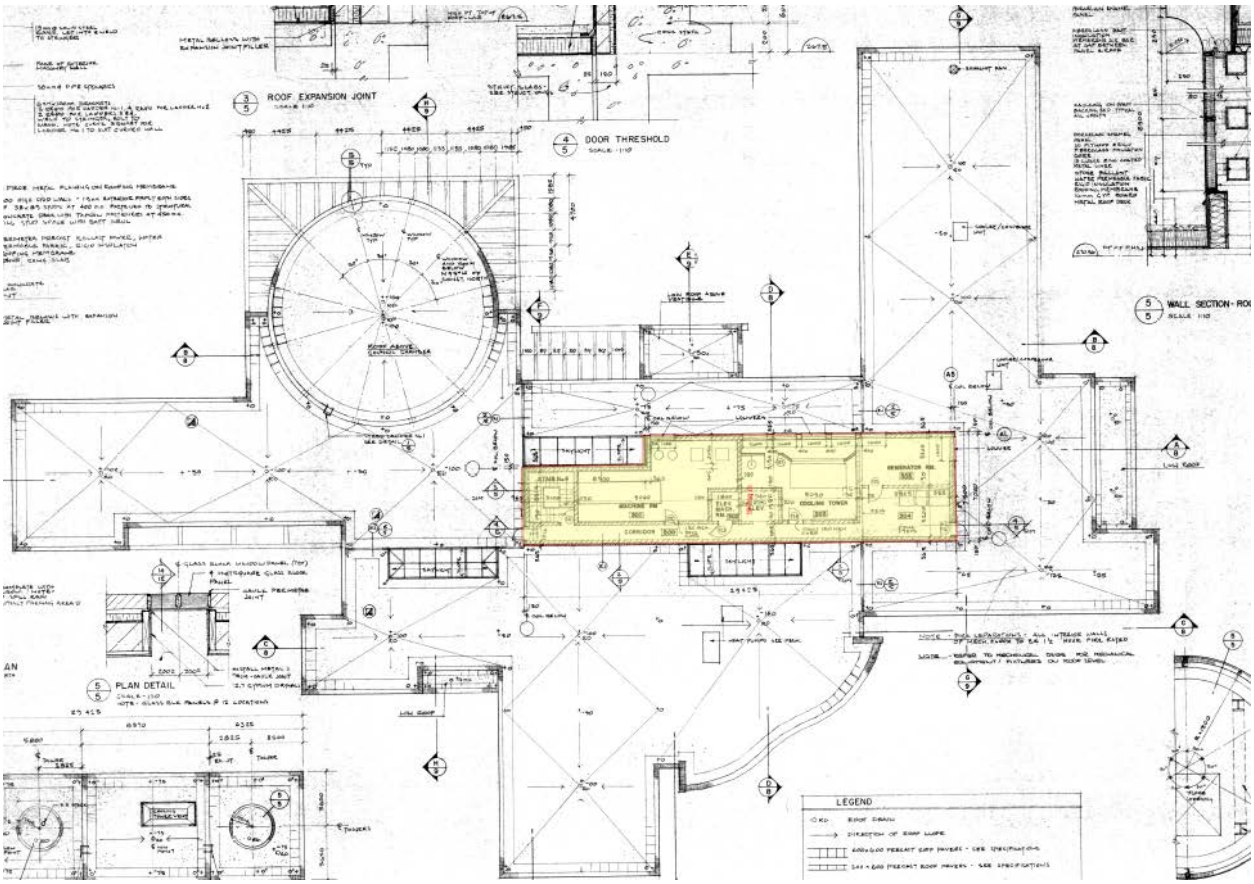
GROSS FLOOR AREA		
Area Description	**Floor Elevation**	**Usable Floor Area (m2)**
Ground Floor	NA	1,954.89
Second Floor	NA	1,906.35
Mechanical Penthouse	NA	197.05
Total Usable Floor Area (m2)		**4,058.00 (Rounded)**



LOWER FLOOR



UPPER FLOOR



MECHANICAL PENTHOUSE

Project # 20021
Town Hall - Halton Hills
Class "C" Cost Estimate
August 17, 2020

Alpha Cost Consultants Inc.

PATHWAY SUMMARY	GFA	4,058 m2

PATHWAY - DESCRIPTION	TOTAL COST	UNIT COST / M2
Pathway 1 - Optimize Existing Building System	$3,220,900.00	$793.72
Pathway 2 - Geothermal System Retrofit	$3,559,200.00	$877.08
Pathway 3 - Variable Refrigerant Flow System - Air source System Retrofit	$3,311,500.00	$816.04
Pathway 4 - Variable Refrigerant Flow System Water Source- Geothermal System Retrofit	$3,815,100.00	$940.14
Total Hard Construction Cost	**As Above**	

Project # 20021
Town Hall, Halton Hills Pathway 1
Class "C" Cost Estimate
August 17, 2020

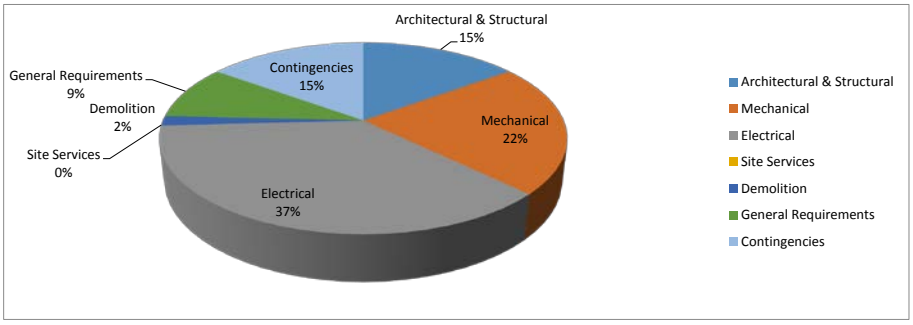
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$102.02		$413,990.00	12.85%
	A3.3- Windows & Entrances		$102.02	$413,990.00		
B	**Interiors**					
	B2 Finishes	4,058	$10.55		$42,794.00	1.33%
	B2.2 - Ceiling Finishes		$10.55	$42,794.00		
C	**Services:**					
	C1 Mechanical	4,058	$176.47		$716,100.00	22.23%
	C11 Plumbing & Drainage		$5.35	$21,700.00		
	C13 HVAC		$82.95	$336,600.00		
	C14 Controls		$88.17	$357,800.00		
	C2 Electrical	4,058	$293.20		$1,189,825.00	36.94%
	C21 Service & Distribution		$182.36	$740,000.00		
	C22 Lighting, Devices & Heating		$110.85	$449,825.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$13.00		$52,750.00	1.64%
	D21 Demolition		$6.90	$28,000.00		
	D22 Alterations		$6.10	$24,750.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$72.92		$295,900.00	9.19%
	Z11 General Requirements		$43.89	$178,100.00		
	Z12 Fees		$29.03	$117,800.00		
	Z2 Allowances	4,058	$119.37		$484,400.00	15.04%
	Z21 Design Allowances		$47.22	$191,600.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$72.15	$292,800.00		
	Total Hard Construction Cost		**$793.72**		**$3,220,900.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Pathway 1
Class "C" Cost Estimate
August 17, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY						GROSS FLOOR AREA	4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$413,990.00**	**$102.02**	**12.85%**
A3.3	- Windows & Entrances	0.08	318	m2	$1,302.78	$413,990.00		$102.02	
B2	**Finishes**						**$42,794.00**	**$10.55**	**1.33%**
B2.2	- Ceiling Finishes	0.71	2,892	m2	0	$42,794.00		$10.55	
B3	**Fittings & Equipment**						**$25,150.00**	**$6.20**	**0.78%**
B3.2	- Equipment	1.00	4,058	m2	$6.20	$25,150.00		$6.20	
C	**Services:**								
C1	**Mechanical**						**$716,100.00**	**$176.47**	**22.23%**
C11	- Plumbing & Drainage	1.00	4,058	m2	$5.35	$21,700.00		$5.35	
C13	- HVAC	1.00	4,058	m2	$82.95	$336,600.00		$82.95	
C14	- Controls	1.00	4,058	m2	$88.17	$357,800.00		$88.17	
C2	**Electrical**						**$1,189,825.00**	**$293.20**	**36.94%**
C21	- Service & Distribution	1.00	4,058	m2	$182.36	$740,000.00		$182.36	
C22	- Lighting, Devices & Heating	1.00	4,058	m2	$110.85	$449,825.00		$110.85	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$52,750.00**	**$13.00**	**1.64%**
D21	- Demolition	1.00	4,058	m2	$6.90	$28,000.00		$6.90	
D22	- Alterations	1.00	4,058	m2	$6.10	$24,750.00		$6.10	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$295,900.00**	**$72.92**	**9.19%**
Z11	- General Requirements	1.00	4,058	m2	$43.89	$178,100.00		$43.89	
Z12	- Fees	1.00	4,058	m2	$29.03	$117,800.00		$29.03	
Z2	**Allowances**						**$484,400.00**	**$119.37**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$47.22	$191,600.00		$47.22	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$72.15	$292,800.00		$72.15	
					Total Hard Construction Cost		**$3,220,900.00**	**$793.72**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$413,990.00**
1	Replace all existing windows c/w new insulated glass units (IGU) as follows:					
2	Northwest - Triple pane, fibre glass, U value 0.80					
2.1	- "Window # 2" - 900 x 1600 mm	1	NO	$1,260.00	$1,260.00	
2.2	- "Window # 3" - 1400 x 2200 mm	5	NO	$2,695.00	$13,475.00	
2.3	- "Window # 4 - 1400 x 2210 mm	5	NO	$2,707.25	$13,536.25	
2.4	- "Window # 6" - 1425 x 6210 mm	1	NO	$7,743.09	$7,743.09	
2.5	- "Window # 7" - 2325 x 2200 mm	2	NO	$4,475.63	$8,951.25	
2.6	- "Window # 8" - 1500 x 1600 mm	1	NO	$2,100.00	$2,100.00	
3	Southeast - Double pane, aluminium frame, U value 2.15					
3.1	- "Window # 1" - 1200 x 1600 mm	7	NO	$1,584.00	$11,088.00	
3.2	- "Window # 3" - 1400 x 2200 mm	2	NO	$2,541.00	$5,082.00	
3.3	- "Window # 5 - 3000 x 2200 mm	3	NO	$5,445.00	$16,335.00	
3.4	- "Window # 8" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.5	- "Window # 9" - 2100 x 2200 mm	1	NO	$3,811.50	$3,811.50	
3.6	- "Window # 10" - 2445 x 5160 mm	1	NO	$10,387.08	$10,387.08	
3.7	- "Window # 11" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.8	- "Window # 12" - 3000 x 2810 mm	10	NO	$6,954.75	$69,547.50	
4	Northeast - Triple pane, fibre glass, U value 0.80					
4.1	- "Window # 2" - 900 x 1600 mm	6	NO	$1,260.00	$7,560.00	
4.2	- "Window # 8" - 1500 x 1600 mm	5	NO	$2,100.00	$10,500.00	
4.3	- "Window # 13" - 645 x 2200 mm	1	NO	$1,241.63	$1,241.63	
4.4	- "Window # 15" - 2550 x 2810 mm	4	NO	$6,269.81	$25,079.25	
4.5	- "Window # 16" - 2325 x 6210 mm	1	NO	$12,633.47	$12,633.47	
5	Southwest - Double pane, aluminium frame, U value 2.15					
5.1	- "Window # 1" - 1200 x 1600 mm	1	NO	$1,584.00	$1,584.00	
5.2	- "Window # 2" - 900 x 1600 mm	4	NO	$1,188.00	$4,752.00	
5.3	- "Window # 3" - 1400 x 2200 mm	6	NO	$2,541.00	$15,246.00	
5.4	- "Window # 8" - 1500 x 1600 mm	6	NO	$1,980.00	$11,880.00	
5.5	- "Window # 13" - 645 x 2200 mm	1	NO	$1,170.68	$1,170.68	
5.6	- "Window # 14" - 1125 x 5610 mm	1	NO	$5,206.78	$5,206.78	
6	Caulking/ sealing etc.	1	LS	$13,400.00	$13,400.00	
7	Allowance for new window sills	1	LS	$5,000.00	$5,000.00	
	A3.32 - Glazed Screens					
8	Curtainwall at Cafeteria at southeast c/w triple pane, fibre glass framing and U -Value of 0.80	150	m2	$850.00	$127,500.00	
	Total Cost - WINDOWS & ENTRANCES	**318**	**m2**	**$1,302.78**	**$413,990.00**	
	B2.1 Finishes					
	B2.21 - Ceiling Finishes					**$42,794.00**
9	Minor repairs to drywall ceiling c/w patching and make finishes good after light fixtures installation	1,166	m2	$15.00	$17,490.00	
10	Minor removal / repair to acoustic ceiling c/w replacement of damages tiles after installation of new light fixtures	1,152	m2	$12.00	$13,824.00	
11	Repair to wood grille ceiling in selective areas after inst	574	m2	$20.00	$11,480.00	
	Total For - CEILING FINISHES	**2,892.00**	**m2**	**$14.80**	**$42,794.00**	
	B3.2 Equipment					
	B3.21 - Equipment					**$25,150.00**
12	Appliances will be replaced with new EnergyStar rates as follows:					
12.1	- Vending machines	2	NO	$1,800.00	$3,600.00	
12.2	- Display fridge	1	NO	$3,000.00	$3,000.00	
12.3	- Freezer	1	NO	$2,000.00	$2,000.00	
12.4	- Dishwasher	1	NO	$1,500.00	$1,500.00	

12.5	- Refrigerator	10	NO	$1,000.00	$10,000.00	
12.6	- Stove	1	NO	$2,000.00	$2,000.00	
12.7	- Convection oven	1	NO	$2,200.00	$2,200.00	
13	Disconnect and dispose off existing appliances	1	LS	$850.00	$850.00	
14	Photocopiers/ water fountains etc. - By others				Excluded	
	Total For - EQUIPMENT	**4,058**	**m2**	**$6.20**	**$25,150.00**	

C1 MECHANICAL

C1.11 PLUMBING & DRAINAGE

	C1.11 - Plumbing Equipment					**$17,500.00**
15	Replace existing domestic hot water heater "HWT-1 & 2" with new condensing water heater c/w hook up - 100 US Gallons capacity	1	NO	$17,500.00	$17,500.00	
	C1.16 Natural Gas					**$1,600.00**
16	Existing gas services will be reconnected to new HVAC equipment as below:					
17	Hook-up connections:					
17.1	- Domestic hot water heater	1	NO	$350.00	$350.00	
17.2	- Boilers	2	NO	$350.00	$700.00	
17.3	- Make up air unit	1	NO	$550.00	$550.00	
	C1.17 Other Plumbing Systems:					
	C1.17.1 - Demolition					**$300.00**
18	Disconnect, remove and dispose off existing domestic hot water heater	1	NO	$300.00	$300.00	
	C1.18 General Accounts					**$2,300.00**
19	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$2,300.00	$2,300.00	
	TOTAL FOR - PLUMBING & DRAINAGE	**4,058**	**m2**	**$5.35**	**$21,700.00**	

C1.2 FIRE PROTECTION

20	No work anticipated				Excluded	
	TOTAL FOR - FIRE PROTECTION	**4,058**	**m2**		**$0.00**	

C1.3 HVAC

	C1.31 Heat Generation & Transfer					**$54,900.00**
21	Replace existing heating boilers with new natural gas fired boiler "B1", condensing type, high efficiency 95% c/w operating safety & controls - 525 MBH each	2	NO	$20,000.00	$40,000.00	
22	Flue vent - chimney, stainless steel	2	NO	$2,000.00	$4,000.00	
23	Boiler circulator	2	NO	$1,200.00	$2,400.00	
24	Reconnect existing hot water heating distribution mains c/w existing pumps and piping	1	LS	$3,500.00	$3,500.00	
25	Hook-up connections:					
25.1	- Boiler	2	NO	$1,500.00	$3,000.00	
25.2	- Boiler circulator	2	NO	$1,000.00	$2,000.00	

	C1.32 Cooling Generation & Transfer					**$166,400.00**
26	Replace all existing water source heat pump units with high efficiency units c/w hook up connections (average capacity 2.5 Tons each)	52	NO	$3,200.00	$166,400.00	
	C1.33 Air Distribution and Devices					**$52,300.00**
27	Replace existing make up air unit with new high efficiency condensing unit min. thermal efficiency 90%, gas fired c/w supply air fan, filters, VFD, roof curb and operating safety & controls - 4,600 CFM capacity	1	NO	$39,100.00	$39,100.00	
28	Millwrighting / hoisting for MUA installation	1	NO	$2,000.00	$2,000.00	
29	Galvanized steel sheet metal ductwork as per SMACNA standards of gauges of construction for intake air duct and connection to existing duct mains	200	kg	$18.50	$3,700.00	
30	Provide new ERV with existing building exhaust EF-3 & EF-4 (1500 CFM) each	1	NO	$7,500.00	$7,500.00	
	C1.35 Noise and Vibration Systems					**$0.00**
31	Noise and vibration isolation is included with equipment costs above				Included	
	C1.36 Testing, Balancing and Commissioning					**$14,500.00**
32	Balancing					
33	Adjust, set and balance air & fluid flow rates to meet design criteria. Submit balancing reports	1	NO	$14,500.00	$14,500.00	
34	Commissioning					
35	Factory testing, start -up and demonstration is included with equipment rates				Included	
	C1.37 Other HVAC Systems:					
	C1.37.1 Demolition					**$12,400.00**
36	Disconnect, remove and dispose off existing hot water heating boilers & flue vents etc.	2	NO	$1,000.00	$2,000.00	
37	Disconnect, remove and dispose off existing heat pump units	52	NO	$200.00	$10,400.00	
	C1.38 General Accounts					**$36,100.00**
38	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$36,100.00	$36,100.00	
	TOTAL FOR - HVAC	**4,058**	**m2**	**$82.95**	**$336,600.00**	
	1.4 CONTROLS					
	C1.41 Controls Equipment					**$357,800.00**
39	Provide new DDC based building automation and controls c/w central work station, field devices (zone valves, dampers, sensors/ thermostats), wiring as follows:					
39.1	- Central plant monitoring and control	1	NO	$31,800.00	$31,800.00	
39.2	- Heat pump hydronic loop monitoring & control	1	LS	$3,000.00	$3,000.00	
39.3	- Heat pump controls	52	NO	$3,600.00	$187,200.00	
39.4	- Lighting control	1	LS	$25,000.00	$25,000.00	
39.6	- BAS points (electric baseboard / outdoor ar sensors etc)	40	NO	$1,500.00	$60,000.00	
39.7	- Occupancy sensors	27	NO	$1,200.00	$32,400.00	
40	Disconnect, remove and dispose off existing controls	1	LS	$18,400.00	$18,400.00	

	C1.43 General Accounts				**$0.00**
41	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P - Included in above rates			Included	
	TOTAL FOR - CONTROLS	**4,058 m2**		**$88.17**	**$357,800.00**
	C2 ELECTRICAL				
	C2.1 SERVICES & DISTRIBUTION				
	C2.11 - Main Service / Distribution				**$734,500.00**
42	Integrate new carport PV system to main electrical panel c/w transformer, hydro meter and accessories	1 LS	$10,000.00	$10,000.00	
43	Car port c/w photo voltaic system equal to "Ecohive" c/w:				
43.1	- Foundation/ helical piles	1 LS	$724,500.00	$724,500.00	
43.2	- 20 spots carports	3 NO		Included	
43.3	- Solar carport structure, galvanized steel c/w posts / solar panel supports	1 NO		Included	
43.4	- Solar panels to produce 196.6 KW	504 NO		Included	
43.5	- Strings/ circuit combiner/	10 NO		Included	
43.6	- ESA certification			Included	
	C2.14 - Motor Controls & Wiring				**$5,500.00**
44	Power connections c/w wiring and conduit :				
44.1	- Domestic water heater	1 NO	$200.00	$200.00	
44.2	- Appliances will be reconnected to existing circuits - included in appliances cost			Included	
44.3					
44.4	Load side wiring c/w disconnect switches :				
44.5	- Boilers & circulators	2 NO	$1,400.00	$2,800.00	
44.6	- MUA - weatherproof disconnect switch	1 NO	$2,000.00	$2,000.00	
44.7	- ERV	1 NO	$500.00	$500.00	
	TOTAL FOR - SERVICES & DISTRIBUTION	**4,058 m2**	**$182.36**	**$740,000.00**	
	C2.2 Lights, Devices & Heating				
	C2.21 - Lighting				**$449,825.00**
45	Replace existing light fixtures with new LED type as follows (based on equivalent to existing light fixtures)				
46	Type "A" - 150 mm Diameter Downlight	107 NO	$350.00	$37,450.00	
47	Type "B" - 178 mm Square Downlight	154 NO	$350.00	$53,900.00	
48	Type "C" - 112 mm Diameter Downlight	28 NO	$325.00	$9,100.00	
49	Type "D" - 125 mm Diameter White Cylinder	72 NO	$400.00	$28,800.00	
50	Type "E" light troffers - 200 round glass opal	38 NO	$200.00	$7,600.00	
51	Type "F" - 660x1283 frameless acrylic white diffuser	33 NO	$400.00	$13,200.00	
52	Type "F1" - 1200x600 c/w framed k12 acrylic lens	44 NO	$300.00	$13,200.00	
53	Type "F2" - 1200x300	26 NO	$300.00	$7,800.00	
54	Type "F3" - 1200 long c/w 12x13x14 cube louver	8 NO	$300.00	$2,400.00	
55	Type "F4" - 1200 long c/w 12x13x13 cube louver	14 NO	$300.00	$4,200.00	
56	Type "F5" - 1200 long strip	338 NO	$350.00	$118,300.00	
57	Type "F6" - 1200 long strip	18 NO	$350.00	$6,300.00	
58	Type "F7" - 2400 long tandem strip	7 NO	$450.00	$3,150.00	
59	Type "F8" - 1200 long strip c/w dimming ballast	78 NO	$400.00	$31,200.00	
60	Type "F11" - 1200 long strip c/w wire guard	22 NO	$400.00	$8,800.00	
61	Type "F12" - 2400 long tandem c/w wire guard	6 NO	$450.00	$2,700.00	

62	Type "G" - lamp holders on 300 centers	1	NO	$350.00	$350.00	
63	Type "G1" - 115 square chrome lamp holder	3	NO	$250.00	$750.00	
64	Type "H" - 280 round opal lexan white diffuser	9	NO	$450.00	$4,050.00	
65	Type "J" - Opal glass cylinder with white aluminum disc	1	NO	$400.00	$400.00	
66	Type "K" - Adjustable low voltage spotlight	8	NO	$200.00	$1,600.00	
67	Type "L" - 105 diameter downlight	11	NO	$325.00	$3,575.00	
68	Type "M" - adjustable uplighting floor square	5	NO	$350.00	$1,750.00	
69	Type "N" - 2-200 1/8 ball shaped uplight segments	2	NO	$400.00	$800.00	
70	Type "O4" - Planter light buried quartz lamp	3	NO	$250.00	$750.00	
71	Type "O6" - Sign light metal halide	5	NO	$150.00	$750.00	
72	Type "O7" - Sign light metal halide	3	NO	$150.00	$450.00	
73	Type "O9" - downlight c/w milligroove baffle	7	NO	$350.00	$2,450.00	
74	Type "O10" - 200 square bevelled clear volcanic glass	6	NO	$300.00	$1,800.00	
75	Type "O11" - 400x410 wall floodlight	1	NO	$250.00	$250.00	
76	Type "R" - square downlight	62	NO	$350.00	$21,700.00	
77	Type "T1" - lite capsule track lite	5	NO	$250.00	$1,250.00	
78	Type "V"- enclosed vaportight lampholder	7	NO	$350.00	$2,450.00	
79	Wiring, conduits and connection with existing circuit is included in above rates				Included	
80	Demolition					
81	Disconnect, remove and disposal of light fixtures	1132	NO	$50.00	$56,600.00	
	TOTAL FOR - LIGHT, DEVICES & HEATING	**4,058**	**m2**	**$110.85**	**$449,825.00**	

D SITE & ANCILLARY WORK

D2.1 - ANCILLARY WORK

D2.11 - Demolition **$28,000.00**

82	Remove existing window c/w supports and disposal	79	NO	$250.00	$19,750.00	
83	Remove existing curtainwall assembly at Cafeteria	150	m2	$55.00	$8,250.00	

D2.12 - Hazardous Material **$0.00**

84	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$6.90**	**$28,000.00**	

D2.2 - ALTERATIONS

D2.21 - Alterations **$24,750.00**

85	Rework on existing window openings to install new windows	79	NO	$250.00	$19,750.00	
86	New curtainwall connections with existing walls	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$6.10**	**$24,750.00**	

Z GENERAL REQUIREMENTS & ALLOWANCES

Z1.1 - GENERAL REQUIREMENTS

	Z1.11 - Supervision & Labour Expenses				**$134,200.00**
87	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1 LS	$134,200.00	$134,200.00	
	Z1.12 - Temporary Conditions				**$0.00**
88	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$43,900.00**
89	Permits by Owner			Excluded	
90	General liability and builders risk coverage	1 LS	$19,500.00	$19,500.00	
91	Labour & material performance bond	1 LS	$24,400.00	$24,400.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$178,100.00**	

Z1.2 - FEES

	Z1.11 - General Contractor Fees				**$117,800.00**
92	Contractor fees for overhead & profit - 4.5%	1 LS	$117,800.00	$117,800.00	
	TOTAL FOR - FEES	**1 LS**		**$117,800.00**	

Z2.1 - ALLOWANCES

	Z2.11 - Design Allowances				**$191,600.00**
93	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$191,600.00	$191,600.00	
	Z2.21 - Escalation Allowances				**$0.00**
94	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$292,800.00**
95	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$292,800.00	$292,800.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$484,400.00**	

Project # 20021
Town Hall, Halton Hills Pathway 2
Class "C" Cost Estimate
August 17, 2020

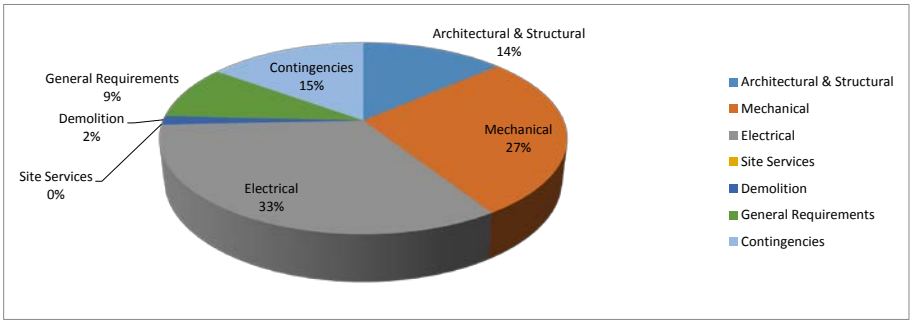
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$102.02		$413,990.00	11.63%
	A3.3- Windows & Entrances		$102.02	$413,990.00		
B	**Interiors**					
	B2 Finishes	4,058	$10.55		$42,794.00	1.20%
	B2.2 - Ceiling Finishes		$10.55	$42,794.00		
C	**Services:**					
	C1 Mechanical	4,058	$240.04		$974,100.00	27.37%
	C11 Plumbing & Drainage		$3.40	$13,800.00		
	C13 HVAC		$146.01	$592,500.00		
	C14 Controls		$90.64	$367,800.00		
	C2 Electrical	4,058	$292.76		$1,188,025.00	33.38%
	C21 Service & Distribution		$181.91	$738,200.00		
	C22 Lighting, Devices & Heating		$110.85	$449,825.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$13.00		$52,750.00	1.48%
	D21 Demolition		$6.90	$28,000.00		
	D22 Alterations		$6.10	$24,750.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$80.61		$327,100.00	9.19%
	Z11 General Requirements		$48.52	$196,900.00		
	Z12 Fees		$32.08	$130,200.00		
	Z2 Allowances	4,058	$131.91		$535,300.00	15.04%
	Z21 Design Allowances		$52.17	$211,700.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$79.74	$323,600.00		
	Total Hard Construction Cost		**$877.08**		**$3,559,200.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Pathway 2
Class "C" Cost Estimate
August 17, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY			GROSS FLOOR AREA				4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$413,990.00**	**$102.02**	**11.63%**
A3.3	- Windows & Entrances	0.08	318	m2	$1,302.78	$413,990.00		$102.02	
B2	**Finishes**						**$42,794.00**	**$10.55**	**1.20%**
B2.2	- Ceiling Finishes	0.71	2,892	m2	0	$42,794.00		$10.55	
B3	**Fittings & Equipment**						**$25,150.00**	**$6.20**	**0.71%**
B3.2	- Equipment	1.00	4,058	m2	$6.20	$25,150.00		$6.20	
C	**Services:**								
C1	**Mechanical**						**$974,100.00**	**$240.04**	**27.37%**
C11	- Plumbing & Drainage	1.00	4,058	m2	$3.40	$13,800.00		$3.40	
C13	- HVAC	1.00	4,058	m2	$146.01	$592,500.00		$146.01	
C14	- Controls	1.00	4,058	m2	$90.64	$367,800.00		$90.64	
C2	**Electrical**						**$1,188,025.00**	**$292.76**	**33.38%**
C21	- Service & Distribution	1.00	4,058	m2	$181.91	$738,200.00		$181.91	
C22	- Lighting, Devices & Heating	1.00	4,058	m2	$110.85	$449,825.00		$110.85	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$52,750.00**	**$13.00**	**1.48%**
D21	- Demolition	1.00	4,058	m2	$6.90	$28,000.00		$6.90	
D22	- Alterations	1.00	4,058	m2	$6.10	$24,750.00		$6.10	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$327,100.00**	**$80.61**	**9.19%**
Z11	- General Requirements	1.00	4,058	m2	$48.52	$196,900.00		$48.52	
Z12	- Fees	1.00	4,058	m2	$32.08	$130,200.00		$32.08	
Z2	**Allowances**						**$535,300.00**	**$131.91**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$52.17	$211,700.00		$52.17	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$79.74	$323,600.00		$79.74	
					Total Hard Construction Cost		**$3,559,200.00**	**$877.08**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$413,990.00**
1	Replace all existing windows c/w new insulated glass units (IGU) as follows:					
2	Northwest - Triple pane, fibre glass, U value 0.80					
2.1	- "Window # 2" - 900 x 1600 mm	1	NO	$1,260.00	$1,260.00	
2.2	- "Window # 3" - 1400 x 2200 mm	5	NO	$2,695.00	$13,475.00	
2.3	- "Window # 4 - 1400 x 2210 mm	5	NO	$2,707.25	$13,536.25	
2.4	- "Window # 6" - 1425 x 6210 mm	1	NO	$7,743.09	$7,743.09	
2.5	- "Window # 7" - 2325 x 2200 mm	2	NO	$4,475.63	$8,951.25	
2.6	- "Window # 8" - 1500 x 1600 mm	1	NO	$2,100.00	$2,100.00	
3	Southeast - Double pane, aluminium frame, U value 2.15					
3.1	- "Window # 1" - 1200 x 1600 mm	7	NO	$1,584.00	$11,088.00	
3.2	- "Window # 3" - 1400 x 2200 mm	2	NO	$2,541.00	$5,082.00	
3.3	- "Window # 5 - 3000 x 2200 mm	3	NO	$5,445.00	$16,335.00	
3.4	- "Window # 8" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.5	- "Window # 9" - 2100 x 2200 mm	1	NO	$3,811.50	$3,811.50	
3.6	- "Window # 10" - 2445 x 5160 mm	1	NO	$10,387.08	$10,387.08	
3.7	- "Window # 11" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.8	- "Window # 12" - 3000 x 2810 mm	10	NO	$6,954.75	$69,547.50	
4	Northeast - Triple pane, fibre glass, U value 0.80					
4.1	- "Window # 2" - 900 x 1600 mm	6	NO	$1,260.00	$7,560.00	
4.2	- "Window # 8" - 1500 x 1600 mm	5	NO	$2,100.00	$10,500.00	
4.3	- "Window # 13" - 645 x 2200 mm	1	NO	$1,241.63	$1,241.63	
4.4	- "Window # 15" - 2550 x 2810 mm	4	NO	$6,269.81	$25,079.25	
4.5	- "Window # 16" - 2325 x 6210 mm	1	NO	$12,633.47	$12,633.47	
5	Southwest - Double pane, aluminium frame, U value 2.15					
5.1	- "Window # 1" - 1200 x 1600 mm	1	NO	$1,584.00	$1,584.00	
5.2	- "Window # 2" - 900 x 1600 mm	4	NO	$1,188.00	$4,752.00	
5.3	- "Window # 3" - 1400 x 2200 mm	6	NO	$2,541.00	$15,246.00	
5.4	- "Window # 8" - 1500 x 1600 mm	6	NO	$1,980.00	$11,880.00	
5.5	- "Window # 13" - 645 x 2200 mm	1	NO	$1,170.68	$1,170.68	
5.6	- "Window # 14" - 1125 x 5610 mm	1	NO	$5,206.78	$5,206.78	
6	Caulking/ sealing etc.	1	LS	$13,400.00	$13,400.00	
7	Allowance for new window sills	1	LS	$5,000.00	$5,000.00	
	A3.32 - Glazed Screens					
8	Curtainwall at Cafeteria at southeast c/w triple pane, fibre glass framing and U -Value of 0.80	150	m2	$850.00	$127,500.00	
	Total Cost - WINDOWS & ENTRANCES	**318**	**m2**	**$1,302.78**	**$413,990.00**	
	B2.1 Finishes					
	B2.21 - Ceiling Finishes					**$42,794.00**
9	Minor repairs to drywall ceiling c/w patching and make finishes good after light fixtures installation	1,166	m2	$15.00	$17,490.00	
10	Minor removal / repair to acoustic ceiling c/w replacement of damages tiles after installation of new light fixtures	1,152	m2	$12.00	$13,824.00	
11	Repair to wood grille ceiling in selective areas after inst	574	m2	$20.00	$11,480.00	
	Total For - CEILING FINISHES	**2,892.00**	**m2**	**$14.80**	**$42,794.00**	
	B3.2 Equipment					
	B3.21 - Equipment					**$25,150.00**
12	Appliances will be replaced with new EnergyStar rates as follows:					
12.1	- Vending machines	2	NO	$1,800.00	$3,600.00	
12.2	- Display fridge	1	NO	$3,000.00	$3,000.00	
12.3	- Freezer	1	NO	$2,000.00	$2,000.00	
12.4	- Dishwasher	1	NO	$1,500.00	$1,500.00	

12.5	- Refrigerator	10	NO	$1,000.00	$10,000.00	
12.6	- Stove	1	NO	$2,000.00	$2,000.00	
12.7	- Convection oven	1	NO	$2,200.00	$2,200.00	
13	Disconnect and dispose off existing appliances	1	LS	$850.00	$850.00	
14	Photocopiers/ water fountains etc. - By others				Excluded	
	Total For - EQUIPMENT	**4,058**	**m2**	**$6.20**	**$25,150.00**	

C1 MECHANICAL

C1.11 PLUMBING & DRAINAGE

C1.11 - Plumbing Equipment **$12,000.00**

15	Replace existing domestic hot water heater "HWT-1" with new electric hybrid water heater c/w hook up - 100 US Gallons capacity	1	NO	$12,000.00	$12,000.00	

C1.16 Natural Gas **$0.00**

16	No work required				Costing Base	

C1.17 Other Plumbing Systems:

C1.17.1 - Demolition **$300.00**

17	Disconnect, remove and dispose off existing domestic hot water heater	1	NO	$300.00	$300.00	

C1.18 General Accounts **$1,500.00**

18	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$1,500.00	$1,500.00	
	TOTAL FOR - PLUMBING & DRAINAGE	**4,058**	**m2**	**$3.40**	**$13,800.00**	

C1.2 FIRE PROTECTION

19	No work anticipated				Excluded	
	TOTAL FOR - FIRE PROTECTION	**4,058**	**m2**		**$0.00**	

C1.3 HVAC

C1.31 Geo Thermal System **$330,000.00**

20	Geothermal Based Heating/ Heat rejection System as follows:					
21	Borewell c/w grouting, glycol loop piping, glycol solution - 250 feet deep each	50	NO	$6,500.00	$325,000.00	
22	Interconnection piping to existing heating/ cooling plant	1	LS	$5,000.00	$5,000.00	
23	Existing boilers and cooling tower will be retained for back up				Design base	

C1.32 Cooling Generation & Transfer **$166,400.00**

24	Replace all existing water source heat pump units with high efficiency units c/w hook up connections (average capacity 2.5 Tons each)	52	NO	$3,200.00	$166,400.00	

C1.33 Air Distribution and Devices **$43,100.00**

25	Replace existing make up air unit with water source heat pump unit "WSHP-1" c/w supply air fan, coils, filters, VFD, roof curb and operating safety & controls and hook up connections to heat pump loop - 4,600 CFM capacity	1	NO	$29,900.00	$29,900.00	
26	Millwrighting / hoisting for MUA installation	1	NO	$2,000.00	$2,000.00	
27	Galvanized steel sheet metal ductwork as per SMACNA standards of gauges of construction for intake air duct and connection to existing duct mains	200	kg	$18.50	$3,700.00	
28	Provide new ERV with existing building exhaust EF-3 & EF-4 (1500 CFM) each	1	NO	$7,500.00	$7,500.00	
	C1.35 Noise and Vibration Systems					**$0.00**
29	Noise and vibration isolation is included with equipment costs above				Included	
	C1.36 Testing, Balancing and Commissioning					**$14,500.00**
30	Balancing					
31	Adjust, set and balance air & fluid flow rates to meet design criteria. Submit balancing reports	1	NO	$14,500.00	$14,500.00	
32	Commissioning					
33	Factory testing, start -up and demonstration is included with equipment rates				Included	
	C1.37 Other HVAC Systems:					
	C1.37.1 Demolition					**$10,400.00**
34	Disconnect, remove and dispose off existing heat pump units	52	NO	$200.00	$10,400.00	
	C1.38 General Accounts					**$28,100.00**
35	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$28,100.00	$28,100.00	
	TOTAL FOR - HVAC	**4,058**	**m2**	**$146.01**	**$592,500.00**	
	1.4 CONTROLS					
	C1.41 Controls Equipment					**$367,800.00**
36	Provide new DDC based building automation and controls c/w central work station, field devices (zone valves, dampers, sensors/ thermostats), wiring as follows:					
36.1	- Central plant monitoring and control	1	NO	$31,800.00	$31,800.00	
36.2	- Heat pump hydronic loop monitoring & control	1	LS	$3,000.00	$3,000.00	
36.3	- Heat pump controls	52	NO	$3,600.00	$187,200.00	
36.4	- Lighting control	1	LS	$25,000.00	$25,000.00	
36.5	- Geothermal system	1	LS	$10,000.00	$10,000.00	
36.6	- BAS points (electric baseboard/ outdoor air sensors)	40	NO	$1,500.00	$60,000.00	
36.7	- Occupancy sensors	27	NO	$1,200.00	$32,400.00	
37	Disconnect, remove and dispose off existing controls	1	LS	$18,400.00	$18,400.00	
	C1.43 General Accounts					**$0.00**
38	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P - Included in above rates				Included	
	TOTAL FOR - CONTROLS	**4,058**	**m2**	**$90.64**	**$367,800.00**	

C2 ELECTRICAL

C2.1 SERVICES & DISTRIBUTION

C2.11 - Main Service / Distribution **$734,500.00**

39	Integrate new carport PV system to main electrical panel c/w transformer, hydro meter and accessories	1	LS	$10,000.00	$10,000.00	
40	Car port c/w photo voltaic system equal to "Ecohive" c/w:					
40.1	- Foundation/ helical piles	1	LS	$724,500.00	$724,500.00	
40.2	- 20 spots carports	3	NO		Included	
40.3	- Solar carport structure, galvanized steel c/w posts / solar panel supports	1	NO		Included	
40.4	- Solar panels to produce 196.6 KW	504	NO		Included	
40.5	- Strings/ circuit combiner/	10	NO		Included	
40.6	- ESA certification				Included	

C2.14 - Motor Controls & Wiring **$3,700.00**

41	Power connections c/w wiring and conduit :					
41.1	- Domestic water heater	1	NO	$200.00	$200.00	
41.2	- Appliances will be reconnected to existing circuits - included in appliances cost				Included	
42	Load side wiring c/w disconnect switches :					
42.1	- WSHP -1 - weatherproof disconnect switch	1	NO	$2,000.00	$2,000.00	
42.2	- ERV	1	NO	$500.00	$500.00	
42.3	- Geothermal circulator/ manifold	1	NO	$1,000.00	$1,000.00	

TOTAL FOR - SERVICES & DISTRIBUTION	**4,058**	**m2**	**$181.91**	**$738,200.00**	

C2.2 Lights, Devices & Heating

C2.21 - Lighting **$449,825.00**

43	Replace existing light fixtures with new LED type as follows (based on equivalent to existing light fixtures)					
44	Type "A" - 150 mm Diameter Downlight	107	NO	$350.00	$37,450.00	
45	Type "B" - 178 mm Square Downlight	154	NO	$350.00	$53,900.00	
46	Type "C" - 112 mm Diameter Downlight	28	NO	$325.00	$9,100.00	
47	Type "D" - 125 mm Diameter White Cylinder	72	NO	$400.00	$28,800.00	
48	Type "E" light troffers - 200 round glass opal	38	NO	$200.00	$7,600.00	
49	Type "F" - 660x1283 frameless acrylic white diffuser	33	NO	$400.00	$13,200.00	
50	Type "F1" - 1200x600 c/w framed k12 acrylic lens	44	NO	$300.00	$13,200.00	
51	Type "F2" - 1200x300	26	NO	$300.00	$7,800.00	
52	Type "F3" - 1200 long c/w 12x13x14 cube louver	8	NO	$300.00	$2,400.00	
53	Type "F4" - 1200 long c/w 12x13x13 cube louver	14	NO	$300.00	$4,200.00	
54	Type "F5" - 1200 long strip	338	NO	$350.00	$118,300.00	
55	Type "F6" - 1200 long strip	18	NO	$350.00	$6,300.00	
56	Type "F7" - 2400 long tandem strip	7	NO	$450.00	$3,150.00	
57	Type "F8" - 1200 long strip c/w dimming ballast	78	NO	$400.00	$31,200.00	
58	Type "F11" - 1200 long strip c/w wire guard	22	NO	$400.00	$8,800.00	
59	Type "F12" - 2400 long tandem c/w wire guard	6	NO	$450.00	$2,700.00	
60	Type "G" - lamp holders on 300 centers	1	NO	$350.00	$350.00	
61	Type "G1" - 115 square chrome lamp holder	3	NO	$250.00	$750.00	
62	Type "H" - 280 round opal lexan white diffuser	9	NO	$450.00	$4,050.00	
63	Type "J" - Opal glass cylinder with white aluminum disc	1	NO	$400.00	$400.00	
64	Type "K" - Adjustable low voltage spotlight	8	NO	$200.00	$1,600.00	

65	Type "L" - 105 diameter downlight	11	NO	$325.00	$3,575.00	
66	Type "M" - adjustable uplighting floor square	5	NO	$350.00	$1,750.00	
67	Type "N" - 2-200 1/8 ball shaped uplight segments	2	NO	$400.00	$800.00	
68	Type "O4" - Planter light buried quartz lamp	3	NO	$250.00	$750.00	
69	Type "O6" - Sign light metal halide	5	NO	$150.00	$750.00	
70	Type "O7" - Sign light metal halide	3	NO	$150.00	$450.00	
71	Type "O9" - downlight c/w milligroove baffle	7	NO	$350.00	$2,450.00	
72	Type "O10" - 200 square bevelled clear volcanic glass	6	NO	$300.00	$1,800.00	
73	Type "O11" - 400x410 wall floodlight	1	NO	$250.00	$250.00	
74	Type "R" - square downlight	62	NO	$350.00	$21,700.00	
75	Type "T1" - lite capsule track lite	5	NO	$250.00	$1,250.00	
76	Type "V" - enclosed vaportight lampholder	7	NO	$350.00	$2,450.00	
77	Wiring, conduits and connection with existing circuit is included in above rates				Included	
78	Demolition					
79	Disconnect, remove and disposal of light fixtures	1132	NO	$50.00	$56,600.00	
	TOTAL FOR - LIGHT, DEVICES & HEATING	**4,058**	**m2**	**$110.85**	**$449,825.00**	

D SITE & ANCILLARY WORK

D2.1 - ANCILLARY WORK

D2.11 - Demolition **$28,000.00**

80	Remove existing window c/w supports and disposal	79	NO	$250.00	$19,750.00	
81	Remove existing curtainwall assembly at Cafeteria	150	m2	$55.00	$8,250.00	

D2.12 - Hazardous Material **$0.00**

82	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$6.90**	**$28,000.00**	

D2.2 - ALTERATIONS

D2.21 - Alterations **$24,750.00**

83	Rework on existing window openings to install new windows	79	NO	$250.00	$19,750.00	
84	New curtainwall connections with existing walls	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$6.10**	**$24,750.00**	

Z GENERAL REQUIREMENTS & ALLOWANCES

Z1.1 - GENERAL REQUIREMENTS

Z1.11 - Supervision & Labour Expenses **$148,300.00**

85	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1	LS	$148,300.00	$148,300.00	

Z1.12 - Temporary Conditions **$0.00**

86	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$48,600.00**
87	Permits by Owner			Excluded	
88	General liability and builders risk coverage	1 LS	$21,600.00	$21,600.00	
89	Labour & material performance bond	1 LS	$27,000.00	$27,000.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$196,900.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$130,200.00**
90	Contractor fees for overhead & profit - 4.5%	1 LS	$130,200.00	$130,200.00	
	TOTAL FOR - FEES	**1 LS**		**$130,200.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$211,700.00**
91	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$211,700.00	$211,700.00	
	Z2.21 - Escalation Allowances				**$0.00**
92	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$323,600.00**
93	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$323,600.00	$323,600.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$535,300.00**	

Project # 20021
Town Hall, Halton Hills Pathway 3
Class "C" Cost Estimate
August 17, 2020

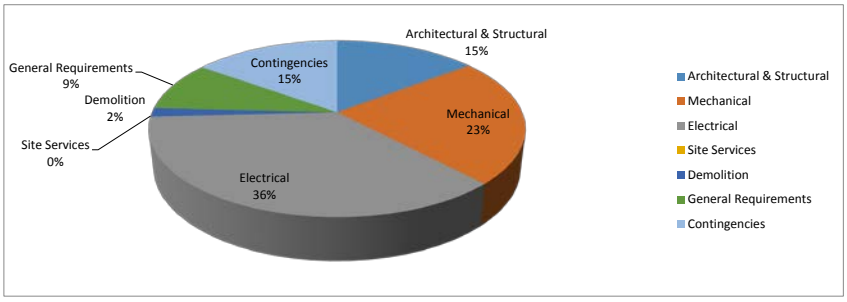
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$102.02		$413,990.00	12.50%
	A3.3- Windows & Entrances		$102.02	$413,990.00		
B	**Interiors**					
	B2 Finishes	4,058	$10.55		$42,794.00	1.29%
	B2.2 - Ceiling Finishes		$10.55	$42,794.00		
C	**Services:**					
	C1 Mechanical	4,058	$190.87		$774,545.00	23.39%
	C11 Plumbing & Drainage		$3.40	$13,800.00		
	C13 HVAC		$155.95	$632,845.00		
	C14 Controls		$31.52	$127,900.00		
	C2 Electrical	4,058	$295.69		$1,199,925.00	36.24%
	C21 Service & Distribution		$184.84	$750,100.00		
	C22 Lighting, Devices & Heating		$110.85	$449,825.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$13.00		$52,750.00	1.59%
	D21 Demolition		$6.90	$28,000.00		
	D22 Alterations		$6.10	$24,750.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$75.01		$304,400.00	9.19%
	Z11 General Requirements		$45.15	$183,200.00		
	Z12 Fees		$29.87	$121,200.00		
	Z2 Allowances	4,058	$122.70		$497,900.00	15.04%
	Z21 Design Allowances		$48.52	$196,900.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$74.17	$301,000.00		
	Total Hard Construction Cost		**$816.04**		**$3,311,500.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Pathway 3
Class "C" Cost Estimate
August 17, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY						GROSS FLOOR AREA	4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$413,990.00**	**$102.02**	**12.50%**
A3.3	- Windows & Entrances	0.08	318	m2	$1,302.78	$413,990.00		$102.02	
B2	**Finishes**						**$42,794.00**	**$10.55**	**1.29%**
B2.2	- Ceiling Finishes	0.71	2,892	m2	0	$42,794.00		$10.55	
B3	**Fittings & Equipment**						**$25,150.00**	**$6.20**	**0.76%**
B3.2	- Equipment	1.00	4,058	m2	$6.20	$25,150.00		$6.20	
C	**Services:**								
C1	**Mechanical**						**$774,545.00**	**$190.87**	**23.39%**
C11	- Plumbing & Drainage	1.00	4,058	m2	$3.40	$13,800.00		$3.40	
C13	- HVAC	1.00	4,058	m2	$155.95	$632,845.00		$155.95	
C14	- Controls	1.00	4,058	m2	$31.52	$127,900.00		$31.52	
C2	**Electrical**						**$1,199,925.00**	**$295.69**	**36.24%**
C21	- Service & Distribution	1.00	4,058	m2	$184.84	$750,100.00		$184.84	
C22	- Lighting, Devices & Heating	1.00	4,058	m2	$110.85	$449,825.00		$110.85	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$52,750.00**	**$13.00**	**1.59%**
D21	- Demolition	1.00	4,058	m2	$6.90	$28,000.00		$6.90	
D22	- Alterations	1.00	4,058	m2	$6.10	$24,750.00		$6.10	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$304,400.00**	**$75.01**	**9.19%**
Z11	- General Requirements	1.00	4,058	m2	$45.15	$183,200.00		$45.15	
Z12	- Fees	1.00	4,058	m2	$29.87	$121,200.00		$29.87	
Z2	**Allowances**						**$497,900.00**	**$122.70**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$48.52	$196,900.00		$48.52	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$74.17	$301,000.00		$74.17	
					Total Hard Construction Cost		**$3,311,500.00**	**$816.04**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$413,990.00**
1	Replace all existing windows c/w new insulated glass units (IGU) as follows:					
2	Northwest - Triple pane, fibre glass, U value 0.80					
2.1	- "Window # 2" - 900 x 1600 mm	1	NO	$1,260.00	$1,260.00	
2.2	- "Window # 3" - 1400 x 2200 mm	5	NO	$2,695.00	$13,475.00	
2.3	- "Window # 4 - 1400 x 2210 mm	5	NO	$2,707.25	$13,536.25	
2.4	- "Window # 6" - 1425 x 6210 mm	1	NO	$7,743.09	$7,743.09	
2.5	- "Window # 7" - 2325 x 2200 mm	2	NO	$4,475.63	$8,951.25	
2.6	- "Window # 8" - 1500 x 1600 mm	1	NO	$2,100.00	$2,100.00	
3	Southeast - Double pane, aluminium frame, U value 2.15					
3.1	- "Window # 1" - 1200 x 1600 mm	7	NO	$1,584.00	$11,088.00	
3.2	- "Window # 3" - 1400 x 2200 mm	2	NO	$2,541.00	$5,082.00	
3.3	- "Window # 5 - 3000 x 2200 mm	3	NO	$5,445.00	$16,335.00	
3.4	- "Window # 8" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.5	- "Window # 9" - 2100 x 2200 mm	1	NO	$3,811.50	$3,811.50	
3.6	- "Window # 10" - 2445 x 5160 mm	1	NO	$10,387.08	$10,387.08	
3.7	- "Window # 11" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.8	- "Window # 12" - 3000 x 2810 mm	10	NO	$6,954.75	$69,547.50	
4	Northeast - Triple pane, fibre glass, U value 0.80					
4.1	- "Window # 2" - 900 x 1600 mm	6	NO	$1,260.00	$7,560.00	
4.2	- "Window # 8" - 1500 x 1600 mm	5	NO	$2,100.00	$10,500.00	
4.3	- "Window # 13" - 645 x 2200 mm	1	NO	$1,241.63	$1,241.63	
4.4	- "Window # 15" - 2550 x 2810 mm	4	NO	$6,269.81	$25,079.25	
4.5	- "Window # 16" - 2325 x 6210 mm	1	NO	$12,633.47	$12,633.47	
5	Southwest - Double pane, aluminium frame, U value 2.15					
5.1	- "Window # 1" - 1200 x 1600 mm	1	NO	$1,584.00	$1,584.00	
5.2	- "Window # 2" - 900 x 1600 mm	4	NO	$1,188.00	$4,752.00	
5.3	- "Window # 3" - 1400 x 2200 mm	6	NO	$2,541.00	$15,246.00	
5.4	- "Window # 8" - 1500 x 1600 mm	6	NO	$1,980.00	$11,880.00	
5.5	- "Window # 13" - 645 x 2200 mm	1	NO	$1,170.68	$1,170.68	
5.6	- "Window # 14" - 1125 x 5610 mm	1	NO	$5,206.78	$5,206.78	
6	Caulking/ sealing etc.	1	LS	$13,400.00	$13,400.00	
7	Allowance for new window sills	1	LS	$5,000.00	$5,000.00	
	A3.32 - Glazed Screens					
8	Curtainwall at Cafeteria at southeast c/w triple pane, fibre glass framing and U -Value of 0.80	150	m2	$850.00	$127,500.00	
	Total Cost - WINDOWS & ENTRANCES	**318**	**m2**	**$1,302.78**	**$413,990.00**	
	B2.1 Finishes					
	B2.21 - Ceiling Finishes					**$42,794.00**
9	Minor repairs to drywall ceiling c/w patching and make finishes good after light fixtures installation	1,166	m2	$15.00	$17,490.00	
10	Minor removal / repair to acoustic ceiling c/w replacement of damages tiles after installation of new light fixtures	1,152	m2	$12.00	$13,824.00	
11	Repair to wood grille ceiling in selective areas after inst	574	m2	$20.00	$11,480.00	
	Total For - CEILING FINISHES	**2,892.00**	**m2**	**$14.80**	**$42,794.00**	
	B3.2 Equipment					
	B3.21 - Equipment					**$25,150.00**
12	Appliances will be replaced with new EnergyStar rates as follows:					
12.1	- Vending machines	2	NO	$1,800.00	$3,600.00	
12.2	- Display fridge	1	NO	$3,000.00	$3,000.00	
12.3	- Freezer	1	NO	$2,000.00	$2,000.00	
12.4	- Dishwasher	1	NO	$1,500.00	$1,500.00	

12.5	- Refrigerator	10	NO	$1,000.00	$10,000.00	
12.6	- Stove	1	NO	$2,000.00	$2,000.00	
12.7	- Convection oven	1	NO	$2,200.00	$2,200.00	
13	Disconnect and dispose off existing appliances	1	LS	$850.00	$850.00	
14	Photocopiers/ water fountains etc. - By others				Excluded	
	Total For - EQUIPMENT	**4,058**	**m2**	**$6.20**	**$25,150.00**	
	C1 MECHANICAL					
	C1.11 PLUMBING & DRAINAGE					
	C1.11 - Plumbing Equipment					**$12,000.00**
15	Replace existing domestic hot water heater "HWT-1" with new electric hybrid water heater c/w hook up - 100 US Gallons capacity	1	NO	$12,000.00	$12,000.00	
	C1.16 Natural Gas					**$0.00**
16	No work required				Costing Base	
	C1.17 Other Plumbing Systems:					
	C1.17.1 - Demolition					**$300.00**
17	Disconnect, remove and dispose off existing domestic hot water heater	1	NO	$300.00	$300.00	
	C1.18 General Accounts					**$1,500.00**
18	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$1,500.00	$1,500.00	
	TOTAL FOR - PLUMBING & DRAINAGE	**4,058**	**m2**	**$3.40**	**$13,800.00**	
	C1.2 FIRE PROTECTION					
19	No work anticipated				Excluded	
	TOTAL FOR - FIRE PROTECTION	**4,058**	**m2**		**$0.00**	
	C1.3 HVAC					
	C1.31 Variable Refrigerant Flow (VRF) System					**$575,045.00**
20	VRF based heating / cooling for boiling ventilation package equal to Mits Air c/w :	1	LS	$410,445.00	$410,445.00	
20.1	- Indoor units - 2.5 Tons each	52	NO		Included	
20.2	- Outdoor condenser (s)	1	NO		Included	
20.3	- BC controllers/ manifolds	1	LS		Included	
20.4	- Installation/ millwrighting for above system	1	LS	$63,900.00	$63,900.00	
21	Interconnection refrigerant piping, thermally insulated and charged	1	LS	$100,700.00	$100,700.00	
	C1.32 Cooling Generation & Transfer					**$0.00**
22	Included in above VRF system				Included	
	C1.33 Air Distribution and Devices					**$13,200.00**
23	Replace existing make up air unit with air source heat pump unit "ASHP" c/w supply air fan, coils, filters, VFD, roof curb and operating safety & controls and hook up connections to heat pump loop - 4,600 CFM capacity - Included in above Mits Air package				Included	

24	Millwrighting / hoisting for ASHP installation	1	NO	$2,000.00	$2,000.00	
25	Galvanized steel sheet metal ductwork as per SMACNA standards of gauges of construction for intake air duct and connection to existing duct mains	200	kg	$18.50	$3,700.00	
26	Provide new ERV with existing building exhaust EF-3 & EF-4 (1500 CFM) each	1	NO	$7,500.00	$7,500.00	
	C1.35 Noise and Vibration Systems					**$0.00**
27	Noise and vibration isolation is included with equipment costs above				Included	
	C1.36 Testing, Balancing and Commissioning					**$3,000.00**
28	Balancing					
29	Adjust, set and balance air flow rates to meet design criteria. Submit balancing reports	1	NO	$3,000.00	$3,000.00	
30	Commissioning					
31	Factory testing, start -up and demonstration is included with equipment rates				Included	
	C1.37 Other HVAC Systems:					
	C1.37.1 Demolition					**$35,400.00**
32	Disconnect, remove and dispose off existing heat pump units	52	NO	$200.00	$10,400.00	
33	Decommission existing hydronic piping loop. Leave distribution network in place.	1	LS	$5,000.00	$5,000.00	
34	Disconnect, remove and dispose off existing boilers, cooling towers, circulators, gauges etc,	1	LS	$20,000.00	$20,000.00	
	C1.38 General Accounts					**$6,200.00**
35	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$6,200.00	$6,200.00	
	TOTAL FOR - HVAC	**4,058**	**m2**	**$155.95**	**$632,845.00**	
	1.4 CONTROLS					
	C1.41 Controls Equipment					**$127,900.00**
36	Provide new DDC based building automation and controls c/w central work station, field devices (zone valves, dampers, sensors/ thermostats), wiring as follows:					
36.1	- Central plant monitoring and control	1	NO	$25,000.00	$25,000.00	
36.5	- VRF system - Integration only	1	LS	$20,000.00	$20,000.00	
36.2	- VRF units monitoring & control - included with VRF system				Included	
36.3	- Zone temperature and humidity monitoring / control - included with VRF system				Included	
36.4	- Lighting control	1	LS	$25,000.00	$25,000.00	
36.6	- BAS points	17	NO	$1,500.00	$25,500.00	
36.7	- Occupancy sensors	27	NO	$1,200.00	$32,400.00	
	C1.43 General Accounts					**$0.00**
37	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P - Included in above rates				Included	
	TOTAL FOR - CONTROLS	**4,058**	**m2**	**$31.52**	**$127,900.00**	

C2 ELECTRICAL

C2.1 SERVICES & DISTRIBUTION

C2.11 - Main Service / Distribution **$734,500.00**

38	Integrate new carport PV system to main electrical panel c/w transformer, hydro meter and accessories	1	LS	$10,000.00	$10,000.00	
39	Car port c/w photo voltaic system equal to "Ecohive" c/w:					
39.1	- Foundation/ helical piles	1	LS	$724,500.00	$724,500.00	
39.2	- 20 spots carports	3	NO		Included	
39.3	- Solar carport structure, galvanized steel c/w posts / solar panel supports	1	NO		Included	
39.4	- Solar panels to produce 196.6 KW	504	NO		Included	
39.5	- Strings/ circuit combiner/	10	NO		Included	
39.6	- ESA certification				Included	

C2.14 - Motor Controls & Wiring **$15,600.00**

40	Power connections c/w wiring and conduit :					
40.1	- Domestic water heater	1	NO	$200.00	$200.00	
40.2	- Appliances will be reconnected to existing circuits - included in appliances cost				Included	
40.3	- VRF indoor units	52	NO	$200.00	$10,400.00	
41	Load side wiring c/w disconnect switches :					
41.1	- Air source heat pump unit - weatherproof disconnect switch	1	NO	$2,000.00	$2,000.00	
41.2	- ERV	1	NO	$500.00	$500.00	
41.3	- VRF condenser unit	1	NO	$2,500.00	$2,500.00	

TOTAL FOR - SERVICES & DISTRIBUTION	**4,058**	**m2**	**$184.84**	**$750,100.00**	

C2.2 Lights, Devices & Heating

C2.21 - Lighting **$449,825.00**

42	Replace existing light fixtures with new LED type as follows (based on equivalent to existing light fixtures)					
43	Type "A" - 150 mm Diameter Downlight	107	NO	$350.00	$37,450.00	
44	Type "B" - 178 mm Square Downlight	154	NO	$350.00	$53,900.00	
45	Type "C" - 112 mm Diameter Downlight	28	NO	$325.00	$9,100.00	
46	Type "D" - 125 mm Diameter White Cylinder	72	NO	$400.00	$28,800.00	
47	Type "E" light troffers - 200 round glass opal	38	NO	$200.00	$7,600.00	
48	Type "F" - 660x1283 frameless acrylic white diffuser	33	NO	$400.00	$13,200.00	
49	Type "F1" - 1200x600 c/w framed k12 acrylic lens	44	NO	$300.00	$13,200.00	
50	Type "F2" - 1200x300	26	NO	$300.00	$7,800.00	
51	Type "F3" - 1200 long c/w 12x13x14 cube louver	8	NO	$300.00	$2,400.00	
52	Type "F4" - 1200 long c/w 12x13x13 cube louver	14	NO	$300.00	$4,200.00	
53	Type "F5" - 1200 long strip	338	NO	$350.00	$118,300.00	
54	Type "F6" - 1200 long strip	18	NO	$350.00	$6,300.00	
55	Type "F7" - 2400 long tandem strip	7	NO	$450.00	$3,150.00	
56	Type "F8" - 1200 long strip c/w dimming ballast	78	NO	$400.00	$31,200.00	
57	Type "F11" - 1200 long strip c/w wire guard	22	NO	$400.00	$8,800.00	
58	Type "F12" - 2400 long tandem c/w wire guard	6	NO	$450.00	$2,700.00	
59	Type "G" - lamp holders on 300 centers	1	NO	$350.00	$350.00	
60	Type "G1" - 115 square chrome lamp holder	3	NO	$250.00	$750.00	
61	Type "H" - 280 round opal lexan white diffuser	9	NO	$450.00	$4,050.00	
62	Type "J" - Opal glass cylinder with white aluminum disc	1	NO	$400.00	$400.00	

63	Type "K" - Adjustable low voltage spotlight	8	NO	$200.00	$1,600.00	
64	Type "L" - 105 diameter downlight	11	NO	$325.00	$3,575.00	
65	Type "M" - adjustable uplighting floor square	5	NO	$350.00	$1,750.00	
66	Type "N" - 2-200 1/8 ball shaped uplight segments	2	NO	$400.00	$800.00	
67	Type "O4" - Planter light buried quartz lamp	3	NO	$250.00	$750.00	
68	Type "O6" - Sign light metal halide	5	NO	$150.00	$750.00	
69	Type "O7" - Sign light metal halide	3	NO	$150.00	$450.00	
70	Type "O9" - downlight c/w milligroove baffle	7	NO	$350.00	$2,450.00	
71	Type "O10" - 200 square bevelled clear volcanic glass	6	NO	$300.00	$1,800.00	
72	Type "O11" - 400x410 wall floodlight	1	NO	$250.00	$250.00	
73	Type "R" - square downlight	62	NO	$350.00	$21,700.00	
74	Type "T1" - lite capsule track lite	5	NO	$250.00	$1,250.00	
75	Type "V" - enclosed vaportight lampholder	7	NO	$350.00	$2,450.00	
76	Wiring, conduits and connection with existing circuit is included in above rates				Included	
77	Demolition					
78	Disconnect, remove and disposal of light fixtures	1132	NO	$50.00	$56,600.00	
	TOTAL FOR - LIGHT, DEVICES & HEATING	**4,058**	**m2**	**$110.85**	**$449,825.00**	

D SITE & ANCILLARY WORK

D2.1 - ANCILLARY WORK

D2.11 - Demolition **$28,000.00**

79	Remove existing window c/w supports and disposal	79	NO	$250.00	$19,750.00	
80	Remove existing curtainwall assembly at Cafeteria	150	m2	$55.00	$8,250.00	

D2.12 - Hazardous Material **$0.00**

81	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$6.90**	**$28,000.00**	

D2.2 - ALTERATIONS

D2.21 - Alterations **$24,750.00**

82	Rework on existing window openings to install new windows	79	NO	$250.00	$19,750.00	
83	New curtainwall connections with existing walls	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$6.10**	**$24,750.00**	

Z GENERAL REQUIREMENTS & ALLOWANCES

Z1.1 - GENERAL REQUIREMENTS

Z1.11 - Supervision & Labour Expenses **$138,000.00**

84	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1	LS	$138,000.00	$138,000.00	

	Z1.12 - Temporary Conditions				**$0.00**
85	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$45,200.00**
86	Permits by Owner			Excluded	
87	General liability and builders risk coverage	1 LS	$20,100.00	$20,100.00	
88	Labour & material performance bond	1 LS	$25,100.00	$25,100.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$183,200.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$121,200.00**
89	Contractor fees for overhead & profit - 4.5%	1 LS	$121,200.00	$121,200.00	
	TOTAL FOR - FEES	**1 LS**		**$121,200.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$196,900.00**
90	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$196,900.00	$196,900.00	
	Z2.21 - Escalation Allowances				**$0.00**
91	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$301,000.00**
92	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$301,000.00	$301,000.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$497,900.00**	

Project # 20021
Town Hall, Halton Hills Pathway 4
Class "C" Cost Estimate
August 17, 2020

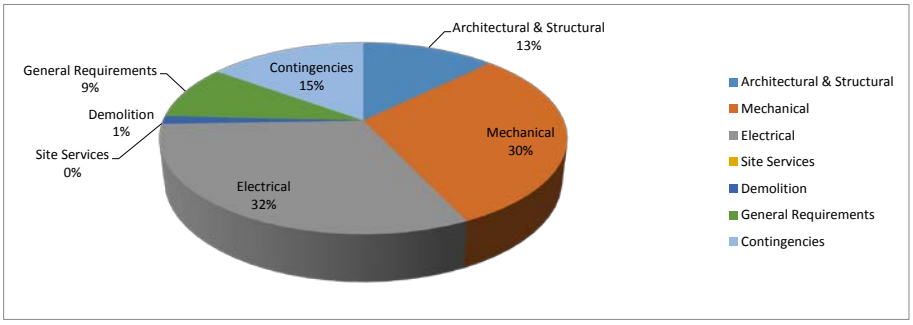
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$102.02		$413,990.00	10.85%
	A3.3- Windows & Entrances		$102.02	$413,990.00		
B	**Interiors**					
	B2 Finishes	4,058	$10.55		$42,794.00	1.12%
	B2.2 - Ceiling Finishes		$10.55	$42,794.00		
C	**Services:**					
	C1 Mechanical	4,058	$284.91		$1,156,145.00	30.30%
	C11 Plumbing & Drainage		$3.40	$13,800.00		
	C13 HVAC		$247.52	$1,004,445.00		
	C14 Controls		$33.98	$137,900.00		
	C2 Electrical	4,058	$295.69		$1,199,925.00	31.45%
	C21 Service & Distribution		$184.84	$750,100.00		
	C22 Lighting, Devices & Heating		$110.85	$449,825.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$13.00		$52,750.00	1.38%
	D21 Demolition		$6.90	$28,000.00		
	D22 Alterations		$6.10	$24,750.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$86.40		$350,600.00	9.19%
	Z11 General Requirements		$52.00	$211,000.00		
	Z12 Fees		$34.40	$139,600.00		
	Z2 Allowances	4,058	$141.38		$573,700.00	15.04%
	Z21 Design Allowances		$55.91	$226,900.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$85.46	$346,800.00		
	Total Hard Construction Cost		**$940.14**		**$3,815,100.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Pathway 4
Class "C" Cost Estimate
August 17, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY			GROSS FLOOR AREA				4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$413,990.00**	**$102.02**	**10.85%**
A3.3	- Windows & Entrances	0.08	318	m2	$1,302.78	$413,990.00		$102.02	
B2	**Finishes**						**$42,794.00**	**$10.55**	**1.12%**
B2.2	- Ceiling Finishes	0.71	2,892	m2	0	$42,794.00		$10.55	
B3	**Fittings & Equipment**						**$25,150.00**	**$6.20**	**0.66%**
B3.2	- Equipment	1.00	4,058	m2	$6.20	$25,150.00		$6.20	
C	**Services:**								
C1	**Mechanical**						**$1,156,145.00**	**$284.91**	**30.30%**
C11	- Plumbing & Drainage	1.00	4,058	m2	$3.40	$13,800.00		$3.40	
C13	- HVAC	1.00	4,058	m2	$247.52	$1,004,445.00		$247.52	
C14	- Controls	1.00	4,058	m2	$33.98	$137,900.00		$33.98	
C2	**Electrical**						**$1,199,925.00**	**$295.69**	**31.45%**
C21	- Service & Distribution	1.00	4,058	m2	$184.84	$750,100.00		$184.84	
C22	- Lighting, Devices & Heating	1.00	4,058	m2	$110.85	$449,825.00		$110.85	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$52,750.00**	**$13.00**	**1.38%**
D21	- Demolition	1.00	4,058	m2	$6.90	$28,000.00		$6.90	
D22	- Alterations	1.00	4,058	m2	$6.10	$24,750.00		$6.10	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$350,600.00**	**$86.40**	**9.19%**
Z11	- General Requirements	1.00	4,058	m2	$52.00	$211,000.00		$52.00	
Z12	- Fees	1.00	4,058	m2	$34.40	$139,600.00		$34.40	
Z2	**Allowances**						**$573,700.00**	**$141.38**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$55.91	$226,900.00		$55.91	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$85.46	$346,800.00		$85.46	
					Total Hard Construction Cost		**$3,815,100.00**	**$940.14**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$413,990.00**
1	Replace all existing windows c/w new insulated glass units (IGU) as follows:					
2	Northwest - Triple pane, fibre glass, U value 0.80					
2.1	- "Window # 2" - 900 x 1600 mm	1	NO	$1,260.00	$1,260.00	
2.2	- "Window # 3" - 1400 x 2200 mm	5	NO	$2,695.00	$13,475.00	
2.3	- "Window # 4 - 1400 x 2210 mm	5	NO	$2,707.25	$13,536.25	
2.4	- "Window # 6" - 1425 x 6210 mm	1	NO	$7,743.09	$7,743.09	
2.5	- "Window # 7" - 2325 x 2200 mm	2	NO	$4,475.63	$8,951.25	
2.6	- "Window # 8" - 1500 x 1600 mm	1	NO	$2,100.00	$2,100.00	
3	Southeast - Double pane, aluminium frame, U value 2.15					
3.1	- "Window # 1" - 1200 x 1600 mm	7	NO	$1,584.00	$11,088.00	
3.2	- "Window # 3" - 1400 x 2200 mm	2	NO	$2,541.00	$5,082.00	
3.3	- "Window # 5 - 3000 x 2200 mm	3	NO	$5,445.00	$16,335.00	
3.4	- "Window # 8" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.5	- "Window # 9" - 2100 x 2200 mm	1	NO	$3,811.50	$3,811.50	
3.6	- "Window # 10" - 2445 x 5160 mm	1	NO	$10,387.08	$10,387.08	
3.7	- "Window # 11" - 1500 x 1600 mm	2	NO	$1,980.00	$3,960.00	
3.8	- "Window # 12" - 3000 x 2810 mm	10	NO	$6,954.75	$69,547.50	
4	Northeast - Triple pane, fibre glass, U value 0.80					
4.1	- "Window # 2" - 900 x 1600 mm	6	NO	$1,260.00	$7,560.00	
4.2	- "Window # 8" - 1500 x 1600 mm	5	NO	$2,100.00	$10,500.00	
4.3	- "Window # 13" - 645 x 2200 mm	1	NO	$1,241.63	$1,241.63	
4.4	- "Window # 15" - 2550 x 2810 mm	4	NO	$6,269.81	$25,079.25	
4.5	- "Window # 16" - 2325 x 6210 mm	1	NO	$12,633.47	$12,633.47	
5	Southwest - Double pane, aluminium frame, U value 2.15					
5.1	- "Window # 1" - 1200 x 1600 mm	1	NO	$1,584.00	$1,584.00	
5.2	- "Window # 2" - 900 x 1600 mm	4	NO	$1,188.00	$4,752.00	
5.3	- "Window # 3" - 1400 x 2200 mm	6	NO	$2,541.00	$15,246.00	
5.4	- "Window # 8" - 1500 x 1600 mm	6	NO	$1,980.00	$11,880.00	
5.5	- "Window # 13" - 645 x 2200 mm	1	NO	$1,170.68	$1,170.68	
5.6	- "Window # 14" - 1125 x 5610 mm	1	NO	$5,206.78	$5,206.78	
6	Caulking/ sealing etc.	1	LS	$13,400.00	$13,400.00	
7	Allowance for new window sills	1	LS	$5,000.00	$5,000.00	
	A3.32 - Glazed Screens					
8	Curtainwall at Cafeteria at southeast c/w triple pane, fibre glass framing and U -Value of 0.80	150	m2	$850.00	$127,500.00	
	Total Cost - WINDOWS & ENTRANCES	**318**	**m2**	**$1,302.78**	**$413,990.00**	
	B2.1 Finishes					
	B2.21 - Ceiling Finishes					**$42,794.00**
9	Minor repairs to drywall ceiling c/w patching and make finishes good after light fixtures installation	1,166	m2	$15.00	$17,490.00	
10	Minor removal / repair to acoustic ceiling c/w replacement of damages tiles after installation of new light fixtures	1,152	m2	$12.00	$13,824.00	
11	Repair to wood grille ceiling in selective areas after inst	574	m2	$20.00	$11,480.00	
	Total For - CEILING FINISHES	**2,892.00**	**m2**	**$14.80**	**$42,794.00**	
	B3.2 Equipment					
	B3.21 - Equipment					**$25,150.00**
12	Appliances will be replaced with new EnergyStar rates as follows:					
12.1	- Vending machines	2	NO	$1,800.00	$3,600.00	
12.2	- Display fridge	1	NO	$3,000.00	$3,000.00	
12.3	- Freezer	1	NO	$2,000.00	$2,000.00	
12.4	- Dishwasher	1	NO	$1,500.00	$1,500.00	

12.5	- Refrigerator	10	NO	$1,000.00	$10,000.00	
12.6	- Stove	1	NO	$2,000.00	$2,000.00	
12.7	- Convection oven	1	NO	$2,200.00	$2,200.00	
13	Disconnect and dispose off existing appliances	1	LS	$850.00	$850.00	
14	Photocopiers/ water fountains etc. - By others				Excluded	
	Total For - EQUIPMENT	**4,058**	**m2**	**$6.20**	**$25,150.00**	
	C1 MECHANICAL					
	C1.11 PLUMBING & DRAINAGE					
	C1.11 - Plumbing Equipment					**$12,000.00**
15	Replace existing domestic hot water heater "HWT-1" with new electric hybrid water heater c/w hook up - 100 US Gallons capacity	1	NO	$12,000.00	$12,000.00	
	C1.16 Natural Gas					**$0.00**
16	No work required				Costing Base	
	C1.17 Other Plumbing Systems:					
	C1.17.1 - Demolition					**$300.00**
17	Disconnect, remove and dispose off existing domestic hot water heater	1	NO	$300.00	$300.00	
	C1.18 General Accounts					**$1,500.00**
18	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$1,500.00	$1,500.00	
	TOTAL FOR - PLUMBING & DRAINAGE	**4,058**	**m2**	**$3.40**	**$13,800.00**	
	C1.2 FIRE PROTECTION					
19	No work anticipated				Excluded	
	TOTAL FOR - FIRE PROTECTION	**4,058**	**m2**		**$0.00**	
	C1.3 HVAC					
	C1.31 Variable Refrigerant Flow (VRF) System					**$543,545.00**
20	VRF based heating / cooling for boiling ventilation package equal to Mits Air c/w :	1	LS	$378,945.00	$378,945.00	
20.1	- Indoor units - 2.5 Tons each	52	NO		Included	
20.2	- Water source geothermal VRF condenser	1	NO		Included	
20.3	- BC controllers/ manifolds	1	LS		Included	
20.4	- Installation, millwrighting for above system	1	LS	$63,900.00	$63,900.00	
21	Interconnection refrigerant piping, thermally insulated and charged	1	LS	$100,700.00	$100,700.00	
	C1.32 Geo Thermal System					**$330,000.00**
22	Geothermal Based Heating/ Heat rejection System as follows:					
23	Borewell c/w grouting, glycol loop piping, glycol solution - 250 feet deep each	50	NO	$6,500.00	$325,000.00	
24	Interconnection piping to existing heating/ cooling plant	1	LS	$5,000.00	$5,000.00	

	C1.33 Air Distribution and Devices					**$43,100.00**
26	Replace existing make up air unit with air source heat pump unit "WSHP-1" c/w supply air fan, coils, filters, VFD, roof curb and operating safety & controls and hook up connections to geothermal loop - 4,600 CFM capacity	1	NO	$29,900.00	$29,900.00	
27	Millwrighting / hoisting for WSHP installation	1	NO	$2,000.00	$2,000.00	
28	Galvanized steel sheet metal ductwork as per SMACNA standards of gauges of construction for intake air duct and connection to existing duct mains	200	kg	$18.50	$3,700.00	
29	Provide new ERV with existing building exhaust EF-3 & EF-4 (1500 CFM) each	1	NO	$7,500.00	$7,500.00	
	C1.35 Noise and Vibration Systems					**$0.00**
30	Noise and vibration isolation is included with equipment costs above				Included	
	C1.36 Testing, Balancing and Commissioning					**$3,000.00**
31	Balancing					
32	Adjust, set and balance air flow rates to meet design criteria. Submit balancing reports	1	NO	$3,000.00	$3,000.00	
33	Commissioning					
34	Factory testing, start -up and demonstration is included with equipment rates				Included	
	C1.37 Other HVAC Systems:					
	C1.37.1 Demolition					**$35,400.00**
35	Disconnect, remove and dispose off existing heat pump units	52	NO	$200.00	$10,400.00	
36	Decommission existing hydronic piping. Leave distribution network in place.	1	LS	$5,000.00	$5,000.00	
37	Disconnect, remove and dispose off existing boilers, cooling tower, circulators & gauges etc,	1	LS	$20,000.00	$20,000.00	
	C1.38 General Accounts					**$49,400.00**
38	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P	1	LS	$49,400.00	$49,400.00	
	TOTAL FOR - HVAC	**4,058**	**m2**	**$247.52**	**$1,004,445.00**	
	1.4 CONTROLS					
	C1.41 Controls Equipment					**$137,900.00**
39	Provide new DDC based building automation and controls c/w central work station, field devices (zone valves, dampers, sensors/ thermostats), wiring as follows:					
39.1	- Central plant monitoring and control	1	NO	$25,000.00	$25,000.00	
39.2	- VRF system - Integration only	1	LS	$20,000.00	$20,000.00	
39.3	- VRF units monitoring & control - included with VRF system				Included	
39.4	- Zone temperature and humidity monitoring / control - included with VRF system				Included	
39.5	- Lighting control	1	LS	$25,000.00	$25,000.00	
39.6	- BAS points	17	NO	$1,500.00	$25,500.00	
39.7	- Occupancy sensors	27	NO	$1,200.00	$32,400.00	
39.8	- Geothermal system	1	LS	$10,000.00	$10,000.00	
	C1.43 General Accounts					**$0.00**
40	Miscellaneous cost including shop drawings, co-ordination, clean up, tool rentals, O & P - Included in above rates				Included	
	TOTAL FOR - CONTROLS	**4,058**	**m2**	**$33.98**	**$137,900.00**	

C2 ELECTRICAL

C2.1 SERVICES & DISTRIBUTION

C2.11 - Main Service / Distribution **$734,500.00**

41	Integrate new carport PV system to main electrical panel c/w transformer, hydro meter and accessories	1	LS	$10,000.00	$10,000.00	
42	Car port c/w photo voltaic system equal to "Ecohive" c/w:					
42.1	- Foundation/ helical piles	1	LS	$724,500.00	$724,500.00	
42.2	- 20 spots carports	3	NO		Included	
42.3	- Solar carport structure, galvanized steel c/w posts / solar panel supports	1	NO		Included	
42.4	- Solar panels to produce 196.6 KW	504	NO		Included	
42.5	- Strings/ circuit combiner/	10	NO		Included	
42.6	- ESA certification				Included	

C2.14 - Motor Controls & Wiring **$15,600.00**

43	Power connections c/w wiring and conduit :					
43.1	- Domestic water heater	1	NO	$200.00	$200.00	
43.2	- Appliances will be reconnected to existing circuits - included in appliances cost				Included	
43.3	- VRF indoor units	52	NO	$200.00	$10,400.00	
44	Load side wiring c/w disconnect switches :					
44.1	- Air source heat pump unit - weatherproof disconnect switch	1	NO	$2,000.00	$2,000.00	
44.2	- ERV	1	NO	$500.00	$500.00	
44.3	- VRF condenser unit	1	NO	$2,500.00	$2,500.00	

TOTAL FOR - SERVICES & DISTRIBUTION	**4,058**	**m2**	**$184.84**	**$750,100.00**	

C2.2 Lights, Devices & Heating

C2.21 - Lighting **$449,825.00**

	Replace existing light fixtures with new LED type as follows (based on equivalent to existing light fixtures)					
42						
43	Type "A" - 150 mm Diameter Downlight	107	NO	$350.00	$37,450.00	
44	Type "B" - 178 mm Square Downlight	154	NO	$350.00	$53,900.00	
45	Type "C" - 112 mm Diameter Downlight	28	NO	$325.00	$9,100.00	
46	Type "D" - 125 mm Diameter White Cylinder	72	NO	$400.00	$28,800.00	
47	Type "E" light troffers - 200 round glass opal	38	NO	$200.00	$7,600.00	
48	Type "F" - 660x1283 frameless acrylic white diffuser	33	NO	$400.00	$13,200.00	
49	Type "F1" - 1200x600 c/w framed k12 acrylic lens	44	NO	$300.00	$13,200.00	
50	Type "F2" - 1200x300	26	NO	$300.00	$7,800.00	
51	Type "F3" - 1200 long c/w 12x13x14 cube louver	8	NO	$300.00	$2,400.00	
52	Type "F4" - 1200 long c/w 12x13x13 cube louver	14	NO	$300.00	$4,200.00	
53	Type "F5" - 1200 long strip	338	NO	$350.00	$118,300.00	
54	Type "F6" - 1200 long strip	18	NO	$350.00	$6,300.00	
55	Type "F7" - 2400 long tandem strip	7	NO	$450.00	$3,150.00	
56	Type "F8" - 1200 long strip c/w dimming ballast	78	NO	$400.00	$31,200.00	
57	Type "F11" - 1200 long strip c/w wire guard	22	NO	$400.00	$8,800.00	
58	Type "F12" - 2400 long tandem c/w wire guard	6	NO	$450.00	$2,700.00	
59	Type "G" - lamp holders on 300 centers	1	NO	$350.00	$350.00	
60	Type "G1" - 115 square chrome lamp holder	3	NO	$250.00	$750.00	
61	Type "H" - 280 round opal lexan white diffuser	9	NO	$450.00	$4,050.00	

62	Type "J" - Opal glass cylinder with white aluminum disc	1	NO	$400.00	$400.00	
63	Type "K" - Adjustable low voltage spotlight	8	NO	$200.00	$1,600.00	
64	Type "L" - 105 diameter downlight	11	NO	$325.00	$3,575.00	
65	Type "M" - adjustable uplighting floor square	5	NO	$350.00	$1,750.00	
66	Type "N" - 2-200 1/8 ball shaped uplight segments	2	NO	$400.00	$800.00	
67	Type "O4" - Planter light buried quartz lamp	3	NO	$250.00	$750.00	
68	Type "O6" - Sign light metal halide	5	NO	$150.00	$750.00	
69	Type "O7" - Sign light metal halide	3	NO	$150.00	$450.00	
70	Type "O9" - downlight c/w milligroove baffle	7	NO	$350.00	$2,450.00	
71	Type "O10" - 200 square bevelled clear volcanic glass	6	NO	$300.00	$1,800.00	
72	Type "O11" - 400x410 wall floodlight	1	NO	$250.00	$250.00	
73	Type "R" - square downlight	62	NO	$350.00	$21,700.00	
74	Type "T1" - lite capsule track lite	5	NO	$250.00	$1,250.00	
75	Type "V" - enclosed vaportight lampholder	7	NO	$350.00	$2,450.00	
76	Wiring, conduits and connection with existing circuit is included in above rates				Included	
77	Demolition					
78	Disconnect, remove and disposal of light fixtures	1132	NO	$50.00	$56,600.00	
	TOTAL FOR - LIGHT, DEVICES & HEATING	**4,058**	**m2**	**$110.85**	**$449,825.00**	

D SITE & ANCILLARY WORK

D2.1 - ANCILLARY WORK

	D2.11 - Demolition					**$28,000.00**
79	Remove existing window c/w supports and disposal	79	NO	$250.00	$19,750.00	
80	Remove existing curtainwall assembly at Cafeteria	150	m2	$55.00	$8,250.00	
	D2.12 - Hazardous Material					**$0.00**
81	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$6.90**	**$28,000.00**	

D2.2 - ALTERATIONS

	D2.21 - Alterations					**$24,750.00**
82	Rework on existing window openings to install new windows	79	NO	$250.00	$19,750.00	
83	New curtainwall connections with existing walls	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$6.10**	**$24,750.00**	

Z GENERAL REQUIREMENTS & ALLOWANCES

Z1.1 - GENERAL REQUIREMENTS

	Z1.11 - Supervision & Labour Expenses				**$159,000.00**
84	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1 LS	$159,000.00	$159,000.00	
	Z1.12 - Temporary Conditions				**$0.00**
85	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$52,000.00**
86	Permits by Owner			Excluded	
87	General liability and builders risk coverage	1 LS	$23,100.00	$23,100.00	
88	Labour & material performance bond	1 LS	$28,900.00	$28,900.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$211,000.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$139,600.00**
89	Contractor fees for overhead & profit - 4.5%	1 LS	$139,600.00	$139,600.00	
	TOTAL FOR - FEES	**1 LS**		**$139,600.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$226,900.00**
90	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$226,900.00	$226,900.00	
	Z2.21 - Escalation Allowances				**$0.00**
91	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$346,800.00**
92	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$346,800.00	$346,800.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$573,700.00**	

Project # 20021
Town Hall Halton Hills Building Envelope Retrofit Options
Summary
Class "C" Cost Estimate
August 19, 2020

Alpha Cost Consultants Inc.

WALL RETROFIT OPTIONS SUMMARY		
	Hard Construction Costs	**Total Cost**
	Option 1 - Kingspan Insulated Metal Panel	$974,100.00
	Option 2 - EIFS Wall	$821,800.00
	Option 3 - Clip and Rail W/ Lightweight Cladding	$868,800.00
	Total Hard Construction Cost	**As Above**

Project # 20021
Town Hall, Halton Hills Building Envelope Retrofit Kingspan Insulated Metal Panel W
Class "C" Cost Estimate
August 19, 2020

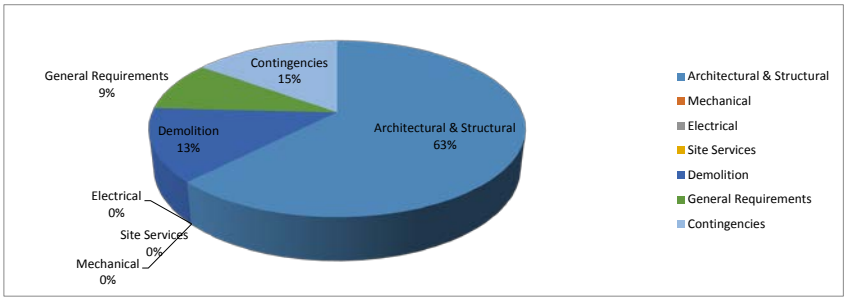
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$149.79		$607,850.00	62.40%
	A3.2 - Wall Above Grade		$149.79	$607,850.00		
	A3.3- Windows & Entrances		$0.00	$0.00		
B	**Interiors**					
	B2 Finishes	4,058	$0.00		$0.00	0.00%
	B2.2 - Ceiling Finishes		$0.00	$0.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$32.10		$130,250.00	13.37%
	D21 Demolition		$28.43	$115,375.00		
	D22 Alterations		$3.67	$14,875.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$22.06		$89,500.00	9.19%
	Z11 General Requirements		$13.28	$53,900.00		
	Z12 Fees		$8.77	$35,600.00		
	Z2 Allowances	4,058	$36.10		$146,500.00	15.04%
	Z21 Design Allowances		$14.27	$57,900.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$21.83	$88,600.00		
	Total Hard Construction Cost		**$240.04**		**$974,100.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Building Envelope Retrofit Kingspan Insulated Metal Panel Wall Option
Class "C" Cost Estimate
August 19, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY			GROSS FLOOR AREA				4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	Exterior Enclosure						$607,850.00	$149.79	62.40%
A3.2	- Walls Above Grade	0.44	1,775	m2	$342.45	$607,850.00		$149.79	
A3.3	- Windows & Entrances	1.00	4,058	m2	$0.00	$0.00		$0.00	
B2	Finishes						$0.00	$0.00	0.00%
B2.2	- Ceiling Finishes	0.00	0	m2	0	$0.00		$0.00	
D	Site & Ancillary Work:								
D2	Ancillary Work						$130,250.00	$32.10	13.37%
D21	- Demolition	1.00	4,058	m2	$28.43	$115,375.00		$28.43	
D22	- Alterations	1.00	4,058	m2	$3.67	$14,875.00		$3.67	
Z Z1	General Requirements & Allowances: General Requirements						$89,500.00	$22.06	9.19%
Z11	- General Requirements	1.00	4,058	m2	$13.28	$53,900.00		$13.28	
Z12	- Fees	1.00	4,058	m2	$8.77	$35,600.00		$8.77	
Z2	Allowances						$146,500.00	$36.10	15.04%
Z21	- Design Allowances	1.00	4,058	m2	$14.27	$57,900.00		$14.27	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$21.83	$88,600.00		$21.83	
					Total Hard Construction Cost		$974,100.00	$240.04	100%

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.2 Wall Above Grade					
	A3.21 - Wall Above Grade					**$607,850.00**
1	Power wash and clean existing concrete block masonry	1775	m2	$10.00	$17,750.00	
2	Kingspan metal panel c/w air barrier, 3" Panel, ship-lap seam with mechanical fasteners into CMU with sealant	1775	m2	$280.00	$497,000.00	
3	Wrap around windows @ doors	724	LM	$25.00	$18,100.00	
4	Wall connections at top and bottom	593	LM	$35.00	$20,755.00	
5	Miscellenous metal supports	1	LS	$20,000.00	$20,000.00	
6	Backer rod & sealant around windows / curtain wall	761	LM	$45.00	$34,245.00	
	Total Cost - WALLS ABOVE GRADE	**1775**	**m2**	**$342.45**	**$607,850.00**	
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$0.00**
7	Separate Estimate				Separate Estimate	
	Total Cost - WINDOWS & ENTRANCES	**4058**	**m2**	**$0.00**	**$0.00**	
	D SITE & ANCILLARY WORK					
	D2.1 - ANCILLARY WORK					
	D2.11 - Demolition					**$115,375.00**
8	Remove existing wall components including existing masonry, air barrier, insulation and disposal off site	1775	m2	$65.00	$115,375.00	
	D2.12 - Hazardous Material					**$0.00**
9	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$28.43**	**$115,375.00**	
	D2.2 - ALTERATIONS					
	D2.21 - Alterations					**$14,875.00**
10	Rework around existing window openings	79	NO	$125.00	$9,875.00	
11	Rework around existing curtainwall	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$3.67**	**$14,875.00**	
	Z GENERAL REQUIREMENTS & ALLOWANCES					
	Z1.1 - GENERAL REQUIREMENTS					
	Z1.11 - Supervision & Labour Expenses					**$40,600.00**
12	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1	LS	$40,600.00	$40,600.00	

	Z1.12 - Temporary Conditions				**$0.00**
13	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$13,300.00**
14	Permits by Owner			Excluded	
15	General liability and builders risk coverage	1 LS	$5,900.00	$5,900.00	
16	Labour & material performance bond	1 LS	$7,400.00	$7,400.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$53,900.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$35,600.00**
17	Contractor fees for overhead & profit - 4.5%	1 LS	$35,600.00	$35,600.00	
	TOTAL FOR - FEES	**1 LS**		**$35,600.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$57,900.00**
18	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$57,900.00	$57,900.00	
	Z2.21 - Escalation Allowances				**$0.00**
19	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$88,600.00**
20	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$88,600.00	$88,600.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$146,500.00**	

Project # 20021
Town Hall, Halton Hills Building Envelope Retrofit EIFS Wall Option
Class "C" Cost Estimate
August 19, 2020

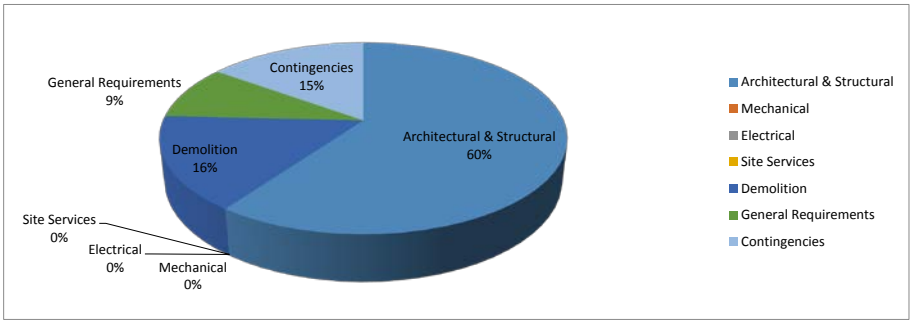
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$121.36		$492,475.00	59.93%
	A3.2 - Wall Above Grade		$121.36	$492,475.00		
	A3.3- Windows & Entrances		$0.00	$0.00		
B	**Interiors**					
	B2 Finishes	4,058	$0.00		$0.00	0.00%
	B2.2 - Ceiling Finishes		$0.00	$0.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$32.10		$130,250.00	15.85%
	D21 Demolition		$28.43	$115,375.00		
	D22 Alterations		$3.67	$14,875.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$18.61		$75,500.00	9.19%
	Z11 General Requirements		$11.19	$45,400.00		
	Z12 Fees		$7.42	$30,100.00		
	Z2 Allowances	4,058	$30.46		$123,600.00	15.04%
	Z21 Design Allowances		$12.05	$48,900.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$18.41	$74,700.00		
	Total Hard Construction Cost		**$202.51**		**$821,800.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Building Envelope Retrofit EIFS Wall Option
Class "C" Cost Estimate
August 19, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY						GROSS FLOOR AREA	4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$492,475.00**	**$121.36**	**59.93%**
A3.2	- Walls Above Grade	0.44	1,775	m2	$277.45	$492,475.00		$121.36	
A3.3	- Windows & Entrances	1.00	4,058	m2	$0.00	$0.00		$0.00	
B2	**Finishes**						**$0.00**	**$0.00**	**0.00%**
B2.2	- Ceiling Finishes	0.00	0	m2	0	$0.00		$0.00	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$130,250.00**	**$32.10**	**15.85%**
D21	- Demolition	1.00	4,058	m2	$28.43	$115,375.00		$28.43	
D22	- Alterations	1.00	4,058	m2	$3.67	$14,875.00		$3.67	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$75,500.00**	**$18.61**	**9.19%**
Z11	- General Requirements	1.00	4,058	m2	$11.19	$45,400.00		$11.19	
Z12	- Fees	1.00	4,058	m2	$7.42	$30,100.00		$7.42	
Z2	**Allowances**						**$123,600.00**	**$30.46**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$12.05	$48,900.00		$12.05	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$18.41	$74,700.00		$18.41	
	Total Hard Construction Cost						**$821,800.00**	**$202.51**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.2 Wall Above Grade					
	A3.21 - Wall Above Grade					**$492,475.00**
1	Power wash and clean existing concrete block masonry	1775	LS	$10.00	$17,750.00	
2	Durock moisture barrier/adhesive	1775	m2	$15.00	$26,625.00	
3	Durock pucc-rock insulation board with integral reinforcing mesh	1775	m2	$25.00	$44,375.00	
4	Durock reinforcement mesh embedded in durock base coat	1775	m2	$125.00	$221,875.00	
5	Durock finish coat	1775	m2	$50.00	$88,750.00	
6	Wrap around windows @ doors	724	LM	$25.00	$18,100.00	
7	Wall connections at top and bottom	593	LM	$35.00	$20,755.00	
8	Miscellenous metal supports	1	LS	$20,000.00	$20,000.00	
9	Backer rod & sealant around windows / curtain wall	761	LM	$45.00	$34,245.00	
	Total Cost - WALLS ABOVE GRADE	**1775**	**m2**	**$277.45**	**$492,475.00**	
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$0.00**
10	Separate Estimate				Separate Estimate	
	Total Cost - WINDOWS & ENTRANCES	**4058**	**m2**	**$0.00**	**$0.00**	
	D SITE & ANCILLARY WORK					
	D2.1 - ANCILLARY WORK					
	D2.11 - Demolition					**$115,375.00**
11	Remove existing wall components including existing masonry, air barrier, insulation and disposal off site	1775	m2	$65.00	$115,375.00	
	D2.12 - Hazardous Material					**$0.00**
12	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$28.43**	**$115,375.00**	
	D2.2 - ALTERATIONS					
	D2.21 - Alterations					**$14,875.00**
13	Rework around existing window openings	79	NO	$125.00	$9,875.00	
14	Rework around existing curtainwall	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$3.67**	**$14,875.00**	
	Z GENERAL REQUIREMENTS & ALLOWANCES					
	Z1.1 - GENERAL REQUIREMENTS					
	Z1.11 - Supervision & Labour Expenses					**$34,200.00**

15	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1 LS	$34,200.00	$34,200.00	
	Z1.12 - Temporary Conditions				**$0.00**
16	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$11,200.00**
17	Permits by Owner			Excluded	
18	General liability and builders risk coverage	1 LS	$5,000.00	$5,000.00	
19	Labour & material performance bond	1 LS	$6,200.00	$6,200.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$45,400.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$30,100.00**
20	Contractor fees for overhead & profit - 4.5%	1 LS	$30,100.00	$30,100.00	
	TOTAL FOR - FEES	**1 LS**		**$30,100.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$48,900.00**
21	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$48,900.00	$48,900.00	
	Z2.21 - Escalation Allowances				**$0.00**
22	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$74,700.00**
23	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$74,700.00	$74,700.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$123,600.00**	

Project # 20021
Town Hall, Halton Hills Building Envelope Retrofit Clip & Rail Wall Option
Class "C" Cost Estimate
August 19, 2020

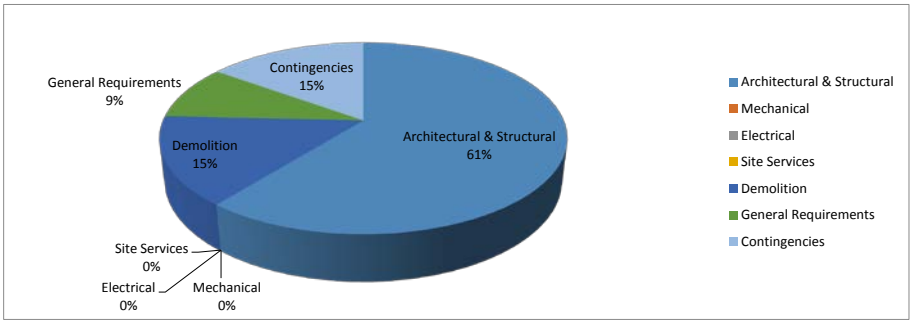
Alpha Cost Consultants Inc.

MASTER COST SUMMARY	GROSS FLOOR AREA	4,058 m2

	Hard Construction Costs	GFA (m2)	Unit (Cost/m2)	Sub - Elements Total	Element Total	% of Total
A	**Building Shell**					
	A3 Exterior Enclosure	4,058	$130.11		$527,975.00	60.77%
	A3.2 - Wall Above Grade		$130.11	$527,975.00		
	A3.3- Windows & Entrances		$0.00	$0.00		
B	**Interiors**					
	B2 Finishes	4,058	$0.00		$0.00	0.00%
	B2.2 - Ceiling Finishes		$0.00	$0.00		
D	**Site & Ancillary Work:**					
	D2 Ancillary Work	4,058	$32.10		$130,250.00	14.99%
	D21 Demolition		$28.43	$115,375.00		
	D22 Alterations		$3.67	$14,875.00		
Z	**General Requirements & Allowances:**					
	Z1 General Requirements	4,058	$19.69		$79,900.00	9.20%
	Z11 General Requirements		$11.85	$48,100.00		
	Z12 Fees		$7.84	$31,800.00		
	Z2 Allowances	4,058	$32.21		$130,700.00	15.04%
	Z21 Design Allowances		$12.74	$51,700.00		
	Z22 Escalation Allowances		$0.00	$0.00		
	Z23 Construction Allowances		$19.47	$79,000.00		
	Total Hard Construction Cost		**$214.10**		**$868,800.00**	**100%**

Soft Costs Items List	Cost
Consultant Fees- Architect, Structural Engineer, Mechanical, Electrical Consultant, Civil Consultant , Speciality Consultants Etc.	Excluded
Land Acquisition Costs	Excluded
Permits and Development Charges	Excluded
Soil Testing	Excluded
Construction or Project Management Fees	Excluded
Independent Inspection and Testing	Excluded
Legal Fees	Excluded
Disbursements	Excluded
Owner Supplied Furnishings, Fixtures, and Equipment	Excluded
Operational Expenses	Excluded
Financing , Loan Fees and Interest Charges	Excluded
Harmonized Sales Tax	Excluded
Soft Costs Items Total	**$0.00**

BUILDING ELEMENTAL COST BREAKDOWN



Project # 20002
Town Hall, Halton Hills Building Envelope Retrofit Clip & Rail Wall Option
Class "C" Cost Estimate
August 19, 2020

Alpha Cost Consultants Inc.

ELEMENTAL COST SUMMARY						GROSS FLOOR AREA	4,058 m2		
CIQS Code		Ratio GFA	Element Quantity	Unit	Unit Rate	Sub Element Total	Element Total	Unit Cost/ GFA	% of Total
A3	**Exterior Enclosure**						**$527,975.00**	**$130.11**	**60.77%**
A3.2	- Walls Above Grade	0.44	1,775	m2	$297.45	$527,975.00		$130.11	
A3.3	- Windows & Entrances	1.00	4,058	m2	$0.00	$0.00		$0.00	
B2	**Finishes**						**$0.00**	**$0.00**	**0.00%**
B2.2	- Ceiling Finishes	0.00	0	m2	0	$0.00		$0.00	
D	**Site & Ancillary Work:**								
D2	**Ancillary Work**						**$130,250.00**	**$32.10**	**14.99%**
D21	- Demolition	1.00	4,058	m2	$28.43	$115,375.00		$28.43	
D22	- Alterations	1.00	4,058	m2	$3.67	$14,875.00		$3.67	
Z	**General Requirements & Allowances:**								
Z1	**General Requirements**						**$79,900.00**	**$19.69**	**9.20%**
Z11	- General Requirements	1.00	4,058	m2	$11.85	$48,100.00		$11.85	
Z12	- Fees	1.00	4,058	m2	$7.84	$31,800.00		$7.84	
Z2	**Allowances**						**$130,700.00**	**$32.21**	**15.04%**
Z21	- Design Allowances	1.00	4,058	m2	$12.74	$51,700.00		$12.74	
Z22	- Escalation Allowances	1.00	4,058	m2	$0.00	$0.00		$0.00	
Z23	- Construction Allowances	1.00	4,058	m2	$19.47	$79,000.00		$19.47	
					Total Hard Construction Cost		**$868,800.00**	**$214.10**	**100%**

	Description	Quantity	Unit of Measurement	Rate	Subtotal	Total
	A. SHELL					
	A3.2 Wall Above Grade					
	A3.21 - Wall Above Grade					**$527,975.00**
1	Power wash and clean existing concrete block masonry	1775	m2	$10.00	$17,750.00	
2	Air barrier/adhesive	1775	m2	$25.00	$44,375.00	
3	5" Inches mineral wool (rockwool cavityrock)	1775	m2	$35.00	$62,125.00	
4	Clip and rail system	1775	m2	$175.00	$310,625.00	
5	Wrap around windows @ doors	724	LM	$25.00	$18,100.00	
6	Wall connections at top and bottom	593	LM	$35.00	$20,755.00	
7	Miscellenous metal supports	1	LS	$20,000.00	$20,000.00	
8	Backer rod & sealant around windows / curtain wall	761	LM	$45.00	$34,245.00	
	Total Cost - WALLS ABOVE GRADE	**1775**	**m2**	**$297.45**	**$527,975.00**	
	A3.3 Windows and Entrances					
	A3.31- Windows & Louvers					**$0.00**
9	Separate Estimate				Separate Estimate	
	Total Cost - WINDOWS & ENTRANCES	**4058**	**m2**	**$0.00**	**$0.00**	
	D SITE & ANCILLARY WORK					
	D2.1 - ANCILLARY WORK					
	D2.11 - Demolition					**$115,375.00**
10	Remove existing wall components including existing masonry, air barrier, insulation and disposal off site	1775	m2	$65.00	$115,375.00	
	D2.12 - Hazardous Material					**$0.00**
11	Hazardous material abatement by Owner				Excluded	
	TOTAL FOR - ANCILLARY WORK	**4,058**	**m2**	**$28.43**	**$115,375.00**	
	D2.2 - ALTERATIONS					
	D2.21 - Alterations					**$14,875.00**
12	Rework around existing window openings	79	NO	$125.00	$9,875.00	
13	Rework around existing curtainwall	1	LS	$5,000.00	$5,000.00	
	TOTAL FOR - ALTERATIONS	**4,058**	**m2**	**$3.67**	**$14,875.00**	
	Z GENERAL REQUIREMENTS & ALLOWANCES					
	Z1.1 - GENERAL REQUIREMENTS					
	Z1.11 - Supervision & Labour Expenses					**$36,200.00**
14	Miscellaneous cost including supervision/ subtrades co-ordination/ project management, co-ordination, clean up, tool rentals, consumables, site office, site access and temporary conditions - 5.5%	1	LS	$36,200.00	$36,200.00	

	Z1.12 - Temporary Conditions				**$0.00**
15	Temporary conditions including bin rental, site hoarding/ protections etc. included with Z1.11 above			Included	
	Z1.13 - Permits, Insurance & Bonds				**$11,900.00**
16	Permits by Owner			Excluded	
17	General liability and builders risk coverage	1 LS	$5,300.00	$5,300.00	
18	Labour & material performance bond	1 LS	$6,600.00	$6,600.00	
	TOTAL FOR - GENERAL REQUIREMENTS	**1 LS**		**$48,100.00**	
	Z1.2 - FEES				
	Z1.11 - General Contractor Fees				**$31,800.00**
19	Contractor fees for overhead & profit - 4.5%	1 LS	$31,800.00	$31,800.00	
	TOTAL FOR - FEES	**1 LS**		**$31,800.00**	
	Z2.1 - ALLOWANCES				
	Z2.11 - Design Allowances				**$51,700.00**
20	Design contingency to cover design gap for design refinement & completion until final design stage - 7%	1 LS	$51,700.00	$51,700.00	
	Z2.21 - Escalation Allowances				**$0.00**
21	Cost based on 3rd Quarter 2020 Construction Values. Any escalation to future project schedule has been excluded.			Excluded	
	Z2.31 - Construction Allowances				**$79,000.00**
22	Construction contingency for post tender/ contract changes (change orders/ change directives) - 10%	1 LS	$79,000.00	$79,000.00	
	TOTAL FOR - ALLOWANCES	**1 LS**		**$130,700.00**	