SUCF Project No. 231040
Replace Mechanical Systems Study—French Hall
State University of Technology at Canton

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1. Executive Summary

French Hall was built circa 1967 and served as the Administration and Library Building for the SUNY Canton Campus. French Hall is a two-story office building, constructed into the side of a hill. The main entrance is located "at grade" on the west side of the building with a secondary exit on the lower level, at grade, on the east side of the building. French Hall continues to function as the campus administrative office building.

The building is fully occupied by administrative staff; however, the characteristics/components of the HVAC systems make a phased approach to construction challenging and cost prohibitive. The campus indicated that vacating the building can be accommodated to facilitate the HVAC system replacement. Our recommendations in the report assume the building is not occupied during construction.

Remediating hazardous materials will compound the difficulty of replacing the mechanical systems in occupied buildings. Previous renovation data indicates no ACM is present in drywall, ceiling tiles or joint compound. We have assumed there is ACM in mechanical systems, HVAC pipe insulation and boiler breechings. The presence of Hazardous Materials will be confirmed through testing during design phase.

The study evaluated three (3) possible HVAC system replacement options, weighing the pros and cons as well as the constructability/phasing of each system. None of the systems studied utilize fossil fuels. Each system utilizes electric energy only, in accordance with SUNY and SUCF directives which require buildings to be powered by renewable energy sources.

A snow melt system is considered for each proposed option. We explored the possibility of utilizing a ground source heat pump system to provide hot water for snow melt, with boiler backup. However, the energy demand for the snow melt system is nearly as great as the heating demand for the building. Utilizing the heat pump ground loop will exhaust the heat available in the ground loop for the building heating needs.

The snow melt operation is infrequent; therefore, the snow melt system was addressed using a dedicated electric boiler and was not incorporated into the operation of any of the proposed ground source heat pump systems.

We have also carried a sum of $140,000 in the report estimate to cover renovations to the French Hall Lower Level toilet rooms, for ADA compliance. This sum is carried in all options.

A life cycle cost analysis (LCCA) was conducted to further investigate how each system would perform from an energy, first cost, and maintenance cost standpoint over the life of the mechanical system. These systems are:

System Option 1: Variable Air Volume system with heat recovery, and outdoor air economizer cycle. Heating and cooling are provided by ground source water-water heat pump equipment generating both hot and chilled water.

System Option 2: Four-pipe Fan Coil Unit heating and cooling combined with decoupled dedicated outdoor air units (DOAS) with heat recovery. Heating and cooling are provided by ground source water-water heat pump equipment generating both hot and chilled water.

System Option 3: Geothermal ground-source heat pump (GSHP) water-air equipment with heating and cooling combined with decoupled dedicated outdoor air units (DOAS) with heat recovery.

Geothermal water-air heat pump system was found to offer the Campus the best value from the standpoint of first cost and operating efficiency over the life of the system. It also has the least complex constructability requirements. Therefore, GSHP System Option 3 is recommended.

A. Cost

Rough construction costs were estimated for each system option. These costs were used in the Life Cycle Cost Analysis (LCCA) to help determine the most economical alternative. A summary of life cycle costs for each option is shown in the figure below. First costs, equipment replacement costs and utility costs are shown based on a 20-year analysis. The system options are ranked according to net present value (NPV). Details of the project construction costs (first costs) are provided in Section 7 of this report.

System Option Annual Energy Use, Cost, and Intensity Overview								
HVAC System/Model	**Electricity (kWh)**	**Natural Gas (Therm)**	**Electricity Cost**	**Gas Cost**	**Total Utility Cost**	**Modeled Energy Use Intensity (kBtu/sf/year)***	**Building Peak Load w/ Snowmelt (kW)**	**Building Peak Load w/o Snowmelt (kW)**
Calibrated Existing Conditions Model	267,516	12,807	$ 14,528	$ 9,157	$ 23,685	109.4	n/a	n/a
Adjusted Existing Conditions Model	271,530	14,708	$ 14,757	$ 10,517	$ 25,274	119.5	n/a	n/a
Option 1: VAV w/ GL	353,419	-	$ 22,755	$ -	$ 22,755	**60.1**	296.0	82.7
Option 2: FCU w/ GL	270,596	-	$ 17,844	$ -	$ 17,844	**46.1**	280.3	66.3
Option 3: GSHP	223,329	-	$ 15,467	$ -	$ 15,467	**38.0**	276.0	62.5

*EUI includes 270kW electric boiler for options 1-3 for snow melt system, which contributes approximately 5.1 EUI in each model and adds ~210kW peak load during winter operating conditions

Life Cycle Cost Analysis			
HVAC System/Model	**Total Project Construction Cost** (includes snowmelt & ADA restroom in each scenario)	**20 Year Discounted Cash Flow Costs**	**Total 20 Year Life Cycle Net Present Value**
Option 1: VAV w/ GL	$ (5,589,269)	$ (381,133)	$ (5,970,402)
Option 2: FCU w/ GL	$ (5,603,295)	$ (305,368)	$ (5,908,663)
Option 3: GSHP	$ (5,094,111)	$ (268,697)	$ (5,362,808)

Net Present Value Life Cycle Costs: French Hall MEP System Options

The Ground Source Heat Pump with Water to Air Heat Pump Units, (Option 3), has the lowest estimated life cycle cost as well as the lowest net present value. Additionally, Option 3 uses the least amount of energy.

The GSHP option will have the lowest carbon emissions, the lowest EUI, and is the only option that achieves an EUI under 40 kBtu/sf/year.

B. Constructability/Phasing

Due to the complexity of each recommended system, and the wholesale replacement of existing heating and cooling systems as part of any recommendation, a phased approach, though possible, is not recommended.

Both heating and cooling equipment will be required to be removed from the mechanical room, in their entirety, to create enough space for the recommended heat pump infrastructure of any of the three recommended systems. The duration of construction is anticipated to be a minimum of 18 months and will span cooling seasons and heating seasons.

To accommodate phased construction, a parallel mechanical room must be constructed to house the heat pump and ventilation systems. Once construction is complete, it may be possible to renovate and re-occupy a portion of the existing mechanical room, however, there will be a net-loss in habitable floor space in French Hall.

To achieve the most efficient and cost-effective schedule for renovation, and result in maximum habitable space once the project is complete, vacating the building during construction is the recommended approach.

Discussions with the campus in March of 2020 indicated that French Hall could be completely vacated during construction. Additional space to re-deploy staff will become available once the Dana Hall is complete. Space will be available in areas of Wicks Hall formerly occupied by Campus Police as well as unassigned areas in Dana Hall.

Plans have been included in this report to allow for a better understanding on how the geothermal system would be implemented in French Hall. These plans should be used as a guideline for timeframe and construction sequencing for the removal of the existing systems and installation of the new mechanical and electrical system(s).

C. Energy Modeling and Analysis

Energy modeling was used both to capture the performance of the existing building conditions and to evaluate the system options. An energy model of the existing conditions for French Hall was created with eQUEST software and calibrated to the utility bill data provided by the campus. This model was revised for each of the three system options. The energy consumption and energy costs of each of these options was used to inform the life cycle cost analysis.

2.0 Existing Conditions

2.1 HVAC Systems Summary

French Hall was constructed circa 1966 and occupied in 1967. French Hall is a 21,000-sf two-story office building that serves the offices of SUNY Canton administration and admissions.

The MEP systems for French Hall are in the lower level mechanical/electrical rooms. An air handler that serves the upper level is in a mechanical space located over the East Entry Stairs. The main electrical switchgear for French Hall is in a neighboring building, Nevaldine Hall.

Figure 1: French Hall West Elevation

Figure 2: French Hall East Elevation

2.2 Central Heating System

Low pressure (15 psig) steam is produced by a 2000 MBH, natural gas fired boiler located in the lower level mechanical room. The boiler manufacturer is Cleaver Brooks.

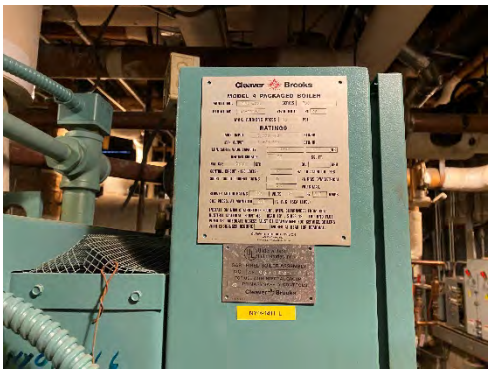


Figure 3: Existing Steam Boiler

A portion of the steam generated by the boiler is used in the preheat coil sections of the air handlers serving the first and second floors. However, most of the steam is used to generate heating hot water via a skid-mounted pump/heat exchanger system located adjacent to the boiler, see Figure 4. The skid distributes heating hot water to duct mounted reheat coils serving the upper and lower levels, perimeter finned tube, and fan coil units on both floors.

The building heating system is original, however, the current steam boiler is not original to the original boiler was replaced circa 2007, The piping, heating hot water skid, condensate pumps and air handlers are original to the building and beyond their useful life expectancy.

The existing steam heating system, by its nature, is inefficient. The steam boiler has a maximum efficiency of 80%, and system losses associated with the conversion of steam to hydronic heat likely reduce the effective efficiency to 75%-78%.

A 15-18% improvement in energy efficiency could be recognized by switching to condensing hot water boilers and direct hydronic distribution systems.

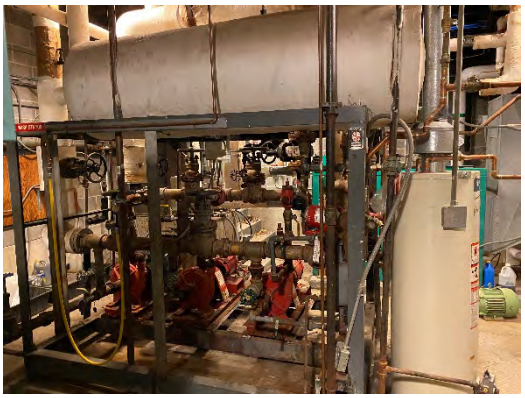


Figure 4: Existing Steam/HW Converter Station

2.3 Cooling/Air Conditioning System

Air Conditioning for French hall is achieved via a central water chiller located in the mechanical room. Chilled water is generated by a 77 ton, water-cooled centrifugal chiller manufactured by Carrier. The chiller appears to be original to the building.

The coinciding Baltimore Air Coil cooling tower was installed circa at the time of the chiller and is located on an equipment pad adjacent to the mechanical room, outside the building. A condenser water pump circulates water from the chiller to the cooling tower and appears to be original equipment. The tower is in poor condition and will be replaced during the summer of 2020

The chilled water system serves cooling coils in the air handling unit that serves the second floor "core areas", as well as fan coil units that serve perimeter offices and lower level offices and conference rooms.

Figure 3: 77 Ton Water-Cooled Chiller in Mech Room

Figure 4: Cooling Tower adjacent to French Hall

2.4 Air-Handling and Ventilation Equipment

French Hall is served by two original air handling units.

Lower Level Ventilation Unit: The ventilation unit serving the lower level is a 1,560 CFM, steam-heating-only, air handler, located in a storage room in the North-West Corner of the lower level. This air handler provides tempered ventilation air and distributes ventilation air throughout the lower level, via ductwork, to offices, conference rooms and common areas. Space temperature control in the lower level is provided by fan-coil units located in the individual spaces.

The lower level air handler is reported to be noisy and has been disabled. No ventilation is provided to the lower level offices now that this unit has been de-commissioned

Upper Level Air Handling Unit: The unit serving the upper level is a 6,400 CFM heating and cooling air handler, located in a mechanical space above the main communicating stair. The air handler is equipped with a steam pre-heat coil, a steam re-heat coil, and a chilled water cooling-coil.

This air handler distributes heating and cooling to the "core" of the upper level via duct systems and supplies minimal air to perimeter offices. Space heating and cooling for perimeter offices is provided by fan-coil units located along the exterior walls.

The upper level air handler is located in a mechanical space over the communicating stair. Access to the Upper Level Air Handling Unit is only available through a 24"x24" hatchway, available through a private office. Maintaining this air handler is extremely difficult and inconvenient.

Figure 5: 1,560 CFM Lower Level Vent. Unit

Figure 6: Access to 6,400 CFM Upper Level AHU

2.5 French Hall Fan-Coil Equipment

All of the upper level perimeter offices in French Hall, and the entirety of the lower level is heated and cooled using fan-coil equipment. The fan coil equipment is "two-pipe" and utilizes hydronic supply and return piping to each unit to heat and cool the spaces. In the mechanical room, a change-over valve exists between the chilled water system and the heating hot water system.

Depending on the season, either chilled water or hot water is distributed to the fan coil equipment. A steel enclosure conceals perimeter fan coils and finned tube radiation on both levels.

Internal rooms on the lower level are equipped with floor mounted, console-type, fan coil units.

Figure 7: Lower Level Perimeter Fan Coil and Finned Tube System

Figure 8: Typical Lower Level Console Fan - Coil Unit

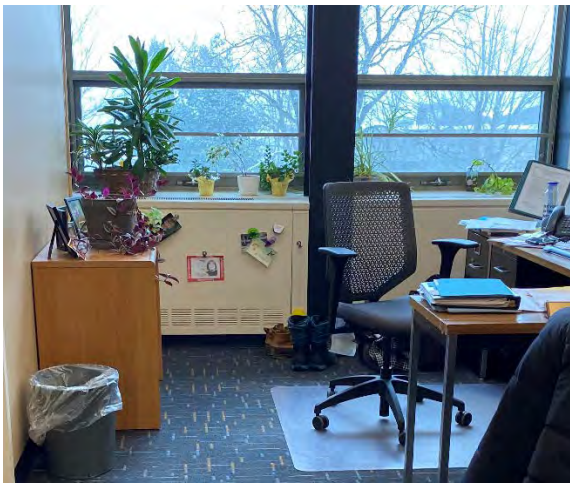


Figure 9: Upper Level Finned tube and Fan Coil Enclosure

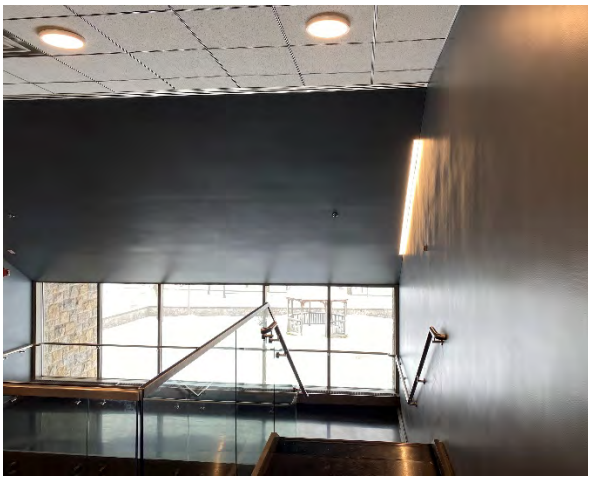


Figure 10: Upper Level Air Handler is Located above Communicating Stair

2.6 Exhaust Systems

Exhaust for the building is minimal. Exhaust is limited to general toilet rooms and mechanical spaces and relieved out louvers and roof vents. Equipment is original to the building, beyond its useful life, and recommended to be replaced.

2.7 HVAC Control Systems

The building automation controls are accomplished through a combination of pneumatics which are original to the building and newer Siemens DDC control. The control head end box is in the lower level mechanical room and actuators and valves appear to be a combination of pneumatic or DDC electric, depending on their vintage. Pneumatics are provided by an air compressor located in the lower level mechanical room.

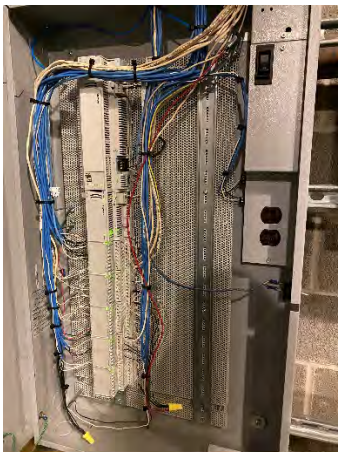


Figure 11: Existing Building Controls

Figure 12: Control Air Compressor

2.8 Central Data Center HVAC Systems

A portion of the lower level of French Hall serves as the campus telephone and communication hub. The space is served by a dedicated Computer Room Air Conditioning Unit (CRAC Unit). The unit capacity is nominally 5 tons, and it is equipped with its own dedicated condensing unit. The CRAC unit is a Data-Aire split system and is new as of April 2020.

Figure 13: Computer Room Air Conditioning Unit

3.0 Electrical Existing Conditions

3.1 Electrical Service Entrance

The French Hall electrical service is fed from a one-unit substation located in the lower level of Nevaldine Hall. Nevaldine Hall is a separate building located on the east side of French Hall. The Nevaldine Hall unit substation consists of a 5kV selector switch fed by two 4160V circuits from the campus double ended radial distribution system. The campus distribution system is backed up by a medium voltage standby generator system. Transfer between the two 4160V circuits is manual.

A fused load break disconnect feeds a 4160V – 277/480V dry type transformer, and a switchboard distribution section consisting of individually mounted molded case circuit breakers. French Hall electrical service is fed from a 700-amp, 480V, 3-pole circuit breaker within the distribution section.

Figure 14:
French Hall Unit Substation
5kV Selector Switch & Fuse Section

Figure 15:
French Hall Unit Substation
Transformer & Switchboard Section

Figure 16:
French Hall 700-amp, 480-volt, 3-pole Feeder Circuit Breaker

3.2 French Hall Electrical Service Entrance

French Hall has an Electrical Room on the building's lower level and an Electrical Closet on the upper level. The Nevaldine 700-amp feed, 480Y/277V, 3-phase underground electrical service enters the building in the lower level Electrical Room and terminates in the French Hall's Main Distribution Panel which is equipped with a 600-amp, 480V, 3-pole main circuit breaker.

The existing service size is adequate for the current building requirements. However, if the building's existing HVAC system is replaced by a Geothermal Ground Source Heat Pump system, the capacity of the existing electrical service is a concern. Refer to Electrical concept Design Considerations (Section 5) and Electrical System Recommendations (Section 6)

Figure 17:
French Hall Lower Electrical Closet

Figure 18:
Upper Level Electrical Closet – Left Wall

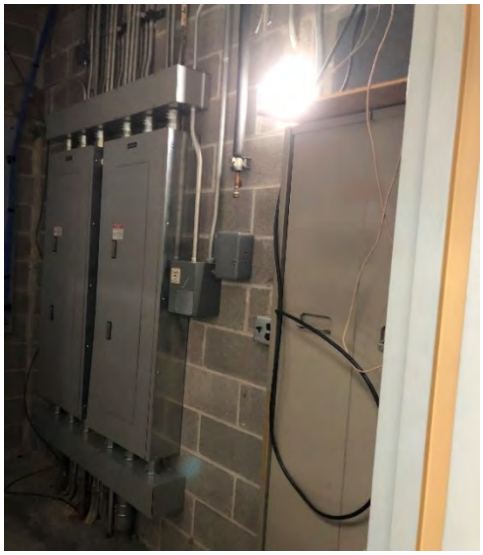


Figure 19:
Upper Level Electrical Closet – Right Wall

3.3 Electrical Distribution System / Branch Panelboards

The Main Distribution Panel distributes 480Y/277V power to: lighting/HVAC equipment panelboards in the Electrical Room and upper level Electrical Closet; an elevator panelboard; the building's chiller and motor starter rack and to an 112.5kV, 480V:208Y/120V dry transformer.

The 112.5kVA transformer provides 208Y/120V, 3-phase power to power/utility panelboards in the Electrical Room and upper level Electrical Closet, and also to a power/utility panelboards located in the elevator machine room, north east telecommunications room, and main telecommunications room.

The panelboards in the lower level Electrical Room and telecommunications room are original to the building, and they are approaching 55 years while their life expectancy is 40 years. They are Federal Pacific manufactured panelboards, which are obsolete and have a history for failure.

The panelboards in the upper level Electrical Closet have been replaced with Eaton Cutler Hammer Panelboards.

Figure 20:
Lower Level Electrical Room –
Typical Branch Circuit Panelboard

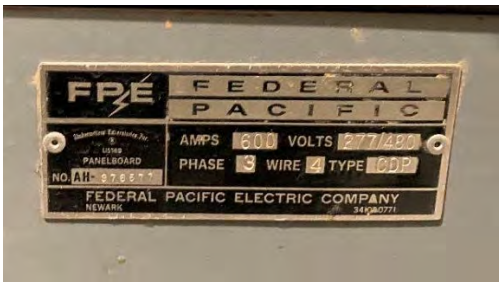


Figure 21: Panelboard Nameplate

Figures 22:
Upper Level Electrical Closet – Typical Branch Panelboards

3.4 Telecommunications Room Back-Up Power Generator

An open set 25kVA, 208Y/120V (70 Amps) generator is located in the Mechanical Room, which is adjacent to the lower level Electrical Room. An automatic transfer switch is located in the Electrical Room. The generator provides back-up power to the adjacent eight-circuit load center and to the Telecommunications Room's panelboard.

The eight-circuit load center indicates that it serves emergency loads, however this installation does not meet the NFPA 110 emergency lighting requirements. The Telecommunications Room panelboard serves the room's HVAC equipment, power, and lighting.

The age of the generator is currently unknown. A monthly inspection journal indicates inspections starting in 2010, but the generator appears to be much older than that. The performance of the system may not be reliable, as indicated by a note taped to the transfer switch enclosure.

Figure 23:
Telecommunications Room Back-Up Power - Natural Gas 25kVA Generator

Figures 24:
Automatic Transfer Switch with Operation Instructions for
"IF POWER FAILURE AND GENERATOR DIDN'T TRANSFER"

Figure 25:
Transfer Switch

Figure 26:
8-Circuit Load Center

3.5 Central Emergency and Exit Lighting Inverter System

The emergency lighting inverter is located in the main electrical room, which is not compliant with NFPA 110 (Standard for Emergency and Standby Power Systems) current requirements. Per NFPA 110, a Level 1 EPS (Emergency Power Supply) must be installed in a room separated from the rest of the building by construction with a 2-hour fire rating.

From the available existing construction documents, this system provides emergency power to the building's exit lights, and to 32VDC luminaires located throughout the building. A building shutdown would need to be performed to verify that the emergency illumination is compliant with today's codes.

The building does not have emergency lighting at the exit egress, which does not meet NFPA 101 (Life Safety Code.) In addition, the exit lights are to remain illuminated at all times, however many exit lights are not illuminated, and it is suspected that they therefore are not illuminated in the event of loss of power to the building.

Figure 27:
Emergency Lighting Inverter

Figure 28:
32VDC Emergency Luminaire

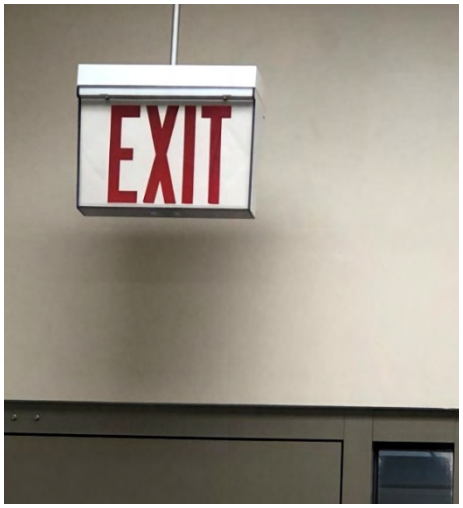


Figure 29:
Exit Luminaire – Not Illuminated

3.6 Fire Alarm System

The fire alarm control panel (FACP) is located in the upper level Electrical Closet. It has been upgraded to an addressable Simplex 4100ES model. The enclosure from the original FACP is now being used as a pull box.

The building does not have a remote annunciation panel (as required by NFPA) at the area where first responders enter a building.

Smoke detection, manual pull stations and notification appliances are located throughout the building. A few areas were noted where additional notification appliances should be added. Otherwise (with exception to the remote annunciation panel), the fire alarm system appears to the current requirements of NFPA 72 (National Fire Alarm and Signaling Code.)

Figure 30:
Addressable Fire Alarm Control Panel

Figure 31:
Fire Alarm Initiating Devices & Notification Appliances

3.7 Telecommunication and Data Systems

The campus Telecommunications and Data Equipment Room is located on the lower level of French Hall. The telecommunications is an analog system and serves the entire SUNY Canton Campus.

A (HFC-277ea) Clean Extinguishing Agent System is installed in the room. Upon detection of smoke within the room, this fire suppression system is activated. A warning bell and strobe annunciator are located above the systems panel with an “Extinguishing System Abort” yellow push-and-hold button located to the side of the panel. Warning signage is provided on the control panel. Warning Signage and horn/strobe annunciation are also posted outside the door.

A dedicated panelboard in the room provides power for the Room’s HVAC, lighting, and power. The panelboard has back up power by the generator. The room is environmentally controlled and is sufficiently cooled.

An additional data rack is located in an IT Closet located on the lower level in the north-east corner of the building. The IT Closet also has a dedicated panelboard that provides power for the IT

Room's HVAC, lighting, and power. The panelboard also provides power to the Security System equipment located within the room. The data rack is equipped with an UPS. The room is environmentally controlled and is sufficiently cooled.

Figure 32:
Analog Telecommunication System Serves the Entire SUNY Canton Campus

Figure 33:
Data Rack

Figure 34:
Clean Extinguishing Agent System

Figure 35:
Warning Signage and Horn/Strobe Annunciation

Figures 36:
Telecommunication Vault - South Side of Building

Figure 37:
Telecommunications Cables to Vault

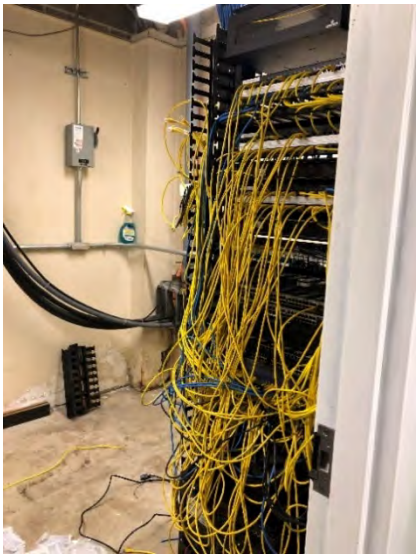


Figure 38:
North East Data Closet

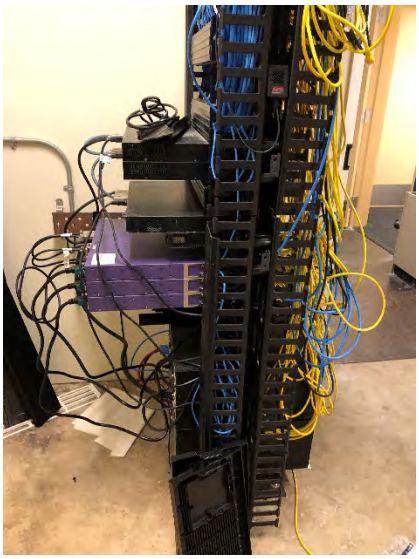


Figure 39:
Data Rack

Figure 40:
Telecommunication Cable to Campus Buildings

3.8 WIFI Wireless Internet

Wireless access points (for wireless internet connection) were observed throughout the upper and lower floors.

Two (2) types of routers were noted, ceiling and wall mounted. It appears that new routers have been installed, and the old routers have not been removed. Ceiling and wall mounted routers located near each other are labeled with the same IP address.

Figures 41:
Ceiling and Wall Mounted Wireless Internet Routers with the Same IP Address

3.9 Security / Access Control / Surveillance Systems

Card swipes are located on the doors from the vestibules to the lobbies on the upper and lower levels.

A security camera was observed in the upper lobby. A Stanley Security Solutions Panel is located in the north-east data closet.

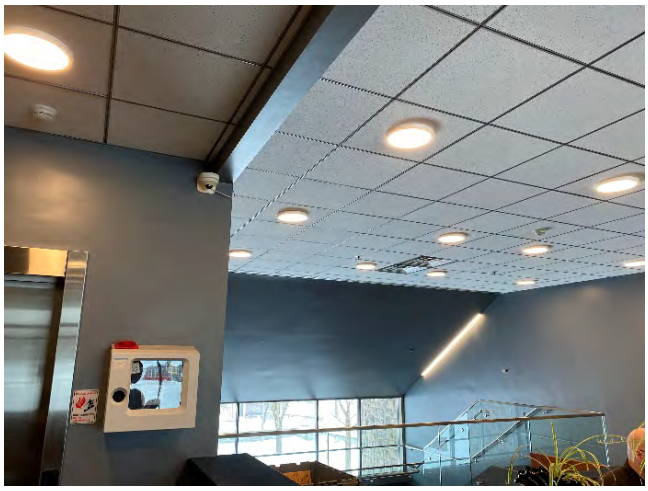


Figure 42:
Security Camera – Upper Level Lobby Area

Figure 43:
Stanley Security Solutions Panel - NE Data Closet

Figure 44:
Card Swipe – Upper Level Vest. to Lobby Door

Figure 45:
Card Swipe – Lower Level Vest. to Lobby

3.10 Interior Luminaires:

Many of the building's luminaires are fluorescent lay-in-grid troffers, with deep cell parabolic which were very popular in the late 1990's. Open office area light luminaires have been replaced with a bat wing LED type recessed troffer. Other areas have florescent lensed recessed troffers, recessed can luminaires, and surface mounted round LED luminaires in the upper lobby.

Figures 46:
Representative Photos of Interior Luminaires

3.11 Interior Lighting Controls

All open offices, corridors, lobbies and vestibule area lighting are controlled by wall snap switches. This does not meet the requirements of the NYS Energy Code over the past 30 years.

Individual offices and upper level storage room and break room have been retrofitted with wall mounted vacancy sensors. In compliance with current code requirements, the sensors are set such that they have to be manually turned on, but will turn the luminaires off when occupancy is no longer detected.

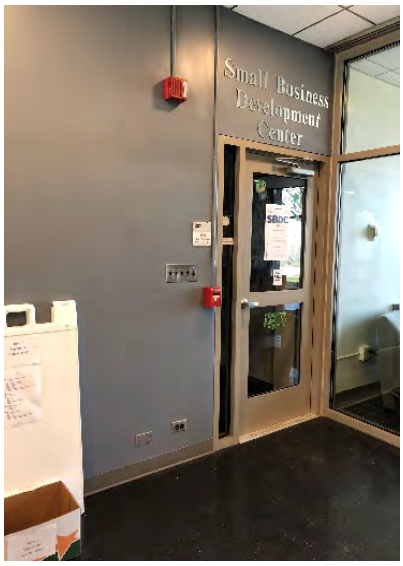


Figure 47:

Examples of Lighting Switch Banks

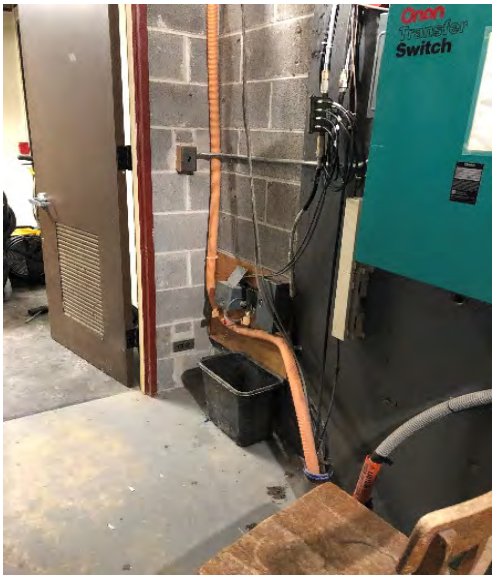


Figure 48:
Utility Room Light Switch

Figure 49:
Vacancy Sensor - Upper Level Storage Room

3.12 Exterior Building Mounted Luminaires and Control:

Recessed can lighting is installed in the overhangs around the exterior of the building. The 120-volt exterior lighting is fed from a panelboard located in the upper level electrical closet. An Intermatic Astronomic time clock is located adjacent to the panelboard.

Although the exterior lighting meets the NYS Energy Code requirements, there is no emergency egress lighting and therefore does not meet NFPA 101 Life Safety Code.

Figure 50:
Upper Level Entrance

Figure 51:
Lower Level Entrance

Figure 52:
North Exterior Building Lighting

Figure 53:
South Exterior Building Lighting

Figure 54:
Astronomic Time Clock

MEP Concept Design Considerations

4.1 HVAC Concept Design Considerations

The system issues and corresponding design challenges that will be important are:

Project HVAC Considerations	Design Challenges
Phasing/Constructability	Limited Swing Space, no additional space in mechanical room to construct parallel systems. Both heating and cooling systems will need to be removed in their entirety prior to installation of new heat pump equipment.
Project Cost	First Cost vs. Life Cycle Cost
Energy Efficiency (Low Cost)	Equipment and System Eff Meeting Campus Goals
Comfort Conditions	Existing building envelope/proper system zoning. Equipment to handle variability of occupancy and thermal loads
Indoor Air Quality	Demand Controlled Ventilation without introducing excess outdoor air requiring conditioning
Low Noise/Good Acoustical Isolation	Minimize noise in office environment

The building renovation will include all new HVAC systems and zoning within the existing envelope.

The college has requested that the air handling unit over the stairway be removed and relocated as part of the project. This equipment is at the end of its useful life and is logistically difficult to maintain. The mechanical space shall be demolished and converted to store-front glazing offering a view of the campus from the entry lobby. New air handling equipment will be relocated to the basement mechanical room

We recommend removing the existing steam and chilled water plants and updating mechanical systems with high-performance hydronics for better efficiency and control.

New HVAC systems will utilize energy conservation techniques to the greatest extent possible and components designed with accessibility for maintenance.

Heating and cooling systems shall be designed and zoned to enable the building to operate at part-load capacity and minimize the amount of ventilation air required by measuring CO2 levels.

The mechanical systems shall be designed to exceed New York State Energy Code (with supplements) and meet or exceed the performance requirements of SUCF Directive 1B-2, Deep Energy Retrofit projects.

4.2 HVAC System Options

The building is essentially divided into two HVAC zones. The upper floor central air handler and perimeter systems and similar distribution on the lower floor. Airside systems are constructed in such a fashion that phased construction could take place one floor at a time. However, the central plant systems, hot water and chilled water, are centralized in a very small mechanical room.

Both the boiler, the chiller and their associated distribution pumps must be removed in their entirety to make room for the new heat pump equipment. Given the limited space in the mechanical room, a phased construction approach is not recommended. We suggest that the building be completely vacated during construction so both the heating and cooling systems can be removed in their

entirety and replaced with new heat pump equipment. The campus has indicated that Staff from French Hall could be re-deployed once Dana Hall is complete and occupied, and additional administrative space becomes available on campus. An estimated 18 month construction window is anticipated.

The campus indicated that re-deploying staff to other locations was possible, and that additional office space will become available in Wicks Hall and in Dana Hall once construction at Dana Hall is complete.

Pathfinder has evaluated three system options, which we believe are best suited for this building type and function. Each system was analyzed for its ability to provide incremental control and its ability to meet the performance characteristics of Deep Energy Retrofits.

Each system is all-electric and will not use fossil fuels. Renewable sources of electricity may be used to provide all heating and cooling in the building.

- **Option1**: Variable Air Volume system with heat recovery and free-cooling outdoor air economizer cycle. The Central Plant will consist of Water-Water Ground Source Heat Pump Equipment generator both heating hot water and cooling chilled water.
- **Option 2**: Four-pipe Fan Coil Unit heating and cooling combined with decoupled dedicated outdoor air units (DOAS) with heat recovery. Fan coil units will be located within the building zones, and the central decoupled DOAS unit will distribute ventilation through the spaces. The central Plant will consist of Water-Water Ground Source Heat Pump Equipment generator both heating hot water and cooling chilled water.
- **Option 3**: Traditional ground source heat pump system with water-air heat pumps located within the building zones and a central, decoupled DOAS with heat recovery unit providing tempered ventilation to the spaces.
- **All Options**: A ground source heat exchanger (GSHX) will be utilized as the heat-source/sink for the mechanical systems. After discussion with the campus and review of the surrounding terrain, Parking Lot 7 appears to be large enough to accommodate a full GSHP system for French Hall and have the capacity for the number of vertical wells needed to fully condition the building. A vault will be provided to consolidate the well-field piping in a common location, and 4” pipes extended from the vault to French Hall. The vault will be expandable and will allow for integration of the well field to other potential GSHP buildings on campus. That is, the design of the loop will allow for expansion to a district GSHP field loop.

  Our office has modeled the GSHP Heat Exchanger using GLHEPro 5.0, software developed by Oklahoma State University. We optimized the loop for a 30-year life considering the unbalanced heating and cooling loads. Our well field will consist of 70 wells at a depth of approximately 400 feet deep each. Output from the GSHP sizing software is included in the appendix of this report. The Ground Heat Exchanger sizing is based on assumptions of soil and rock thermo-conductivity. It is recommended that a formal thermo-conductivity test be performed, with a test well, prior to finalizing the GSHP heat exchanger design.

Parking Lot #7 – Proposed Ground Source Heat Exchanger Location

Site East of French Hall – Alternate Location for Ground Source Heat Exchanger
Rolling terrain and trees may make this location a challenge for drilling equipment.

Snow Melt (All Options): Underground piping to accommodate a future snow melt system will be installed in the courtyard to the East of French Hall as part of a site improvement project during the summer of 2020. Incorporating the snow melt system into the proposed GSHP loop, with boiler "backup" was considered, however after further investigation, was discounted, and a dedicated electric boiler is recommended. The determining factors that led to the recommendation of an electric boiler are as follows:

- Snow melt systems are estimated to require a peak demand of approximately 750,000 Btuh (270 kW). This peak is nearly the same as the building peak heating load.
- Operating the snow melt system using GSHP water would detrimentally affect the heat pump's ability to condition the building. Installing additional wells to accommodate the snowmelt load is not economically viable. It would require doubling the size of the proposed GSHX well field, at a cost of over $400,000.
- Utilizing Heat Pump water with boiler backup added to the complexity and expense of the control system. Additional control points, change-over valves, pumps, etc…

- It is estimated that the snow melt system will be active approximately 150 hours per year. Given the blended electric rate of $0.05 per kWh, this would result in an annual cost of approximately $2,000.

Given the minimal use of snow melt, we recommend providing a dedicated 270 kW electric boiler to address the snow melt system, as needed. This boiler can also be connected to the water returning from the GSHX to supplement heating during extreme winter temperatures.

4.2.1. Option 1: Variable Air Volume System

Heating System

The proposed heating system is hydronic. The building will be heated by a circulated hot water system serving heating coils located in air handling units, zone VAV terminal units, baseboard radiation, unit heaters, and convectors.

The heating hot water source will be a centralized water-water ground source heat pump unit located in the lower level mechanical rooms.

Base-mounted vertical inline distribution pumps, located in a mechanical space, will circulate hot water to the air handling unit and VAV boxes. We recommend that the existing perimeter finned tube enclosures be removed, additional insulation installed below the windows, and slotted linear diffusers be installed along the perimeter walls to wash the envelope with warm air during the heating season.

All hydronic pumping systems will be equipped with redundant, variable speed pumps.

The heating water loop will be variable flow and provide low temperature (+/-120°F maximum) hot water to air handling unit coils, unit heaters, terminal control units, and miscellaneous terminal heating units. The heating water pumps will utilize a variable frequency drives, based on demand. The system differential pressure operating setpoint will be automatically reset based on analyzing all control valve positions. The heating water loop supply temperature will be reset based on outside air temperature.

A dedicated heating glycol loop will temper ventilation air and protect the system from freezing.

The heating and cooling plant will consist of three (3) 60-ton (500 MBH Heating), water to water heat pump units, similar to Water Furnace WDM-060 units. Three units will provide N+1 redundancy. This equipment will generate up to 150 gpm of 115°F hot water for building heating and up to 180 gpm of 42°F chilled water for building cooling. Hot and Chilled water can be generated simultaneously.

A dedicated 270 KW electric boiler will be provided for the courtyard and entry snow melt system. The boiler will also supplement the GSHP source loop temperature, on extreme days, to boost the performance of the heating system, if needed.

The heating system will operate whenever the outside air temperatures are 65°F or less, or as scheduled through the BMS. Snow melt systems will operate in accordance with ASHRAE 90.1 6.3.4.7, which controls based on slab temperature, outdoor air temperature, and moisture sensors located in the courtyard slab.

Cooling System

As described above, the heating and cooling plant will consist of three (3) 60-ton (500 MBH Heating), water to water heat pump units, similar to Water Furnace WDM-060 units. Three units will provide N+1 redundancy. This equipment will generate up to 150 gpm of 115°F hot water for building heating and up to 180 gpm of 42°F chilled water for building cooling. Hot and Chilled water can be generated simultaneously.

The chilled water system will be “primary/secondary” with duplex primary pumps circulating the chiller and duplex secondary pumps circulating chilled water to air handling unit cooling coils.

Secondary pumps will be variable flow and track based on chilled water demand. The system differential pressure operating setpoint will be automatically reset based on analyzing all control valve positions.

Chilled water piping will be welded Schedule 40 Black Steel and insulated in accordance with ASHRAE Requirements.

The Chiller System (i.e., mechanical cooling) shall operate automatically whenever outside air temperatures are above 60°F, or as scheduled through the energy management system.

Air Distribution Systems

A single 20,000 cfm air handling unit is proposed for French Hall and will be located in a mechanical space on the lower level. There is insufficient space to install the air handler within the existing mechanical room, therefore additional floor space must be encumbered and converted to a mechanical equipment room.

The unit will provide the necessary ventilation and supply air to maintain the desired environmental conditions and make-up air requirements. Minimum ventilation air rates will be determined by the requirements set forth by the current ASHRAE Standard 62 and the Mechanical Code of New York State, and modulated based on CO2 monitoring.

The air handler will be equipped with 100% outside air economizer cycle for free cooling. All air-moving equipment and ductwork will be replaced in accordance with requirements of SMACNA and ASHRAE.

The proposed air handling unit will be a semi-custom unit, variable air volume, medium pressure air handling unit(s) with direct drive, plenum type airfoil supply fans, return fans, economizer Section, mixing box, filter Section with 30% (MERV 8) prefilters and 85% (MERV 13) final filters (with differential pressure gauge across each filer bank), hot water preheat coil with circulating pump(s), and chilled water coil. Outside air, relief air, return air and supply air streams will be equipped with air flow measuring stations.

The return air fan will volumetrically track supply air. Relief air will volumetrically track outside air to maintain a slight positive building pressure.

All outside air will be preconditioned via a heat recovery wheel, capturing energy from the exhaust air stream.

The air handling unit will distribute air at nominally (55°F) to zone VAV boxes. Each office, conference room or common zone will be provided with a VAV box with reheat coil for independent control.

Return air will be combination plenum/duct.

Advantages

The advantages of this system include:

- Full air-side economizer for free cooling (i.e., no mechanical cooling).
- Single centrally located air handling unit for simplified maintenance.
- Combined heating HW and Chilled water systems with N+1 redundancy
- VAV systems tend to be quiet since there is no radiated fan noise from the terminal units.
- Improved zone level temperature control.

- Ability to generate simultaneous hot water and chilled water with minimal energy use, via the heat pump system.

Disadvantages

The disadvantages of a VAV system include:

- It is an 'all air' system and the building's heating and cooling energy is transported through large ductwork which could be challenging in areas of limited ceiling space.
- Limited level of control in that the system is either in heating mode or cooling mode. This system can only accommodate simultaneous heating and cooling on days when ambient conditions can provide economizer cooling.
- The new central air handler will be large and will require giving up additional floor space to accommodate its installation. A roof mounted unit is also a possibility; however this will require construction of a penthouse enclosure to meet SUCF Directives.
- Large first cost.

Constructability

The installation of a central VAV air handling system would be challenging. There is not adequate room for the air handler in the existing mechanical room, additional floor space in the lower level or a rooftop unit would be required.

The existing mechanical room is too small to accommodate the installation of the new water-water heat pumps, hydronic pumps, and accessories without first removing the existing boiler, chiller and pump sets.

The duration of construction is estimated to be approximately 18 months.

A phased approach is not feasible for this alternative. We recommend that the building be vacated so complete renovation can occur.

System Performance

Under this option, the estimated cost to install a central air VAV system is **$5,589,269**. The annual energy cost projection based on energy modeling is **$22,755.** For this study, it has been assumed that at year 20, the water-water heat pump units, air handling unit and all associated pumps would need to be replaced. Also starting at year 20, VAV boxes would begin being replaced at a rate of 10% per year. Total system replacement costs after 20 years are estimated at **$532,840**. Refer to the Energy Modeling and LCCA section of this report for additional information.

4.2.2. Option 2: Four-Pipe Fan Coil Unit System

Heating System

The proposed heating system is hydronic. The building will be heated by a circulated hot water system serving heating coils located in fan coil units and ventilation equipment.

The heating hot water source will be a centralized water-water ground source heat pump unit located in the lower level mechanical rooms.

Base-mounted vertical inline distribution pumps, located in a mechanical space, will circulate hot water to the dedicated ventilation air handlers and fan coils.

We recommend that the existing perimeter finned tube enclosures be removed, additional insulation installed below the windows, and slotted linear diffusers be installed along the perimeter walls to wash the envelope with warm air during the heating season.

All hydronic pumping systems will be equipped with redundant, variable speed pumps.

The heating water loop will be variable flow and provide low temperature (+/-120°F maximum) hot water to air handling unit coils, unit heaters, terminal control units, and miscellaneous terminal heating units. The heating water pumps will utilize a variable frequency drives, based on demand. The system differential pressure operating setpoint will be automatically reset based on analyzing all control valve positions. The heating water loop supply temperature will be reset based on outside air temperature.

A dedicated heating glycol loop will temper ventilation air and protect the system from freezing.

The heating and cooling plant will consist of three (3) 60-ton (500 MBH Heating), water to water heat pump units, similar to Water Furnace WDM-060 units. Three units will provide N+1 redundancy. This equipment will generate up to 150 gpm of 115°F hot water for building heating and up to 180 gpm of 42°F chilled water for building cooling. Hot and Chilled water can be generated simultaneously.

A dedicated 270 KW electric boiler will be provided for the courtyard and entry snow melt system. The boiler will also supplement the GSHP source loop temperature, on extreme days, to boost the performance of the heating system, if needed.

The heating system will operate whenever the outside air temperatures are 65°F or less, or as scheduled through the BMS. Snow melt systems will operate via temperature and moisture sensors located in the courtyard slab.

Cooling System

As described above, the heating and cooling plant will consist of three (3) 60-ton (500 MBH Heating), water to water heat pump units, similar to Water Furnace WDM-060 units. Three units will provide N+1 redundancy. This equipment will generate up to 150 gpm of 115°F hot water for building heating and up to 180 gpm of 42°F chilled water for building cooling. Hot and Chilled water can be generated simultaneously.

The chilled water system will be “primary/secondary” with duplex primary pumps circulating the chiller and duplex secondary pumps circulating chilled water to air handling unit cooling coils.

Secondary pumps will be variable flow and track based on chilled water demand. The system differential pressure operating setpoint will be automatically reset based on analyzing all control valve positions.

Chilled water piping will be welded Schedule 40 Black Steel and insulated in accordance with ASHRAE Requirements.

The Chiller System (i.e., mechanical cooling) shall operate automatically whenever outside air temperatures are above 60°F, or as scheduled through the energy management system.

Air Distribution Systems

A combination of console and horizontal-ducted fan-coil units will be provided for each room or zones of common rooms. These units will recirculate air within the space and be equipped with both heating and cooling coils, (4-pipe units).

We recommend that the existing perimeter finned tube enclosures be removed, additional insulation installed below the windows, and slotted linear diffusers be installed along the perimeter walls to wash the envelope with warm air during the heating season.

Ventilation for spaces will be supplied through dedicated outdoor air-handling systems (DOAS). DOAS units will consist heat recovery technology and provide neutral ventilation air to each room or zone.

DOAS equipment will monitor space CO2 levels and provide the minimum amount of outside air for ventilation as determined by the requirements set forth by ASHRAE Standard 62, The International Mechanical Code and the makeup air requirements to maintain a slight positive building pressure.

Exhaust air will be brought back to the heat recovery unit for energy reclamation via a ducted return air system, then discharged to the outside.

We anticipate one 4,000 cfm DOAS unit for French Hall. Heat recovery media will be made up of multiple heat wheels and flat plate heat exchangers with supplemental heating and cooling coils. A bypass will be provided around heat recovery media to allow for "economizer-free-cooling" operation.

As each fan-coil will provide cooling, a dedicated condensate drainage system will need to be provided for the system.

Advantages

The advantages of this system include:

- Superior indoor air quality through use of dedicated ventilation air units.
- Superior air-side energy-conserving heat recovery.
- Ability to generate simultaneous hot water and chilled water with minimal energy use, via the heat pump system.
- Fan coil units are relatively quiet and are readily available in a wide range of sizes and capacities. These units are easily and inexpensively serviced (fan motor and throwaway filter). This system also has the flexibility to be installed concurrently while keeping the fan coil and air handling systems online and operational.

Disadvantages

The disadvantages of the system include:

- Does not allow for full airflow free cooling through an air-cooled economizer cycle. Free cooling is only available on ventilation air.
- Multiple locations to maintain fan coil motors, filters.
- Requires a dedicated condensate drain system to each fan coil unit.

Constructability

The installation of a four-pipe fan coil unit system will be very flexible, and the installation of smaller unitary equipment will be less disruptive than central ducted system.

Energy recovery DOAS unit(s) are compact, will be installed in the lower level mechanical room and ventilation duct extended to occupied spaces. We anticipate the existing mechanical space on the lower level will be large enough to accommodate the new ventilation equipment.

Ventilation distribution duct serving the upper floor will be installed in a new shaft and distributed to the new fan coils and/or offices throughout the upper floor.

However, as in Option 1, the existing mechanical room is too small to accommodate the installation of the new water-water heat pumps, DOAS unit, hydronic pumps, and accessories without first removing the existing boiler, chiller and pump sets.

The duration of construction is estimated to be approximately 18 months.

A phased approach is not feasible for this alternative. We recommend that the building be vacated so complete renovation can occur.

System Performance

The construction estimates to install the four-pipe fan coil unit system described in this option is **$5,603,295**. The annual energy cost projection based on energy modeling is **$17,844** For this study, it has been assumed that at year 20, the chillers, cooling tower, boilers, DOAS units and all associated pumps would have to be replaced. Also starting at year 20, individual fan-coil units would start to be replaced at a rate of 10% per year. Total system replacement costs at 20 years are estimated at **$517,060**. Refer to the Energy Modeling and LCCA section of this report for additional information

Option 3: Water to Air Geothermal System

Geothermal water-to-air heat pumps have the inherent heat recovery capability to capture waste heat from interior spaces and reuse it for perimeter spaces when the building requires simultaneous heating and cooling during the Spring/Fall seasons.

Heating/Cooling System

Heat for French Hall will be provided via water-source heat pump equipment. Similar to fan-coil units, this equipment will be incremental and distributed to serve individual rooms or common zones.

In Water to Air heat pump equipment, the heat exchange between the ground loop and the space occurs directly within the water air heat pumps. No additional system for heating hot water or cooling chilled water is required. Similar to Fan Coils, each water-air heat pump unit will provide warm air or cool air depending on the space needs.

While heat pumps are more complex than fan coil units, they are quiet, efficient, and the need for a large central mechanical room is minimal.

The source water loop will be pumped from the GSHX, through the building to each heat pump unit. Heat will be extracted or rejected to this loop, as needed by the heat pumps serving the building zones.

We recommend that the existing perimeter finned tube enclosures be removed, additional insulation installed below the windows, and slotted linear diffusers be installed along the perimeter walls to wash the envelope with warm air during the heating season.

Equipment space in the mechanical room will be minimal. Base-mounted vertical inline distribution pumps located in a mechanical space will circulate the GSHX water to each water-air heat pump located in the building zones, above ceilings, or wall mounted consoles.

Air Distribution Systems

A combination of console and horizontal-ducted water-to-air ground source heat pump units will be provided for each room or zones of common rooms. These units will recirculate air within the space and will be capable of providing either heating or cooling, year-round, depending on the space needs.

Ventilation for spaces will be supplied through dedicated outdoor air-handling systems (DOAS). DOAS units will consist heat recovery technology and provide neutral ventilation air to each room or zone.

DOAS equipment will monitor airflow to the space and adjust ventilation volume to maintain a slight positive building pressure.

Exhaust air will be brought back to the heat recovery unit for energy reclamation via a ducted return air system, then discharged to the outside.

We anticipate one (1) 4,000 cfm DOAS units for French Hall The units will be similar to a Topaz Transom Heat Recovery Air Handlers which combine the technologies of plate heat exchangers and air to air heat pumps to condition ventilation air to neutral conditions.

As each water to air heat pump will provide cooling, a dedicated condensate drainage system will need to be provided for the system.

Advantages

The advantages of this system include:

- Heat pump units can provide simultaneous heating and cooling and will provide occupants with a higher level of temperature and comfort control.
- Superior indoor air quality through use of dedicated ventilation air units.
- Superior energy-conserving heat recovery both on dedicated outside air and through the building via the heat pump loop.
- Heat pump units are relatively quiet and are readily available in a wide range of sizes and capacities. These units are easily serviced (fan motor and throwaway filter).
- This system also has the flexibility to be installed concurrently while keeping the fan coil and air handling systems online and operational.

Disadvantages

The disadvantages of the system include:

- Does not allow for free cooling through an air-cooled economizer cycle. Free cooling can only occur on DOAS ventilation air.
- Multiple locations to maintain compressors, motors and filters.
- Condensate drain system to each heat pump unit.

Constructability

The installation of a water to air heat pump unit system will be very flexible, and the installation of smaller unitary equipment will be less disruptive than central ducted system.

Energy recovery DOAS unit(s) are compact, will be installed in the lower level mechanical room and ventilation duct extended to occupied spaces. We anticipate the existing mechanical space on the lower level will be large enough to accommodate the new ventilation equipment.

Ventilation distribution duct serving the upper floor will be installed in a new shaft and distributed to the new fan coils and/or offices throughout the upper floor.

The size of the existing mechanical room is too small to accommodate the installation of the new DOAS unit, hydronic pumps, and accessories without first removing the existing boiler, chiller and pump sets.

The duration of construction is estimated to be approximately 18 months.

A phased approach is not feasible for this alternative. We recommend that the building be vacated so complete renovation can occur.

System Performance

Under this option, the proposed first cost for installing a hybrid geothermal heat pump system would be **$5,094,111** The annual energy cost projection based on energy modeling is **$15,467.**

For this study, it has been assumed that at year 20, the DOAS units, supplemental boiler, and hydronic loop pumps would have to be replaced. Also starting at year 20, individual water-source heat pump units would start to be replaced at a rate of 10% per year. Total system replacement costs over 20 years is estimated at **$342,880**. Refer to the Energy Modeling and LCCA section of this report for additional information

4.3 Building Automatic Temperature Controls / Energy Management System

The automatic temperature control system will utilize direct digital control (DDC) with electric/electronic actuation. The automatic temperature control system will be BACnet based and tied into a web-based energy management system. All control and monitoring points will be consistent with the Campus's current standards and be reviewed with the Facilities Department during design.

Automatic Temperature Controls shall be capable of operating per the sequence of operation, including when the Energy Management System is manually overridden.

The Basic Design Criteria shall be as follows:

1. Cooling Mode:
   a. Outdoor Temperature: 83°F DB, 70°F WB
   b. Indoor Temperature: 75°F DB, 65% RH or less
2. Heating Mode:
   a. Outdoor Temperature: -12°F DB
   b. Indoor Temperature: 70°F DB
3. Chilled Water System (at 83 deg F Ambient):
   a. 45°F Supply Water Temperature
   b. 60°F Return Water Temperature
4. Heating Water System (at -12 deg F Ambient):
   a. Conventional:
      i. 140°F Supply Water Temperature
      ii. 100°F Return Water Temperature
   a. Hybrid Geothermal:
      i. 110°F Supply Water Temperature
      ii. 90°F Return Water Temperature
5. Ventilation Rates (ASHRAE Standard 62):
   a. Office Spaces:
      i. 5 CFM per person
      ii. .06 CFM per sq. ft.
6. Water Source Heat Pump:
   Geothermal Loop – Variable 40°F minimum to 90°F maximum supply water Temperature

5.0 Electrical Concept Design Considerations

5.1 Nevaldine Hall – Electrical Service Unit Substation

It is difficult to pinpoint when electrical equipment will reach its end-of-life and fail, however the existing Nevaldine Hall unit substation is beyond its life expectancy by approximately 15 years. In addition, the unit substation switchboard was manufactured by the Empire Electric, which is obsolete, and only reconditioned parts are available.

The switchboard distribution section contains circuit breakers that feed French Hall and the Service Building/University Police.

Though replacing this gear is not part of the project scope, we believe this may need to be addressed at some point by the campus.

5.2 French Hall – Electrical Service Entrance Size

The existing 600 amps (480V, 3-phase) electrical service within French Hall (fed from the 700 amp breaker in Nevaldine), is adequate for the current building requirements. However, if the building's existing HVAC system is replaced by an all-electric Geothermal Ground Source Heat Pump system, the capacity of the existing electrical service will be exceeded.

The electrical service size based upon the projected Geothermal HVAC equipment loads, and the (eQuest) lighting and plug-load values used in the energy modeling, calculates to a 650 amps (480V, 3-phase) service. This does not consider other miscellaneous equipment that is not part of the HVAC system, lighting, and plug loads.

The system power factor, which is a measurement of the electrical efficiency, is another concern. A poor power factor causes a greater loss of power in the electrical distribution system and requires a larger service to compensate for it.

Documents for the service entrance conductors/conduit are not available, but this information should be able to be obtained by removing the cover plate of the main distribution panelboard. It is known that the service entrance conductors were installed before 1966, and age is a concern. It is doubtful that the existing conductors can be removed from the conduit, making the conduits unusable.

For the purposes of this study and estimating, we recommend increasing the service size to 1000 amps.

5.3 French Hall - Electrical Distribution System / Branch Panelboards

The panelboards in French Hall lower level Electrical Room (including the service entrance Main Distribution Panelboard) and the Telecommunications Room are Federal Pacific manufactured panelboards. Federal Pacific panelboards are obsolete and have a history of failing to operate properly. Using UL 289 test conditions, the Consumer Product safety Commission (CPSC) found that Federal Pacific Electric panelboard circuit breakers can melt to the panelboard bus bar, and no longer trip or can be shut off manually. This malfunction has led to fires and/or electrical shock.

The original building Federal Pacific panelboard schedules have been marked-up over the many years and are not known if they are accurate. Spare circuit breakers in these panelboards were not identified. The newer Eaton/Cutler Hammer panelboard schedules indicate sufficient available spare circuit positions.

The existing service 112.5kV, 480V:208Y/120V dry transformer appears original to the building, and in addition to exceeding its life expectancy, it's efficiency will be poor.

It is suspected that all branch panelboard feeder conductors are original to the building, and therefore beyond their life expectancy. Additionally, when the building was built, it was common practice to use the conduit as the equipment ground. Today, common practice is to run an equipment grounding conductor with the phase wiring.

5.4 Central Emergency and Exit Lighting Inverter System

The emergency lighting inverter is located in the main electrical room, which does not comply with NFPA 110 (Standard for Emergency and Standby Power Systems) current requirements. Per NFPA 110, a Level 1 EPS (Emergency Power Supply) must be installed in a room separated from the rest of the building by construction with a 2-hour fire rating.

From the available existing construction documents, this system provides emergency power to the building's exit lights, and to 32VDC luminaires located throughout the building. A building power shutdown would need to be performed to verify that the emergency illumination is compliant with today's codes.

The building does not have emergency lighting at the exit egress, which does not meet NFPA 101 (Life Safety Code.) In addition, the exit lights are to remain illuminated at all times, however many exit lights are not illuminated, and it is suspected that they therefore are not illuminated in the event of loss of normal power to the building.

5.5 Standby Generator

The generator provides back-up power to the Telecommunications Room, which is the analog phone service to the entire campus. It also provides power to an 8-circuit load center that has emergency lighting loads on it, however the installation of the generator does not meet NFPA 110 emergency lighting requirements and therefore cannot be used for emergency lighting.

The age of the generator is currently unknown. A most recent monthly inspection journal indicates inspections starting in 2010, but the generator appears to be much older than that. The performance of the system does not seem to be reliable, as indicated by a note taped to the Automatic Transfer Switch with Operation Instructions for, "IF POWER FAILURE AND GENERATOR DIDN'T TRANSFER"

5.6 Telecommunications System

The telecommunications is an antiquated analog system that serves the entire SUNY Canton Campus. Analog systems are known as POTS (Plain Old Telephone System) and are considered "relics of a bygone era." In addition to aged equipment concerns, finding personnel capable of managing these aging systems is becoming difficult.

Digital telephone service and VoIP (Voice over Internet Protocol) are more advanced means of communication and are commonly accepted by consumer groups. Digital phone service comes with advanced features, such as call forwarding, voicemail, and conference or 3-way calling.

5.7 Interior Luminaires and Lighting Controls

Many of the building's luminaires remain fluorescent type. Today's common LED luminaires are much more energy efficient and are widely used.

With exceptions of individual offices (and the upper level storage room and break room), the interior building lighting is controlled by manual wall switches which have not been compliant for decades with the Energy Conservation Code of New York State. In addition, daylight sensors would be a good application for the upper level open office areas with skylights, vestibules, and the stairwell from the upper level lobby to the lower.

6.0 System Recommendations

6.1 Mechanical System

The preliminary benefits and risks of each system are summarized in the following table.

Characteristics	VAV System with Ground Source Central Plant (1)	FCU System with Ground Source Central Plant (2)	Water to Air Ground Source System (3)
Individual zone control	Good	Excellent	Excellent
Flexibility to add zones	Excellent	Good	Excellent
Indoor air quality (ventilation)	Good	Excellent	Excellent
Acoustic isolation	Good	Good	Good
Energy efficiency	Good	Good	Very Good
Risks	Phasing Distribution space for ductwork	Coil drainage in spaces	Coil drainage in spaces and additional mech equipment to maintain
Ease of Installation	Poor	Fair	Fair to Good
Ease of Maintenance	Fair	Fair	Fair
Utility cost 1st yr (total building)	$22,755	$17,844	$15,467
First cost	$5,589,269	$5,603,295	$5,094,111
Life cycle cost (20 years, NPV)	$5,970,402	$5,908,663	$5,362,808

Notes:
1. Refer to Energy Modeling and LCCA section of report for additional information on system costs.

Based on the analysis above, we recommend that the Geothermal Water to Air Heat Pump System be installed for French Hall. The Geothermal System allows for the most flexibility in construction phasing while providing the College with the best life cycle cost out of the three HVAC systems analyzed.

The system also has characteristics that compliment French Hall's need for good zone control, acoustical performance, and the ability to capture, reuse, and transfer heat/energy between perimeter and interior spaces (Heat Recovery/Energy Efficient).

This system also best aligns itself with the clean/green energy and sustainability goals of New York State, SUCF, SUNY, and SUNY Canton. The geothermal system meets Executive Order 88 and would be an ideal candidate for the new SUCF Deep Energy Retrofit of Existing Buildings program by reducing the building's annual site energy consumption by 50% and reducing the annual site carbon consumption by 25%. It also follows the directive issued by the current SUNY Chancellor by installing systems that use or can be supplied by clean power and can contribute to reducing carbon emissions through a 'deep-energy retrofit'. The system could also be used as a teaching tool for students who enroll in the SUNY Canton Alternative & Renewable Energy Systems Academic Program.

The mechanical rooms could be laid out to allow for onsite learning about how a renewable energy system (ground source) is installed and operated.

6.2 Electrical Recommendations

6.2.1 Nevaldine Hall – Electrical Service Unit Substation

The Nevaldine unit substation that provides power to French Hall is not part of the scope of this report. However, the unit substation is obsolete and past its life expectancy, and therefore, it is recommended that it be examined. If the Nevaldine unit substation should fail, it will not only disrupt normal and back-up power to Neveldine Hall, but also to French Hall and to the Service Building/University Police. (Note: Improved efficiency is also a significant portion of the economic case to replace the old transformer section.)

6.2.2 French Hall – Electrical Service Entrance Size

It is projected that in if the building's existing HVAC system is replaced by a Geothermal Ground Source Heat Pump system, the capacity of the existing electrical service will be exceeded.

The lighting and plug loads used in the calculations are based upon the (eQuest) energy modeling values. To find a more realistic load, a demand meter can be temporarily installed to provide electrical usage readings.

It is suggested to install the meter over a two-week period when the building is at full occupancy during the summer months when the highest demand is anticipated with the chiller system operating. The demand metering will also provide important information on the buildings power factor, and how efficiently the building's power is being used. If the power factor is poor, a larger electrical service will be required to compensate for it.

It is recommended to replace/upgrade the existing electrical service entrance, and to route a new set of conduits from Nevaldine Hall to French Hall during the reconstruction of the courtyard.

For the purposes of this study, we assumed upgrading the service to 1000 amps.

6.2.3 French Hall – Electrical Distribution System / Branch Panelboards

The Federal Pacific panelboards are obsolete and well past their life expectancy. Federal Pacific panelboards have a history of failing to operate properly, which has led to fires and/or electrical shock. It is recommended to replace these panelboards. Labor time should be spent to trace all branch circuiting associated with these panelboards and to provide updated panelboard schedules with all the existing equipment served. The quantity of spare circuit breakers should be determined, and possible sub-panelboards may need to be added if not sufficient.

The panelboard feeders are also recommended to be replaced and include an equipment grounding conductor routed with the phase conductors.

6.2.4 Central Emergency and Exit Lighting Inverter System

The installation of the central emergency and exit lighting inverter system does not comply with the NEC and the NFPA requirements for a Level 1 emergency power for building exit and emergency lighting

It is recommended to relocate this system to a dedicated room with a fire suppression system in compliance with the requirements of NFPA 111, Stored Electrical Energy Emergency and Standby Power Systems; and NEC Article 110, Requirements for Electrical Installation.

It is also recommended to perform a building power shutdown and verify that the emergency lighting meets the lumen level required to meet code for egress lighting. All exit lights need to be continuously illuminated, and it is suggested to replace the failed exit lights with LED type.

Emergency exit egress lighting needs to be added to the outside of the building at all exits.

6.2.5 Standby Generator

It may be desirable to replace the aged and unreliable generator system especially since it provides back-up power for the entire campus telecom system.

If the generator remains used as a back-up power source, it can remain installed in the current location. However, any emergency associated equipment cannot be connected to this system as it does not meet NFPA requirements for an emergency power source. These circuits need to be traced out and possibly replaced with lighting/equipment with emergency battery back-up.

We did not include the cost of replacing the existing generator as part of our construction estimate.

6.2.6 Telecommunications System

It is recommended to provide a study to evaluate the existing antiquated analog telecommunication system. The college may want to consider replacing the system with a digital / VoIP (Voice over Internet Protocol) system.

6.2.7 Lighting and Lighting Control

It is recommended to replace all aged fluorescent luminaires with energy efficient LED type luminaires that flatter the space and are durable, attractive, and functional. New lighting controls should be installed in compliance with the current Energy Conservation Code of New York State. The incorporation of daylight sensors is recommended for the upper level open office areas with skylights, vestibules, and the stairwell from the upper level lobby to the lower.

7.0 Energy Modeling

Pathfinder is proposing three HVAC system alternatives for this study. In order to more thoroughly evaluate the proposed system alternatives, energy modeling is being used as a tool to compare the relative energy performance of the system options. eQUEST energy modeling software was used to model annual energy consumption and energy costs of the three HVAC system options.

At the completion of this study, sufficient information should be available to better select HVAC system type(s) and features for design development of HVAC upgrades to French Hall. Data was gathered during a walk-through of the facility, by interviewing facilities personnel and other employees, and by reviewing CAD files, drawings and other data provided by SUNY Canton. The engineering analysis was conducted using a combination of building energy model simulation and spreadsheet tools.

7.1 Utility Bill Analysis

Utility Rate Summary

The 12-month period of January 2017 – December 2017 was analyzed for this study and represents "annual" values in this report unless stated otherwise. From a previous study completed by Pathfinder, SUNY Canton Wicks MacArthur annual energy costs were based on a blended electric utility charge of $0.052/kWh, consisting of average electric demand charges of $3.046/kW and electric energy charges of $0.046/kWh. Natural gas costs averaged $0.715/therm. These rates have been carried over for the French Hall project since both projects reside on the same SUNY campus.

Utility Costs Used for Analysis

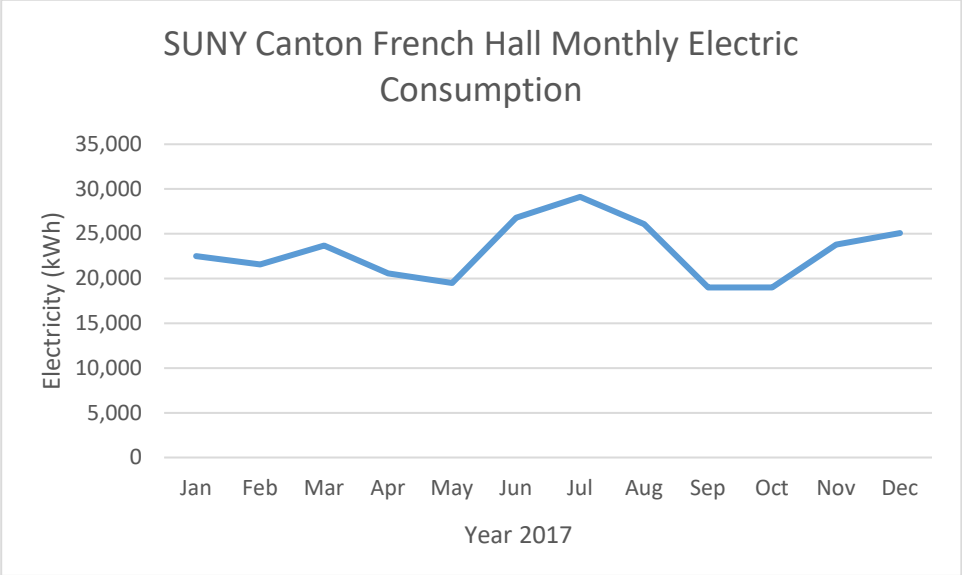
	$ / therm	$/kW	$/kWh
Unit Costs	**$0.715**	**$3.046**	**$0.046**

Existing Conditions Energy Use Summary

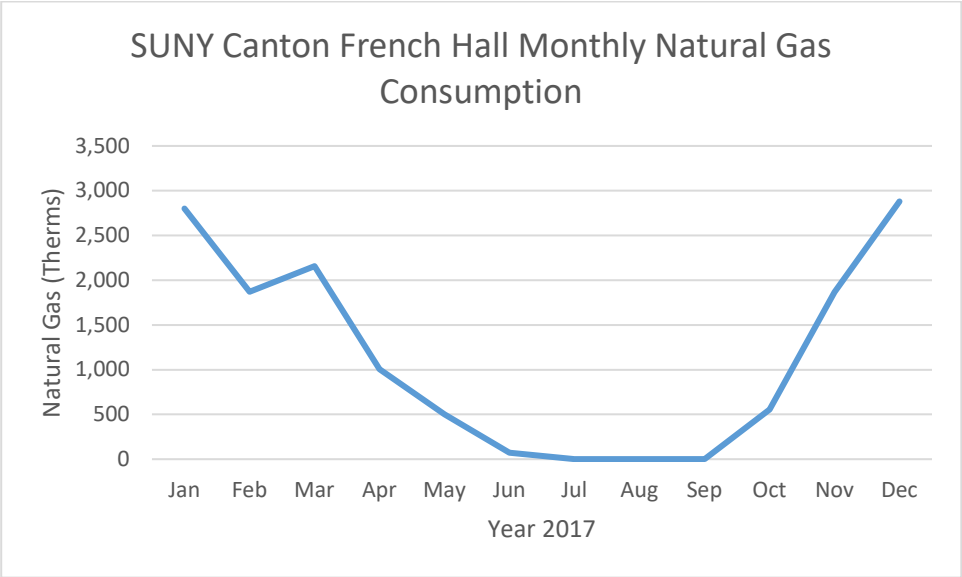
Metered utility data was provided for French Hall, and the existing electrical energy and natural gas consumption values are shown below. The January 2017 gas consumption value was not recorded, so an educated guess of 2800 CCF was used for calculation and trend purposes. No electric demand data was available from the sub-meter data. Monthly electrical consumption at French Hall for the 12-month period of January 2017 – December 2017 is shown in the figure below. Total electricity consumption was 276,641 kWh. Annual gas consumption from January 2017 through December 2017 was 13,713 Therms.

French Hall 12-Month Utility Analysis – January 2017 to December 2017

Date	Elec (kWh)	Gas (ccf)
Jan-17	22,500	*2,800.0*
Feb-17	21,562	1,870.2
Mar-17	23,680	2,154.8
Apr-17	20,574	1,004.6
May-17	19,483	500.3
Jun-17	26,797	72.4
Jul-17	29,121	2.1
Aug-17	26,073	1.2
Sep-17	19,010	1.0
Oct-17	19,002	556.1
Nov-17	23,779	1,867.7
Dec-17	25,060	2,879.2
Totals	276,641	13,710



Monthly Electricity Consumption – French Hall



Monthly Natural Gas Consumption – French Hall

Energy Use Intensity

Energy use intensity (EUI) is a metric for comparing buildings of similar use accounting for building size. The site EUI for French Hall is **111.8 kBtu/sf/year**, based on a building floor area of 20,700 ft^2. (The floor area used in the building simulation energy model is slightly lower – 20,055 ft^2.) The relative contributions of electricity and natural gas to the floor-area-based EUI are shown in the table below. The energy cost index based on floor area is broken out by electric and natural gas consumption in the table below.

French Hall Energy Use Intensity

Annual Energy Consumption Profile				
Energy Type	**Annual Energy Consumption**	**Equivalent MMBTU**	**Annual kBTU/sf**	**% of Total**
Electricity (KWH)	276,641	944	45.599	41%
Gas (CCF)	13,710	1,371	66.230	59%
Total	**N.A.**	**2,315**	**111.829**	**100%**

French Hall Energy Cost Index

Annual Energy Cost Profile				
Energy Type	**Annual Energy Costs**	**Average Cost/Unit**	**Annual Cost/sf**	**% of Total**
Electricity (KWH)	$14,385	$0.052	$0.69	59%
Gas (CCF)	$9,802	$0.715	$0.47	41%
Total	**$24,188**	**n/a**	**$1.17**	**100%**

7.2 Adjusted Baseline Model

The ventilation system "AV-1" has not been in operation for the past 5 years, and thus, many areas of the building have not been properly ventilated. Since the proposed design will include code-minimum ventilation, all energy comparisons should be reflective of the same ventilation rate. Because of this, an "Adjusted" Baseline model was created by adding code-minimum ventilation to the spaces originally served by AV-1. This ultimately changed baseline values as follows:

Adjusted French Hall Energy Use Intensity

Adjusted Baseline Annual Energy Consumption Profile				
Energy Type	**Annual Energy Consumption**	**Equivalent MMBTU**	**Annual kBTU/sf**	**% of Total**
Electricity (KWH)	271,531	926	44.757	39%
Gas (CCF)	14,708	1,471	71.053	61%
Total	**N.A.**	**2,397**	**115.8**	**100%**

Adjusted French Hall Energy Cost Index

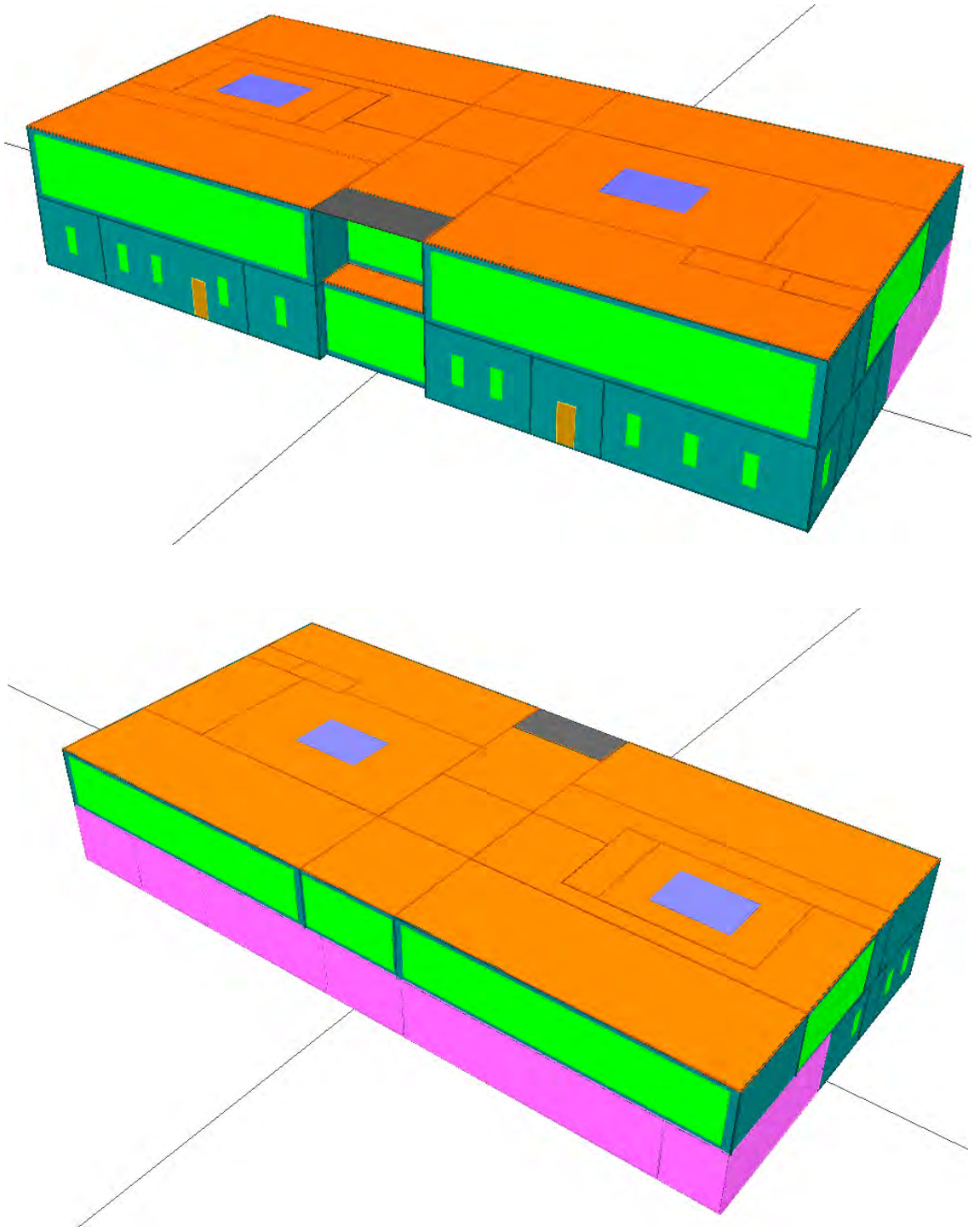
Adjusted Baseline Annual Energy Cost Profile				
Energy Type	**Annual Energy Costs**	**Average Cost/Unit**	**Annual Cost/sf**	**% of Total**
Electricity (KWH)	$14,120	$0.052	$0.68	58%
Gas (CCF)	$10,335	$0.715	$0.50	42%
Total	**$24,455**	**$10.20**	**$1.18**	**100%**

The Adjusted Site EUI for French Hall is **115.8 kBtu/sf/year**, based on a building floor area of 20,700 sf.

7.3 Building Data & Modeling Inputs

The engineering analysis used a computer-model simulation of the existing buildings, created using eQUEST, a whole-building energy simulation software program. The model represents all energy-using systems associated with occupant and equipment loads, existing envelope, interior lighting, exterior lighting, mechanical heating and cooling systems, domestic hot water and general plug and process loads.

The building geometry for the energy model was generated based on CAD files and copies of floorplan drawings. One unique aspect of French Hall is the fact that the first floor is partially underground. These walls have different thermal properties which impact the building's energy usage in a different way and has been modeled accordingly. A 3-D view of the energy model geometry is shown below.

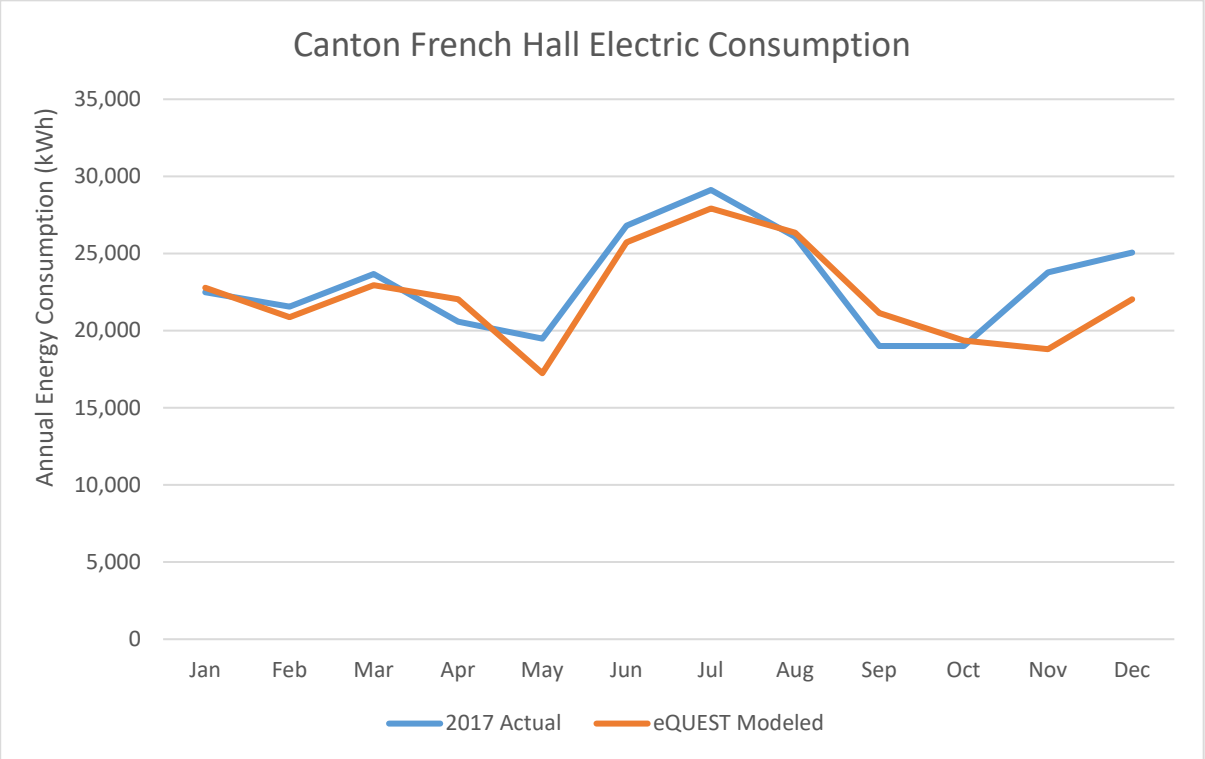


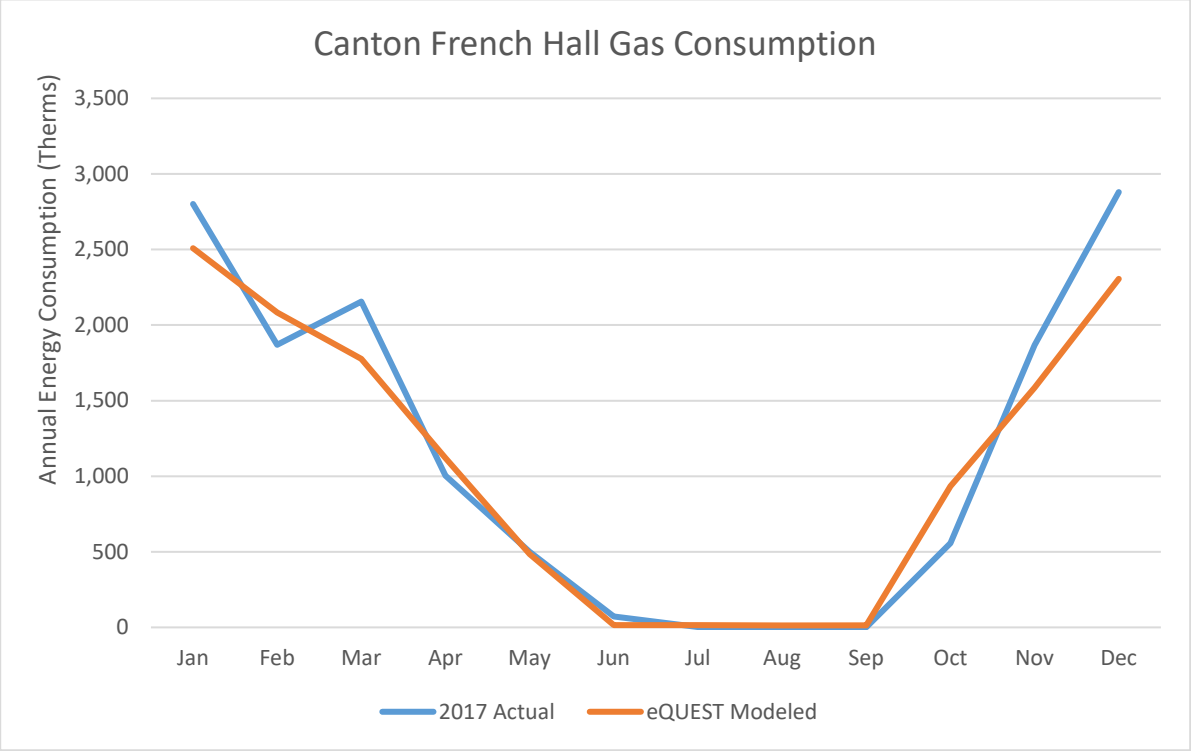
3-D Views from eQUEST model of French Hall, SUNY Canton

7.4 Calibrated Model

The computer model of existing conditions was calibrated to match the actual utility use of the facility as indicated by utility bills. The calibrated energy model was then used to evaluate the proposed HVAC system alternatives. To calibrate the model, adjustments were made primarily to loads and schedules, so that energy modeling output for electric consumption and natural gas consumption closely matched the historic demand and energy use of French Hall, in order to demonstrate that the model is representative of existing conditions. Since a detailed ASHRAE Level II energy audit was not within the scope of this study, several assumptions had to be made regarding details of building system components and loads.

Output from the calibrated energy model is compared to actual utility data in the graphs below. Total annual electricity consumption of the model is within 4% of the utility data. Modeled gas use is within 7% of utility data.





7.5 Modeling of Proposed System Options

Three HVAC system options were evaluated. Each of these systems is described in the main body of this report. Based on the energy modeling output for each of the system option models, the annual electric and natural gas consumption, costs, and intensities are shown in the table below.

System Option Annual Energy Use, Cost, and Intensity Overview

HVAC System/Model	Electricity (kWh)	Natural Gas (Therm)	Electricity Cost	Gas Cost	Total Utility Cost	Modeled Energy Use Intensity (kBtu/sf/year)*	Building Peak Load w/ Snowmelt (kW)	Building Peak Load w/o Snowmelt (kW)
Calibrated Existing Conditions Model	267,516	12,807	$ 14,528	$ 9,157	$ 23,685	109.4	n/a	n/a
Adjusted Existing Conditions Model	271,530	14,708	$ 14,757	$ 10,517	$ 25,274	119.5	n/a	n/a
Option 1: VAV w/ GL	353,419	-	$ 22,755	$ -	$ 22,755	**60.1**	296.0	82.7
Option 2: FCU w/ GL	270,596	-	$ 17,844	$ -	$ 17,844	**46.1**	280.3	66.3
Option 3: GSHP	223,329	-	$ 15,467	$ -	$ 15,467	**38.0**	276.0	62.5

*EUI includes 270kW electric boiler for options 1-3 for snow melt system, which contributes approximately 5.1 EUI in each model and adds ~210kW peak load during winter operating conditions

Each of the proposed HVAC system options would provide an improvement in energy performance relative to the existing building conditions, but only Option 3 meets SUCF Directive 1B-2.

7.6 Life Cycle Cost Analysis (LCCA)

The life cycle costs of each of the HVAC options was determined based on first costs (estimated equipment and labor costs from Trophy Point) and annual energy cost. Annual energy costs were determined by the energy models. A 20-year project life was used for the HVAC project. Equipment replacement costs were estimated for each option, but not included in the life cycle cost analysis because each system is expected to have the same life expectancy. Expected replacement costs are shown in the table below.

HVAC System Equipment Replacement Costs			
HVAC System Component	**Option 1: VAV w/ GL**	**Option 2: FCU w/ GL**	**Option 3: GSHP**
Main AHU with energy recovery Year 20 Replacement	$ 139,600	$ -	$ -
VAV Terminal Units at each zone Replace 5 each year 2020-2030	$2,750 each year, $27,500 total	$ -	$ -
W2W Heat Pump Chiller/Boiler, heat exchanger, glycol makeup units and all pumps Year 20 Replacement	$ 365,740	$ 377,940	$ -
DOAS with energy recovery Year 20 Replacement	$ -	$ 35,120	$ 35,120
FCU Terminal Units Replace 5 each year 2020-2030	$ -	$10,400 each year, $104,000 total	$ -
Terminal W2A Heat Pump Units at each zone Replace 5 each year 2020-2030	$ -	$ -	$13,200 each year, $132,000 total
W2W heating and cooling heat pump assembly, dual scroll compressors, heat exchanger, glycol makeup units and all pumps Year 20 Replacement	$ -	$ -	$ 175,760
Total System Replacement Cost	**$ 532,840**	**$ 517,060**	**$ 342,880**

Parameters for the LCCA are shown in the table below.

French Hall Life Cycle Cost Analysis Parameters

Option 1: Variable Air Volume w/ GL System:	
2.60%	Cost of Utility increase per year
353,419	**Whole Building Elec Required (kWh)**
$ 22,755	**Whole Building Initial Utility Cost**
$ 2,000	Annual Maintenance Cost
2.30%	Maintenance costs increase over time
Option 2: Four-Pipe Fan Coil Unit w/ GL System:	
2.60%	Cost of Utility increase per year
270,596	**Whole Building Elec Required (kWh)**
$ 17,844	**Whole Building Initial Utility Cost**
$ 2,000	Annual Maintenance Cost
2.30%	Maintenance costs increase over time
Option 3: Ground-source Heat Pump:	
2.60%	Cost of Utility increase per year
223,329	**Whole Building Elec Required (kWh)**
$ 15,467	**Whole Building Initial Utility Cost**
$ 2,000	Annual Maintenance Cost
2.30%	Maintenance costs increase over time
ALL Inputs:	5% Discount Rate 20 year lifespan

The net present value (NPV) of each of the HVAC options was determined. Life Cycle Costs are summarized in the table below.

Life Cycle Cost Analysis			
HVAC System/Model	**Total Project Construction Cost** (includes snowmelt & ADA restroom in each scenario)	**20 Year Discounted Cash Flow Costs**	**Total 20 Year Life Cycle Net Present Value**
Option 1: VAV w/ GL	$ (5,589,269)	$ (381,133)	$ (5,970,402)
Option 2: FCU w/ GL	$ (5,603,295)	$ (305,368)	$ (5,908,663)
Option 3: GSHP	$ (5,094,111)	$ (268,697)	$ (5,362,808)

The Ground Source Heat Pump System (Option 3) has the lowest estimated life cycle cost. The system is most efficient and provides the lowest utility costs while simultaneously costs the least to install and replace in the future. This option also has the lowest carbon emissions and can be net-zero carbon in the future when SUNY Canton sources their electricity from renewable, zero-carbon resources. The societal cost of carbon was not considered for this analysis, but it is important to take

into consideration for future discussion and submissions. The combination of highest energy efficiency, lowest initial install cost, and lowest replacement costs make Option 3 the superior system choice.

7.7 SUCF Goals and Conclusion

SUCF is in the process of modifying the deep energy retrofit goals (Directive 1B-2) for all major renovations and gut rehabilitations. As an office building with on-site HVAC equipment, the anticipated (but not yet published) energy target for French Hall is an annual site energy use intensity (EUI) of **38.0 kBtu/sf/yr**. See below the EUI breakdown by End-Use for each model.

Energy Model Breakdown by End-Use Energy Use Intensity (EUI - kBtu/sf/year)							
System	Lights	Equipment	DHW	Exterior Lighting	SnowMelt	HVAC (Htg, Clg, Pumps, Fans)	TOTAL
VAV	5.19	10.59	0.85	0.88	5.08	37.55	**60.1**
FCU	5.19	10.59	0.85	0.88	5.08	23.46	**46.0**
GSHP	5.19	10.59	0.85	0.88	5.08	15.41	**38.0**

Of the 3 options, the GSHP option is the only option to meet the anticipated Directive 1B-2, and that is given a full LED lighting upgrade 30% better than Code is installed while also insulating a portion of the envelope to R30 where the existing fin tube panels will be removed. Additional energy conservation measures are not within the scope of this report, but it is important to note that the Snow Melt system already contributes over 5 EUI to each model. As discussions are held, alternatives to the heavy energy-using snow melt system should be considered. Overall, the traditional GSHP system is recommended due to lowest construction costs, lowest replacement costs, and superior energy efficiency enabling the project to meet Directive 1B-2.

French Hall Energy Model BEPS – Building Energy Performance Output Reports

VAVRH with GLC & Heat Pump Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 15:08:58 BDL RUN 8

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	239.0	57.0	0.0	182.2	275.0	0.0	0.0	17.1	17.6	1104.4
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	239.0	57.0	0.0	182.2	275.0	0.0	0.0	17.1	17.6	1206.2

TOTAL SITE ENERGY 1206.21 MBTU 60.1 KBTU/SQFT-YR GROSS-AREA 60.1 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 3618.63 MBTU 180.4 KBTU/SQFT-YR GROSS-AREA 180.4 KBTU/SQFT-YR NET-AREA

FCU with GLC & Heat Pump Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 14:45:30 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	223.4	45.3	0.0	143.9	58.0	0.0	0.0	17.1	17.6	821.7
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	223.4	45.3	0.0	143.9	58.0	0.0	0.0	17.1	17.6	923.5

TOTAL SITE ENERGY 923.54 MBTU 46.1 KBTU/SQFT-YR GROSS-AREA 46.1 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 2770.61 MBTU 138.2 KBTU/SQFT-YR GROSS-AREA 138.2 KBTU/SQFT-YR NET-AREA

GSHP Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 14:32:03 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	127.7	30.8	0.0	78.9	71.9	0.0	0.0	17.1	17.6	660.4
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	127.7	30.8	0.0	78.9	71.9	0.0	0.0	17.1	17.6	762.2

TOTAL SITE ENERGY 762.22 MBTU 38.0 KBTU/SQFT-YR GROSS-AREA 38.0 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 2286.65 MBTU 114.0 KBTU/SQFT-YR GROSS-AREA 114.0 KBTU/SQFT-YR NET-AREA

Calibrated Existing Conditions Baseline Model

Canton French Hall Wizard DOE-2.3-50h 4/17/2020 12:09:03 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	289.3	0.0	212.8	97.8	180.9	0.0	36.9	77.9	0.0	0.0	0.0	17.6	913.0
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	1262.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	1280.7
MBTU	289.3	0.0	212.8	1359.0	180.9	0.0	36.9	77.9	0.0	0.0	19.0	17.6	2193.7

TOTAL SITE ENERGY 2193.70 MBTU 109.4 KBTU/SQFT-YR GROSS-AREA 109.4 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 4019.75 MBTU 200.4 KBTU/SQFT-YR GROSS-AREA 200.4 KBTU/SQFT-YR NET-AREA

Adjusted Existing Conditions Baseline Model

Canton French Hall Wizard DOE-2.3-50h 4/16/2020 9:23:40 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	289.3	0.0	212.8	98.4	180.6	0.0	32.8	95.3	0.0	0.0	0.0	17.6	926.7
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	1452.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	1470.8
MBTU	289.3	0.0	212.8	1550.0	180.6	0.0	32.8	95.3	0.0	0.0	19.0	17.6	2397.6

TOTAL SITE ENERGY 2397.56 MBTU 119.5 KBTU/SQFT-YR GROSS-AREA 119.5 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 4251.02 MBTU 212.0 KBTU/SQFT-YR GROSS-AREA 212.0 KBTU/SQFT-YR NET-AREA

Section 8 – Energy Model Output

French Hall Energy Model BEPS – Building Energy Performance Output Reports

VAVRH with GLC & Heat Pump Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 15:08:58 BDL RUN 8

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	239.0	57.0	0.0	182.2	275.0	0.0	0.0	17.1	17.6	1104.4
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	239.0	57.0	0.0	182.2	275.0	0.0	0.0	17.1	17.6	1206.2

TOTAL SITE ENERGY 1206.21 MBTU 60.1 KBTU/SQFT-YR GROSS-AREA 60.1 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 3618.63 MBTU 180.4 KBTU/SQFT-YR GROSS-AREA 180.4 KBTU/SQFT-YR NET-AREA

FCU with GLC & Heat Pump Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 14:45:30 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	223.4	45.3	0.0	143.9	58.0	0.0	0.0	17.1	17.6	821.7
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	223.4	45.3	0.0	143.9	58.0	0.0	0.0	17.1	17.6	923.5

TOTAL SITE ENERGY 923.54 MBTU 46.1 KBTU/SQFT-YR GROSS-AREA 46.1 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 2770.61 MBTU 138.2 KBTU/SQFT-YR GROSS-AREA 138.2 KBTU/SQFT-YR NET-AREA

GSHP Model

Canton French Hall Wizard DOE-2.3-50h 5/20/2020 14:32:03 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	104.1	0.0	212.3	127.7	30.8	0.0	78.9	71.9	0.0	0.0	17.1	17.6	660.4
EM2S ELECTRICITY													
MBTU	0.0	0.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBTU	104.1	0.0	314.2	127.7	30.8	0.0	78.9	71.9	0.0	0.0	17.1	17.6	762.2

TOTAL SITE ENERGY 762.22 MBTU 38.0 KBTU/SQFT-YR GROSS-AREA 38.0 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 2286.65 MBTU 114.0 KBTU/SQFT-YR GROSS-AREA 114.0 KBTU/SQFT-YR NET-AREA

Calibrated Existing Conditions Baseline Model

Canton French Hall Wizard DOE-2.3-50h 4/17/2020 12:09:03 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	289.3	0.0	212.8	97.8	180.9	0.0	36.9	77.9	0.0	0.0	0.0	17.6	913.0
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	1262.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	1280.7
MBTU	289.3	0.0	212.8	1359.0	180.9	0.0	36.9	77.9	0.0	0.0	19.0	17.6	2193.7

TOTAL SITE ENERGY 2193.70 MBTU 109.4 KBTU/SQFT-YR GROSS-AREA 109.4 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 4019.75 MBTU 200.4 KBTU/SQFT-YR GROSS-AREA 200.4 KBTU/SQFT-YR NET-AREA

Adjusted Existing Conditions Baseline Model

Canton French Hall Wizard DOE-2.3-50h 4/16/2020 9:23:40 BDL RUN 1

REPORT- BEPS Building Energy Performance WEATHER FILE- MASSENA AP NY

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	289.3	0.0	212.8	98.4	180.6	0.0	32.8	95.3	0.0	0.0	0.0	17.6	926.7
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	1452.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	1470.8
MBTU	289.3	0.0	212.8	1550.0	180.6	0.0	32.8	95.3	0.0	0.0	19.0	17.6	2397.6

TOTAL SITE ENERGY 2397.56 MBTU 119.5 KBTU/SQFT-YR GROSS-AREA 119.5 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 4251.02 MBTU 212.0 KBTU/SQFT-YR GROSS-AREA 212.0 KBTU/SQFT-YR NET-AREA

Section 9 - Hazardous Materials Report

ATLANTIC TESTING LABORATORIES

WBE certified company

Canton
6431 U.S. Highway 11
P.O. Box 29
Canton, NY 13617
315-386-4578 (T)
atlantictesting.com

October 23, 2018

State University of New York (SUNY) at Canton
c/o Aubertine & Currier Architects, Engineers,
and Land Surveyors, P.C.
522 Bradley Street
Watertown, New York 13601

Attn: Mr. Brian Krueger

Re: Limited Hazardous Materials Survey
French Hall - Rehab Main Entrance
SUNY Canton
Canton, New York
SUCF Project No. L23132
ATL Report No. CT50229CE-01-10-18

Ladies/Gentlemen:

Enclosed is a copy of the Limited Hazardous Materials Survey report prepared for the referenced site. This project was completed in accordance with the scope of work outlined in our contract (ATL No. CT5998-667-10-18), dated October 4, 2018, and authorized by Brian Krueger on October 4, 2018.

Please contact our office should you have any questions, or if we may be of further assistance.

Sincerely,
ATLANTIC TESTING LABORATORIES, Limited

R. Daniel Faulknham
Senior Project Manger

RDF/JDG/ejr

Enclosures

LIMITED HAZARDOUS MATERIALS SURVEY

FRENCH HALL - REHAB MAIN ENTRANCE
SUNY CANTON
CANTON, NEW YORK

WBE certified company

PREPARED BY:

ATLANTIC TESTING LABORATORIES, LIMITED
6431 U.S. Highway 11
Canton, New York 13617

PREPARED FOR:

Aubertine & Currier Architects, Engineers, and Land Surveyors, P.C.
522 Bradley Street
Watertown, New York 13601

ATL REPORT NO. CT50229CE-01-10-18

October 23, 2018

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Purpose

Atlantic Testing Laboratories, Limited (ATL) was retained by Aubertine & Currier Architects, Engineers, and Land Surveyors, P.C., to perform a limited hazardous materials survey of designated areas associated with main entrance of French Hall. The limited survey was performed on October 10, 2018. The purpose of the limited hazardous materials survey was to identify asbestos-containing materials (ACM) and lead-based paint (LBP) that are present on exposed surfaces within the subject areas, and may have a significant impact on planned renovation activities. The limited hazardous materials survey procedures and report format that follow are in general compliance with applicable local, state, and federal rules and regulations.

1.2 Project Team and Certifications

Members of the ATL project team included Brian Babcock, Environmental Specialist, and Evan Renwick, Senior Engineer. Certifications of ATL's field survey team members and a copy of applicable company licenses maintained by ATL are included in Appendix A.

2.0 SCOPE OF WORK

2.1 Project Description

The project site is located at 34 Cornell Drive, Canton, St. Lawrence County, New York.

The intent of the limited hazardous materials survey was to identify suspect ACM and LBP that are located within designated areas associated with the main entrance of French Hall and may be impacted during a proposed renovation project.

The limited hazardous materials survey was conducted for the subject areas, as directed by Brian Krueger, representing Aubertine & Currier Architects, Engineers, and Land Surveyors, P.C. The subject areas were occupied and operational at the time of the sampling event.

2.2 Inaccessible Areas

The extent of inaccessible areas is dependent upon the building type, construction materials, history of renovations and repairs, and project scope. Concealed materials may exist in areas that are not readily exposed to view. Although this limited hazardous materials survey was performed to identify ACM and LBP within the subject areas, potential ACM or LBP may have escaped detection that could be encountered during future building renovation activities. Wall, ceiling, floor, roofing, and/or other component systems may contain concealed suspect ACM or LBP. If any suspect ACM or LBP are encountered during renovation activities, the activities disturbing the suspect ACM or LBP must stop and the material must be sampled and laboratory analyzed in accordance with applicable regulations.

2.3 Document Review

Documents that were provided to ATL for review during the limited hazardous materials survey included:

- SUCF PNL23132 French Hall Rehab Main Entrance Drawings G100, A001, A050, A100, and A210, prepared by Aubertine & Currier Architects, Engineers, and Land Surveyors, P.C., dated September 20, 2018.

2.4 Limitations

This report has been prepared in accordance with the scope of work outlined in ATL's contract (ATL No. CT5998-667-10-18), dated October 4, 2018, and should not be used as abatement specifications or design documents. The findings, conclusions, and recommendations presented in this report are based on the field observations made by representatives of ATL and the information provided by representatives of Aubertine & Currier Architects, Engineers, and Land Surveyors, P.C.

Quantities and locations of sampled materials are approximate, and should be verified by the abatement contractor(s) prior to providing actual cost quotations and/or initiating abatement activities. Variations in reported quantities and locations for sampled materials, in addition to the discovery of suspect materials not identified in this report, is possible due to the presence of inaccessible areas, as described in Section 2.2 of this report.

The findings and opinions are relevant to the dates of our site work and should not be relied on to represent conditions at substantially later dates.

3.0 ASBESTOS

3.1 Methodology

A visual examination of the subject areas was conducted by an Asbestos Building Inspector to identify suspect ACM. Functional spaces were identified to assist while locating suspect ACM. A functional space is defined as a spatially distinct area within a building that contains identifiable populations of building occupants. A functional space may include a room, a group of rooms, or other defined area, and several functional spaces may comprise a single homogeneous sampling area. A homogeneous sampling area is defined as an area that is uniform by color, texture, construction/application, and general appearance. Each identified functional space was visually examined to determine the locations of suspect ACM. These materials were then delineated into homogeneous sampling areas.

Samples of each accessible homogeneous area were collected and placed in clean, labeled containers. The appropriate custody documentation was completed and the suspect ACM samples were submitted to AmeriSci New York (AmeriSci), located in New York, New York. The samples were laboratory analyzed by polarized light microscopy (PLM) and transmission electron microscopy (TEM) methodologies, as applicable. AmeriSci is a New York State Department of Health (NYSDOH) certified laboratory for PLM and TEM analysis under Environmental Laboratory Approval Program (ELAP) No. 11480. AmeriSci is also accredited by the National Institute of Standards and Technology (NIST), under the National Voluntary Laboratory Accreditation Program (NVLAP).

3.2 Regulatory Compliance

In New York State, there are multiple regulatory agencies that have jurisdiction over ACM in buildings. Asbestos survey requirements are primarily regulated or specified by the New York State Department of Labor (NYSDOL), the New York State Department of Health (NYSDOH), the Occupational Safety and Health Administration (OSHA), and the United States Environmental Protection Agency (EPA).

The NYSDOL established Part 56 of The Official Compilation of Codes, Rules, and Regulations (cited as 12 NYCRR, Part 56) to address the proper identification, handling, removal, and disposal of ACM in buildings. Asbestos survey requirements are specified in Subpart 56-5.1 "Asbestos Survey Requirements for Building/Structure Demolition, Renovation, Remodeling and Repair." The NYSDOL also works in conjunction with the NYSDOH to establish and maintain asbestos safety training program requirements, and enforce personnel certifications and licensing protocol for asbestos contractors.

The OSHA defines requirements for asbestos surveys and identification of ACM and presumed asbestos-containing materials (PACM) in 29 CFR 1926.1101 (k) "Communication of Hazards." Under this regulation, OSHA makes reference to conducting inspections according to 1926.1101 (k)(5)(ii)(B) and 1926.1101 (k)(5)(iii) or pursuant to the requirements of the Asbestos Hazard Emergency Response Act (AHERA) 40 CFR Part 763, Subpart E "Asbestos-Containing Materials in Schools." The AHERA is regulated by the EPA, and applies to primary and secondary schools only; however, the procedures mandated under AHERA are generally considered the industry standards for surveys, as these are typically the most stringent.

3.3 Summary of Findings

A total of 13 homogeneous areas of suspect ACM were identified during the visual examination, from which 33 bulk samples were collected and subsequently submitted to a NYSDOH approved laboratory for analysis. Approximate sample locations are depicted on the Sample Location Plan, contained in Appendix B. A copy of laboratory reports and sample custody documentation are contained in Appendix C. Table D-I contained in Appendix D, provides a summary of the identified suspect ACM and associated analytical results.

The EPA, NYSDOL, and other regulatory agencies define ACM as any material containing greater than 1% of asbestos. None of the materials sampled were determined to be ACM.

Other materials that were observed, but are not considered suspect ACM, include the following;

• Glass	• Nylon-Coated Wire Jacket
• Wood	• Metal
• Ceramic Tile	

4.0 LEAD-BASED PAINT

4.1 Methodology

A visual examination of the subject building was conducted by a Lead Risk Assessor to identify visible and accessible painted surfaces. The painted surfaces were categorized into homogeneous areas from which tests could be conducted. Each homogeneous area was tested using a Heuresis Pb200i XRF Analyzer. This equipment provides instantaneous measurements for lead concentration in mg/cm^2, and displays readings that are positive or

negative indications for LBP. Calibration checks for the XRF equipment were performed in accordance with the manufacturer's recommendations.

4.2 Regulatory Compliance

Although New York State has established Title X, Part 67 of The Official Compilation of Codes, Rules, and Regulations (cited as NYCRR Title X, Part 67) for "Lead Poisoning Prevention and Control," LCM inspections and risk assessments are generally subject to the requirements of federal regulations. The United States Department of Housing and Urban Development (HUD), EPA, and OSHA are the primary federal regulatory agencies responsible for the establishment and enforcement of such regulations. On a state level, the NYSDOH does require laboratories to be certified to perform lead analysis under the ELAP.

The HUD "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" include details pertaining to sampling and analysis of suspect LBP, in addition to the identification and control of LBP hazards. The HUD guidelines pertain to federally owned or assisted housing; however, these are commonly referenced and made mandatory by other regulatory agencies. The EPA requirements for LBP activities, specified in 40 CFR Part 745, apply to targeted housing and child-occupied facilities, and are similar to HUD guideline requirements.

The OSHA Construction Standard for Lead (29 CFR 1926.62) applies to employees of an employer who may or will be exposed to occupational levels of lead. OSHA requires employees to maintain, at a minimum, awareness, respiratory protection, and hazard communication training.

4.3 Summary of Findings

A total of 9 locations were tested using the XRF spectrometer. Approximate sample locations are depicted on the Sample Location Plan, contained in Appendix B. A summary of the XRF results and calibration checks are provided in Appendix E. The XRF results provided in Table E-I of Appendix E represent painted surfaces that were determined to be LCM, per HUD criteria. Table E-II of Appendix E identifies painted surfaces that contain detectable concentrations of lead, but are not considered LCM, as compared to HUD criteria. Painted surfaces that did not contain lead at a concentration above the method detection limits are summarized in Table E-III of Appendix E. Calibration checks for the XRF spectrometer are provided in Table E-IV of Appendix E.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are prepared from ATL's understanding that designated areas associated with the main entrance of French Hall may be subject to a renovation project. Should the management of the building areas change, it is recommended that the findings be revisited to reflect appropriate operations and management practices for hazardous materials containing items.

5.1 General

1. Concealed regulated hazardous materials may exist at the site that could be encountered during future building renovation activities. Wall, ceiling, floor, roofing, and/or other component systems may contain concealed suspect hazardous materials. If any suspect hazardous materials or hazardous materials-containing items are encountered during

renovation activities, the activities disturbing the suspect material must stop and the material must be sampled and laboratory analyzed or otherwise managed pursuant to in accordance with applicable regulations.

5.2 Asbestos-Containing Materials

1. None of the materials sampled were determined to be ACM.

2. Subpart 56-5(g) of 12 NYCRR Part 56 specifies requirements for transmittal of asbestos survey information by the owner or owner's agent. One copy of the asbestos survey report shall be sent to the local government entity charged with issuing a permit for such demolition, renovation, remodeling, or repair work under applicable State or local laws. If controlled demolition or pre-demolition activities will be performed, one copy of the asbestos survey report shall be submitted to the appropriate Asbestos Control Bureau district office. One copy of the asbestos survey report must be kept on the construction site throughout the duration of the asbestos project and any associated demolition, renovation, remodeling, or repair project.

5.3 Lead-Containing Materials

1. The materials listed in Table E-I of Appendix E were determined to be LCM per HUD criteria. Table E-II of Appendix E lists materials that are not considered LCM per HUD criteria, but contain detectable concentrations of lead and are regulated under OSHA.

2. Identified LCM or paint with a detectable concentration of lead should be managed in accordance with applicable EPA and OSHA requirements prior to or during demolition, renovation, remodeling, or repair work.

3. Demolition/renovation contractors are required to conduct exposure monitoring or use historical objective data to ensure that employee exposures do not exceed the action level of 30 $\mu g/m^3$.

APPENDIX A

LICENSES AND CERTIFICATIONS

Asbestos Certificate Code Classifications

The following letter codes shown on the enclosed asbestos certificates represent the corresponding asbestos classifications:

A - Asbestos Handler
B - Allied Trades
C - Air Sampling Technician
D - Building Inspector
E - Management Planner
F - Operations & Maintenance
G - Asbestos Supervisor
H - Asbestos Project Monitor
I - Asbestos Project Designer

New York State – Department of Labor
Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

Atlantic Testing Laboratories, Limited

P.O. Box 29

Canton, NY 13617

FILE NUMBER: 99-0911
LICENSE NUMBER: 29276
LICENSE CLASS: RESTRICTED
DATE OF ISSUE: 10/06/2017
EXPIRATION DATE: 10/31/2018

Duly Authorized Representative – Marijean B Remington:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

Eileen M. Franko, Director
For the Commissioner of Labor

SH 432 (8/12)

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2019
Issued April 01, 2018

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. PAUL J. MUCHA
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

NY Lab Id No: 11480

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual
	EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual

Serial No.: 57809

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200546-0

AmeriSci New York

New York, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2018-07-01 through 2019-06-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

NVLAP® National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

AmeriSci New York
117 E. 30th Street
New York, NY 10016
Mr. Paul Mucha
Phone: 212-679-8600 Fax: 212-679-2711
Email: pmucha@amerisci.com
http://www.amerisci.com

ASBESTOS FIBER ANALYSIS **NVLAP LAB CODE 200546-0**

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

For the National Voluntary Laboratory Accreditation Program

United States Environmental Protection Agency

This is to certify that

Atlantic Testing Laboratories, Limited

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires April 21, 2019

LBP-8962-1

Certification #

April 07, 2016

Issued On

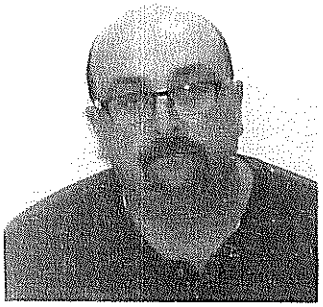
Michelle Price, Chief

Lead, Heavy Metals, and Inorganics Branch

United States Environmental Protection Agency

This is to certify that

Brian Joel Babcock



has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

Risk Assessor

In the Jurisdiction of:

New York

This certification is valid from the date of issuance and expires January 11, 2018

NY-R-88559-2

Certification #

October 21, 2014

Issued On

John Gorman, Chief

Pesticides & Toxic Substances Branch

STATE OF NEW YORK - DEPARTMENT OF LABOR
ASBESTOS CERTIFICATE

N.Y.S

BRIAN J BABCOCK
CLASS(EXPIRES)
C ATEC(09/18) D INSP(09/18)
H PM (09/18)

CERT# 07-06992
DMV# 162012578

MUST BE CARRIED ON ASBESTOS PROJECTS

New York State Department of Health Certificate of Asbestos Safety Training

This form is the official record of successful completion of a New York State accredited asbestos safety training course.

Certificate No. 817296

I –To be completed by Trainee

Name of Trainee (print)	NYS Depart. of Motor Vehicles ID (DMV ID)[1]	
BRIAN BABCOCK	162 012 578	
Signature of Trainee	Telephone Number	Date of Birth[1]
	315 262 4197	09/22/1967

Address: 21201 WEAVER RD (Street or PO Box) WATERTOWN (City) N.Y. (State) 13601 (Zip Code)

II—To be completed by Training Sponsor

Provider's Name	Telephone Number
Cornerstone Training Institute	585-319-3625
Address: 460 State Street, 2nd Floor, Rochester, NY 14608 Zip Code	Course Location: 460 State Street, Rochester, NY 14608

Course Title: Inspector ☐ Initial ☑ Refresher *NYS DOH use only* ☐ DOH Equivalency [2]

Training Language: ☑ English ☐ Other: _____ Exam Grade/Date: 100% 8/7/18

Dates of Training: From: 8/7/18 To: 8/7/18 Expires: 8/7/19

I certify that the asbestos safety training course given on the above date complied with both 10 NYCRR Part 73 and TSCA Title II, was consistent with the curriculum and instructors approved by the New York State Department of Health, and the trainee receiving this certificate completed the training course and successfully passed the examination.

Training Director[2]: Darren Yehl (Print) _____ (Signature) STUDENT

DOH-2832 (10/03) [1] Optional Information [2] DOH Equivalency signed by NYS DOH representative only

---

New York State Department of Health Certificate of Asbestos Safety Training

This form is the official record of successful completion of a New York State accredited asbestos safety training course.

Certificate No. 817303

I –To be completed by Trainee

Name of Trainee (print)	NYS Depart. of Motor Vehicles ID (DMV ID)[1]	
BRIAN BABCOCK	162 012 578	
Signature of Trainee	Telephone Number	Date of Birth[1]
	315 262 4197	09/22/1967

Address: 21201 WEAVER RD (Street or PO Box) WATERTOWN (City) N.Y. (State) 13601 (Zip Code)

II—To be completed by Training Sponsor

Provider's Name	Telephone Number
Cornerstone Training Institute	585-319-3625
Address: 460 State Street, 2nd Floor, Rochester, NY 14608 Zip Code	Course Location: 460 State Street, Rochester, NY 14608

Course Title: Project Monitor ☐ Initial ☑ Refresher *NYS DOH use only* ☐ DOH Equivalency [2]

Training Language: ☑ English ☐ Other: _____ Exam Grade/Date: 92/8-9-18

Dates of Training: From: 8/9/18 To: 8/9/18 Expires: 8/9/19

I certify that the asbestos safety training course given on the above date complied with both 10 NYCRR Part 73 and TSCA Title II, was consistent with the curriculum and instructors approved by the New York State Department of Health, and the trainee receiving this certificate completed the training course and successfully passed the examination.

Training Director[2]: For Darren Yehl by Lyon Bumingham (Print) _____ (Signature) STUDENT

DOH-2832 (10/03) [1] Optional Information [2] DOH Equivalency signed by NYS DOH representative only

New York State Department of Health Certificate of Asbestos Safety Training

This form is the official record of successful completion of a New York State accredited asbestos safety training course.

Certificate No. 795793

I –To be completed by Trainee

Name of Trainee (print)	NYS Depart. of Motor Vehicles ID (DMV ID)[1]	
Evan Renwick	286 624 082	
Signature of Trainee	Telephone Number	Date of Birth[1]
	845-264-7561	7/26/87

Address

(Street or PO Box) 46 A[illegible] (City) Potsdam (State) NY (Zip Code) 13676

II—To be completed by Training Sponsor

Provider's Name	Telephone Number
Cornerstone Training Institute	585 319 3625
Address: 460 State Street, 2nd Floor Zip Code: Rochester, NY 14608	Course Location: 460 State St Rochester NY 14608

Course Title: Inspector ☒ Initial ☐ Refresher | *NYS DOH use only* ☐ DOH Equivalency [2]

Training Language: ☑ English ☐ Other: _____ Exam Grade/Date: 98% 10/20/17

Dates of Training: From: 10/18/17 To: 10/20/17 Expires: 10/20/18

I certify that the asbestos safety training course given on the above date complied with both 10 NYCRR Part 73 and TSCA Title II, was consistent with the curriculum and instructors approved by the New York State Department of Health, and the trainee receiving this certificate completed the training course and successfully passed the examination.

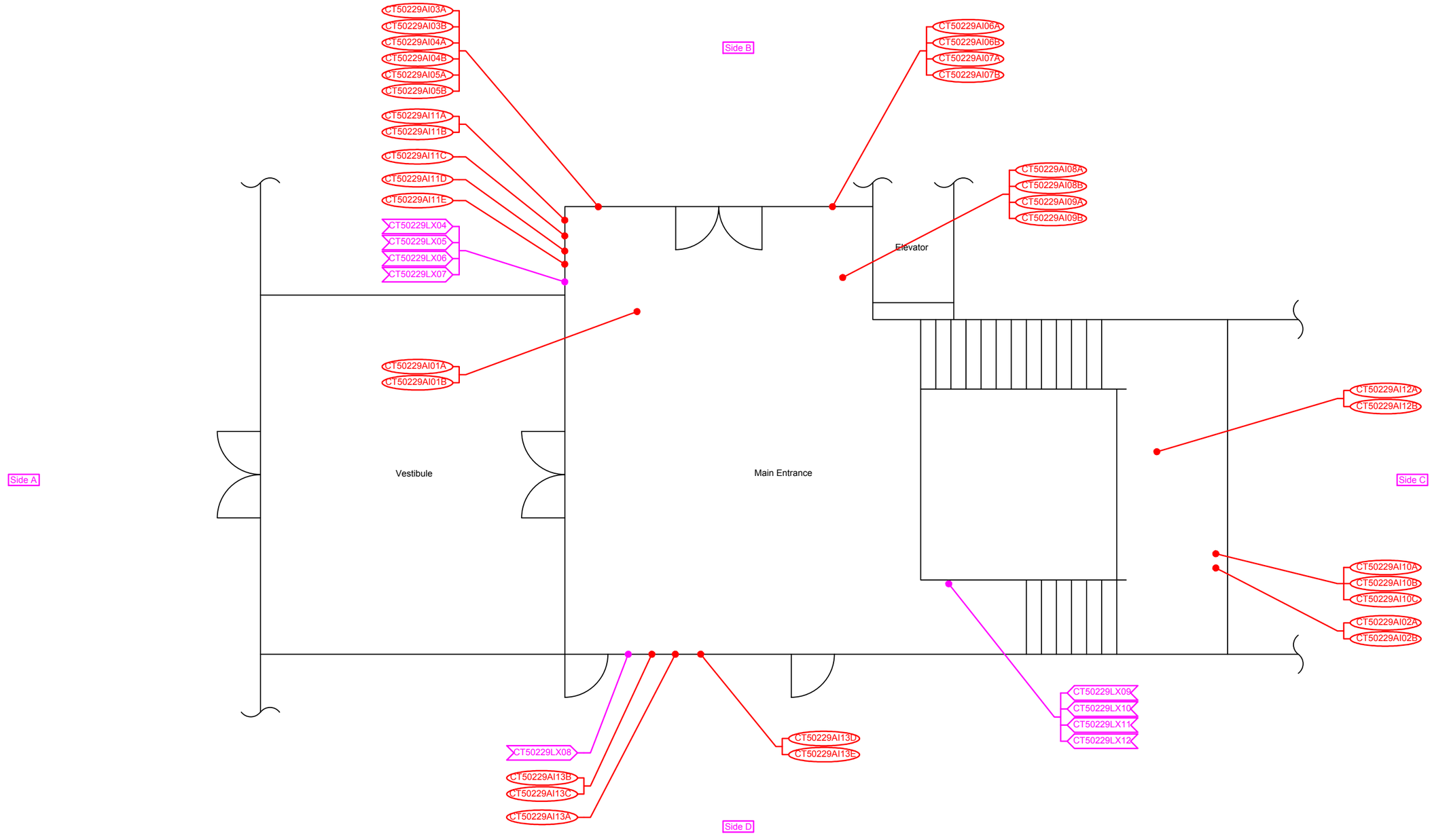
Training Director[2]: Kevin Hutton by Lynn Burlingham _____
(Print) (Signature)

STUDENT

DOH-2832 (10/03) [1] Optional Information [2] DOH Equivalency signed by NYS DOH representative only

APPENDIX B

SAMPLE LOCATION PLAN



Partial Second Floor Sample Location Plan

Scale: NTS

LEGEND :

CT50229AI01A	Suspect Asbestos Sample ID and Approximate Location
CT50229LX01	Suspect Lead-Based XRF Sample ID and Approximate Location
Side A	Side Designation for XRF Sampling

SAMPLE LOCATION PLAN	Drawn By:	Drawing:	Scale:	Project No.:	Date :
	JDF	1 of 1	As Noted	CT50229	October 2018

French Hall
SUNY Canton
Canton, New York

ATLANTIC TESTING LABORATORIES, Limited
Albany, NY Binghamton, NY Canton, NY Elmira, NY Poughkeepsie, NY
Plattsburgh, NY Rochester, NY Syracuse, NY Utica, NY Watertown, NY
WBE Certified Company
www.AtlanticTesting.com

APPENDIX C

LABORATORY REPORTS AND CUSTODY DOCUMENTATION

AmeriSci New York
117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Atlantic Testing Laboratories, Limited
Attn: Dan Faulknham
P.O. Box 29

Canton, NY 13617

Date Received 10/11/18 **AmeriSci Job #** 218102293
Date Examined 10/13/18 **P.O. #**
ELAP # 11480 **Page** 1 **of** 6
RE: CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI01A	218102293-01	*No*	NAD [1]
1	**Location:** Main Entrance - Row 1: White 1-By 1-Foot Fissured Ceiling Tile		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 27.2 %			
CT50229AI01B	218102293-02	*No*	NAD
1	**Location:** Main Entrance - Row 1: White 1-By 1-Foot Fissured Ceiling Tile		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 27 %			
CT50229AI02A	218102293-03	*No*	NAD
2	**Location:** Main Entrance - Row 2: Brown Ceiling Tile Adhesive Row 1		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Brown, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 42.8 %			
CT50229AI02B	218102293-04	*No*	NAD
2	**Location:** Main Entrance - Row 2: Brown Ceiling Tile Adhesive Row 1		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Brown, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 41.6 %			
CT50229AI03A	218102293-05	*No*	NAD
3	**Location:** Main Entrance - Row 3: White Gypsum Wall Board		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Cellulose 10 %, Non-fibrous 90 %			

See Reporting notes on last page

PLM Bulk Asbestos Report

CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI03B	218102293-06	***No***	NAD
3	**Location:** Main Entrance - Row 3: White Gypsum Wall Board		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Cellulose 15 %, Non-fibrous 85 %			
CT50229AI04A	218102293-07	***No***	NAD
4	**Location:** Main Entrance - Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Cellulose 100 %, Non-fibrous Trace			
CT50229AI04B	218102293-08	***No***	NAD
4	**Location:** Main Entrance - Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Cellulose 100 %, Non-fibrous Trace			
CT50229AI05A	218102293-09	***No***	NAD
5	**Location:** Main Entrance - Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI05B	218102293-10	***No***	NAD
5	**Location:** Main Entrance - Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI06A	218102293-11	***No***	NAD
6	**Location:** Main Entrance - Row 6: Black 4-Inch Cove Base		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 1.8 %			

See Reporting notes on last page

PLM Bulk Asbestos Report

CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI06B	218102293-12	***No***	NAD
6	**Location:** Main Entrance - Row 6: Black 4-Inch Cove Base		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 1 %			
CT50229AI07A	218102293-13	***No***	NAD
7	**Location:** Main Entrance - Row 7: Off-White Cove Base Associated Adhesive		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Cream, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 33 %			
CT50229AI07B	218102293-14	***No***	NAD
7	**Location:** Main Entrance - Row 7: Off-White Cove Base Associated Adhesive		(by NYS ELAP 198.6) by Kensen Caro on 10/13/18
Analyst Description: Cream, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 31 %			
CT50229AI08A	218102293-15	***No***	NAD
8	**Location:** Main Entrance - Row 8: Light Gray CFT Grout		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Dark Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI08B	218102293-16	***No***	NAD
8	**Location:** Main Entrance - Row 8: Light Gray CFT Grout		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Dark Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI09A	218102293-17	***No***	NAD
9	**Location:** Main Entrance - Row 9: Gray CFT Mortar Row 8		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			

See Reporting notes on last page

PLM Bulk Asbestos Report

CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI09B 9	218102293-18 **Location:** Main Entrance - Row 9: Gray CFT Mortar Row 8	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI10A 10	218102293-19 **Location:** Main Entrance - Row 10: White Plaster Ceiling	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI10B 10	218102293-20 **Location:** Main Entrance - Row 10: White Plaster Ceiling	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI10C 10	218102293-21 **Location:** Main Entrance - Row 10: White Plaster Ceiling	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI11A 11	218102293-22 **Location:** Main Entrance - Row 11: Gray Plaster Wall Base Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Light Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Cellulose Trace, Non-fibrous 100 %			
CT50229AI11B 11	218102293-23 **Location:** Main Entrance - Row 11: Gray Plaster Wall Base Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Cellulose 2 %, Non-fibrous 98 %			

See Reporting notes on last page

PLM Bulk Asbestos Report

CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI11C 11	218102293-24 **Location:** Main Entrance - Row 11: Gray Plaster Wall Base Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Light Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI11D 11	218102293-25 **Location:** Main Entrance - Row 11: Gray Plaster Wall Base Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Light Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Cellulose Trace, Non-fibrous 100 %			
CT50229AI11E 11	218102293-26 **Location:** Main Entrance - Row 11: Gray Plaster Wall Base Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Light Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI12A 12	218102293-27 **Location:** Main Entrance - Row 12: Black Terrazzo Floor	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Black, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI12B 12	218102293-28 **Location:** Main Entrance - Row 12: Black Terrazzo Floor	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: Black, Homogeneous, Non-Fibrous, Cementitious, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI13A 13	218102293-29 **Location:** Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat	***No***	NAD (by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			

See Reporting notes on last page

PLM Bulk Asbestos Report

CT50229; SUNY Canton French Hall; Canton, New York

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
CT50229AI13B	218102293-30	*No*	NAD
13	**Location:** Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI13C	218102293-31	*No*	NAD
13	**Location:** Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI13D	218102293-32	*No*	NAD
13	**Location:** Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			
CT50229AI13E	218102293-33	*No*	NAD
13	**Location:** Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat		(by NYS ELAP 198.1) by Kensen Caro on 10/13/18
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material **Asbestos Types:** **Other Material:** Non-fibrous 100 %			

Reporting Notes:

(1) This job was - Analyzed using Motic BA310 Pol Scope S/N 1190000538

Analyzed by: Kensen Caro _____

*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis by Appd E to Subpt E, 40 CFR 763 (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite or 198.6 for NOB samples or EPA 400 pt ct by Appd E to Subpt E, 40 CFR 763 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. AIHA-LAP, LLC Lab ID 102843, RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054.

Reviewed By:_____ _____END OF REPORT_____

Client Name: Atlantic Testing Laboratories, Limited

Table I
Summary of Bulk Asbestos Analysis Results
CT50229; SUNY Canton French Hall; Canton, New York

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	CT50229AI01A	1	0.239	12.1	60.7	27.2	NAD	NAD
Location:	Main Entrance - Row 1: White 1-By 1-Foot Fissured Ceiling Tile							
02	CT50229AI01B	1	0.215	12.6	60.5	27.0	NAD	NAD
Location:	Main Entrance - Row 1: White 1-By 1-Foot Fissured Ceiling Tile							
03	CT50229AI02A	2	0.292	50.3	6.8	42.8	NAD	NAD
Location:	Main Entrance - Row 2: Brown Ceiling Tile Adhesive Row 1							
04	CT50229AI02B	2	0.257	40.1	18.3	41.6	NAD	NAD
Location:	Main Entrance - Row 2: Brown Ceiling Tile Adhesive Row 1							
05	CT50229AI03A	3	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 3: White Gypsum Wall Board							
06	CT50229AI03B	3	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 3: White Gypsum Wall Board							
07	CT50229AI04A	4	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3							
08	CT50229AI04B	4	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3							
09	CT50229AI05A	5	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3							
10	CT50229AI05B	5	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3							
11	CT50229AI06A	6	0.224	37.1	61.2	1.8	NAD	NAD
Location:	Main Entrance - Row 6: Black 4-Inch Cove Base							
12	CT50229AI06B	6	0.296	49.7	49.3	1.0	NAD	NAD
Location:	Main Entrance - Row 6: Black 4-Inch Cove Base							
13	CT50229AI07A	7	0.270	45.6	21.5	33.0	NAD	NAD
Location:	Main Entrance - Row 7: Off-White Cove Base Associated Adhesive							
14	CT50229AI07B	7	0.187	45.5	23.5	31.0	NAD	NAD
Location:	Main Entrance - Row 7: Off-White Cove Base Associated Adhesive							
15	CT50229AI08A	8	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 8: Light Gray CFT Grout							
16	CT50229AI08B	8	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 8: Light Gray CFT Grout							

See Reporting notes on last page

Table I
Summary of Bulk Asbestos Analysis Results
CT50229; SUNY Canton French Hall; Canton, New York

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	CT50229AI09A	9	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 9: Gray CFT Mortar Row 8							
18	CT50229AI09B	9	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 9: Gray CFT Mortar Row 8							
19	CT50229AI10A	10	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 10: White Plaster Ceiling							
20	CT50229AI10B	10	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 10: White Plaster Ceiling							
21	CT50229AI10C	10	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 10: White Plaster Ceiling							
22	CT50229AI11A	11	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 11: Gray Plaster Wall Base Coat							
23	CT50229AI11B	11	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 11: Gray Plaster Wall Base Coat							
24	CT50229AI11C	11	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 11: Gray Plaster Wall Base Coat							
25	CT50229AI11D	11	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 11: Gray Plaster Wall Base Coat							
26	CT50229AI11E	11	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 11: Gray Plaster Wall Base Coat							
27	CT50229AI12A	12	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 12: Black Terrazzo Floor							
28	CT50229AI12B	12	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 12: Black Terrazzo Floor							
29	CT50229AI13A	13	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat							
30	CT50229AI13B	13	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat							
31	CT50229AI13C	13	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat							
32	CT50229AI13D	13	----	----	----	----	NAD	NA
Location:	Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat							

See Reporting notes on last page

Client Name: Atlantic Testing Laboratories, Limited

Table I
Summary of Bulk Asbestos Analysis Results

CT50229; SUNY Canton French Hall; Canton, New York

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
33	CT50229AI13E	13	----	----	----	----	NAD	NA

Location: Main Entrance - Row 13: White Plaster Row 11 Wall Top Coat

Analyzed by: Feyza Gungor_____; Date Analyzed 10/16/2018

**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or ELAP 198.1 for New York friable samples or ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or ELAP 198.4; for New York samples; NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses): NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, AIHA-LAP, LLC (PLM) Lab ID 102843.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

Reviewed By:_____

ATLANTIC TESTING LABORATORIES
ASBESTOS BULK SAMPLE CHAIN-OF-CUSTODY RECORD

Albany	Binghamton	Canton	Plattsburgh	Poughkeepsie	Rochester	Syracuse	Utica	Wat
22 Corporate Drive	126 Park Avenue	6431 U.S. Highway 11	130 Arizona Ave	251 Upper North Road	3495 Winton Place	6085 Court Street Road	301 St. Anthony Street	26581 N
Clifton Park, NY 12065	Binghamton, NY 13903	Canton, NY 13617	Plattsburgh, NY 12903	Highland, NY 12528	Rochester, NY 14623	Syracuse, NY 13206	Utica NY 13501	Waterto
518-383-9144 (T)	607-773-1812 (T)	315-386-4578 (T)	518-563-5878 (T)	845-691-6098 (T)	585-427-9020 (T)	315-699-5281 (T)	315-735-3309 (T)	315-7
518-383-9166 (F)	607-773-1835 (F)	315-386-1012 (F)	518-562-1321 (F)	845-691-6099 (F)	585-427-9021 (F)	315-699-3374 (F)	315-735-0742 (F)	315-7
labsAT@atlantictesting.com	labsET@atlantictesting.com	labsCT@atlantictesting.com	labsPL@atlantictesting.com	labsPT@atlantictesting.com	labsRT@atlantictesting.com	labsST@atlantictesting.com	labsUT@atlantictesting.com	labsWT@at

Project Number: CT50229	**Project Name:** Suny Canton French Hall	**Project Location:** Canton New York	
Project Manager: Dan Faulknham	**Email Results:** LabsCT @atlantictesting.com	**Page Number:** 1 of 4	

Turn Around Time:	☐ 12 hr	☐ 24 hr	☐ 48 hr	☐ 72 hr	☑ 5 day ☐ Other:
Special Instructions:	☑ Positive Stop Analysis	☐ If negative by PLM-NOB, analyze by TEM-NOB	☐ Other:		

Date	Sample Number	Sample Location	Sample Description	PLM	PLM-NOB	TEM-NOB	Labor II
10/10/2018	CT50229AI01A	Main entrance	Row 1: White 1- by 1-Foot Fissured Ceiling Tile	X			
10/10/2018	CT50229AI01B	Main entrance	Row 1: White 1- by 1-Foot Fissured Ceiling Tile	X			
10/10/2018	CT50229AI02A	Main entrance	Row 2: Brown Ceiling Tile Adheisve Row 1		X	X	
10/10/2018	CT50229AI02B	Main entrance	Row 2: Brown Ceiling Tile Adheisve Row 1		X	X	
10/10/2018	CT50229AI03A	Main entrance	Row 3: White Gypsum Wall Board	X			
10/10/2018	CT50229AI03B	Main entrance	Row 3: White Gypsum Wall Board	X			
10/10/2018	CT50229AI04A	Main entrance	Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3		X	X	
10/10/2018	CT50229AI04B	Main entrance	Row 4: White Gypsum Wall Board Associated White Seam Tape Row 3		X	X	
10/10/2018	CT50229AI05A	Main entrance	Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3	X			
10/10/2018	CT50229AI05B	Main entrance	Row 5: White Gypsum Wall Board Associated White Joint Compound Row 3	X			

Sampler:	Laboratory:	Field and Laboratory Remarks:
Name: Evan Renwick Date: 10/10/18	Name: Ben Horan Date: 10/11/18	
Signature: Time: 1100	Signature: Time: 1140	
Samples Relinquished By:	**Samples Received By:**	
Name: Evan Renwick Date: 10/10/18	Name: Date:	
Signature: Time: 1750	Signature: Time:	
Name: Date:	Name: Date:	
Signature: Time:	Signature: Time:	

#218102293

ATLANTIC TESTING LABORATORIES
ASBESTOS BULK SAMPLE CHAIN-OF-CUSTODY RECORD

Albany	Binghamton	Canton	Plattsburgh	Poughkeepsie	Rochester	Syracuse	Utica	Wat
22 Corporate Drive	126 Park Avenue	6431 U.S. Highway 11	130 Arizona Ave	251 Upper North Road	3495 Winton Place	6085 Court Street Road	301 St. Anthony Street	26581 N
ifton Park, NY 12065	Binghamton, NY 13903	Canton, NY 13617	Plattsburgh, NY 12903	Highland, NY 12528	Rochester, NY 14623	Syracuse, NY 13206	Utica NY 13501	Waterto
518-383-9144 (T)	607-773-1812 (T)	315-386-4578 (T)	518-563-5878 (T)	845-691-6098 (T)	585-427-9020 (T)	315-699-5281 (T)	315-735-3309 (T)	315-7
518-383-9166 (F)	607-773-1835 (F)	315-386-1012 (F)	518-562-1321 (F)	845-691-6099 (F)	585-427-9021 (F)	315-699-3374 (F)	315-735-0742 (F)	315-7
AT@atlantictesting.com	labsET@atlantictesting.com	labsCT@atlantictesting.com	labsPL@atlantictesting.com	labsPT@atlantictesting.com	labsRT@atlantictesting.com	labsST@atlantictesting.com	labsUT@atlantictesting.com	labsWT@at

oject Number: CT50229	**Project Name:** Suny Canton French Hall	**Project Location:** Canton New York	
oject Manager: Dan Faulknham	**Email Results:** labsCT @atlantictesting.com	**Page Number:** 2 of 4	

urn Around Time:	☐ 12 hr	☐ 24 hr	☐ 48 hr	☐ 72 hr	☑ 5 day	☐ Other:
pecial Instructions:	☑ Positive Stop Analysis	☐ If negative by PLM-NOB, analyze by TEM-NOB	☐ Other:		

Date	Sample Number	Sample Location	Sample Description	PLM	PLM-NOB	TEM-NOB	Labor II
10/10/2018	CT50229AI06A	Main entrance	Row 6: Black 4-Inch Cove Base		X	X	
10/10/2018	CT50229AI06B	Main entrance	Row 6: Black 4-Inch Cove Base		X	X	
10/10/2018	CT50229AI07A	Main entrance	Row 7: Off-White Cove Base Associated ~~Yellow~~ Adhesive		X	X	
10/10/2018	CT50229AI07B	Main entrance	Row 7: Off-White Cove Base Associated ~~Yellow~~ Adhesive		X	X	
10/10/2018	CT50229AI08A	Main entrance	Row 8: Light Gray CFT Grout	X			
10/10/2018	CT50229AI08B	Main entrance	Row 8: Light Gray CFT Grout	X			
10/10/2018	CT50229AI09A	Main entrance	Row 9: Gray CFT Mortar Row 8	X			
10/10/2018	CT50229AI09B	Main entrance	Row 9: Gray CFT Mortar Row 8	X			
10/10/2018	CT50229AI10A	Main entrance	Row 10: White Plaster ~~Wall~~ Ceiling	X			
10/10/2018	CT50229AI10B	Main entrance	Row 10: White Plaster ~~Wall~~ Ceiling	X			

Sampler:	Laboratory:	Field and Laboratory Remarks:
Name: Evan Dancewicz Date: 10/10/18	Name: Ben Homa Date: 10/11/18	
Signature: Time: 1100	Signature: Time: 1140	
Samples Relinquished By:	**Samples Received By:**	
Name: Evan Dancewicz Date: 10/10/18	Name: Date:	
Signature: Time: 1530	Signature: Time:	
Name: Date:	Name: Date:	#218102293
Signature: Time:	Signature: Time:	

ATLANTIC TESTING LABORATORIES
ASBESTOS BULK SAMPLE CHAIN-OF-CUSTODY RECORD

Albany	Binghamton	Canton	Plattsburgh	Poughkeepsie	Rochester	Syracuse	Utica	Wat
22 Corporate Drive	126 Park Avenue	6431 U.S. Highway 11	130 Arizona Ave	251 Upper North Road	3495 Winton Place	6085 Court Street Road	301 St. Anthony Street	26581 N
ifton Park, NY 12065	Binghamton, NY 13903	Canton, NY 13617	Plattsburgh, NY 12903	Highland, NY 12528	Rochester, NY 14623	Syracuse, NY 13206	Utica NY 13501	Waterto
518-383-9144 (T)	607-773-1812 (T)	315-386-4578 (T)	518-563-5878 (T)	845-691-6098 (T)	585-427-9020 (T)	315-699-5281 (T)	315-735-3309 (T)	315-7
518-383-9166 (F)	607-773-1835 (F)	315-386-1012 (F)	518-562-1321 (F)	845-691-6099 (F)	585-427-9021 (F)	315-699-3374 (F)	315-735-0742 (F)	315-7
AT@atlantictesting.com	labsET@atlantictesting.com	labsCT@atlantictesting.com	labsPL@atlantictesting.com	labsPT@atlantictesting.com	labsRT@atlantictesting.com	labsST@atlantictesting.com	labsUT@atlantictesting.com	labsWT@at

oject Number: CT50229	**Project Name:** Suny Canton French Hall	**Project Location:** Canton New York	
oject Manager: Dan Faulknham	**Email Results:** LabsCT @atlantictesting.com	**Page Number:** 3 of 4	

urn Around Time:	☐ 12 hr	☐ 24 hr	☐ 48 hr	☐ 72 hr	☑ 5 day ☐ Other:
pecial Instructions:	☑ Positive Stop Analysis	☐ If negative by PLM-NOB, analyze by TEM-NOB	☐ Other:		

Date	Sample Number	Sample Location	Sample Description	PLM	PLM-NOB	TEM-NOB	Labor II
10/10/2018	CT50229AI10C	Main entrance	Row 10: White Plaster Ceiling	X			
10/10/2018	CT50229AI11A	Main entrance	Row 11: Gray Plaster wall base coat	X			
10/10/2018	CT50229AI11B	Main entrance	Row 11: Gray Plaster wall base coat	X			
10/10/2018	CT50229AI11C	Main entrance	Row 11: Gray Plaster wall base coat	X			
10/10/2018	CT50229AI11D	Main entrance	Row 11: Gray Plaster wall base coat	X			
10/10/2018	CT50229AI11E	Main entrance	Row 11: Gray Plaster wall base coat	X			
10/10/2018	CT50229AI12A	Main entrance	Row 12: Black Terrazzo floor	X			
10/10/2018	CT50229AI12B	Main entrance	Row 12: Black Terrazzo floor	X			
10/10/2018	CT50229AI13A	Main entrance	Row 13: White Plaster Row 11 wall top coat	X			
10/10/2018	CT50229AI13B	Main entrance	Row 13: White Plaster Row 11 wall Top coat	X			

ampler:

ame: Evan Resnick Date: 10/10/18

gnature: Time: 1100

amples Relinquished By:

ame: Evan Resnick Date: 10/10/18

gnature: Time: 1730

ame: Date:

gnature: Time:

Laboratory:

Name: Ben Hora Date: 10/11/18

Signature: Time: 1140

Samples Received By:

Name: Date:

Signature: Time:

Name: Date:

Signature: Time:

Field and Laboratory Remarks:

#218102293

ATLANTIC TESTING LABORATORIES
ASBESTOS BULK SAMPLE CHAIN-OF-CUSTODY RECORD

Albany	Binghamton	Canton	Plattsburgh	Poughkeepsie	Rochester	Syracuse	Utica	Wat
22 Corporate Drive	126 Park Avenue	6431 U.S. Highway 11	130 Arizona Ave	251 Upper North Road	3495 Winton Place	6085 Court Street Road	301 St. Anthony Street	26581 N
fton Park, NY 12065	Binghamton, NY 13903	Canton, NY 13617	Plattsburgh, NY 12903	Highland, NY 12528	Rochester, NY 14623	Syracuse, NY 13206	Utica NY 13501	Waterto
518-383-9144 (T)	607-773-1812 (T)	315-386-4578 (T)	518-563-5878 (T)	845-691-6098 (T)	585-427-9020 (T)	315-699-5281 (T)	315-735-3309 (T)	315-7
518-383-9166 (F)	607-773-1835 (F)	315-386-1012 (F)	518-562-1321 (F)	845-691-6099 (F)	585-427-9021 (F)	315-699-3374 (F)	315-735-0742 (F)	315-7
AT@atlantictesting.com	labsET@atlantictesting.com	labsCT@atlantictesting.com	labsPL@atlantictesting.com	labsPT@atlantictesting.com	labsRT@atlantictesting.com	labsST@atlantictesting.com	labsUT@atlantictesting.com	labsWT@at

oject Number: CT50229	**Project Name:** Suny Canton French Hall	**Project Location:** Canton New York	
oject Manager: Dan Faulknham	**Email Results:** labsCT @atlantictesting.com	**Page Number:** 4 of 4	

ırn Around Time:	☐ 12 hr	☐ 24 hr	☐ 48 hr	☐ 72 hr	☑ 5 day ☐ Other:
pecial Instructions:	☑ Positive Stop Analysis	☐ If negative by PLM-NOB, analyze by TEM-NOB	☐ Other:		

Date	Sample Number	Sample Location	Sample Description	PLM	PLM-NOB	TEM-NOB	Labo II
10/10/2018	CT50229AI13C	Main entrance	Row 13: White Plaster Row 11 Wall Top Coat	X			
10/10/2018	CT50229AI13D	Main entrance	Row 13: White Plaster Row 11 Wall Top Coat	X			
10/10/2018	CT50229AI13E	Main entrance	Row 13: White Plaster Row 11 Wall Top Coat	X			

ampler:	**Laboratory:**	**Field and Laboratory Remarks:**
ame: Evan Renwick **Date:** 10/10/18	**Name:** Ben Hong **Date:** 10/11/18	
gnature: **Time:** 1100	**Signature:** **Time:** 1140	
amples Relinquished By:	**Samples Received By:**	
ame: Evan Renwick **Date:** 10/10/18	**Name:** **Date:**	
gnature: **Time:** 1730	**Signature:** **Time:**	
ame: **Date:**	**Name:** **Date:**	#218102293
gnature: **Time:**	**Signature:** **Time:**	

APPENDIX D

SUMMARY TABLES

KEY FOR SUMMARY TABLES

Acronyms for the Known or Assumed ACM:

CFT = Ceramic Floor Tile
CWT = Ceramic Wall Tile
EPDM = Ethylene Propylene Diene Monomer
HVAC = Heating, Ventilation, and Air Conditioning
TSI = Thermal System Insulation

Abbreviations for Friable/ACM Type:

Y = Yes N= No M = Miscellaneous S = Surfacing T = Thermal System Insulation

Descriptions for Conditions:

The listed conditions of Good, Fair, and Poor generally correspond with the AHERA descriptions of Good, Damaged, and Significantly Damaged for different types of materials. The following summarizes additional details relative to the listed conditions.

Surfacing (Surf.) and Miscellaneous (Misc.) Materials

- Good: Material with no visible damage or deterioration, or showing only very limited damage or deterioration
- Fair: Material with characteristics of surface crumbling, blistered, water-stained, gouged, marred, or otherwise abraded over less than one tenth of the surface if the damage is evenly distributed or one quarter if the damage is localized.
- Poor: Material with one or more of the following characteristics:
  - Surface crumbling or blistering is present over at least one tenth of the surface, if the damage is evenly distributed or one quarter if the damage is localized.
  - One tenth (or one quarter, if localized) of material hanging from the surface, deteriorated, or showing adhesive failure.
  - Water stains, gouges, or mars over at least one tenth of the surface if the damage is evenly distributed or one quarter if the damage is localized.

Thermal System Insulation (TSI) Materials

- Good: Material with no visible damage or deterioration, or showing only very limited damage or deterioration
- Fair: Material with one or more of the following characteristics:
  - A few water stains or less than one tenth of insulation with missing jackets.
  - Crushed insulation or water stains, gouges, punctures, or mars on up to one tenth of the insulation if the damage is evenly distributed or up to one quarter if the damage is localized.
- Poor: Material with one or more of the following characteristics:
  - Missing jackets on at least one tenth of the piping or equipment.
  - Crushed or heavily gouged or punctured insulation on at least one tenth of the component (pipe runs/risers, boiler, tank, duct, etc.) if the damage is evenly distributed or one quarter if the damage is localized.

Notes:

[1] Sample Location Plan is enclosed in Appendix B.

[2] NAD = No Asbestos Detected

[3] Quantities and locations are approximate and must be verified by asbestos abatement contractors prior to providing actual cost quotations and/or initiating abatement activities.

[4] NA = Not Applicable

.

Table D-I
Summary of Suspect ACM and Analytical Results

Material	General Location[1]	Friable/ ACM Type	% Asbestos[2A]	Condition	Sample Numbers	Estimated Quantity[3, 4]
White 1- by 1-Foot Fissured Ceiling Tile	Main Entrance	Y/M	NAD	Good	CT50229AI01A CT50229AI01B	NA
Brown Adhesive Associated with White 1- by 1-Foot Fissured Ceiling Tile	Main Entrance	N/M	NAD	Good	CT50229AI02A CT50229AI02B	NA
White Gypsum Wall Board	Main Entrance	Y/M	NAD	Good	CT50229AI03A CT50229AI03B	NA
White Seam Tape Associated with White Gypsum Wall Board	Main Entrance	N/M	NAD	Good	CT50229AI04A CT50229AI04B	NA
White Joint Compound Associated with White Gypsum Wall Board	Main Entrance	Y/M	NAD	Good	CT50229AI05A CT50229AI05B	NA
Black 4-Inch Cove Base	Main Entrance	N/M	NAD	Good	CT50229AI06A CT50229AI06B	NA
Off-White Adhesive Associated with Black 4-Inch Cove Base	Main Entrance	N/M	NAD	Good	CT50229AI07A CT50229AI07B	NA
Light Gray CFT Grout	Main Entrance	N/M	NAD	Good	CT50229AI08A CT50229AI08B	NA
Light Gray CFT Mortar	Main Entrance	N/M	NAD	Good	CT50229AI09A CT50229AI09B	NA
White Plaster Ceiling	Main Entrance	Y/S	NAD	Good	CT50229AI10A CT50229AI10B CT50229AI10C	NA
Gray Wall Plaster Base Coat	Main Entrance	Y/S	NAD	Good	CT50229AI11A CT50229AI11B CT50229AI11C CT50229AI11D CT50229AI11E	NA
Black Terrazzo Floor	Main Entrance	N/M	NAD	Good	CT50229AI12A CT50229AI12B	NA
White Wall Plaster Top Coat	Main Entrance	Y/S	NAD	Good	CT50229AI13A CT50229AI13B CT50229AI13C CT50229AI13D CT50229AI13E	NA

APPENDIX E

SUMMARY OF XRF RESULTS AND CALIBRATION CHECKS

Table E-I

Summary of XRF Test Results - Lead Detected at Greater than or Equal to 1 mg/cm^2

Reading No	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm^2)
CT50229LX05	10/10/18 9:00:06	Column	N/A	Metal	A	Intact	Off-White	French Hall	Main Entrance	10.2

Notes:

Alpha numerical room side designations were based on A beginning with the address side of the building and progressing clockwise around the room.

Table E-II
Summary of XRF Results - Lead Detected at Less than 1 mg/cm2

Reading No	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm^2)
CT50229LX04	10/10/18 8:59:36	Room	Wall	Plaster	A	Intact	Off-White	French Hall	Main Entrance	0.1
CT50229LX12	10/10/18 9:07:21	Radiator	Cover	Metal	D	Intact	Black	French Hall	Main Entrance	0.1

Notes:

Alpha numerical room side designations were based on A beginning with the address side of the building and progressing clockwise around the room.

Table E-III
Summary of XRF Test Results - No Lead Detected

Reading No	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm^2)
CT50229LX06	10/10/18 9:01:56	Room	Wall	Metal	B	Intact	Off-White	French Hall	Main Entrance	0
CT50229LX07	10/10/18 9:02:27	Door	Casing	Wood	B	Intact	Green	French Hall	Main Entrance	0
CT50229LX08	10/10/18 9:03:15	Room	Wall	Wood	D	Intact	Green	French Hall	Main Entrance	0
CT50229LX09	10/10/18 9:04:51	Stair	Railing	Metal	D	Intact	Black	French Hall	Main Entrance	0
CT50229LX10	10/10/18 9:05:13	Stair	Balusters	Metal	D	Intact	Black	French Hall	Main Entrance	0
CT50229LX11	10/10/18 9:06:32	Stair	Stringer	Metal	D	Intact	Black	French Hall	Main Entrance	0

Notes:

Alpha numerical room side designations were based on A beginning with the address side of the building and progressing clockwise around the room.

Table E-IV
Summary of XRF Calibration Results

Reading No	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm^2)
CT50229LX01	10/10/18 8:54:32				Calibration			French Hall		1
CT50229LX02	10/10/18 8:54:57				Calibration			French Hall		1.1
CT50229LX03	10/10/18 8:55:20				Calibration			French Hall		1
CT50229LX13	10/10/18 9:10:23				Calibration			French Hall		1.1
CT50229LX14	10/10/18 9:10:52				Calibration			French Hall		1.1
CT50229LX15	10/10/18 9:11:24				Calibration			French Hall		1

Notes:

Alpha numerical room side designations were based on A beginning with the address side of the building and progressing clockwise around the room.

Section 10 – System Option Cost Estimates

TROPHY POINT

Construction Services & Consulting

CONCEPT ESTIMATE

FRENCH HALL - MECHANICAL SYSTEMS REPLACEMENT STUDY
SUNY CANTON

CANTON, NY

SUCF PROJECT NO. 231040

PREPARED FOR:
PATHFINDER ENGINEERS & ARCHITECTS, LLP

PROJECT NO: 19-0795a-0369

May 15, 2020
(Revision 1)

Trophy Point, LLC
Construction Services & Consulting

4588 South Park Avenue
Blasdell, NY 14219
Phone: (716) 823-0006
Fax: (716) 831-0001

787 Pine Valley Drive, Suite A
Pittsburgh, PA 15239
Phone: (716) 436-5571
Fax: (716) 831-0001

WWW.TROPHYPOINT.COM

PROJECT SUMMARY — TOTAL COST

PROJECT CONSTRUCTION COST OPTIONS

GEOTHERMAL VARIABLE AIR VOLUME (VAV)	**$**	**4,981,097**
GEOTHERMAL FOUR PIPE FAN COIL UNIT (FCU) WITH DOAS	**$**	**5,083,518**
GEOTHERMAL WATER-TO-WATER HEAT PUMP (WWHP) WITH DOAS	**$**	**4,574,334**
ELECTRIC BOILER PLANT FOR EXISTING-TO-REMAIN (SITE) SNOWMELT	**$**	**379,777**

ESTIMATE NOTES / ASSUMPTIONS / CLARIFICATIONS

- BASED ON PATHFINDER ENGINEERS & ARCHITECTS, LLP CONCEPT DOCUMENTS DATED 05/01/2020 AND UPDATED DRAFT REPORT DATED 5/3/2020.
- NEW YORK STATE PREVAILING WAGE RATES FOR ST. LAWRENCE COUNTY.
- CONSTRUCTION START MAY 2022; COMPLETION SEPTEMBER 2023; MID-POINT DECEMBER 2022.
- NORMAL WORKING HOURS AND CONDITIONS; EXCLUDES PREMIUMS FOR A CONDENSED CONSTRUCTION SCHEDULE.
- SINGLE PRIME CONTRACT (COMPETITIVELY BID) - ENTIRE PROJECT BID AT ONE TIME.
- PREMISES TO BE OCCUPIED DURING CONSTRUCTION (WORK AREAS TO BE VACANT).
- OUTDOOR (SITE) SNOWMELT TO BE PROVIDED BY OTHERS - PRIOR TO THE START OF THIS PROJECT.
- ASBESTOS AND HAZARDOUS MATERIALS REPORT NOT AVAILABLE AT TIME OF ESTIMATE. ESTIMATE INCLUDES ALLOWANCE OF $2 / SF FOR ASBESTOS AND HAZARDOUS MATERIALS ABATEMENT.

Note: This estimate represents a reasonable opinion of cost based on several public and proprietary sources of information. It is not a prediction of the successful bid from a contractor as bids will vary due to fluctuating market conditions, errors and omissions, proprietary specifications, lack of surplus bidders, perception of risk, and so on. Consequently, this estimate is expected to fall within the range of bids from multiple competitive contractors or subcontractors. However, we do not warrant that bids or negotiated prices will not vary from the final construction cost estimate.

GEOTHERMAL VAV SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.80%	$1.91
DIVISION 5 - METALS		$15,000	$15,000	$30,000	0.60%	$1.44
DIVISION 7 - THERMAL AND MOISTURE PROTECTION		$5,000	$5,000	$10,000	0.20%	$0.48
DIVISION 9 - FINISHES		$125,000	$138,800	$263,800	5.30%	$12.62
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.10%	$5.00
DIVISION 23 - HVAC		$1,088,400	$906,500	$1,994,900	40.05%	$95.45
DIVISION 26 - ELECTRICAL		$260,345	$221,690	$482,035	9.68%	$23.06
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.50%	$8.33
SUB-TOTAL		$1,663,300	$1,436,000	$3,099,300	62.22%	$148.29
GENERAL CONDITIONS	10.0%			$309,900	6.22%	$14.83
OVERHEAD AND PROFIT	10.0%			$340,920	6.84%	$16.31
DESIGN CONTINGENCY	15.0%			$562,518	11.29%	$26.91
BID CONTINGENCY	5.0%			$215,632	4.33%	$10.32
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$452,827	9.09%	$21.67
TOTAL - GEOTHERMAL VAV SUMMARY	**20,900 GSF**			**$4,981,097**	**100.00%**	**$238.33**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 5 - METALS						
Steel dunnage for rooftop AHU	1 ALLOW	$15,000.00	$15,000	$15,000.00	$15,000	$30,000
TOTAL DIVISION 5 - METALS			**15,000**		**15,000**	**30,000**
TOTAL DIVISION 5 - METALS SAY			**$15,000**		**$15,000**	**$30,000**
DIVISION 7 - THERMAL AND MOISTURE PROTECTION						
Patch roof at new framing and AHU, modify roof warranty	1 ALLOW	$5,000.00	$5,000	$5,000.00	$5,000	$10,000
TOTAL DIVISION 7 - THERMAL AND MOISTURE PROTECTION			**5,000**		**5,000**	**10,000**
TOTAL DIVISION 7 - THERMAL AND MOISTURE PROTECTION SAY			**$5,000**		**$5,000**	**$10,000**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required) for VAV system ductwork	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	3,000.00	3,000	7,000.00	7,000	10,000
TOTAL DIVISION 9 - FINISHES			**125,000**		**138,775**	**263,775**
TOTAL DIVISION 9 - FINISHES SAY			**$125,000**		**$138,800**	**$263,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Rooftop enthalpy energy recovery (EER) variable air volume (VAV) hvac air handling unit (AHU), 20000 cfm, including glycol preheat coil and chilled water cooling coil, supply air fan and return air fan, fan variable frequency drives, MERV 8 prefilters, MERV 13 final filters, airflow measurement stations for supply air, return air, outdoor air intake and relief air	1 EA	130,000.00	130,000	9,600.00	9,600	139,600

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Variable air volume supply air terminal units including hot water reheat coil - quantity estimated for building spaces by appliying the report narrative description to the 2014 window / roof project floor plans						
- Floor 1	25 EA	350.00	8,750	200.00	5,000	13,750
- Floor 2	24 EA	350.00	8,400	200.00	4,800	13,200
Geothermal 3-module water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) header / rack configuration - the 3 modules together capable of generating up to 150 gpm of 115 F heating hot water and up to 180 gpm of 42 F chilled water, and capable of simultaneously generating both heating hot water and chilled water for 4-pipe operation	1 LS	220,000.00	220,000	7,680.00	7,680	227,680
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol preheat, to serve EER VAV AHU preheat coil	1 EA	6,500.00	6,500	960.00	960	7,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For EER VAV AHU preheat	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the 3-module water - to - water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) heating hot water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Glycol heating pumps serving rooftop EER VAV AHU preheat coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the rooftop EER VAV AHU - since the rooftop EER VAV AHU is the only load served by these glycol preheat pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary heating hot water building distribution pumps - serving VAV box reheat coils, cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Secondary chilled water pumps serving rooftop EER VAV AHU (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,500.00	2,500	560.00	560	3,060
- Glycol preheat system	1 EA	1,500.00	1,500	480.00	480	1,980
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Thermal expansion tanks						
- Heating hot water system	1 EA	3,500.00	3,500	640.00	640	4,140
- Glycol preheat system	1 LS	3,000.00	3,000	560.00	560	3,560
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters (floor 1 mechanical rooms and floor 1 storage room)	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fans for toilet rooms and for kitchen	3 EA	1,500.00	4,500	560.00	1,680	6,180

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Geothermal 3-module water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	6,780.00	6,780	1,680.00	1,680	8,460
- Rooftop enthalpy energy recovery variable air volume (VAV) hvac air handling unit including glycol preheat coil and chilled water coil (4-pipe)	1 EA	3,970.00	3,970	880.00	880	4,850
- Variable air volume supply air terminal unit hot water reheat coils	49 EA	200.00	9,800	160.00	7,840	17,640
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol preheat, to serve EER VAV AHU preheat coil	1 EA	3,420.00	3,420	640.00	640	4,060
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heating hot water						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	35.13	2,389	43.20	2,938	5,326
- Branch piping to glycol preheat heat exchanger, 2-1/2" diameter	92 LF	20.00	1,840	34.00	3,128	4,968
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	17.20	12,556	15.40	11,242	23,798
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	6.40	1,280	10.50	2,100	3,380
- Runout piping from mains to 49 vav box reheat coils	1,960 LF	6.40	12,544	10.50	20,580	33,124

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Glycol preheat from heat exchanger to pumps and to rooftop EER VAV AHU preheat coil, 2-1/2" diameter	160 LF	20.00	3,200	34.00	5,440	8,640
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Piping from secondary pumps to rooftop EER VAV AHU, 4" diameter	160 LF	35.13	5,621	43.20	6,912	12,533
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing - estimated	15,000 LB	1.38	20,700	7.00	105,000	125,700
Transfer air ductwork assemblies	1 LS	5,000.00	5,000	5,600.00	5,600	10,600
Air inlets and outlets (at ceiling)						
- Linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for return air and exhaust air, and for supply air in rooms with no windows	100 EA	80.00	8,000	70.00	7,000	15,000
Fire dampers, control dampers, sounds attenuators, etc.	1 LS	10,000.00	10,000	7,000.00	7,000	17,000
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Heating hot water piping						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	8.80	810	9.60	883	1,693
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	8.80	598	9.60	653	1,251
- Branch piping to glycol preheat heat exchanger, 2-1/2" diameter	92 LF	7.20	662	7.33	674	1,337

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	6.30	4,599	6.94	5,066	9,665
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	2.30	460	5.70	1,140	1,600
- Runout piping from mains to 49 vav box reheat coils	1,960 LF	2.30	4,508	5.70	11,172	15,680
Glycol preheat from heat exchanger to pumps and to rooftop EER VAV AHU preheat coil, 2-1/2" diameter	160 LF	7.20	1,152	7.33	1,173	2,325
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	6.10	561	8.89	818	1,379
- Piping from secondary pumps to rooftop EER VAV AHU, 4" diameter	160 LF	6.10	976	8.89	1,422	2,398
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Sheetmetal work insulation	1 LS	6,600.00	6,600	38,600.00	38,600	45,200
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	25,600.00	25,600	25,600
DIRECT DIGITAL CONTROLS (DDC)						
Rooftop enthalpy energy recovery (EER) variable air volume (VAV) hvac air handling unit (AHU) including glycol preheat coil and chilled water coil, supply air fan and return air fan, airflow measurement for supply air, return air, outdoor air intake and relief air	1 EA	12,600.00	12,600	18,900.00	18,900	31,500
3-Module Water - to - water heat pump heating and cooling plant, 3 hydronic systems / 6-pipe	1 LS	10,800.00	10,800	16,200.00	16,200	27,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Variable air volume supply air terminal unit hot water reheat coils	49 EA	800.00	39,200	1,200.00	58,800	98,000
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fans for toilet rooms and for kitchen	3 EA	720.00	2,160	1,080.00	3,240	5,400
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060
Concrete pads for equipment	280 SF	9.10	2,548	6.32	1,770	4,318
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
TOTAL DIVISION 23 - HVAC			**1,088,368**		**906,518**	**1,994,885**
TOTAL DIVISION 23 - HVAC SAY			**$1,088,400**		**$906,500**	**$1,994,900**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	4 EA	750.00	3,000	1,232.00	4,928	7,928
Unit heater / cabinet unit heater connection including means of disconnect, conduit and circuiting back to source power panel	5 EA	500.00	2,500	924.00	4,620	7,120
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	13 EA	150.00	1,950	462.00	6,006	7,956
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**260,345**		**221,690**	**482,035**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$260,300**		**$221,700**	**$482,000**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

GEOTHERMAL FCU SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.79%	$1.91
DIVISION 9 - FINISHES		$123,500	$135,300	$258,800	5.09%	$12.38
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.06%	$5.00
DIVISION 23 - HVAC		$1,120,400	$964,200	$2,084,600	41.01%	$99.74
DIVISION 26 - ELECTRICAL		$266,720	$234,318	$501,038	9.86%	$23.97
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.42%	$8.33
SUB-TOTAL		$1,680,200	$1,482,800	$3,163,000	62.22%	$151.34
GENERAL CONDITIONS	10.0%			$316,300	6.22%	$15.13
OVERHEAD AND PROFIT	10.0%			$347,930	6.84%	$16.65
DESIGN CONTINGENCY	15.0%			$574,085	11.29%	$27.47
BID CONTINGENCY	5.0%			$220,066	4.33%	$10.53
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$462,138	9.09%	$22.11
TOTAL - GEOTHERMAL FCU SUMMARY	**20,900 GSF**			**$5,083,518**	**100.00%**	**$243.23**

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2- HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2- HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2- HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required)	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	1,500.00	1,500	3,500.00	3,500	5,000
TOTAL DIVISION 9 - FINISHES			**123,500**		**135,275**	**258,775**
TOTAL DIVISION 9 - FINISHES SAY			**$123,500**		**$135,300**	**$258,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, 4000 cfm, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	30,000.00	30,000	5,120.00	5,120	35,120
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	1,000.00	4,000	640.00	2,560	6,560

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Ducted fan coil units, 4-pipe hot water heating coil and chilled water cooling coil - quantity based on estimated VAV quantity (estimated for building spaces by applying the report narrative description to the 2014 window / roof project floor plans)						
- Floor 1	25 EA	1,600.00	40,000	480.00	12,000	52,000
- Floor 2	24 EA	1,600.00	38,400	480.00	11,520	49,920
Geothermal water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) 6-pipe header / rack configuration - to generate 150 gpm of 115 F heating hot water / 180 gpm of 42 F chilled water - capable of simultaneously generating both heating hot water and chilled water for 4-pipe heating and coolng operation	1 LS	220,000.00	220,000	7,680.00	7,680	227,680
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol heating, to serve energy recovery VAV DOAS heating coil	1 EA	5,500.00	5,500	960.00	960	6,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For ER VAV DOAS heating	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the 3-module water - to - water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) heating hot water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Glycol heating pumps serving indoor ER VAV DOAS heating coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the indoor ER VAV DOAS - since the indoor ER VAV DOAS is the only load served by these glycol heating pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary heating hot water building distribution pumps - serving fan coil unit heating coils, cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Secondary chilled water pumps serving indoor ER VAV DOAS and serving fan coil unit cooling coils (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,500.00	2,500	560.00	560	3,060
- Glycol heating system	1 EA	1,200.00	1,200	320.00	320	1,520
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Thermal expansion tanks						
- Heating hot water system	1 EA	3,500.00	3,500	640.00	640	4,140
- Glycol heating system	1 LS	2,500.00	2,500	560.00	560	3,060
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fan for kitchen	1 EA	1,500.00	1,500	560.00	560	2,060
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	250.00	2,000	140.00	1,120	3,120

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Geothermal 3-module water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	6,780.00	6,780	1,680.00	1,680	8,460
- Indoor energy recovery variable air volume (VAV) DOAS air handling unit including glycol heating coil and chilled water coil (4-pipe)	1 EA	1,220.00	1,220	480.00	480	1,700
- Ducted fan coil units, 4-pipe, heatng hot water and chilled water cooling	49 EA	420.00	20,580	320.00	15,680	36,260
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol heating, to serve ER VAV DOAS heating coil	1 EA	1,050.00	1,050	440.00	440	1,490
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heating hot water						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	35.13	2,389	43.20	2,938	5,326
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	27.00	2,484	19.00	1,748	4,232
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	17.20	12,556	15.40	11,242	23,798
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	6.40	1,280	10.50	2,100	3,380
- Runout piping from mains to 49 fan coil unit heating coils	1,960 LF	6.40	12,544	10.50	20,580	33,124

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2" diameter average	730 LF	27.00	19,710	19.00	13,870	33,580
- Runout piping from mains to 49 fan coil unit cooling coils	1,960 LF	10.30	20,188	11.80	23,128	43,316
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Indoor VAV ER DOAS AHU	25 LF	17.20	430	15.40	385	815
- Fan coil units (49)	980 LF	10.30	10,094	11.80	11,564	21,658
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing	10,000 LB	1.38	13,800	7.00	70,000	83,800
Air inlets and outlets (at ceiling)						
- Ducted fan coil unit linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for FCU return air and for DOAS return air and exhaust air, and for FCU supply air in rooms with no windows, and for DOAS supply air	150 EA	80.00	12,000	70.00	10,500	22,500
Louvers, roof ventilators, fire dampers, control dampers, sounds attenuators, etc.	1 LS	8,000.00	8,000	5,600.00	5,600	13,600
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heating hot water piping						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	8.80	810	9.60	883	1,693
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	8.80	598	9.60	653	1,251
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	6.30	580	6.94	638	1,218
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	2.60	1,898	6.24	4,555	6,453
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	2.30	460	5.70	1,140	1,600
- Runout piping from mains to 49 fan coil unit heating coils	1,960 LF	2.30	4,508	5.70	11,172	15,680
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	6.30	706	6.94	777	1,483
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	6.10	561	8.89	818	1,379
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	4.50	504	6.55	734	1,238
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2" diameter average	730 LF	4.50	3,285	6.55	4,782	8,067
- Runout piping from mains to 49 fan coil unit cooling coils	1,960 LF	3.90	7,644	6.08	11,917	19,561
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Condensate drain for indoor VAV ER DOAS	25 LF	1.80	45	5.62	141	186
Condensate drain for fan coil units (49)	980 LF	1.70	1,666	5.38	5,272	6,938
Sheetmetal work insulation	1 LS	4,450.00	4,450	25,950.00	25,950	30,400
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	32,000.00	32,000	32,000

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIRECT DIGITAL CONTROLS (DDC)						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	10,800.00	10,800	16,200.00	16,200	27,000
DDC CO2 monitoring for DOAS system	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	360.00	1,440	540.00	2,160	3,600
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	720.00	5,760	1,080.00	8,640	14,400
DDC controls for outdoor air intake and exhaust air discharge control dampers for indoor DOAS AHU	2 EA	720.00	1,440	1,080.00	2,160	3,600
3-Module Water - to - water heat pump heating and cooling plant, 3 hydronic systems / 6-pipe	1 LS	10,800.00	10,800	16,200.00	16,200	27,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Fan coil units, 4-pipe, heating hot water and chilled water	49 EA	1,000.00	49,000	1,400.00	68,600	117,600
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fan for kitchen	1 EA	720.00	720	1,080.00	1,080	1,800
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	4,000.00	4,000	2,240.00	2,240	6,240
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Concrete pads for equipment	380 SF	9.10	3,458	6.32	2,402	5,860
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
TOTAL DIVISION 23 - HVAC			**1,120,369**		**964,211**	**2,084,579**
TOTAL DIVISION 23 - HVAC SAY			**$1,120,400**		**$964,200**	**$2,084,600**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Unit heater / cabinet unit heater connection including means of disconnect, conduit and circuiting back to source power panel	5 EA	500.00	2,500	924.00	4,620	7,120
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	2 EA	150.00	300	462.00	924	1,224
Fan coil unit connection, means of disconnect, conduit and circuiting	49 EA	225.00	11,025	462.00	22,638	33,663

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**266,720**		**234,318**	**501,038**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$266,700**		**$234,300**	**$501,000**
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

GEOTHERMAL WWHP SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.87%	$1.91
DIVISION 9 - FINISHES		$123,500	$135,300	$258,800	5.66%	$12.38
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.28%	$5.00
DIVISION 23 - HVAC		$885,000	$902,300	$1,787,300	39.07%	$85.52
DIVISION 26 - ELECTRICAL		$259,320	$222,152	$481,472	10.53%	$23.04
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.81%	$8.33
SUB-TOTAL		$1,437,400	$1,408,800	$2,846,200	62.22%	$136.18
GENERAL CONDITIONS	10.0%			$284,600	6.22%	$13.62
OVERHEAD AND PROFIT	10.0%			$313,080	6.84%	$14.98
DESIGN CONTINGENCY	15.0%			$516,582	11.29%	$24.72
BID CONTINGENCY	5.0%			$198,023	4.33%	$9.47
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$415,849	9.09%	$19.90
TOTAL - GEOTHERMAL WWHP SUMMARY	**20,900 GSF**			**$4,574,334**	**100.00%**	**$218.87**

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required)	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	1,500.00	1,500	3,500.00	3,500	5,000
TOTAL DIVISION 9 - FINISHES			**123,500**		**135,275**	**258,775**
TOTAL DIVISION 9 - FINISHES SAY			**$123,500**		**$135,300**	**$258,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, 4000 cfm, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	30,000.00	30,000	5,120.00	5,120	35,120

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	1,000.00	4,000	640.00	2,560	6,560
Water source heat pumps, 2-pipe heat pump loop water - quantity based on estimated VAV quantity (estimated for building spaces by applying the report narrative description to the 2014 window / roof project floor plans)						
- Floor 1	25 EA	2,000.00	50,000	640.00	16,000	66,000
- Floor 2	24 EA	2,000.00	48,000	640.00	15,360	63,360
Geothermal water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) header / rack configuration - capable of simultaneously generating both heating hot water and chilled water for 4-pipe operation	1 LS	37,500.00	37,500	2,560.00	2,560	40,060
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol heating, to serve energy recovery VAV DOAS heating coil	1 EA	5,500.00	5,500	960.00	960	6,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For ER VAV DOAS heating	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the water - to -water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump (primary) heating hot water pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Glycol heating pumps serving indoor ER VAV DOAS heating coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the indoor ER VAV DOAS - since the indoor ER VAV DOAS is the only load served by these glycol heating pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary heating hot water building distribution pumps serving glycol heat exchanger and serving cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary chilled water pumps serving indoor ER VAV DOAS (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,000.00	2,000	480.00	480	2,480
- Glycol heating system	1 EA	1,200.00	1,200	320.00	320	1,520
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,000.00	2,000	480.00	480	2,480
Thermal expansion tanks						
- Heating hot water system	1 EA	3,000.00	3,000	560.00	560	3,560
- Glycol heating system	1 LS	2,500.00	2,500	560.00	560	3,060
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,000.00	2,000	480.00	480	2,480
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fan for kitchen	1 EA	1,500.00	1,500	560.00	560	2,060
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	250.00	2,000	140.00	1,120	3,120
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Geothermal water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	4,230.00	4,230	720.00	720	4,950
- Indoor energy recovery variable air volume (VAV) DOAS air handling unit including glycol heating coil and chilled water coil (4-pipe)	1 EA	1,220.00	1,220	480.00	480	1,700
- Water source heat pump units, 2-pipe, heat pump loop	49 EA	310.00	15,190	160.00	7,840	23,030
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol heating, to serve ER VAV DOAS heating coil	1 EA	1,050.00	1,050	440.00	440	1,490
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heat pump loop						
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2-1/2" diameter average	730 LF	20.00	14,600	37.20	27,156	41,756
- Runout piping from mains to 49 water source heat pumps	1,960 LF	10.30	20,188	11.80	23,128	43,316
Heating hot water						
- Main piping from water-to-water heat pump to primary pumps, 2-1/2" diameter	92 LF	20.00	1,840	37.20	3,422	5,262
- Main secondary building pump piping, 2-1/2" diameter (floor 1 mechanical room)	68 LF	20.00	1,360	37.20	2,530	3,890
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	27.00	2,484	19.00	1,748	4,232

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Piping to 2 suspended unit heaters and to 3 cabinet unit heaters	300 LF	10.30	3,090	11.80	3,540	6,630
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Chilled water						
- From the water-to-water heat pump plant to primary pumps, 2-1/2" diameter	92 LF	20.00	1,840	37.20	3,422	5,262
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Indoor VAV ER DOAS AHU	25 LF	17.20	430	15.40	385	815
- Water source heat pump units (49)	980 LF	10.30	10,094	11.80	11,564	21,658
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing	10,000 LB	1.38	13,800	7.00	70,000	83,800
Air inlets and outlets (at ceiling)						
- Ducted water source heat pump unit linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for WSHP return air and for DOAS return air and exhaust air, and for WSHP supply air in rooms with no windows, and for DOAS supply air	150 EA	80.00	12,000	70.00	10,500	22,500
Louvers, roof ventilators, fire dampers, control dampers, sounds attenuators, etc.	1 LS	8,000.00	8,000	5,600.00	5,600	13,600
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heat pump loop piping						
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2-1/2" diameter average	730 LF	4.90	3,577	6.94	5,066	8,643
- Runout piping from mains to 49 water source heat pumps	1,960 LF	3.90	7,644	6.08	11,917	19,561
Heating hot water piping						
- Main piping from water-to-water heat pump to primary pumps, 2-1/2" diameter	92 LF	7.20	662	7.33	674	1,337
- Main secondary building pump piping, 2-1/2" diameter (floor 1 mechanical room)	68 LF	7.20	490	7.33	498	988
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	6.30	580	6.94	638	1,218
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	300 LF	2.30	690	5.70	1,710	2,400
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	6.30	706	6.94	777	1,483
Chilled water						
- From the water-to-water heat pump plant to primary pumps, 2-1/2" diameter	92 LF	4.90	451	6.94	638	1,089
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	4.50	504	6.55	734	1,238
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Condensate drain for indoor VAV ER DOAS	25 LF	1.80	45	5.62	141	186
Condensate drain for water source heat pump units (49)	980 LF	1.70	1,666	5.38	5,272	6,938
Sheetmetal work insulation	1 LS	4,450.00	4,450	25,950.00	25,950	30,400
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	28,800.00	28,800	28,800

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIRECT DIGITAL CONTROLS (DDC)						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	10,800.00	10,800	16,200.00	16,200	27,000
DDC CO2 monitoring for DOAS system	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	360.00	1,440	540.00	2,160	3,600
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	720.00	5,760	1,080.00	8,640	14,400
DDC controls for outdoor air intake and exhaust air discharge control dampers for indoor DOAS AHU	2 EA	720.00	1,440	1,080.00	2,160	3,600
Water - to - water heat pump heating and cooling unit, 3 hydronic systems / 6-pipe	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Water source heat pump units, 2-pipe, heat pump water	49 EA	900.00	44,100	1,300.00	63,700	107,800
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fan for kitchen	1 EA	720.00	720	1,080.00	1,080	1,800
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	4,000.00	4,000	2,240.00	2,240	6,240
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Concrete pads for equipment	380 SF	9.10	3,458	6.32	2,402	5,860
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
TOTAL DIVISION 23 - HVAC			**884,966**		**902,328**	**1,787,293**
TOTAL DIVISION 23 - HVAC SAY			**$885,000**		**$902,300**	**$1,787,300**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	2 EA	150.00	300	462.00	924	1,224
Heat pump connection, conduit and circuiting	49 EA	125.00	6,125	308.00	15,092	21,217
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**259,320**		**222,152**	**481,472**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$259,300**		**$222,200**	**$481,500**
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

ELECTRIC BOILER PLANT SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL
DIVISION 23 - HVAC		$132,500	$81,000	$213,500	56.22%
DIVISION 26 - ELECTRICAL		$7,000	$15,800	$22,800	6.00%
SUB-TOTAL		$139,500	$96,800	$236,300	62.22%
GENERAL CONDITIONS	10.0%			$23,630	6.22%
OVERHEAD AND PROFIT	10.0%			$25,993	6.84%
DESIGN CONTINGENCY	15.0%			$42,888	11.29%
BID CONTINGENCY	5.0%			$16,441	4.33%
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$34,525	9.09%
TOTAL - ELECTRIC BOILER PLANT SUMMA				**$379,777**	**100.00%**

ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect piping from existing-to-remain snowmelt manifolds	1 LS	$500.00	$500	$1,920.00	$1,920	$2,420
EQUIPMENT						
Electric glycol snowmelt boiler, 270 kW - located in floor 1 mechanical room (northeast corner of floor 1), including options and accessories	1 EA	55,000.00	55,000	5,120.00	5,120	60,120
Glycol makeup unit	1 EA	3,700.00	3,700	960.00	960	4,660
Pumps including pump trim and variable frequency drives						
- Boiler pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Snow melt distribution pumps (1 standby)	2 EA	6,000.00	12,000	1,920.00	3,840	15,840
Air separator	1 EA	2,300.00	2,300	640.00	640	2,940
Thermal expansion tank	1 EA	3,500.00	3,500	800.00	800	4,300
Makeup water assembly	1 EA	2,000.00	2,000	640.00	640	2,640
Connections to existing-to-remain snowmelt manifolds						
- Main building entrance (west) - 600 sq.ft. snowmelt area (single manifold)	1 EA	100.00	100	320.00	320	420
- Back of building (east) - 8000 sq.ft. snowmelt area (multiple manifolds)	1 LS	600.00	600	1,920.00	1,920	2,520
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Snowmelt boiler	1 EA	2,260.00	2,260	640.00	640	2,900
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES) - estimated						
Glycol snowmelt boiler plant (main) piping	124 LF	35.13	4,356	43.20	5,357	9,713
Glycol snowmelt distribution piping						
- Main entrance (600 sq.ft.) - piping to single manifold	126 LF	13.30	1,676	13.80	1,739	3,415
- Back of building (8000 sq.ft.) - piping to multiple manifolds						
- Main piping	262 LF	26.25	6,878	37.20	9,746	16,624
- Sub-main piping	270 LF	17.20	4,644	15.40	4,158	8,802
- Drops to manifolds	80 LF	13.30	1,064	13.80	1,104	2,168

ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Pipe insulation	738 LF	9.00	6,642	9.17	6,767	13,409
Equipment insulation (e.g. pumps, air separator, thermal expansion tank, etc.)	1 LS	350.00	350	1,248.00	1,248	1,598
TESTING, ADJUSTING AND BALANCING						
Snowmelt equipment and glycol snowmelt system flow balancing	1 LS	0.00	0	5,120.00	5,120	5,120
DIRECT DIGITAL CONTROLS (DDC)						
Electric snowmelt boiler	1 EA	2,400.00	2,400	3,600.00	3,600	6,000
Snowmelt boiler pumps (1 standby)	2 EA	1,600.00	3,200	2,400.00	4,800	8,000
Snowmelt distribution pumps (1 standby)	2 EA	1,600.00	3,200	2,400.00	4,800	8,000
Glycol makeup unit	1 EA	800.00	800	1,200.00	1,200	2,000
Existing - to - remain snowmelt zones						
- Main entrance (600 sq.ft.) - single zone	1 EA	800.00	800	1,200.00	1,200	2,000
- Back of building (8000 sq.ft.) - multiple zones	1 LS	3,200.00	3,200	4,800.00	4,800	8,000
MISCELLANEOUS ITEMS						
Material handling, lifting, rigging and hoisting	1 LS	500.00	500	1,280.00	1,280	1,780
Cleaning	1 LS	200.00	200	960.00	960	1,160
Concrete pads for equipment	72 SF	9.10	655	6.32	455	1,110
Labelling and identification	1 LS	250.00	250	750.00	750	1,000
Cut, patch and firestop	1 LS	750.00	750	2,560.00	2,560	3,310
TOTAL DIVISION 23 - HVAC			**132,525**		**81,005**	**213,529**
TOTAL DIVISION 23 - HVAC SAY			**$132,500**		**$81,000**	**$213,500**

ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 26 - ELECTRICAL						
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	$750.00	$750	$5,000.00	$5,000	$5,750
Snowmelt boiler connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Pump connection including means of disconnect, conduit and circuiting back to source power panel	4 EA	750.00	3,000	1,232.00	4,928	7,928
Tie-in and connections at existing snowmelt sytem including conduit and circuiting back to source power panel	1 LS	1,500.00	1,500	2,464.00	2,464	3,964
MISCELLANEOUS						
Cutting, patching and firestopping	1 LS	750.00	750	1,848.00	1,848	2,598
TOTAL DIVISION 26 - ELECTRICAL			**7,000**		**15,780**	**22,780**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$7,000**		**$15,800**	**$22,800**

TROPHY POINT

Construction Services & Consulting

CONCEPT ESTIMATE

FRENCH HALL - MECHANICAL SYSTEMS REPLACEMENT STUDY
SUNY CANTON

CANTON, NY

SUCF PROJECT NO. 231040

PREPARED FOR:
PATHFINDER ENGINEERS & ARCHITECTS, LLP

PROJECT NO: 19-0795a-0369

May 15, 2020
(Revision 1)

Trophy Point, LLC
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PROJECT SUMMARY — TOTAL COST

PROJECT CONSTRUCTION COST OPTIONS

GEOTHERMAL VARIABLE AIR VOLUME (VAV)	**$**	**5,069,492**
GEOTHERMAL FOUR PIPE FAN COIL UNIT (FCU) WITH DOAS	**$**	**5,083,518**
GEOTHERMAL WATER-TO-WATER HEAT PUMP (WWHP) WITH DOAS	**$**	**4,574,334**
ELEC BOILER FOR EXISTING-TO-REMAIN (SITE) SNOWMELT ALL OPTIONS	**$**	**379,777**
RENOV LOWER LEVEL TOILET ROOMS (PATFINDER EST./SF.) ALL OPTIONS	**$**	**140,000**

ESTIMATE NOTES / ASSUMPTIONS / CLARIFICATIONS

- BASED ON PATHFINDER ENGINEERS & ARCHITECTS, LLP CONCEPT DOCUMENTS DATED 05/01/2020 AND UPDATED DRAFT REPORT DATED 5/3/2020.

- NEW YORK STATE PREVAILING WAGE RATES FOR ST. LAWRENCE COUNTY.

- CONSTRUCTION START MAY 2022; COMPLETION SEPTEMBER 2023; MID-POINT DECEMBER 2022.

- NORMAL WORKING HOURS AND CONDITIONS; EXCLUDES PREMIUMS FOR A CONDENSED CONSTRUCTION SCHEDULE.

- SINGLE PRIME CONTRACT (COMPETITIVELY BID) - ENTIRE PROJECT BID AT ONE TIME.

- PREMISES TO BE OCCUPIED DURING CONSTRUCTION (WORK AREAS TO BE VACANT).

- OUTDOOR (SITE) SNOWMELT TO BE PROVIDED BY OTHERS - PRIOR TO THE START OF THIS PROJECT.

- ASBESTOS AND HAZARDOUS MATERIALS REPORT NOT AVAILABLE AT TIME OF ESTIMATE. ESTIMATE INCLUDES ALLOWANCE OF $2 / SF FOR ASBESTOS AND HAZARDOUS MATERIALS ABATEMENT.

Note: This estimate represents a reasonable opinion of cost based on several public and proprietary sources of information. It is not a prediction of the successful bid from a contractor as bids will vary due to fluctuating market conditions, errors and omissions, proprietary specifications, lack of surplus bidders, perception of risk, and so on. Consequently, this estimate is expected to fall within the range of bids from multiple competitive contractors or subcontractors. However, we do not warrant that bids or negotiated prices will not vary from the final construction cost estimate.

GEOTHERMAL VAV SUMMARY

SUMMARY		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.79%	$1.91
DIVISION 5 - METALS		$15,000	$15,000	$30,000	0.59%	$1.44
DIVISION 7 - THERMAL AND MOISTURE PROTECTION		$5,000	$5,000	$10,000	0.20%	$0.48
DIVISION 9 - FINISHES		$160,000	$158,800	$318,800	6.29%	$15.25
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.06%	$5.00
DIVISION 23 - HVAC		$1,088,400	$906,500	$1,994,900	39.35%	$95.45
DIVISION 26 - ELECTRICAL		$260,345	$221,690	$482,035	9.51%	$23.06
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.43%	$8.33
SUB-TOTAL		$1,698,300	$1,456,000	$3,154,300	62.22%	$150.92
GENERAL CONDITIONS	10.0%			$315,400	6.22%	$15.09
OVERHEAD AND PROFIT	10.0%			$346,970	6.84%	$16.60
DESIGN CONTINGENCY	15.0%			$572,501	11.29%	$27.39
BID CONTINGENCY	5.0%			$219,459	4.33%	$10.50
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$460,863	9.09%	$22.05
TOTAL - GEOTHERMAL VAV SUMMARY	**20,900 GSF**			**$5,069,492**	**100.00%**	**$242.56**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 5 - METALS						
Steel dunnage for rooftop AHU	1 ALLOW	$15,000.00	$15,000	$15,000.00	$15,000	$30,000
TOTAL DIVISION 5 - METALS			**15,000**		**15,000**	**30,000**
TOTAL DIVISION 5 - METALS SAY			**$15,000**		**$15,000**	**$30,000**
DIVISION 7 - THERMAL AND MOISTURE PROTECTION						
Patch roof at new framing and AHU, modify roof warranty	1 ALLOW	$5,000.00	$5,000	$5,000.00	$5,000	$10,000
TOTAL DIVISION 7 - THERMAL AND MOISTURE PROTECTION			**5,000**		**5,000**	**10,000**
TOTAL DIVISION 7 - THERMAL AND MOISTURE PROTECTION SAY			**$5,000**		**$5,000**	**$10,000**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required) for VAV system ductwork	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	3,000.00	3,000	7,000.00	7,000	10,000
Creat new lwr level mech room	1 LS	35,000.00	35,000	20,000.00	20,000	55,000
TOTAL DIVISION 9 - FINISHES			**160,000**		**158,775**	**318,775**
TOTAL DIVISION 9 - FINISHES SAY			**$160,000**		**$158,800**	**$318,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Rooftop enthalpy energy recovery (EER) variable air volume (VAV) hvac air handling unit (AHU), 20000 cfm, including glycol preheat coil and chilled water cooling coil, supply air fan and return air fan, fan variable frequency drives, MERV 8 prefilters, MERV 13 final filters, airflow measurement stations for supply air, return air, outdoor air intake and relief air	1 EA	130,000.00	130,000	9,600.00	9,600	139,600

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Variable air volume supply air terminal units including hot water reheat coil - quantity estimated for building spaces by appliying the report narrative description to the 2014 window / roof project floor plans						
- Floor 1	25 EA	350.00	8,750	200.00	5,000	13,750
- Floor 2	24 EA	350.00	8,400	200.00	4,800	13,200
Geothermal 3-module water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) header / rack configuration - the 3 modules together capable of generating up to 150 gpm of 115 F heating hot water and up to 180 gpm of 42 F chilled water, and capable of simultaneously generating both heating hot water and chilled water for 4-pipe operation	1 LS	220,000.00	220,000	7,680.00	7,680	227,680
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol preheat, to serve EER VAV AHU preheat coil	1 EA	6,500.00	6,500	960.00	960	7,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For EER VAV AHU preheat	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the 3-module water - to - water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) heating hot water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Glycol heating pumps serving rooftop EER VAV AHU preheat coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the rooftop EER VAV AHU - since the rooftop EER VAV AHU is the only load served by these glycol preheat pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary heating hot water building distribution pumps - serving VAV box reheat coils, cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Secondary chilled water pumps serving rooftop EER VAV AHU (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,500.00	2,500	560.00	560	3,060
- Glycol preheat system	1 EA	1,500.00	1,500	480.00	480	1,980
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Thermal expansion tanks						
- Heating hot water system	1 EA	3,500.00	3,500	640.00	640	4,140
- Glycol preheat system	1 LS	3,000.00	3,000	560.00	560	3,560
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters (floor 1 mechanical rooms and floor 1 storage room)	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fans for toilet rooms and for kitchen	3 EA	1,500.00	4,500	560.00	1,680	6,180
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Geothermal 3-module water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	6,780.00	6,780	1,680.00	1,680	8,460
- Rooftop enthalpy energy recovery variable air volume (VAV) hvac air handling unit including glycol preheat coil and chilled water coil (4-pipe)	1 EA	3,970.00	3,970	880.00	880	4,850
- Variable air volume supply air terminal unit hot water reheat coils	49 EA	200.00	9,800	160.00	7,840	17,640
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol preheat, to serve EER VAV AHU preheat coil	1 EA	3,420.00	3,420	640.00	640	4,060
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heating hot water						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	35.13	2,389	43.20	2,938	5,326
- Branch piping to glycol preheat heat exchanger, 2-1/2" diameter	92 LF	20.00	1,840	34.00	3,128	4,968
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	17.20	12,556	15.40	11,242	23,798
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	6.40	1,280	10.50	2,100	3,380
- Runout piping from mains to 49 vav box reheat coils	1,960 LF	6.40	12,544	10.50	20,580	33,124
Glycol preheat from heat exchanger to pumps and to rooftop EER VAV AHU preheat coil, 2-1/2" diameter	160 LF	20.00	3,200	34.00	5,440	8,640

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Piping from secondary pumps to rooftop EER VAV AHU, 4" diameter	160 LF	35.13	5,621	43.20	6,912	12,533
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing - estimated	15,000 LB	1.38	20,700	7.00	105,000	125,700
Transfer air ductwork assemblies	1 LS	5,000.00	5,000	5,600.00	5,600	10,600
Air inlets and outlets (at ceiling)						
- Linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for return air and exhaust air, and for supply air in rooms with no windows	100 EA	80.00	8,000	70.00	7,000	15,000
Fire dampers, control dampers, sounds attenuators, etc.	1 LS	10,000.00	10,000	7,000.00	7,000	17,000
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Heating hot water piping						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	8.80	810	9.60	883	1,693
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	8.80	598	9.60	653	1,251
- Branch piping to glycol preheat heat exchanger, 2-1/2" diameter	92 LF	7.20	662	7.33	674	1,337
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	6.30	4,599	6.94	5,066	9,665
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	2.30	460	5.70	1,140	1,600

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Runout piping from mains to 49 vav box reheat coils	1,960 LF	2.30	4,508	5.70	11,172	15,680
Glycol preheat from heat exchanger to pumps and to rooftop EER VAV AHU preheat coil, 2-1/2" diameter	160 LF	7.20	1,152	7.33	1,173	2,325
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	6.10	561	8.89	818	1,379
- Piping from secondary pumps to rooftop EER VAV AHU, 4" diameter	160 LF	6.10	976	8.89	1,422	2,398
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Sheetmetal work insulation	1 LS	6,600.00	6,600	38,600.00	38,600	45,200
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	25,600.00	25,600	25,600
DIRECT DIGITAL CONTROLS (DDC)						
Rooftop OR Indoor enthalpy energy recovery (EER) variable air volume (VAV) hvac air handling unit (AHU) including glycol preheat coil and chilled water coil, supply air fan and return air fan, airflow measurement for supply air, return air, outdoor air intake and relief air	1 EA	12,600.00	12,600	18,900.00	18,900	31,500
3-Module Water - to - water heat pump heating and cooling plant, 3 hydronic systems / 6-pipe	1 LS	10,800.00	10,800	16,200.00	16,200	27,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Variable air volume supply air terminal unit hot water reheat coils	49 EA	800.00	39,200	1,200.00	58,800	98,000
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fans for toilet rooms and for kitchen	3 EA	720.00	2,160	1,080.00	3,240	5,400
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060
Concrete pads for equipment	280 SF	9.10	2,548	6.32	1,770	4,318
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
TOTAL DIVISION 23 - HVAC			**1,088,368**		**906,518**	**1,994,885**
TOTAL DIVISION 23 - HVAC SAY			**$1,088,400**		**$906,500**	**$1,994,900**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	4 EA	750.00	3,000	1,232.00	4,928	7,928
Unit heater / cabinet unit heater connection including means of disconnect, conduit and circuiting back to source power panel	5 EA	500.00	2,500	924.00	4,620	7,120
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	13 EA	150.00	1,950	462.00	6,006	7,956
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**260,345**		**221,690**	**482,035**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$260,300**		**$221,700**	**$482,000**

VAV DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

GEOTHERMAL FCU SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.79%	$1.91
DIVISION 9 - FINISHES		$123,500	$135,300	$258,800	5.09%	$12.38
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.06%	$5.00
DIVISION 23 - HVAC		$1,120,400	$964,200	$2,084,600	41.01%	$99.74
DIVISION 26 - ELECTRICAL		$266,720	$234,318	$501,038	9.86%	$23.97
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.42%	$8.33
SUB-TOTAL		$1,680,200	$1,482,800	$3,163,000	62.22%	$151.34
GENERAL CONDITIONS	10.0%			$316,300	6.22%	$15.13
OVERHEAD AND PROFIT	10.0%			$347,930	6.84%	$16.65
DESIGN CONTINGENCY	15.0%			$574,085	11.29%	$27.47
BID CONTINGENCY	5.0%			$220,066	4.33%	$10.53
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$462,138	9.09%	$22.11
TOTAL - GEOTHERMAL FCU SUMMARY	**20,900 GSF**			**$5,083,518**	**100.00%**	**$243.23**

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2- HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2- HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2- HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required)	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	1,500.00	1,500	3,500.00	3,500	5,000
TOTAL DIVISION 9 - FINISHES			**123,500**		**135,275**	**258,775**
TOTAL DIVISION 9 - FINISHES SAY			**$123,500**		**$135,300**	**$258,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, 4000 cfm, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	30,000.00	30,000	5,120.00	5,120	35,120
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	1,000.00	4,000	640.00	2,560	6,560

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Ducted fan coil units, 4-pipe hot water heating coil and chilled water cooling coil - quantity based on estimated VAV quantity (estimated for building spaces by applying the report narrative description to the 2014 window / roof project floor plans)						
- Floor 1	25 EA	1,600.00	40,000	480.00	12,000	52,000
- Floor 2	24 EA	1,600.00	38,400	480.00	11,520	49,920
Geothermal water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) 6-pipe header / rack configuration - to generate 150 gpm of 115 F heating hot water / 180 gpm of 42 F chilled water - capable of simultaneously generating both heating hot water and chilled water for 4-pipe heating and coolng operation	1 LS	220,000.00	220,000	7,680.00	7,680	227,680
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol heating, to serve energy recovery VAV DOAS heating coil	1 EA	5,500.00	5,500	960.00	960	6,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For ER VAV DOAS heating	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the 3-module water - to - water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) heating hot water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Glycol heating pumps serving indoor ER VAV DOAS heating coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the indoor ER VAV DOAS - since the indoor ER VAV DOAS is the only load served by these glycol heating pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Secondary heating hot water building distribution pumps - serving fan coil unit heating coils, cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Secondary chilled water pumps serving indoor ER VAV DOAS and serving fan coil unit cooling coils (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,500.00	2,500	560.00	560	3,060
- Glycol heating system	1 EA	1,200.00	1,200	320.00	320	1,520
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Thermal expansion tanks						
- Heating hot water system	1 EA	3,500.00	3,500	640.00	640	4,140
- Glycol heating system	1 LS	2,500.00	2,500	560.00	560	3,060
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,500.00	2,500	560.00	560	3,060
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fan for kitchen	1 EA	1,500.00	1,500	560.00	560	2,060
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	250.00	2,000	140.00	1,120	3,120
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Geothermal 3-module water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	6,780.00	6,780	1,680.00	1,680	8,460
- Indoor energy recovery variable air volume (VAV) DOAS air handling unit including glycol heating coil and chilled water coil (4-pipe)	1 EA	1,220.00	1,220	480.00	480	1,700

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Ducted fan coil units, 4-pipe, heatng hot water and chilled water cooling	49 EA	420.00	20,580	320.00	15,680	36,260
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol heating, to serve ER VAV DOAS heating coil	1 EA	1,050.00	1,050	440.00	440	1,490
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heating hot water						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	35.13	2,389	43.20	2,938	5,326
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	27.00	2,484	19.00	1,748	4,232
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	17.20	12,556	15.40	11,242	23,798
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	6.40	1,280	10.50	2,100	3,380
- Runout piping from mains to 49 fan coil unit heating coils	1,960 LF	6.40	12,544	10.50	20,580	33,124
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	35.13	3,232	43.20	3,974	7,206
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2" diameter average	730 LF	27.00	19,710	19.00	13,870	33,580
- Runout piping from mains to 49 fan coil unit cooling coils	1,960 LF	10.30	20,188	11.80	23,128	43,316
Refrigerant						

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Indoor VAV ER DOAS AHU	25 LF	17.20	430	15.40	385	815
- Fan coil units (49)	980 LF	10.30	10,094	11.80	11,564	21,658
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing	10,000 LB	1.38	13,800	7.00	70,000	83,800
Air inlets and outlets (at ceiling)						
- Ducted fan coil unit linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for FCU return air and for DOAS return air and exhaust air, and for FCU supply air in rooms with no windows, and for DOAS supply air	150 EA	80.00	12,000	70.00	10,500	22,500
Louvers, roof ventilators, fire dampers, control dampers, sounds attenuators, etc.	1 LS	8,000.00	8,000	5,600.00	5,600	13,600
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heating hot water piping						
- Main piping from water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	8.80	810	9.60	883	1,693
- Main secondary building pump piping, 4" diameter (floor 1 mechanical room)	68 LF	8.80	598	9.60	653	1,251
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	6.30	580	6.94	638	1,218
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 1-1/2" diameter average	730 LF	2.60	1,898	6.24	4,555	6,453
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	200 LF	2.30	460	5.70	1,140	1,600
- Runout piping from mains to 49 fan coil unit heating coils	1,960 LF	2.30	4,508	5.70	11,172	15,680
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	6.30	706	6.94	777	1,483
Chilled water						
- From the 3-module water-to-water heat pump plant to primary pumps, 4" diameter	92 LF	6.10	561	8.89	818	1,379
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	4.50	504	6.55	734	1,238
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2" diameter average	730 LF	4.50	3,285	6.55	4,782	8,067
- Runout piping from mains to 49 fan coil unit cooling coils	1,960 LF	3.90	7,644	6.08	11,917	19,561
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Condensate drain for indoor VAV ER DOAS	25 LF	1.80	45	5.62	141	186
Condensate drain for fan coil units (49)	980 LF	1.70	1,666	5.38	5,272	6,938
Sheetmetal work insulation	1 LS	4,450.00	4,450	25,950.00	25,950	30,400
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	32,000.00	32,000	32,000

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIRECT DIGITAL CONTROLS (DDC)						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	10,800.00	10,800	16,200.00	16,200	27,000
DDC CO2 monitoring for DOAS system	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	360.00	1,440	540.00	2,160	3,600
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	720.00	5,760	1,080.00	8,640	14,400
DDC controls for outdoor air intake and exhaust air discharge control dampers for indoor DOAS AHU	2 EA	720.00	1,440	1,080.00	2,160	3,600
3-Module Water - to - water heat pump heating and cooling plant, 3 hydronic systems / 6-pipe	1 LS	10,800.00	10,800	16,200.00	16,200	27,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Fan coil units, 4-pipe, heating hot water and chilled water	49 EA	1,000.00	49,000	1,400.00	68,600	117,600
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fan for kitchen	1 EA	720.00	720	1,080.00	1,080	1,800
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	4,000.00	4,000	2,240.00	2,240	6,240
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060
Concrete pads for equipment	380 SF	9.10	3,458	6.32	2,402	5,860
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
TOTAL DIVISION 23 - HVAC			**1,120,369**		**964,211**	**2,084,579**
TOTAL DIVISION 23 - HVAC SAY			**$1,120,400**		**$964,200**	**$2,084,600**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Unit heater / cabinet unit heater connection including means of disconnect, conduit and circuiting back to source power panel	5 EA	500.00	2,500	924.00	4,620	7,120
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	2 EA	150.00	300	462.00	924	1,224
Fan coil unit connection, means of disconnect, conduit and circuiting	49 EA	225.00	11,025	462.00	22,638	33,663

FCU DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**266,720**		**234,318**	**501,038**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$266,700**		**$234,300**	**$501,000**
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

GEOTHERMAL WWHP SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL	BLDG $ / GSF
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT		$14,000	$26,000	$40,000	0.87%	$1.91
DIVISION 9 - FINISHES		$123,500	$135,300	$258,800	5.66%	$12.38
DIVISION 21 - FIRE PROTECTION		$41,800	$62,700	$104,500	2.28%	$5.00
DIVISION 23 - HVAC		$885,000	$902,300	$1,787,300	39.07%	$85.52
DIVISION 26 - ELECTRICAL		$259,320	$222,152	$481,472	10.53%	$23.04
DIVISION 33 - SITE IMPROVEMENTS		$113,800	$60,300	$174,100	3.81%	$8.33
SUB-TOTAL		$1,437,400	$1,408,800	$2,846,200	62.22%	$136.18
GENERAL CONDITIONS	10.0%			$284,600	6.22%	$13.62
OVERHEAD AND PROFIT	10.0%			$313,080	6.84%	$14.98
DESIGN CONTINGENCY	15.0%			$516,582	11.29%	$24.72
BID CONTINGENCY	5.0%			$198,023	4.33%	$9.47
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$415,849	9.09%	$19.90
TOTAL - GEOTHERMAL WWHP SUMMARY	**20,900 GSF**			**$4,574,334**	**100.00%**	**$218.87**

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT						
Asbestos abatement including air monitoring	1 ALLOW	$14,000.00	$14,000	$26,000.00	$26,000	$40,000
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT			**14,000**		**26,000**	**40,000**
TOTAL DIVISION 2 - HAZARDOUS MATERIALS ABATEMENT SAY			**$14,000**		**$26,000**	**$40,000**
DIVISION 9 - FINISHES						
Remove and replace ceilings including soffits (soffits where required)	20,900 SF	$5.00	$104,500	$4.75	$99,275	$203,775
Remove upper level mechanical room over east entrance to provide storefront and new open ceiling.	1 ALLOW	10,000.00	10,000	15,000.00	15,000	25,000
Remove perimeter metal casework and furr out wall with new knee wall studs, batt insulation, drywall, finish and paint	500 LF	15.00	7,500	35.00	17,500	25,000
Miscellaneous general trades work - paint, patch, etc.	1 ALLOW	1,500.00	1,500	3,500.00	3,500	5,000
TOTAL DIVISION 9 - FINISHES			**123,500**		**135,275**	**258,775**
TOTAL DIVISION 9 - FINISHES SAY			**$123,500**		**$135,300**	**$258,800**
DIVISION 21 - FIRE PROTECTION						
Wet sprinkler system	20,900 SF	$2.00	$41,800	$3.00	$62,700	$104,500
TOTAL DIVISION 21 - FIRE PROTECTION			**41,800**		**62,700**	**104,500**
TOTAL DIVISION 21 - FIRE PROTECTION SAY			**$41,800**		**$62,700**	**$104,500**

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect and remove wall mounted perimeter heating hot water fan coil units including vertical supply air discharge duct and supply air grille (grille at window sill height = 3'-2" for FL1, 2'-10" for FL2)	60 EA	$25.00	$1,500	$160.00	$9,600	$11,100
Remove perimeter metal enclosure (e.g. heating hot water piping, convectors, etc.)	500 LF	2.50	1,250	10.00	5,000	6,250
Remove the remainder of existing building HVAC systems	1 LS	2,500.00	2,500	12,800.00	12,800	15,300
GEOTHERMAL GROUND COUPLED HEAT EXCHANGER						
Vertical closed loop wells (remote wellfield), 400 ft. depth each, including boring, thermal conductive grout, 1-1/4" diameter closed loop glycol well piping, casing as required, well field underground piping, remote well field arranged at the northwest end of Parking Lot 7 (approx. 210 ft. x 140 ft. rectangular section of parking lot to the left when entering parking lot 7 from paved drive) in array of 10 wells (NE to SW) x 7 wells (NW to SE), wells spaced 20 ft. on center, 180 ft. x 120 ft. overall (centerline distance of end wells) - including earthwork for geothermal well field	70 EA	3,500.00	245,000	4,500.00	315,000	560,000
Common site underground glycol supply and return piping from remote well field to vault at south end of buildng, 4" diameter, approx. 200 ft. path per pipe	400 LF	22.00	8,800	8.00	3,200	12,000
Site underground geothermal vault located at geothermal well field (at Parking Lot 7) - including earthwork, vault glycol piping and valves, core drilling and mechanical link seals at all vault piping penetrations, manhole access from grade	1 EA	15,000.00	15,000	5,120.00	5,120	20,120
EQUIPMENT						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, 4000 cfm, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	30,000.00	30,000	5,120.00	5,120	35,120

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	1,000.00	4,000	640.00	2,560	6,560
Water source heat pumps, 2-pipe heat pump loop water - quantity based on estimated VAV quantity (estimated for building spaces by applying the report narrative description to the 2014 window / roof project floor plans)						
- Floor 1	25 EA	2,000.00	50,000	640.00	16,000	66,000
- Floor 2	24 EA	2,000.00	48,000	640.00	15,360	63,360
Geothermal water-to-water heating and cooling heat pump assembly, including refrigerant R-410A dual scroll compressors, water-to-refrigerant heat exchanger, 6-pipe (geothermal well field supply and return, heating hot water supply and return and chilled water supply and return) header / rack configuration - capable of simultaneously generating both heating hot water and chilled water for 4-pipe operation	1 LS	37,500.00	37,500	2,560.00	2,560	40,060
Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	15,000.00	15,000	1,920.00	1,920	16,920
Plate and frame heat exchanger, heating hot water to glycol heating, to serve energy recovery VAV DOAS heating coil	1 EA	5,500.00	5,500	960.00	960	6,460
Glycol makeup units						
- For geothermal well field	1 EA	4,500.00	4,500	960.00	960	5,460
- For ER VAV DOAS heating	1 EA	4,500.00	4,500	960.00	960	5,460
Pumps including pump trim and integral (EC type) variable frequency drives						
- Geothermal ground coupled heat exchanger (i.e. geothermal well field) glycol pumps (1 standby)	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Building heat pump loop pumps (1 standby) - serves the water - to -water heat pump plant	2 EA	6,000.00	12,000	1,600.00	3,200	15,200
- Water - to - water heat pump (primary) heating hot water pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Water - to - water heat pump plant (primary) chilled water pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Glycol heating pumps serving indoor ER VAV DOAS heating coil (1 standby) - these pumps are also intended to suffice as the coil pumps for the indoor ER VAV DOAS - since the indoor ER VAV DOAS is the only load served by these glycol heating pumps	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary heating hot water building distribution pumps serving glycol heat exchanger and serving cabinet unit heaters and suspended unit heaters (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Secondary chilled water pumps serving indoor ER VAV DOAS (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
Makeup water assemblies for glycol geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water systems	5 EA	2,000.00	10,000	640.00	3,200	13,200
Mechanical room refrigerant monitor	1 EA	8,400.00	8,400	640.00	640	9,040
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	2,500.00	2,500	560.00	560	3,060
Air separators						
- Heating hot water system	1 EA	2,000.00	2,000	480.00	480	2,480
- Glycol heating system	1 EA	1,200.00	1,200	320.00	320	1,520
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,000.00	2,000	480.00	480	2,480
Thermal expansion tanks						
- Heating hot water system	1 EA	3,000.00	3,000	560.00	560	3,560
- Glycol heating system	1 LS	2,500.00	2,500	560.00	560	3,060
- Glycol geothermal well field system	1 EA	2,500.00	2,500	560.00	560	3,060
- Building heat pump system	1 EA	2,500.00	2,500	560.00	560	3,060
- Chilled water system	1 EA	2,000.00	2,000	480.00	480	2,480
Heating hot water cabinet unit heaters	2 EA	1,500.00	3,000	640.00	1,280	4,280
Heating hot water suspended unit heaters	3 EA	800.00	2,400	480.00	1,440	3,840
Roof exhaust fan for kitchen	1 EA	1,500.00	1,500	560.00	560	2,060
Ductless split system(s) for data room(s)	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	250.00	2,000	140.00	1,120	3,120
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Geothermal water - to - water heating and cooling heat pump assembly (6-pipe)	1 LS	4,230.00	4,230	720.00	720	4,950
- Indoor energy recovery variable air volume (VAV) DOAS air handling unit including glycol heating coil and chilled water coil (4-pipe)	1 EA	1,220.00	1,220	480.00	480	1,700
- Water source heat pump units, 2-pipe, heat pump loop	49 EA	310.00	15,190	160.00	7,840	23,030
- Plate and frame heat exchanger to separate the building heat pump loop from the glycol geothermal well field loop	1 EA	4,520.00	4,520	1,120.00	1,120	5,640
- Plate and frame heat exchanger, heating hot water to glycol heating, to serve ER VAV DOAS heating coil	1 EA	1,050.00	1,050	440.00	440	1,490
- Heating hot water cabinet unit heaters	2 EA	220.00	440	160.00	320	760
- Heating hot water suspended unit heaters	3 EA	220.00	660	160.00	480	1,140
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES)						
Geothermal well field piping (in floor 1 mechanical room) from service entrance (from site well field) to pumps and to heat exchanger, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	35.13	3,935	43.20	4,838	8,773
Heat pump loop						
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2-1/2" diameter average	730 LF	20.00	14,600	37.20	27,156	41,756
- Runout piping from mains to 49 water source heat pumps	1,960 LF	10.30	20,188	11.80	23,128	43,316
Heating hot water						
- Main piping from water-to-water heat pump to primary pumps, 2-1/2" diameter	92 LF	20.00	1,840	37.20	3,422	5,262
- Main secondary building pump piping, 2-1/2" diameter (floor 1 mechanical room)	68 LF	20.00	1,360	37.20	2,530	3,890
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	27.00	2,484	19.00	1,748	4,232

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
- Piping to 2 suspended unit heaters and to 3 cabinet unit heaters	300 LF	10.30	3,090	11.80	3,540	6,630
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Chilled water						
- From the water-to-water heat pump plant to primary pumps, 2-1/2" diameter	92 LF	20.00	1,840	37.20	3,422	5,262
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	27.00	3,024	19.00	2,128	5,152
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	5.20	728	11.40	1,596	2,324
Condensate drain						
- Indoor VAV ER DOAS AHU	25 LF	17.20	430	15.40	385	815
- Water source heat pump units (49)	980 LF	10.30	10,094	11.80	11,564	21,658
- Ductless split system(s) for data room(s)	1 LS	500.00	500	600.00	600	1,100
SHEETMETAL WORK						
Galvanized steel ductwork including duct fittings, duct hanger assemblies, shop fabrication, field installation, duct cleaning, duct sealing	10,000 LB	1.38	13,800	7.00	70,000	83,800
Air inlets and outlets (at ceiling)						
- Ducted water source heat pump unit linear slot supply air diffusers at windows and along perimeter walls	100 EA	100.00	10,000	70.00	7,000	17,000
- Rectangular air inlets for WSHP return air and for DOAS return air and exhaust air, and for WSHP supply air in rooms with no windows, and for DOAS supply air	150 EA	80.00	12,000	70.00	10,500	22,500
Louvers, roof ventilators, fire dampers, control dampers, sounds attenuators, etc.	1 LS	8,000.00	8,000	5,600.00	5,600	13,600
INSULATION						
Geothermal well field piping located in floor 1 mechanical room, 4" diameter	112 LF	6.10	683	8.89	996	1,679
Building heat pump loop piping from heat exchanger to pumps and to geothermal 3-module water - to - water heat pump plant, 4" diameter	112 LF	6.10	683	8.89	996	1,679

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Heat pump loop piping						
- Floor 1 and Floor 2 main piping (from floor 1 mechanical room), including risers, 2-1/2" diameter average	730 LF	4.90	3,577	6.94	5,066	8,643
- Runout piping from mains to 49 water source heat pumps	1,960 LF	3.90	7,644	6.08	11,917	19,561
Heating hot water piping						
- Main piping from water-to-water heat pump to primary pumps, 2-1/2" diameter	92 LF	7.20	662	7.33	674	1,337
- Main secondary building pump piping, 2-1/2" diameter (floor 1 mechanical room)	68 LF	7.20	490	7.33	498	988
- Branch piping to glycol heating heat exchanger, 2" diameter	92 LF	6.30	580	6.94	638	1,218
- Runout piping from mains to 2 suspended unit heaters and to 3 cabinet unit heaters	300 LF	2.30	690	5.70	1,710	2,400
Glycol heating from heat exchanger to pumps and to indoor ER VAV DOAS heating coil, 2" diameter	112 LF	6.30	706	6.94	777	1,483
Chilled water						
- From the water-to-water heat pump plant to primary pumps, 2-1/2" diameter	92 LF	4.90	451	6.94	638	1,089
- Piping from secondary pumps to indoor ER VAV DOAS, 2" diameter	112 LF	4.50	504	6.55	734	1,238
Refrigerant						
- Ductless split system(s) for data room(s)	140 LF	1.90	266	6.47	906	1,172
Condensate drain piping for the ductless split system(s) for data room(s)	1 LS	100.00	100	300.00	300	400
Condensate drain for indoor VAV ER DOAS	25 LF	1.80	45	5.62	141	186
Condensate drain for water source heat pump units (49)	980 LF	1.70	1,666	5.38	5,272	6,938
Sheetmetal work insulation	1 LS	4,450.00	4,450	25,950.00	25,950	30,400
Equipment insulation (e.g. 2 plate and frame heat exchangers, 14 pumps, 5 air separators, 5 thermal expansion tanks, etc.)	1 LS	1,700.00	1,700	4,368.00	4,368	6,068
TESTING, ADJUSTING AND BALANCING						
Testing, adjusting and balancing - air and water systems	1 LS	0.00	0	28,800.00	28,800	28,800

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIRECT DIGITAL CONTROLS (DDC)						
Indoor energy recovery dedicated outdoor air system (DOAS) variable air volume (VAV) hvac air handling unit, including flat plate heat recovery exchanger, reversing heat pump, two stage scroll compressor, variable flow supply air and return / exhaust air (EC) fans, glycol heating coil, chilled water cooling coil	1 EA	10,800.00	10,800	16,200.00	16,200	27,000
DDC CO2 monitoring for DOAS system	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Airflow measurement stations for supply air, return (exhaust suction) air, outdoor air intake and relief air (exhaust discharge)	4 EA	360.00	1,440	540.00	2,160	3,600
DOAS VAV AHU Variable air volume supply air terminal units (no reheat coil) - 4 for FL1 and 4 for FL2	8 EA	720.00	5,760	1,080.00	8,640	14,400
DDC controls for outdoor air intake and exhaust air discharge control dampers for indoor DOAS AHU	2 EA	720.00	1,440	1,080.00	2,160	3,600
Water - to - water heat pump heating and cooling unit, 3 hydronic systems / 6-pipe	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
DDC temperature monitoring for supply and return piping for hydronic systems (e.g. geothermal wellfield, building heat pump, glycol preheat, heating hot water and chilled water)	1 LS	3,600.00	3,600	5,400.00	5,400	9,000
Plate and frame heat exchangers	2 EA	1,440.00	2,880	2,160.00	4,320	7,200
Pumps	14 EA	1,440.00	20,160	2,160.00	30,240	50,400
Glycol makeup units	2 EA	720.00	1,440	1,080.00	2,160	3,600
Water source heat pump units, 2-pipe, heat pump water	49 EA	900.00	44,100	1,300.00	63,700	107,800
Refrigerant monitor	1 EA	720.00	720	1,080.00	1,080	1,800
Roof exhaust fan for emergency ventilation - refrigerant monitoring	1 EA	1,080.00	1,080	1,620.00	1,620	2,700
Heating hot water cabinet unit heaters	2 EA	720.00	1,440	1,080.00	2,160	3,600
Heating hot water suspended unit heaters	3 EA	720.00	2,160	1,080.00	3,240	5,400
Roof exhaust fan for kitchen	1 EA	720.00	720	1,080.00	1,080	1,800
Ductless split system(s) for data room(s)	1 LS	1,440.00	1,440	2,160.00	2,160	3,600
MISCELLANEOUS ITEMS						
Crane, material handling, lifting, rigging and hoisting	1 LS	4,000.00	4,000	2,240.00	2,240	6,240
Cleaning	1 LS	500.00	500	2,560.00	2,560	3,060
Concrete pads for equipment	380 SF	9.10	3,458	6.32	2,402	5,860
Labelling and identification	1 LS	1,500.00	1,500	4,500.00	4,500	6,000
Cut, patch and firestop	1 LS	2,500.00	2,500	12,800.00	12,800	15,300

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
TOTAL DIVISION 23 - HVAC			**884,966**		**902,328**	**1,787,293**
TOTAL DIVISION 23 - HVAC SAY			**$885,000**		**$902,300**	**$1,787,300**
DIVISION 26 - ELECTRICAL						
DISTRIBUTION						
Upgrade existing building electrical service with new 1000 amp 480/277v main distribution equipment and associated feeder originating at Nevaldine Hall including removals of existing feeder and MDP	1 ALLOW	$45,000.00	45,000	$25,000.00	$25,000	$70,000
Remove and replace existing lighting and power branch circuit panelboards and associated feeders at each electrical closet throughout French Hall (allowance per floor)	2 EA	15,000.00	30,000	10,000.00	20,000	50,000
EMERGENCY DISTRIBUTION						
Relocate existing central emergency inverter, extend existing inverter loads and transfer emergency loads from generator to inverter system	1 LS	5,000.00	5,000	7,392.00	7,392	12,392
LIGHTING						
LED light fixture and control upgrades throughout French Hall including fixture removal - conduit and circuiting to be modified, extended and reused	20,900 SF	5.00	104,500	2.50	52,250	156,750
Remove and replace existing exterior wall mounted and canopy lights with LED fixtures connected to existing circuiting	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	1,500.00	1,500	15,000.00	15,000	16,500
Air handling unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	2,500.00	2,500	4,928.00	4,928	7,428
Geothermal heat pump system connections including means of disconnect, conduit and circuiting back to source power panel	1 ALLOW	5,000.00	5,000	7,392.00	7,392	12,392
Glycol make-up unit connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	1,000.00	2,000	1,540.00	3,080	5,080
Glycol pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
Loop pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Heat pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Coil pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary hot water distribution pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Secondary chilled water pump connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Exhaust fan connection including means of disconnect, conduit and circuiting back to source power panel	2 EA	750.00	1,500	1,232.00	2,464	3,964
Ductless split system outdoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Ductless split system indoor unit connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	750.00	750	1,232.00	1,232	1,982
VAV unit connection, conduit and circuiting (assume [1] circuit per [4] VAV boxes)	2 EA	150.00	300	462.00	924	1,224
Heat pump connection, conduit and circuiting	49 EA	125.00	6,125	308.00	15,092	21,217
FIRE ALARM						
Building wide fire alarm system including control and annunciator panels, initiation and notification devices, conduit, cabling, testing and programming (includes removal of existing system)	20,900 SF	1.55	32,395	1.70	35,530	67,925
MISCELLANEOUS						
Temporarily remove miscellaneous ceiling mounted devices and reinstall in new ceiling - provide new devices as necessary	1 ALLOW	5,000.00	5,000	5,000.00	5,000	10,000
Cutting, patching and firestopping	1 LS	1,250.00	1,250	3,080.00	3,080	4,330
TOTAL DIVISION 26 - ELECTRICAL			**259,320**		**222,152**	**481,472**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$259,300**		**$222,200**	**$481,500**

WWHP DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 33 - SITE IMPROVEMENTS						
Replace parking lot pavements - for geothermal well field installation in the 210' x 70' northwest end of parking lot 7						
- Remove asphalt paving and dispose	3,267 SY	2.92	9,540	4.59	14,996	24,535
- 12" stone base, 3" binder, and 1-1/2" asphalt topping	3,267 SY	28.35	92,619	10.22	33,389	126,008
- Pavement striping	1 LS	1,050.00	1,050	3,210.00	3,210	4,260
Earthwork for common site underground glycol piping	1 LS	5,000.00	5,000	2,560.00	2,560	7,560
Remainder of site restoration (e.g. at vault and for restoration between the well field (NW end of Lot 7) and building, including allowances for both lawns and pavements	445 SY	12.60	5,607	13.91	6,190	11,797
TOTAL DIVISION 33 - SITE IMPROVEMENTS			**113,816**		**60,344**	**174,160**
TOTAL DIVISION 33 - SITE IMPROVEMENTS SAY			**$113,800**		**$60,300**	**$174,200**

ELECTRIC BOILER PLANT SUMMARY

S U M M A R Y		TOTAL MATERIAL	TOTAL LABOR	TOTAL COST	% OF TOTAL
DIVISION 23 - HVAC		$132,500	$81,000	$213,500	56.22%
DIVISION 26 - ELECTRICAL		$7,000	$15,800	$22,800	6.00%
SUB-TOTAL		$139,500	$96,800	$236,300	62.22%
GENERAL CONDITIONS	10.0%			$23,630	6.22%
OVERHEAD AND PROFIT	10.0%			$25,993	6.84%
DESIGN CONTINGENCY	15.0%			$42,888	11.29%
BID CONTINGENCY	5.0%			$16,441	4.33%
ESCALATION (TO MID-POINT DEC-2022)	10.0%			$34,525	9.09%
TOTAL - ELECTRIC BOILER PLANT SUMMA				**$379,777**	**100.00%**

ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 23 - HVAC						
DEMOLITION						
Disconnect piping from existing-to-remain snowmelt manifolds	1 LS	$500.00	$500	$1,920.00	$1,920	$2,420
EQUIPMENT						
Electric glycol snowmelt boiler, 270 kW - located in floor 1 mechanical room (northeast corner of floor 1), including options and accessories	1 EA	55,000.00	55,000	5,120.00	5,120	60,120
Glycol makeup unit	1 EA	3,700.00	3,700	960.00	960	4,660
Pumps including pump trim and variable frequency drives						
- Boiler pumps (1 standby)	2 EA	4,500.00	9,000	1,280.00	2,560	11,560
- Snow melt distribution pumps (1 standby)	2 EA	6,000.00	12,000	1,920.00	3,840	15,840
Air separator	1 EA	2,300.00	2,300	640.00	640	2,940
Thermal expansion tank	1 EA	3,500.00	3,500	800.00	800	4,300
Makeup water assembly	1 EA	2,000.00	2,000	640.00	640	2,640
Connections to existing-to-remain snowmelt manifolds						
- Main building entrance (west) - 600 sq.ft. snowmelt area (single manifold)	1 EA	100.00	100	320.00	320	420
- Back of building (east) - 8000 sq.ft. snowmelt area (multiple manifolds)	1 LS	600.00	600	1,920.00	1,920	2,520
Prefabricated supply and return piped valve assemblies for hydronic equipment / coils - per piece of equipment						
- Snowmelt boiler	1 EA	2,260.00	2,260	640.00	640	2,900
PIPING SYSTEMS (E.G. PIPE FITTINGS AND PIPE HANGER ASSEMBLIES) - estimated						
Glycol snowmelt boiler plant (main) piping	124 LF	35.13	4,356	43.20	5,357	9,713
Glycol snowmelt distribution piping						
- Main entrance (600 sq.ft.) - piping to single manifold	126 LF	13.30	1,676	13.80	1,739	3,415
- Back of building (8000 sq.ft.) - piping to multiple manifolds						
- Main piping	262 LF	26.25	6,878	37.20	9,746	16,624
- Sub-main piping	270 LF	17.20	4,644	15.40	4,158	8,802
- Drops to manifolds	80 LF	13.30	1,064	13.80	1,104	2,168
Pipe insulation	738 LF	9.00	6,642	9.17	6,767	13,409
Equipment insulation (e.g. pumps, air separator, thermal expansion tank, etc.)	1 LS	350.00	350	1,248.00	1,248	1,598

ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
TESTING, ADJUSTING AND BALANCING						
Snowmelt equipment and glycol snowmelt system flow balancing	1 LS	0.00	0	5,120.00	5,120	5,120
DIRECT DIGITAL CONTROLS (DDC)						
Electric snowmelt boiler	1 EA	2,400.00	2,400	3,600.00	3,600	6,000
Snowmelt boiler pumps (1 standby)	2 EA	1,600.00	3,200	2,400.00	4,800	8,000
Snowmelt distribution pumps (1 standby)	2 EA	1,600.00	3,200	2,400.00	4,800	8,000
Glycol makeup unit	1 EA	800.00	800	1,200.00	1,200	2,000
Existing - to - remain snowmelt zones						
- Main entrance (600 sq.ft.) - single zone	1 EA	800.00	800	1,200.00	1,200	2,000
- Back of building (8000 sq.ft.) - multiple zones	1 LS	3,200.00	3,200	4,800.00	4,800	8,000
MISCELLANEOUS ITEMS						
Material handling, lifting, rigging and hoisting	1 LS	500.00	500	1,280.00	1,280	1,780
Cleaning	1 LS	200.00	200	960.00	960	1,160
Concrete pads for equipment	72 SF	9.10	655	6.32	455	1,110
Labelling and identification	1 LS	250.00	250	750.00	750	1,000
Cut, patch and firestop	1 LS	750.00	750	2,560.00	2,560	3,310
TOTAL DIVISION 23 - HVAC			**132,525**		**81,005**	**213,529**
TOTAL DIVISION 23 - HVAC SAY			**$132,500**		**$81,000**	**$213,500**

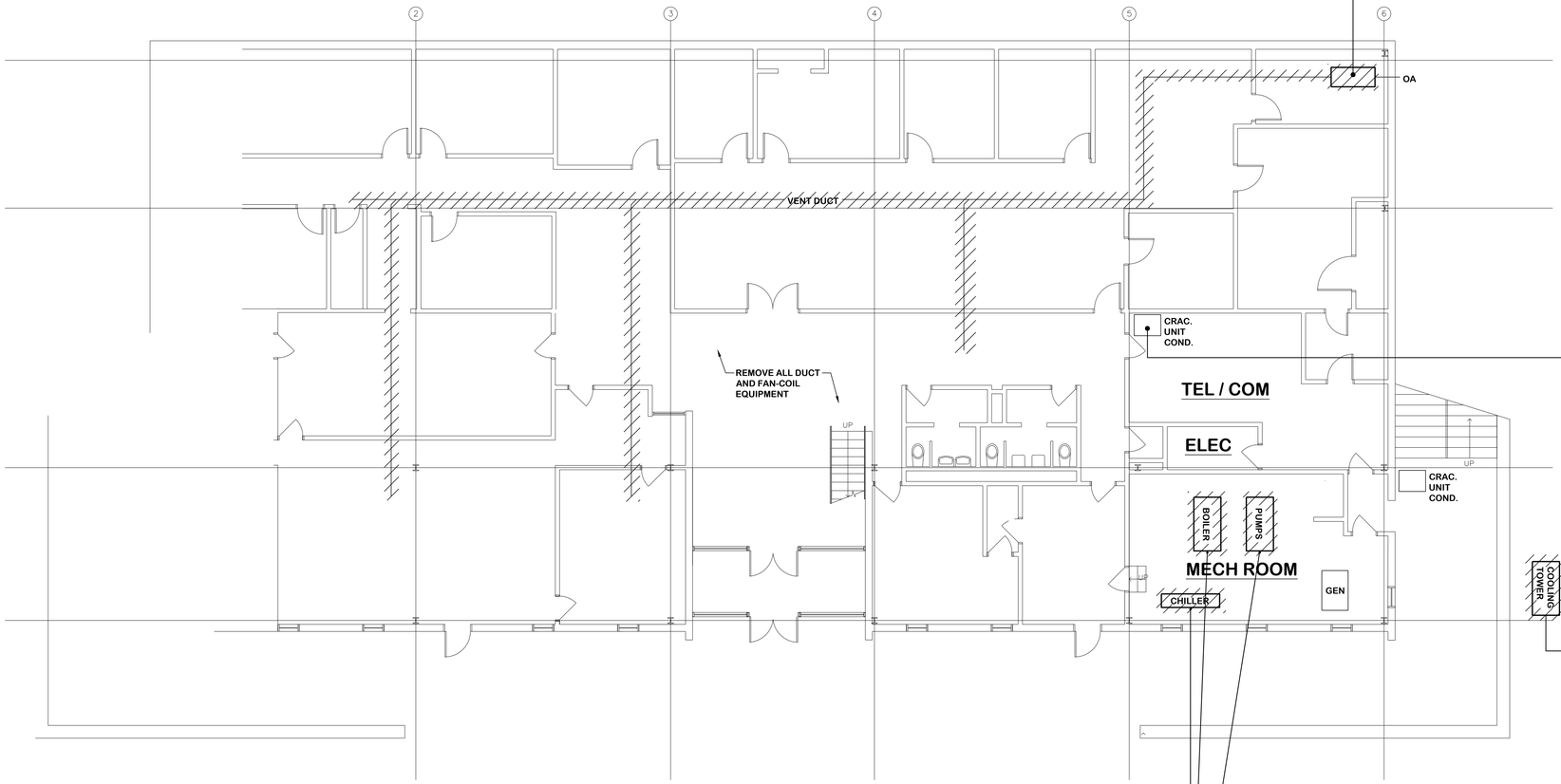
ELECTRIC BOILER PLANT DETAIL

DESCRIPTION	QUANTITY	MATERIAL UNIT PRICE	MATERIAL TOTAL	LABOR UNIT PRICE	LABOR TOTAL	TOTAL
DIVISION 26 - ELECTRICAL						
EQUIPMENT CONNECTIONS						
Disconnect existing HVAC equipment for removal by others - remove disconnect switch, conduit and circuiting back to source	1 ALLOW	$750.00	$750	$5,000.00	$5,000	$5,750
Snowmelt boiler connection including means of disconnect, conduit and circuiting back to source power panel	1 EA	1,000.00	1,000	1,540.00	1,540	2,540
Pump connection including means of disconnect, conduit and circuiting back to source power panel	4 EA	750.00	3,000	1,232.00	4,928	7,928
Tie-in and connections at existing snowmelt sytem including conduit and circuiting back to source power panel	1 LS	1,500.00	1,500	2,464.00	2,464	3,964
MISCELLANEOUS						
Cutting, patching and firestopping	1 LS	750.00	750	1,848.00	1,848	2,598
TOTAL DIVISION 26 - ELECTRICAL			**7,000**		**15,780**	**22,780**
TOTAL DIVISION 26 - ELECTRICAL SAY			**$7,000**		**$15,800**	**$22,800**

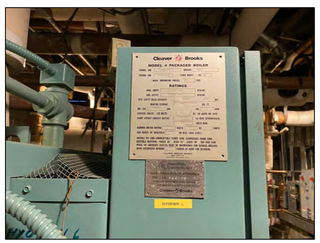
Section 11 – Proposed Phasing Plans
(System 5 – Hybrid Geothermal Option Only)

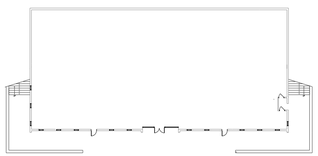
GENERAL NOTES:

1. THE EXISTING MECHANICAL ROOM IS EXTREMELY TIGHT QUARTERS. THE BOILER, CHILLER, PUMPS AND GENERATOR LEAVE NO ROOM TO INSTALL ADDITIONAL EQUIPMENT. EXISTING EQUIPMENT MUST BE REMOVED PRIOR TO INSTALLATION OF ANY NEW SYSTEMS.
2. THE BOILER, CHILLER AND PUMPS MUST REMAIN ACTIVE TO PROVIDE FRENCH HALL WITH HEATING AND COOLING. A PHASED APPROACH OF REMOVING THIS EXISTING EQUIPMENT DURING AN HVAC RENOVATION WILL NOT BE PRACTICAL IN AN OCCUPIED BUILDING.
3. ALL EXISTING HVAC EQUIPMENT IN THE MECHANICAL ROOM WILL BE REMOVED TO ACCOMMODATE NEW HEAT PUMP SYSTEMS. THE GENERATOR MAY REMAIN, AS IT IS A STANDBY UNIT, (NOT AN EMERGENCY UNIT), AND DOES NOT REQUIRE A DEDICATED ROOM.
4. VENTILATION UNIT LOCATED IN THE NW CORNER OF LOWER LEVEL SHALL BE REMOVED, ALONG WITH ALL DISTRIBUTION VENTILATION DUCT.
5. ALL PERIMETER FINNED TUBE, ENCLOSURES AND FAN COIL UNITS SHALL BE REMOVED. EXISTING PERIMETER WALLS SHALL BE INSULATED AND PATCHED WHERE FINNED TUBE HAS BEEN REMOVED.
6. CRAC UNIT AND SERVER ROOM SPLIT SYSTEM WILL REMAIN.



1 **FIRST FLOOR MECHANICAL DEMOLITION PLAN**
1/8"=1'-0"





KEYPLAN
N.T.S.

NORTH

DATE

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PROJECT
FRENCH HALL SUNY CANTON
CORNELL DRIVE
CANTON, NY 13617

TITLE OF DRAWING
FIRST FLOOR MECHANICAL DEMOLITION PLAN

DRAWN BY
DBB

CHECKED
ACS

DATE
5-25-2020

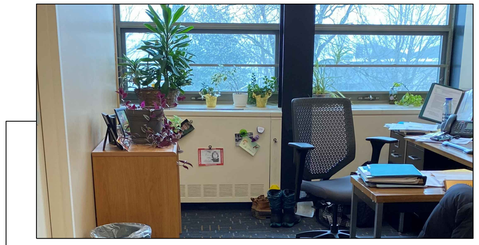
SCALE
1/8" = 1'-0"

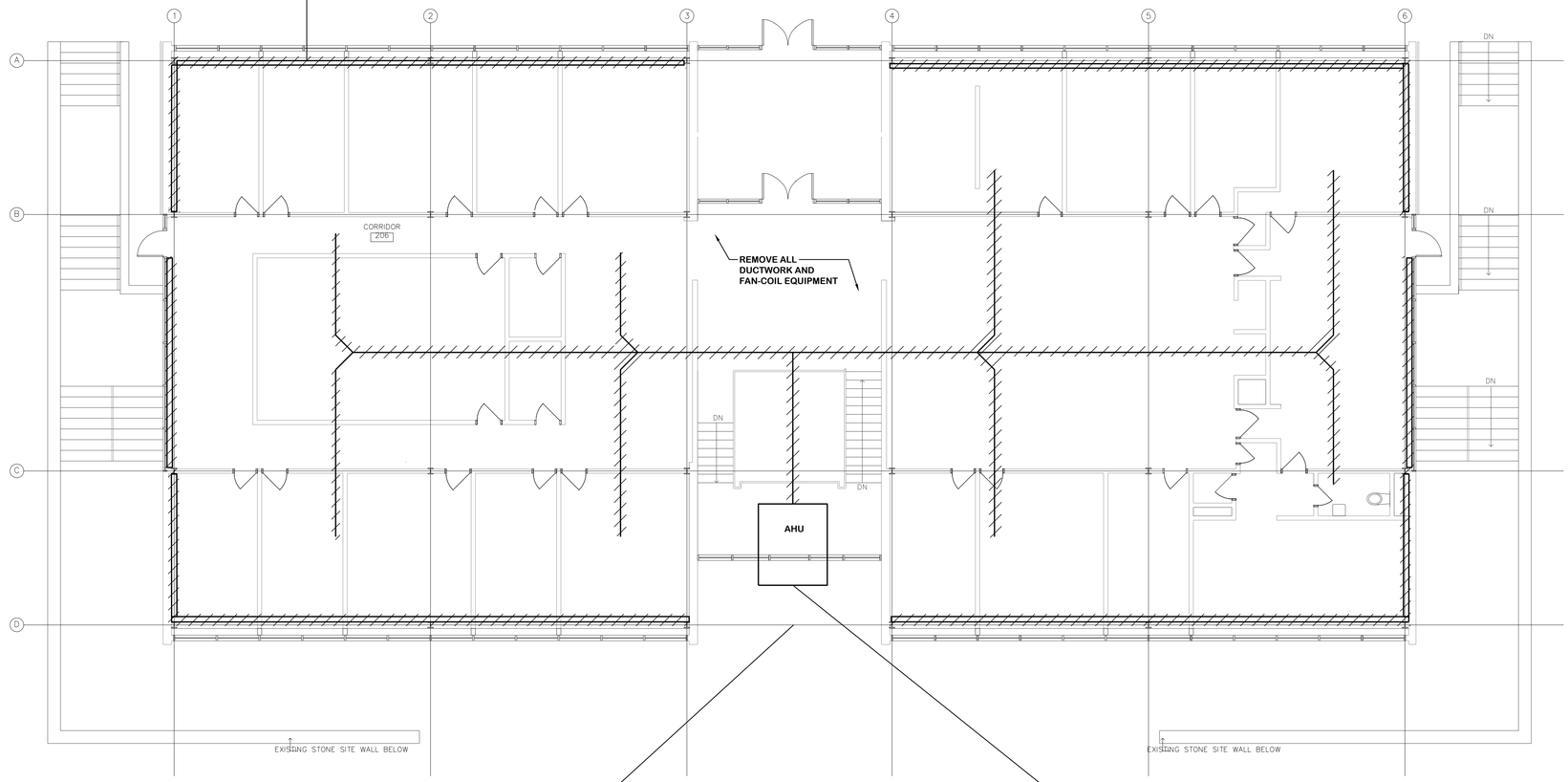
PROJECT NO.
052006

MD100

GENERAL NOTES:

1. THE EXISTING AIR HANDLING UNIT ROOM SHALL BE DISMANTLED AND THE HVAC EQUIPMENT REMOVED. THE SPACE SHALL BE CONVERTED TO STOREFRONT WINDOWS.
2. ALL DISTRIBUTION DUCT FROM AIR HANDLING UNTIL SHALL BE REMOVED.
3. ALL PERIMETER FINNED TUBE, ENCLOSURES AND FAN COIL UNITS SHALL BE REMOVED. EXISTING PERIMETER WALLS SHALL BE INSULATED AND PATCHED WHERE FINNED TUBE HAS BEEN REMOVED.





1 **SECOND FLOOR MECHANICAL DEMOLITION PLAN**
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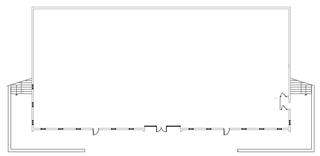

KEYPLAN
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PROJECT
FRENCH HALL SUNY CANTON
CORNELL DRIVE
CANTON, NY 13617

TITLE OF DRAWING
SECOND FLOOR MECHANICAL DEMOLITION PLAN

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ACS

DATE
5-25-2020

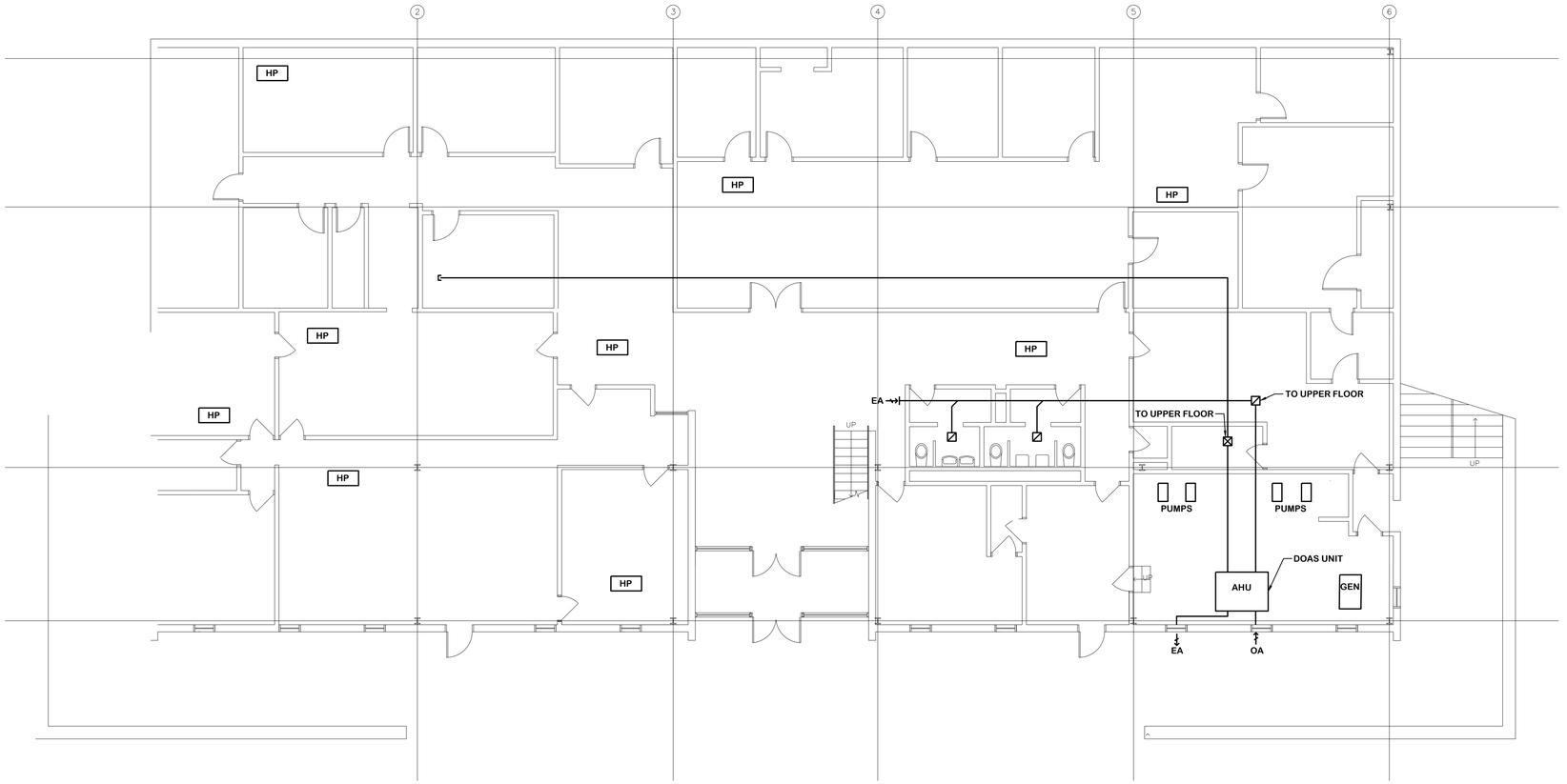
SCALE
1/8" = 1'-0"

PROJECT NO.
052006

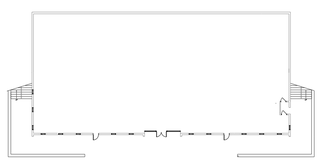
MD101

GENERAL NOTES:

1. MECHANICAL ROOM WILL BE CONVERTED TO THE GSHP PUMP ROOM. PIPING FROM THE WELL FIELD WILL ENTER THIS ROOM AND BE DISTRIBUTED TO HEAT PUMPS THROUGH THE BUILDING.
2. PRIMARY/SECONDARY PUMPING SYSTEM WILL BE UTILIZED. THE WELL FIELD WILL CIRCULATE VIA PRIMARY PUMPS AND THE HP LOOP IN THE BUILDING WILL CIRCULATE VIA SECONDARY PUMPS.
3. AN ELECTRIC BOILER WILL BE PROVIDED FOR THE SNOW MELT SYSTEM AND MAY SERVE AS A BACKUP HEATING SOURCE TO THE GSHP LOOP.
4. NEW VENTILATION EQUIPMENT WILL BE PROVIDED IN THE MECHANICAL ROOM. DOAS EQUIPMENT IS COMPACT AND WILL DISTRIBUTE VENTILATION AIR TO THE UPPER AND LOWER FLOORS.
5. ZONES WILL BE CONDITIONED VIA INCREMENTAL WATER SOURCE HEAT PUMP UNITS.
6. CRAC UNIT AND SERVER ROOM SPLIT SYSTEM WILL REMAIN.



1 **FIRST FLOOR MECHANICAL PLAN**
1/8"=1'-0"



KEYPLAN
N.T.S.

NORTH

REVISIONS	DATE

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PROJECT
FRENCH HALL SUNY CANTON
CORNELL DRIVE
CANTON, NY 13617

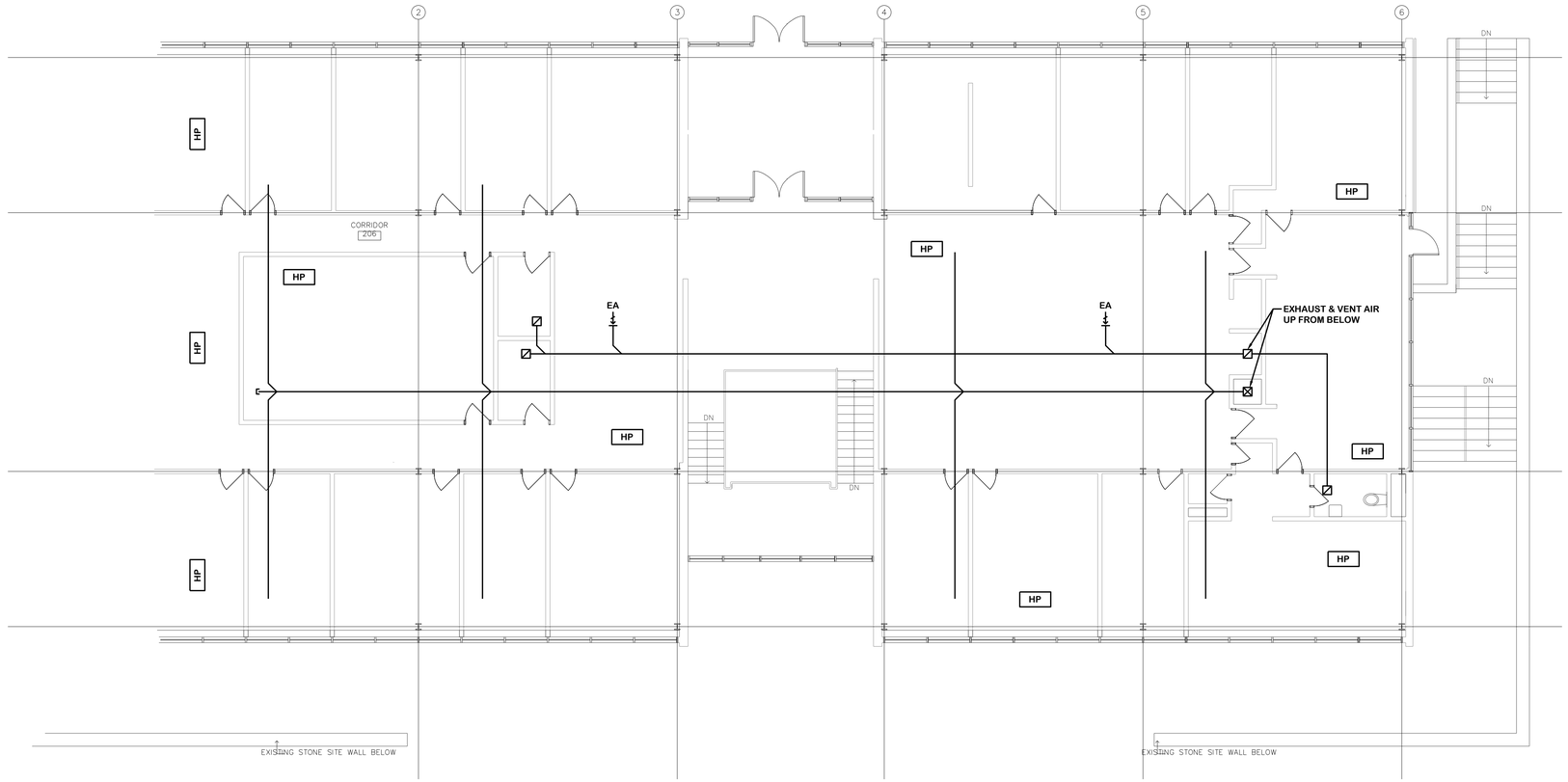
TITLE OF DRAWING
FIRST FLOOR MECHANICAL PLAN

DRAWN BY	DBB
CHECKED	ACS
DATE	5-25-2020
SCALE	1/8" = 1'-0"
PROJECT NO.	052006

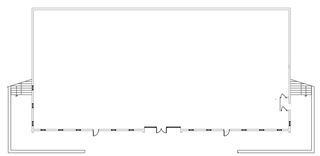
M100

GENERAL NOTES:

1. VENTILATION DUCT FROM THE DOAS EQUIPMENT IN THE MECHANICAL ROOM WILL BE DISTRIBUTED ON THE UPPER FLOOR.
2. ZONES WILL BE CONDITIONED VIA INCREMENTAL WATER SOURCE HEAT PUMP UNITS.



1 SECOND FLOOR MECHANICAL DEMOLITION PLAN
1/8"=1'-0"



KEYPLAN
N.T.S.

NORTH

REVISIONS	DATE

NOT FOR CONSTRUCTION

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PROJECT
FRENCH HALL SUNY CANTON
CORNELL DRIVE
CANTON, NY 13617

TITLE OF DRAWING
SECOND FLOOR MECHANICAL PLAN

DRAWN BY	DBB
CHECKED	ACS
DATE	5-25-2020
SCALE	1/8" = 1'-0"
PROJECT NO.	052006

M101

Section 12 – Geothermal Borefield Location

Printed from GLHEPRO -- Output file

Project Name:
Default

Notes:
Default file for User Manual.

File/Model Name: French Hall GSHP
Simulated On: 5/2/2020 1:50:34 PM
Simulated By: Pathfinder

-------GLHE SYSTEM-------
---System Parameters---
Active borehole length, ft =431.300
Borehole Radius, in =3
Borehole spacing, ft =20
Borehole Geometry : RECTANGULAR CONFIGURATION
: 70 : 5 x 14, rectangle
: Single U-Tube
Soil Type currently used : SUNY Canton
Thermal conductivity of the ground, Btu/(hr·ft·°F) =1.68
Volumetric heat capacity of Ground, Btu/(°F·ft³) =32.058
Volumetric heat capacity of fluid, Btu/(°F·ft³) =60.6332
Undisturbed ground temperature, °F =50.6
Borehole thermal resistance, °F/(Btu/(hr·ft)) =0.3013
Fluid type currently entered : 15% Propylene Glycol / Water
Mass flow rate of the fluid, gal/min =85.02
Density of the fluid, lb/ft³ =63.4421
Heat Pump Selected : WaterFurnace : E058/PSC_MOTOR@11GPM_2000CFM

GLHE Monthly Loads

Month	Total Heating 1000 Btu	Total Cooling 1000 Btu	Peak Heating 1000 Btu/Hr	Peak Cooling 1000 Btu/Hr
January	175821.00	0.00	605.00	0.00
February	145938.00	0.00	576.00	0.00
March	120783.00	0.00	495.00	0.00
April	68640.00	10303.00	350.00	189.00
May	23213.00	26816.00	206.00	240.00
June	0.00	64474.00	0.00	435.00
July	0.00	89071.00	0.00	450.00
August	0.00	79159.00	0.00	452.00
September	18016.00	36495.00	250.00	353.00
October	49490.00	11160.00	295.00	185.00
November	97551.00	0.00	450.00	0.00
December	156476.00	0.00	510.00	0.00

;
;
Peak Heating Hours =9
Peak Cooling Hours =4
;
;

Heat Pump Monthly Loads

Month	Total Heating 1000 Btu	Total Cooling 1000 Btu	Peak Heating 1000 Btu/Hr	Peak Cooling 1000 Btu/Hr
January	175821.00	0.00	605.00	0.00
February	145938.00	0.00	576.00	0.00
March	120783.00	0.00	495.00	0.00
April	68640.00	10303.00	350.00	189.00
May	23213.00	26816.00	206.00	240.00
June	0.00	64474.00	0.00	435.00
July	0.00	89071.00	0.00	450.00
August	0.00	79159.00	0.00	452.00
September	18016.00	36495.00	250.00	353.00
October	49490.00	11160.00	295.00	185.00

November	97551.00	0.00	450.00	0.00
December	156476.00	0.00	510.00	0.00

;
;
Peak Heating Hours =9
Peak Cooling Hours =4
;
;

Simulation Results

****

Borehole Information

Each Borehole Design Length, ft = 431.30
Total Borehole Length, ft = 30191.00
Distance between borehole centers, ft = 20.00

Average Temperature:

the End of Month Temperature due to Average Monthly Loads

Maximum Average Temperature, °F = 51.99 at month 8
Minimum Average Temperature, °F = 35.12 at month 350

Peak temperature

Maximum Peak Temperature, °F = 51.94 at month 8
Minimum Peak Temperature, °F = 34.04 at month 350

Monthly Temperature Summary

Note: EWT = Entering water temperature to heat pump(s)
ExWT = Exiting water temperature from heat pump(s)
Average = End of Month temperature due to Average Monthly Loads
HP Energy = Electrical Energy requirements of Heat Pump(s)

Time (months)	Q (Btu/hr*ft)	HP Energy (kW-hr)	Tf (F)	Average ExWT (F)	Average EWT (F)	Minimum EWT (F)	Maximum EWT (F)
1	13.72	12770.80	41.62	36.61	46.63	45.51	46.63
2	12.60	10644.06	41.49	36.89	46.09	45.00	46.09
3	9.42	8786.51	42.99	39.55	46.43	45.42	46.43
4	4.52	5435.72	45.64	43.99	47.29	46.46	47.25
5	-0.76	2908.62	48.98	49.26	48.71	48.04	48.67
6	-6.41	3042.30	52.97	55.31	50.63	50.63	50.58
7	-8.57	4233.90	54.83	57.96	51.70	51.70	51.65
8	-7.62	3770.46	54.77	57.55	51.99	51.99	51.94
9	-2.17	2990.21	51.71	52.51	50.92	50.05	50.88
10	2.80	4032.54	48.62	47.60	49.65	48.89	49.61
11	7.88	7015.82	44.98	42.11	47.86	46.90	47.86
12	12.20	11425.18	41.50	37.05	45.95	45.04	45.95
13	13.69	12964.86	39.73	34.73	44.72	43.61	44.72
14	12.57	10797.90	39.71	35.12	44.30	43.21	44.30
15	9.40	8912.37	41.21	37.77	44.64	43.63	44.64
16	4.51	5491.48	44.16	42.51	45.80	44.98	45.77
17	-0.76	2916.73	47.71	47.99	47.43	46.77	47.40
18	-6.40	3019.79	51.80	54.13	49.46	49.46	49.41
19	-8.57	4205.29	53.84	56.97	50.71	50.71	50.66
20	-7.62	3745.81	53.83	56.61	51.05	51.05	51.00
21	-2.17	2988.91	50.66	51.45	49.87	48.99	49.82
22	2.80	4065.09	47.31	46.29	48.33	47.58	48.30
23	7.86	7093.57	43.61	40.74	46.48	45.52	46.48
24	12.18	11550.06	40.15	35.70	44.60	43.69	44.60
25	13.67	13100.90	38.44	33.45	43.43	42.31	43.43
26	12.55	10902.85	38.52	33.93	43.10	42.02	43.10

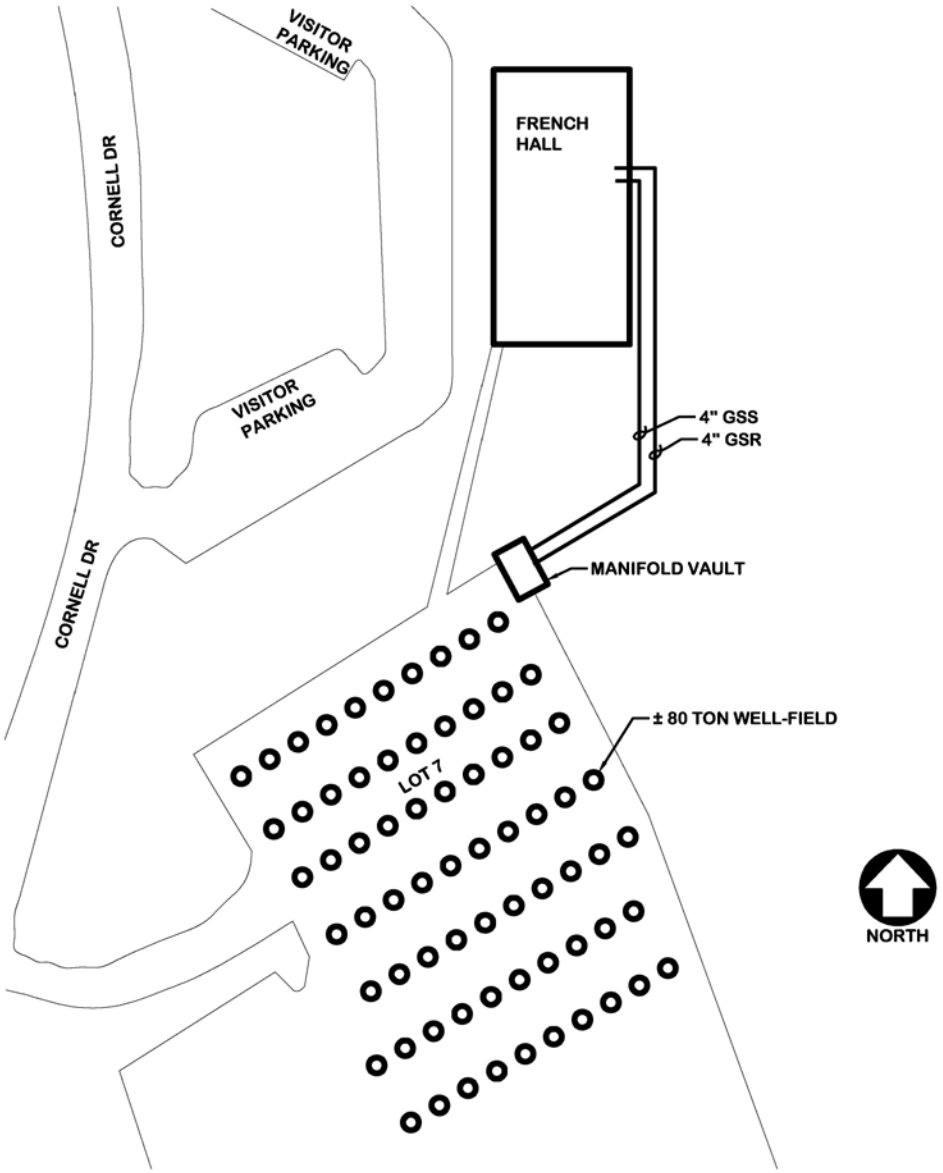
27	9.39	8990.12	40.13	36.71	43.56	42.55	43.56
28	4.50	5528.45	43.20	41.56	44.84	44.02	44.80
29	-0.76	2923.05	46.83	47.11	46.56	45.89	46.52
30	-6.40	3004.75	50.95	53.29	48.61	48.61	48.56
31	-8.56	4181.83	52.97	56.10	49.84	49.84	49.80
32	-7.61	3721.87	52.85	55.63	50.07	50.07	50.02
33	-2.17	2988.65	49.62	50.41	48.83	47.95	48.78
34	2.79	4091.59	46.27	45.25	47.29	46.54	47.26
35	7.85	7151.60	42.59	39.73	45.46	44.51	45.46
36	12.17	11640.88	39.18	34.74	43.62	42.72	43.62
37	13.65	13197.85	37.53	32.55	42.51	41.40	42.51
38	12.54	10977.97	37.67	33.10	42.25	41.17	42.25
39	9.38	9048.13	39.34	35.92	42.77	41.76	42.77
40	4.50	5558.50	42.43	40.79	44.07	43.25	44.04
41	-0.76	2929.03	46.07	46.35	45.79	45.12	45.76
42	-6.40	2991.16	50.13	52.47	47.80	47.80	47.75
43	-8.56	4159.69	52.10	55.22	48.97	48.97	48.92
44	-7.61	3701.75	51.97	54.75	49.20	49.20	49.15
45	-2.17	2989.21	48.75	49.54	47.96	47.08	47.91
46	2.79	4113.61	45.43	44.41	46.45	45.70	46.42
47	7.85	7198.11	41.79	38.93	44.66	43.70	44.66
48	12.15	11712.68	38.43	33.99	42.86	41.96	42.86
49	13.64	13275.25	36.81	31.83	41.79	40.68	41.79
50	12.53	11040.33	36.98	32.41	41.55	40.47	41.55
51	9.37	9098.88	38.65	35.23	42.07	41.07	42.07
52	4.49	5586.14	41.73	40.09	43.37	42.55	43.34
53	-0.77	2935.06	45.35	45.63	45.07	44.41	45.04
54	-6.40	2980.20	49.43	51.76	47.09	47.09	47.04
55	-8.56	4143.23	51.40	54.53	48.28	48.28	48.23
56	-7.61	3687.12	51.29	54.07	48.52	48.52	48.47
57	-2.17	2990.12	48.08	48.88	47.29	46.42	47.25
58	2.79	4130.88	44.78	43.76	45.80	45.05	45.77
59	7.84	7235.26	41.16	38.29	44.02	43.07	44.02
60	12.15	11772.10	37.80	33.37	42.24	41.33	42.24
61	13.63	13341.52	36.21	31.23	41.18	40.07	41.18
62	12.52	11095.36	36.37	31.80	40.94	39.86	40.94
63	9.37	9145.18	38.03	34.61	41.45	40.45	41.45
64	4.49	5611.63	41.10	39.46	42.74	41.91	42.70
65	-0.77	2940.76	44.71	44.99	44.43	43.77	44.40
66	-6.40	2970.96	48.79	51.13	46.45	46.45	46.40
67	-8.56	4129.29	50.78	53.91	47.66	47.66	47.61
68	-7.60	3674.93	50.70	53.47	47.92	47.92	47.87
69	-2.17	2991.24	47.51	48.30	46.72	45.85	46.67
70	2.78	4145.73	44.23	43.21	45.25	44.50	45.21
71	7.84	7265.98	40.61	37.75	43.47	42.52	43.47
72	12.14	11823.99	37.26	32.83	41.70	40.79	41.70
73	13.62	13401.47	35.66	30.69	40.63	39.52	40.63
74	12.51	11145.74	35.82	31.25	40.39	39.31	40.39
75	9.36	9186.07	37.48	34.07	40.90	39.90	40.90
76	4.48	5633.56	40.56	38.92	42.20	41.37	42.16
77	-0.77	2945.76	44.18	44.46	43.90	43.23	43.86
78	-6.40	2963.71	48.26	50.60	45.93	45.93	45.88
79	-8.55	4118.16	50.26	53.38	47.14	47.14	47.09
80	-7.60	3664.93	50.18	52.96	47.41	47.41	47.36
81	-2.17	2992.48	47.00	47.80	46.21	45.34	46.17
82	2.78	4159.32	43.73	42.71	44.75	44.00	44.71
83	7.83	7295.66	40.11	37.25	42.97	42.02	42.97
84	12.13	11873.05	36.76	32.33	41.19	40.28	41.19
85	13.61	13457.53	35.15	30.18	40.12	39.01	40.12
86	12.50	11192.25	35.31	30.75	39.88	38.80	39.88
87	9.35	9223.88	36.98	33.57	40.40	39.39	40.40
88	4.48	5653.71	40.07	38.43	41.70	40.88	41.67
89	-0.77	2950.43	43.70	43.98	43.42	42.75	43.38
90	-6.40	2957.64	47.79	50.13	45.46	45.46	45.41
91	-8.55	4108.80	49.80	52.92	46.68	46.68	46.63
92	-7.60	3656.44	49.72	52.50	46.95	46.95	46.90
93	-2.17	2993.82	46.55	47.34	45.75	44.88	45.71
94	2.78	4172.07	43.27	42.25	44.28	43.53	44.25

95	7.83	7322.83	39.65	36.80	42.51	41.56	42.51
96	12.12	11916.93	36.31	31.88	40.73	39.83	40.73
97	13.60	13506.81	34.70	29.74	39.67	38.56	39.67
98	12.50	11232.81	34.87	30.31	39.43	38.35	39.43
99	9.35	9256.92	36.55	33.13	39.96	38.96	39.96
100	4.48	5671.60	39.63	38.00	41.27	40.45	41.23
101	-0.77	2954.77	43.27	43.55	42.99	42.32	42.95
102	-6.39	2952.36	47.37	49.70	45.03	45.03	44.98
103	-8.55	4100.56	49.38	52.50	46.25	46.25	46.21
104	-7.60	3648.98	49.31	52.08	46.53	46.53	46.48
105	-2.17	2995.20	46.13	46.92	45.34	44.47	45.29
106	2.78	4183.42	42.86	41.84	43.87	43.12	43.84
107	7.82	7346.87	39.25	36.39	42.11	41.16	42.11
108	12.12	11955.80	35.91	31.49	40.33	39.43	40.33
109	13.60	13550.52	34.31	29.35	39.27	38.17	39.27
110	12.49	11268.83	34.48	29.92	39.04	37.96	39.04
111	9.34	9286.30	36.16	32.75	39.57	38.57	39.57
112	4.47	5687.57	39.25	37.62	40.88	40.06	40.85
113	-0.77	2958.74	42.89	43.17	42.61	41.94	42.57
114	-6.39	2947.90	46.99	49.32	44.65	44.65	44.60
115	-8.55	4093.53	49.00	52.12	45.88	45.88	45.83
116	-7.60	3642.61	48.93	51.71	46.16	46.16	46.11
117	-2.17	2996.56	45.76	46.56	44.97	44.10	44.93
118	2.78	4193.63	42.49	41.48	43.51	42.76	43.47
119	7.82	7368.43	38.89	36.04	41.75	40.80	41.75
120	12.11	11990.71	35.55	31.13	39.98	39.07	39.98
121	13.59	13589.82	33.96	29.00	38.92	37.81	38.92
122	12.48	11301.24	34.13	29.58	38.69	37.61	38.69
123	9.34	9312.76	35.81	32.40	39.22	38.22	39.22
124	4.47	5701.23	38.91	37.27	40.54	39.72	40.50
125	-0.77	2962.41	42.54	42.82	42.26	41.60	42.23
126	-6.39	2944.06	46.65	48.98	44.31	44.31	44.26
127	-8.55	4087.44	48.66	51.78	45.54	45.54	45.49
128	-7.60	3637.07	48.60	51.37	45.82	45.82	45.77
129	-2.17	2997.90	45.43	46.22	44.64	43.77	44.59
130	2.77	4202.92	42.16	41.15	43.18	42.43	43.14
131	7.82	7387.99	38.57	35.71	41.42	40.47	41.42
132	12.11	12022.40	35.23	30.81	39.65	38.75	39.65
133	13.58	13625.50	33.64	28.68	38.60	37.49	38.60
134	12.48	11330.70	33.82	29.26	38.37	37.30	38.37
135	9.34	9336.83	35.50	32.09	38.91	37.91	38.91
136	4.47	5714.36	38.59	36.96	40.23	39.40	40.19
137	-0.77	2965.81	42.23	42.51	41.95	41.29	41.92
138	-6.39	2940.71	46.34	48.67	44.00	44.00	43.95
139	-8.55	4082.10	48.35	51.48	45.23	45.23	45.18
140	-7.60	3632.21	48.29	51.07	45.52	45.52	45.47
141	-2.17	2999.21	45.13	45.92	44.34	43.46	44.29
142	2.77	4211.44	41.86	40.85	42.88	42.13	42.84
143	7.81	7405.89	38.27	35.42	41.12	40.17	41.12
144	12.10	12051.41	34.94	30.52	39.36	38.46	39.36
145	13.58	13658.20	33.35	28.39	38.31	37.20	38.31
146	12.47	11357.70	33.53	28.98	38.08	37.01	38.08
147	9.33	9358.92	35.21	31.80	38.62	37.62	38.62
148	4.47	5726.43	38.31	36.68	39.94	39.12	39.90
149	-0.77	2968.99	41.95	42.23	41.67	41.00	41.63
150	-6.39	2937.77	46.05	48.39	43.72	43.72	43.67
151	-8.55	4077.37	48.07	51.19	44.95	44.95	44.90
152	-7.60	3627.89	48.01	50.79	45.24	45.24	45.19
153	-2.17	3000.49	44.85	45.64	44.06	43.19	44.01
154	2.77	4219.31	41.59	40.58	42.60	41.85	42.57
155	7.81	7422.39	38.00	35.14	40.85	39.90	40.85
156	12.10	12078.16	34.67	30.25	39.09	38.19	39.09
157	13.57	13688.37	33.08	28.13	38.04	36.93	38.04
158	12.47	11382.64	33.26	28.71	37.82	36.74	37.82
159	9.33	9379.31	34.95	31.54	38.35	37.35	38.35
160	4.47	5737.60	38.04	36.41	39.67	38.85	39.64
161	-0.77	2971.98	41.68	41.97	41.40	40.74	41.37
162	-6.39	2935.16	45.79	48.12	43.46	43.46	43.41

163	-8.55	4073.15	47.81	50.93	44.69	44.69	44.64
164	-7.60	3624.03	47.75	50.53	44.98	44.98	44.93
165	-2.17	3001.74	44.59	45.39	43.80	42.93	43.75
166	2.77	4226.69	41.33	40.32	42.34	41.60	42.31
167	7.81	7437.91	37.74	34.89	40.59	39.64	40.59
168	12.09	12103.38	34.42	30.00	38.83	37.93	38.83
169	13.57	13716.82	32.83	27.88	37.79	36.68	37.79
170	12.47	11406.11	33.02	28.46	37.57	36.49	37.57
171	9.33	9398.46	34.70	31.30	38.10	37.10	38.10
172	4.46	5748.08	37.80	36.17	39.43	38.61	39.39
173	-0.77	2974.81	41.44	41.72	41.16	40.49	41.12
174	-6.39	2932.81	45.55	47.88	43.21	43.21	43.16
175	-8.55	4069.31	47.57	50.69	44.45	44.45	44.40
176	-7.60	3620.50	47.51	50.28	44.73	44.73	44.68
177	-2.17	3002.97	44.35	45.14	43.56	42.69	43.51
178	2.77	4233.63	41.09	40.08	42.10	41.36	42.07
179	7.81	7452.40	37.50	34.65	40.35	39.40	40.35
180	12.09	12126.89	34.18	29.77	38.60	37.69	38.60
181	13.56	13743.36	32.60	27.65	37.55	36.44	37.55
182	12.46	11428.06	32.78	28.23	37.33	36.26	37.33
183	9.32	9416.44	34.47	31.06	37.87	36.87	37.87
184	4.46	5757.96	37.57	35.94	39.20	38.38	39.16
185	-0.77	2977.52	41.21	41.49	40.93	40.26	40.89
186	-6.39	2930.68	45.32	47.65	42.98	42.98	42.93
187	-8.55	4065.82	47.34	50.46	44.22	44.22	44.17
188	-7.60	3617.30	47.28	50.05	44.51	44.51	44.46
189	-2.17	3004.17	44.12	44.92	43.33	42.46	43.29
190	2.77	4240.14	40.87	39.86	41.88	41.13	41.85
191	7.80	7465.97	37.28	34.43	40.13	39.18	40.13
192	12.09	12148.93	33.96	29.55	38.37	37.47	38.37
193	13.56	13768.24	32.38	27.43	37.33	36.23	37.33
194	12.46	11448.65	32.57	28.02	37.11	36.04	37.11
195	9.32	9433.30	34.25	30.85	37.65	36.65	37.65
196	4.46	5767.25	37.35	35.72	38.98	38.16	38.94
197	-0.77	2980.09	40.99	41.27	40.71	40.05	40.68
198	-6.39	2928.75	45.10	47.43	42.77	42.77	42.72
199	-8.55	4062.64	47.12	50.24	44.00	44.00	43.96
200	-7.60	3614.38	47.07	49.84	44.29	44.29	44.24
201	-2.17	3005.34	43.91	44.71	43.12	42.25	43.07
202	2.77	4246.28	40.66	39.65	41.67	40.92	41.63
203	7.80	7478.74	37.07	34.22	39.92	38.97	39.92
204	12.08	12169.67	33.75	29.34	38.17	37.27	38.17
205	13.56	13791.66	32.18	27.23	37.12	36.02	37.12
206	12.45	11468.03	32.36	27.81	36.91	35.83	36.91
207	9.32	9449.18	34.05	30.65	37.45	36.45	37.45
208	4.46	5776.01	37.15	35.52	38.78	37.96	38.74
209	-0.77	2982.54	40.79	41.07	40.51	39.84	40.47
210	-6.39	2927.00	44.90	47.23	42.57	42.57	42.52
211	-8.55	4059.73	46.92	50.04	43.80	43.80	43.75
212	-7.60	3611.70	46.87	49.64	44.09	44.09	44.04
213	-2.17	3006.48	43.71	44.51	42.92	42.05	42.87
214	2.77	4252.09	40.46	39.45	41.47	40.72	41.44
215	7.80	7490.80	36.88	34.03	39.72	38.78	39.72
216	12.08	12189.25	33.56	29.15	37.97	37.07	37.97
217	13.55	13813.77	31.98	27.03	36.93	35.82	36.93
218	12.45	11486.34	32.17	27.62	36.71	35.64	36.71
219	9.31	9464.19	33.86	30.45	37.26	36.26	37.26
220	4.46	5784.30	36.95	35.33	38.58	37.76	38.55
221	-0.77	2984.89	40.60	40.88	40.31	39.65	40.28
222	-6.39	2925.40	44.71	47.04	42.37	42.37	42.32
223	-8.55	4057.06	46.73	49.85	43.61	43.61	43.56
224	-7.60	3609.24	46.68	49.45	43.90	43.90	43.85
225	-2.17	3007.59	43.52	44.32	42.73	41.86	42.68
226	2.77	4257.59	40.27	39.26	41.28	40.54	41.25
227	7.80	7502.22	36.69	33.84	39.54	38.59	39.54
228	12.08	12207.80	33.38	28.97	37.78	36.88	37.78
229	13.55	13834.73	31.80	26.85	36.75	35.64	36.75
230	12.45	11503.69	31.99	27.44	36.53	35.46	36.53

231	9.31	9478.42	33.67	30.27	37.07	36.08	37.07
232	4.46	5792.17	36.77	35.15	38.40	37.58	38.36
233	-0.77	2987.13	40.42	40.70	40.13	39.47	40.10
234	-6.39	2923.93	44.53	46.86	42.19	42.19	42.14
235	-8.55	4054.60	46.55	49.67	43.43	43.43	43.38
236	-7.60	3606.97	46.50	49.27	43.72	43.72	43.67
237	-2.17	3008.67	43.35	44.14	42.55	41.68	42.51
238	2.77	4262.83	40.09	39.08	41.10	40.36	41.07
239	7.80	7513.07	36.51	33.67	39.36	38.41	39.36
240	12.07	12225.42	33.20	28.79	37.61	36.71	37.61
241	13.55	13854.65	31.63	26.68	36.57	35.47	36.57
242	12.45	11520.19	31.81	27.27	36.36	35.28	36.36
243	9.31	9491.94	33.50	30.10	36.90	35.90	36.90
244	4.46	5799.66	36.60	34.97	38.23	37.41	38.19
245	-0.78	2989.28	40.24	40.53	39.96	39.30	39.93
246	-6.39	2922.58	44.35	46.69	42.02	42.02	41.97
247	-8.55	4052.32	46.38	49.50	43.26	43.26	43.21
248	-7.60	3604.86	46.33	49.10	43.55	43.55	43.50
249	-2.17	3009.73	43.18	43.97	42.38	41.51	42.34
250	2.76	4267.82	39.93	38.92	40.93	40.19	40.90
251	7.79	7523.40	36.35	33.50	39.19	38.24	39.19
252	12.07	12242.21	33.04	28.63	37.44	36.54	37.44
253	13.54	13873.62	31.46	26.52	36.41	35.30	36.41
254	12.44	11535.90	31.65	27.11	36.19	35.12	36.19
255	9.31	9504.83	33.34	29.94	36.74	35.74	36.74
256	4.45	5806.81	36.44	34.81	38.06	37.24	38.03
257	-0.78	2991.35	40.08	40.36	39.80	39.14	39.76
258	-6.39	2921.34	44.19	46.52	41.86	41.86	41.81
259	-8.55	4050.21	46.22	49.34	43.10	43.10	43.05
260	-7.59	3602.90	46.16	48.94	43.39	43.39	43.34
261	-2.17	3010.76	43.01	43.81	42.22	41.35	42.17
262	2.76	4272.59	39.76	38.76	40.77	40.03	40.74
263	7.79	7533.26	36.19	33.34	39.03	38.08	39.03
264	12.07	12258.23	32.88	28.47	37.28	36.38	37.28
265	13.54	13891.73	31.30	26.36	36.25	35.14	36.25
266	12.44	11550.91	31.49	26.95	36.03	34.96	36.03
267	9.31	9517.14	33.18	29.78	36.58	35.58	36.58
268	4.45	5813.64	36.28	34.65	37.91	37.09	37.87
269	-0.78	2993.35	39.92	40.21	39.64	38.98	39.61
270	-6.39	2920.19	44.03	46.37	41.70	41.70	41.65
271	-8.55	4048.24	46.06	49.18	42.94	42.94	42.89
272	-7.59	3601.08	46.01	48.78	43.24	43.24	43.19
273	-2.17	3011.77	42.86	43.65	42.07	41.20	42.02
274	2.76	4277.17	39.61	38.60	40.62	39.87	40.59
275	7.79	7542.69	36.03	33.19	38.88	37.93	38.88
276	12.07	12273.56	32.73	28.32	37.13	36.23	37.13
277	13.54	13909.06	31.15	26.21	36.10	34.99	36.10
278	12.44	11565.27	31.34	26.80	35.88	34.81	35.88
279	9.30	9528.93	33.03	29.63	36.43	35.43	36.43
280	4.45	5820.19	36.13	34.51	37.76	36.94	37.72
281	-0.78	2995.27	39.77	40.06	39.49	38.83	39.46
282	-6.39	2919.12	43.89	46.22	41.55	41.55	41.50
283	-8.54	4046.40	45.91	49.03	42.79	42.79	42.74
284	-7.59	3599.38	45.86	48.63	43.09	43.09	43.04
285	-2.17	3012.76	42.71	43.51	41.92	41.05	41.87
286	2.76	4281.55	39.46	38.46	40.47	39.73	40.44
287	7.79	7551.72	35.89	33.05	38.73	37.79	38.73
288	12.06	12288.25	32.58	28.18	36.99	36.09	36.99
289	13.54	13925.67	31.01	26.07	35.95	34.85	35.95
290	12.44	11579.04	31.20	26.66	35.74	34.67	35.74
291	9.30	9540.22	32.89	29.49	36.28	35.29	36.28
292	4.45	5826.47	35.99	34.36	37.61	36.79	37.58
293	-0.78	2997.13	39.63	39.91	39.35	38.69	39.31
294	-6.39	2918.13	43.74	46.08	41.41	41.41	41.36
295	-8.54	4044.68	45.77	48.89	42.65	42.65	42.60
296	-7.59	3597.78	45.72	48.49	42.95	42.95	42.90
297	-2.17	3013.72	42.57	43.36	41.78	40.91	41.73
298	2.76	4285.77	39.32	38.32	40.33	39.59	40.30

299	7.79	7560.40	35.75	32.91	38.59	37.65	38.59
300	12.06	12302.35	32.44	28.04	36.85	35.95	36.85
301	13.53	13941.62	30.87	25.93	35.81	34.71	35.81
302	12.43	11592.26	31.06	26.52	35.60	34.53	35.60
303	9.30	9551.08	32.75	29.36	36.15	35.15	36.15
304	4.45	5832.51	35.85	34.23	37.48	36.66	37.44
305	-0.78	2998.92	39.49	39.78	39.21	38.55	39.18
306	-6.39	2917.20	43.61	45.94	41.27	41.27	41.22
307	-8.54	4043.07	45.63	48.75	42.51	42.51	42.47
308	-7.59	3596.28	45.58	48.35	42.81	42.81	42.76
309	-2.17	3014.66	42.44	43.23	41.64	40.77	41.59
310	2.76	4289.82	39.19	38.18	40.20	39.45	40.16
311	7.79	7568.74	35.62	32.77	38.46	37.51	38.46
312	12.06	12315.92	32.31	27.91	36.71	35.81	36.71
313	13.53	13956.96	30.74	25.80	35.68	34.58	35.68
314	12.43	11604.98	30.93	26.39	35.47	34.39	35.47
315	9.30	9561.52	32.62	29.22	36.01	35.02	36.01
316	4.45	5838.32	35.72	34.09	37.34	36.53	37.31
317	-0.78	3000.66	39.36	39.65	39.08	38.42	39.05
318	-6.39	2916.34	43.47	45.81	41.14	41.14	41.09
319	-8.54	4041.56	45.50	48.62	42.38	42.38	42.33
320	-7.59	3594.87	45.45	48.22	42.68	42.68	42.63
321	-2.17	3015.58	42.30	43.10	41.51	40.64	41.46
322	2.76	4293.74	39.06	38.05	40.07	39.32	40.03
323	7.78	7576.78	35.49	32.64	38.33	37.38	38.33
324	12.06	12328.98	32.18	27.78	36.58	35.69	36.58
325	13.53	13971.74	30.61	25.67	35.55	34.45	35.55
326	12.43	11617.23	30.80	26.27	35.34	34.27	35.34
327	9.30	9571.58	32.49	29.10	35.89	34.89	35.89
328	4.45	5843.93	35.59	33.97	37.22	36.40	37.18
329	-0.78	3002.33	39.24	39.52	38.95	38.29	38.92
330	-6.39	2915.57	43.35	45.69	41.02	41.02	40.97
331	-8.54	4040.25	45.39	48.50	42.27	42.27	42.22
332	-7.59	3593.68	45.34	48.11	42.57	42.57	42.51
333	-2.17	3016.39	42.19	42.99	41.40	40.53	41.35
334	2.76	4297.12	38.95	37.94	39.95	39.21	39.92
335	7.78	7583.88	35.37	32.53	38.21	37.27	38.21
336	12.05	12340.82	32.07	27.67	36.47	35.57	36.47
337	13.53	13985.36	30.49	25.56	35.43	34.33	35.43
338	12.43	11628.54	30.69	26.15	35.22	34.15	35.22
339	9.30	9580.74	32.38	28.98	35.77	34.77	35.77
340	4.45	5848.90	35.48	33.86	37.10	36.29	37.07
341	-0.78	3003.79	39.13	39.41	38.84	38.18	38.81
342	-6.39	2914.89	43.24	45.58	40.91	40.91	40.86
343	-8.54	4039.04	45.28	48.40	42.16	42.16	42.11
344	-7.59	3592.55	45.23	48.00	42.46	42.46	42.41
345	-2.17	3017.18	42.08	42.88	41.29	40.42	41.24
346	2.76	4300.39	38.84	37.83	39.85	39.10	39.81
347	7.78	7590.57	35.27	32.42	38.11	37.16	38.11
348	12.05	12351.71	31.96	27.56	36.36	35.46	36.36
349	13.52	13997.68	30.39	25.45	35.33	34.22	35.33
350	12.42	11638.76	30.58	26.04	35.12	34.04	35.12
351	9.29	9589.12	32.27	28.88	35.66	34.67	35.66
352	4.45	5853.58	35.37	33.75	37.00	36.18	36.96
353	-0.78	3005.21	39.02	39.31	38.74	38.08	38.70
354	-6.39	2914.25	43.14	45.47	40.81	40.81	40.76
355	-8.54	4037.90	45.17	48.29	42.05	42.05	42.00
356	-7.59	3591.48	45.12	47.90	42.35	42.35	42.30
357	-2.17	3017.95	41.98	42.77	41.19	40.32	41.14
358	2.76	4303.55	38.73	37.73	39.74	39.00	39.71
359	7.78	7597.05	35.16	32.32	38.00	37.06	38.00
360	12.05	12362.24	31.86	27.46	36.26	35.36	36.26



1 **WELL FIELD LOCATION**

SCALE: NTS

Pathfinder
Engineers & Architects

PROJECT
FRENCH HALL

TITLE OF DRAWING
WELL FIELD LOCATION

DATE 5/11/2020

SCALE NTS

PROJECT NO. 52006

Section 13 – Product Cut Sheets

TOPAZ

SELF CONTAINED MUA

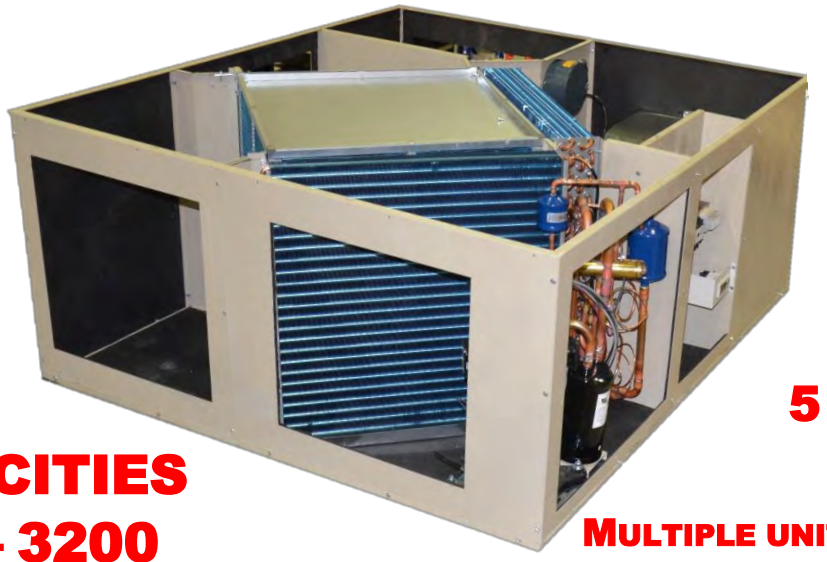
EXHAUST AIR HEAT PUMP

TRANSOM

MAKE UP AIR UNIT

Combines the natural efficiencies of the plate heat exchanger and the heat pump.

By using the waste heat, the Self Contained MUA achieves over 26 compressor EER at 20 °F ambient temp.



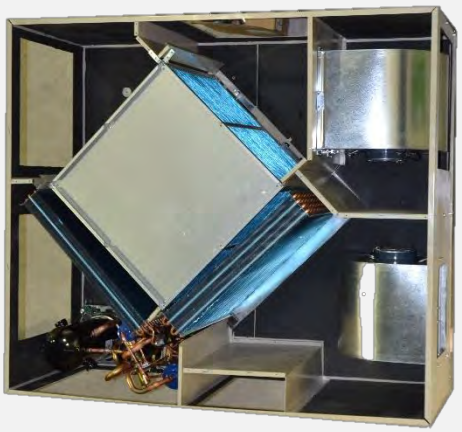
5 MODELS

CAPACITIES
250 – 3200
CFM

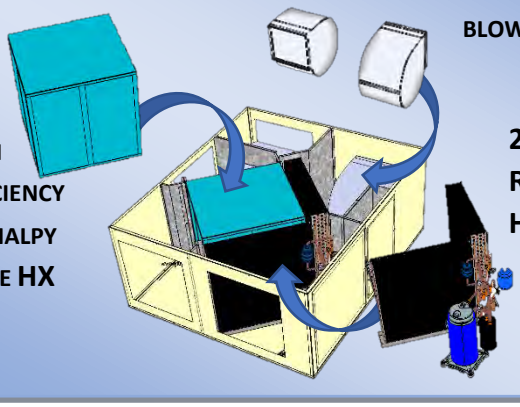
MULTIPLE UNITS CAN BE USED IN TANDEM FOR GREATER CAPACITY

MAIN FEATURES

- FLAT PLATE HEAT RECOVERY EXCHANGER
- REVERSING HEAT PUMP
- TWO STAGE SCROLL COMPRESSOR
- DUAL VARIABLE SPEED EC BLOWERS
- FULLY CHARGED AND FACTORY TESTED REFRIGERATION SYSTEM
- BUILT IN CONTROLS



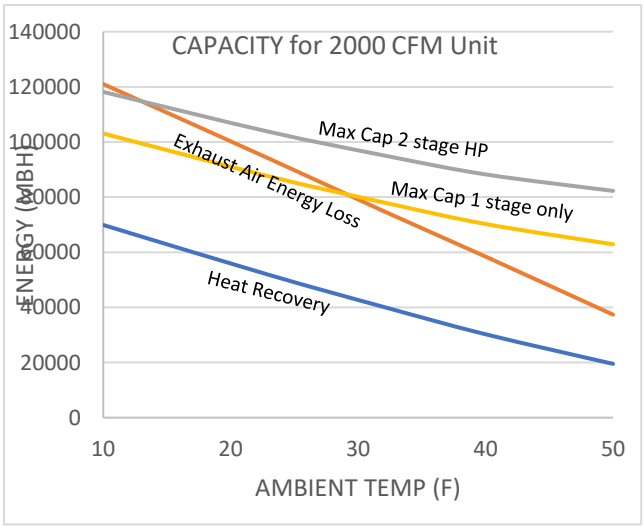
MAJOR COMPONENTS



TRANSOM

REFRIGERANT CIRCUIT INCLUDES

1. Compressor – Scroll 2 stage
2. Tube and fin heat exchangers
3. 4-way Reversing valve
4. Bi-directional Filter/Drier
5. TXV with check valve bypass
6. Sight glass



COOLING MODE

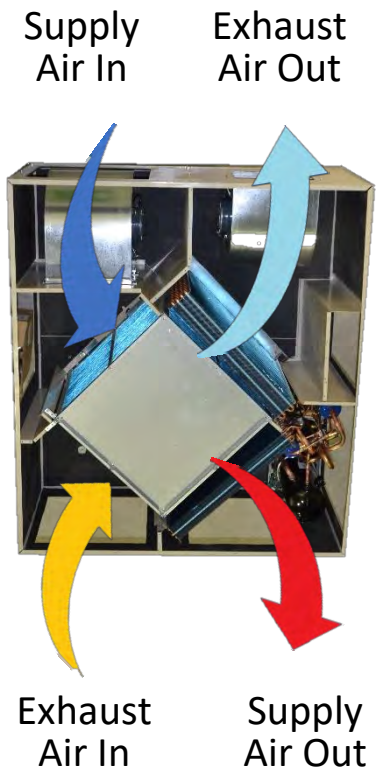
Condenser uses exhaust air which is lower temp than outside air

Supply air is pre-cooled by the heat recovery entering the evaporator

HEATING MODE

Heating mode uses exhaust air for heat source instead of outside cold air

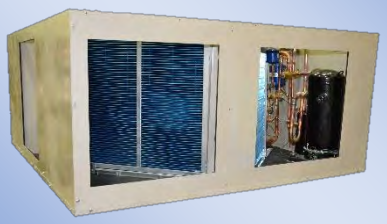
Heat recovery increases the supply air temp from outside so HP does not have to do a full lift



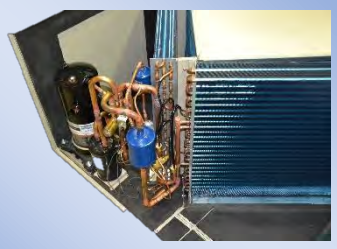
Info@transomcorporation.com
705-717-8010

CEILING MOUNTED

WITH ONLY DUCTING, POWER AND DRAIN TO CONNECT



LARGE ACCESS PANELS FOR SERVICE



NO SIZING OF COMPONENTS
NO REF CONNECTIONS
NO GAS CONNECTIONS

LOWER TEMP OPERATION POSSIBLE BY USING FROST KIT

OPTIONS

FREE COOLING
- BYPASS HEAT RECOVERY HX WHEN AMBIENT PERMITS

BACK UP HEAT ATTACHMENT
- HYDRONIC
- ELECTRIC

TRANSOM

Model		MHP02	MHP05	MHP11	MHP20	MHP35
Air Flow	CFM	250	500	1100	2000	3200
Min Air Flow		360	290	650	1100	1800
Total Heat Capacity	MBH	16.4	30.4	66.5	122.6	177.6
Total Cooling Capacity	MBH	11.2	20.4	43.8	79.4	125.6
Extra Heat	MBH	4.3	6.3	13.1	24.3	24.2
Extra Cooling	MBH	2.3	4.5	10.4	16.0	28.0
Heat Recovery eff	%	48.6	51.4	53.2	53.7	53.9
External static – Supply	In wc	1.15	1.02	1.02	0.92	1.18
External static - Exhaust	In wc	1.02	0.99	0.98	0.93	1.17

Power Source		MHP04	MHP05	MHP08	MHP12	MHP20
208-230/1/60		●	●	●	●	●
208-230/3/60				●	●	●
460/3/60				●	●	●
575/3/60				●	●	●

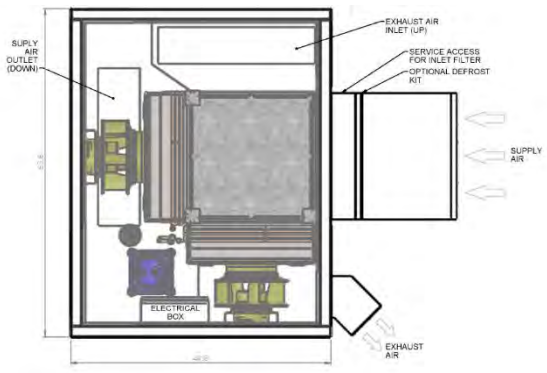
Dimensions		MHP02	MHP05	MHP11	MHP20	MHP35
Length	In	34.1	38.0	43.9	49.8	55.7
Width	In	46.9	50.8	56.7	62.6	68.5
Height	in	12.7	16.6	22.5	28.4	34.3

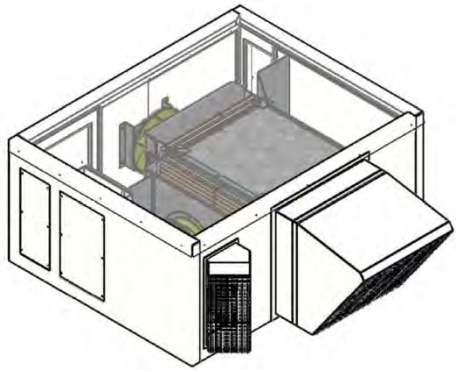
Summer Conditions Ambient 95F / 50% RH
Interior 80F / 50% RH

Winter Conditions Ambient 20F / 80% RH
Interior 68F / 50% RH

APPLICATIONS

Bars, restaurants and industrial kitchens
Eliminate/reduce odors from retail stores, industrial labs
Meeting rooms and lecture halls
Exercise gyms, yoga studios, dance studios
Industrial and commercial applications
Retrofit facilities with dead/stagnant air flow areas
Great for zoning, only have the air changes during occupancy periods
Retrofit applications made easy. Provides air changes without affecting existing HVAC system balancing





ROOF TOP VERSION

Double wall
2” Insulation
Sealed Service Doors
Rain Guard
Supply and Return connections from bellow
Backward curved EC blowers

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Other Products

TRANSOM

LAMBERT CHILLER

- Capacities available in **20 to 80 ton**
- Up to 12 modules
- Redundancy N+1, N+2
- Capacity control
- High turn down
- Brazed plate heat exch.
- Water cooled
- Premade modular header
- Scroll compressors
- Dual circuit
- No cross contamination
- Smallest foot print
- Service access

RAWSON CHILLER

- Capacities available from
- 10 to 32 ton
- Year-round operation
- 2 Stage control
- Energy savings features
- Low temperature kit included
- Brazed Plate HX
- Built-in centrifugal pump
- Flow switch
- Swept fan blade design

TRENT CHILLER

- Capacities available in From 2 to 8.5 ton
- Year-round operation
- Floating head pressure control
- 2 Stage scroll compressors
- Energy savings features
- Low temperature kit included
- Brazed Plate HX
- Built-in centrifugal pump
- Flow switch
- Swept fan blade design
- Variable speed fan
- Hydrophobic coated coil

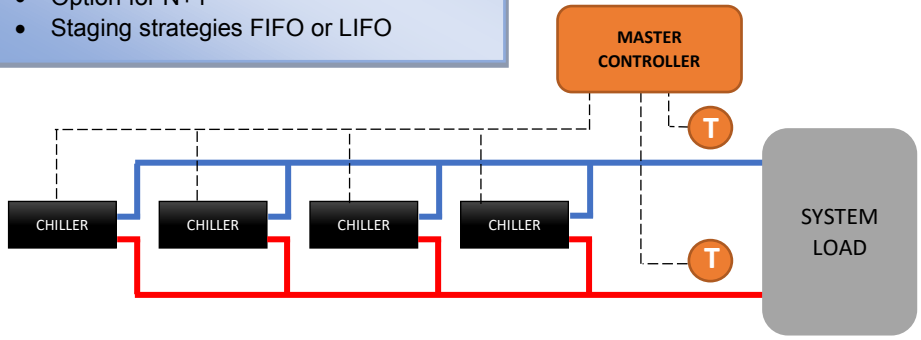
DATA ROOM CONDENSING UNIT

- Capacities available in **2, 3, 4 and 5 ton**
- Year-round operation
- Floating head pressure control
- 2 Stage scroll compressors
- Energy savings features
- Low temperature kit Included
- Swept fan blade design
- Variable speed fan
- Hydrophobic coated coil

Contact Factory
for customized options

MASTER CONTROLLER

- Multiple chillers hooked up in parallel
- Incremental capacity
- Variable flow system
- Master controller stages chillers on/off
- Option for N+1
- Staging strategies FIFO or LIFO



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Barrie, ON
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Ph: 705-717-8010
info@transomcorporation.com
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WaterFurnace.
Commercial Solutions

WC Modular Scroll Chiller

Large Commercial / 20-80 Ton

Water Source/Geothermal Heat Pump

WC MODULAR SCROLL CHILLER FOR COMMERCIAL APPLICATIONS

The WaterFurnace WC Modular Scroll Chiller is the perfect fit for commercial and industrial applications. Its R-410A dual scroll compressors provide high efficiency and the ultimate in capacity control while the modular cabinet design is perfect for multiple chiller bank installations. The optional *6-pipe header rack allows for application and enables the system to provide simultaneous heating and cooling with impressive efficiencies.

KEY FEATURES

HIGH-EFFICIENCY COMPRESSORS: WC Scroll Chillers use high efficiency R-410A dual scroll compressors that are mounted on rubber grommets for vibration isolation.

REMOVABLE *6-PIPE HEADER RACK: Piping racks can be installed and flushed before installing the refrigerant module, and additional header racks can be installed for future central plant expansion. Each header rack is compatible with all tonnage modules. The 4-pipe header racks can be combined with *6 pipe header racks to meet the heat recovery capacity required for every project.

INSULATED & EFFICIENT WATER-TO-REFRIGERANT HEAT EXCHANGER: Large oversized stainless steel interlaced copper-brazed plate water-to-refrigerant heat exchangers provide unparalleled efficiency. All heat exchangers, water lines, and suction lines are insulated to prevent condensation during low temperature inlet water operation.

CONVENIENT CONTROL PANEL FOR EASE OF SERVICE: WC Chiller control panel features a heavy-duty, hinged service door with a convenient user interface display for ease of service and installation. The top control panel features high voltage components such as the electrical disconnect, fuses, and compressor contactors. While the bottom control panel features the main control board, and superheat board. The control panel was designed with the technician in mind to provide convenient, clear wiring with plenty of working space.

4-WAY REVERSING VALVE: WC Chillers enabled for reverse mode* are equipped with a heavy-duty 4-way reversing valve with low refrigerant pressure drop. 4-way valves are operated by the system controller to enhance reliability.

2-WAY ISOLATION VALVES: WC Chillers are equipped with low pressure drop (high Cv) solenoid valves to vary the pump according to flow required.

ADDED CONTROL WITH ELECTRONIC EXPANSION VALVE: Optional electronic expansion valves in the WC Scroll Chillers provide great superheat control along with a wider range of operation. Superheat values are reported back to the system controller which allows more diagnostic information to the technician without requiring the use of refrigerant manifold gauges.

ELECTRICAL DISCONNECT: A factory mounted, internally wired, disconnect is available to provide electrical isolation from high voltage supply at the chiller.

COMPRESSOR PROTECTION MODULE: Most chillers come with external compressor protection module that provides additional motor protection such as reverse phase detection and a pre-wire thermistor. All other models have internal overload protection with reverse phase detection.

FLOW SWITCH FOR EXTENDED COMPRESSOR LIFE: Stainless steel, multi-segment paddle type flow switches come standard on every unit to protect the compressor from running when low flows are encountered.

PROTECTIVE CABINET: All chiller frames are constructed of heavy gauge steel and painted with corrosion resistant, polyester, powder coat paint. The frame includes fork truck pockets to assist in maneuverability of the product during installation.

AVAILABILITY INFO
- SHR Max Size
- Reversability up to 50 ton
- 6 pipe up to 50 ton

**Available in up to 50 ton models*

WC MODULAR SCROLL CHILLER 20-80 TON

Dual Scroll Modular IPLV Ratings

Model	Full Load Rating			IPLV	
	Cooling Capacity (MBtu/hr)	Input Power (kW)	EER	EER	kW/ton
020	265,000	15.8	16.8	21.6	0.557
030	390,000	24.1	16.3	20.5	0.584
040	510,000	31.1	16.4	22.4	0.536
050	620,000	37.9	16.5	22.0	0.546
060	805,000	49.1	16.4	22.0	0.546
070	892,000	54.7	16.3	21.5	0.558
080	990,000	62.5	15.9	21.3	0.564

1/19/17

Dimensional Data: Without Header Rack

Model	Width	Depth	Height
020 - 080	33.0″	55.5″	73.3″

Dimensional Data: With Header Rack

Model	Width	Depth	Height
020 - 080	33.4″	74.98″	74.69″

Modular Physical Data

Model	Scroll Modular						
	020	030	040	050	060	070	080
Refrigerant	R-410A						
Number of Circuits	2	2	2	2	2	2	2
Factory Charge, lbs [kg]	*1 to 1.5 lbs per nominal ton [0.45 to 0.68 kg]						
Compressor	Single Speed Scroll						
Compressor Quantity [tons]	2 [10]	2 [15]	2 [20]	2 [25]	2 [30]	2 [35]	2 [40]
Compressor Weight, lbs [kg] (each)	150 [68]	167 [76]	251 [114]	262 [119]	370 [168]	316 [143]	406 [184]
Oil Charge, oz	112 [3.3]	122 [3.6]	227 [6.7]	227 [6.7]	227 [6.7]	179 [5.3]	227 [6.7]
Evaporator	Brazed Plate						
Quantity	1	1	1	1	1	1	1
Weight, lbs [kg]	80 [36]	127 [57]	157 [71]	194 [88]	217 [98]	241 [109]	241 [109]
Water Volume, gal [L]	2.2 [8.5]	3.6 [13.5]	4.4 [16.8]	5.5 [20.9]	6.2 [23.4]	6.8 [25.9]	6.8 [25.9]
Circuit Configuration	Stainless Steel Dual Circuit						
Condenser	Brazed Plate						
Quantity	1	1	1	1	1	1	1
Weight, lbs [kg]	74 [33]	112 [51]	142 [64]	179 [81]	202 [91]	224 [101]	224 [101]
Water Volume, gal [L]	2 [7.6]	3.1 [11.8]	4 [15.1]	5.1 [19.3]	5.7 [21.7]	6.3 [23.8]	6.3 [23.8]
Circuit Configuration	Stainless Steel Dual Circuit						
Modular							
Shipping Weight, lbs [kg]	1847 [838]	1889 [857]	1921 [871]	1979 [898]	2039 [925]	2046 [928]	2046 [928]

* - Consult nameplate for exact charge quantity.

10/7/16

Header Rack Physical Data

Model	Header Rack	
	4”	6”
4 Pipe		
Water Volume, gal [L]	8.6 [32.7]	17.7 [67.2]
Water Weight, lbs [kg]	72 [33]	148 [67]
Shipping Weight, lbs [kg]	548 [249]	653 [296]
4 Pipe Reversing		
Water Volume, gal [L]	8.6 [32.7]	17.7 [67.2]
Water Weight, lbs [kg]	72 [33]	148 [67]
Shipping Weight, lbs [kg]	615 [279]	720 [327]
6 Pipe Standard		
Water Volume, gal [L]	12.2 [46.3]	26.3 [99.4]
Water Weight, lbs [kg]	102 [46]	219 [99]
Shipping Weight, lbs [kg]	684 [310]	841 [381]
6 Pipe Dedicated Geo		
Water Volume, gal [L]	12.2 [46.3]	26.3 [99.4]
Water Weight, lbs [kg]	102 [46]	219 [99]
Shipping Weight, lbs [kg]	684 [310]	841 [381]

7/05/17

WaterFurnace Commercial Solutions

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Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

Submittal Sheet **EBW-Sub-08**

COMMERCIAL ELECTRIC HOT WATER BOILERS

Job Name: _____

Location: _____

Engineer: _____

Agent/Wholesaler: _____

Contractor: _____

Model No. _____ Gal. Cap. _____

Voltage/Phase _____ kW _____

Design Pressure _____ Operating Temp. _____ Ambient Temp. _____

Equipment Tag(s):

_____

NOTES:

FOR EASE IN ORDERING BY MODEL NUMBER:

B	W	X	30	1400	F
BOILER	HOT WATER	VOLTAGE	VESSEL DIAMETER	KILOWATT	FULL SIZE

This is a 480 Volt, 3 phase, 1400 Kilowatt, full size electric hot water boiler with 30" diameter vessel.

- *For lower KW ratings, please refer to the Compact Boiler.*
- *Models above 1600KW are also available in 40KW increments.*

Operating temperature, ambient room temperature, and pressure must be indicated when placing an order.

Standard Features

- ASME National Board Registered Pressure Vessel
- Heavy Duty Steel Boiler Vessel Housing
- Full Sized Structural Steel Base
- 4" Fiberglass Insulation
- Flanged Inlet and Outlet Connection (above 3")
- ASME Pressure Relief Valve
- Pressure Gauge with Cock
- Full Port Drain Valve
- Low Water Cut-Off with Manual Reset
- Manual Limit Toggle Switches (one per step)
- Adjustable High Limit with Automatic Reset
- Adjustable High Limit with Manual Reset
- Incoloy Sheathed Elements
- Internal Branch Circuit Fusing
- Magnetic Contactors
- Main Supply Circuit Lugs
- 120 Volt Fused Control Transformer
- On/Off Switch with Pilot Light
- Integral Electric Control Panel w/Key Locked Door(s)
- Status Pilot Light for each Step
- Digital Electronic Readout
- Listed by the Underwriters Laboratories
- Electronic Multi-Stage Control (1–4 Step Models)
- Proportional Progressive Sequence Step Control (5+ Step Models)
- CSD-1 Compliant
- 3 Year Limited Tank Warranty / 1 Year Parts Warranty *(See warranty for details)*

Optional Equipment

☐ Additional Step Control
☐ Additional Step Control Circuits
☐ Alarm Bell
Amp Meter: ☐ Single Phase ☐ Three Phase
☐ Aux. Temp. Limit Switches - Manual Reset
☐ BMS Alarm Interface - Auto Reset
☐ BMS Remote Step Control (Remote enable)
☐ BMS Remote Set-Point Control
☐ BMS 120V Interface to Limit Boiler Power Demand
☐ BMS 24V Interface to Limit Boiler Power Demand
☐ Control Panel Door Solenoid Interlock
☐ Flow Switch
☐ Ground Fault Detection (GFI)
☐ High Pressure Limit Switch
☐ Kilowatt (kW)/Hour Meter
☐ kW Hour Meter Combined w/3-phase Amp Meter
☐ Lifting Lugs
☐ Modbus TCP/IP♦
☐ Modbus RTU, BACnet MS/TP, or BACnet IP♦

♦ **IP Address required**. If not provided below, field alteration will result in additional fees.

IP Address for BACnet/Modbus: _____

☐ Outdoor Temperature Reset
☐ Substitute Low Water Cut Off Switch - Float Type
☐ Time Clock
Volt Meter: ☐ Single Phase ☐ Three Phase
☐ Auxiliary Low Water Cutoff Switch
☐ Multifunction Power & Energy Meter
☐ Auto Air Vent (BW*24–42)
Main Power Disconnect - Rotary Handle Safety Switch:
☐ Non-Fused ☐ Fused
Main Power Disconnect - Circuit Breaker:
☐ Non-Auto ☐ Auto
☐ Main Power E-Stop
☐ Dual Feed Electrical Supply (BW*24–42)
☐ SCR (Silicon Controlled Rectifier)
☐ SCCR (Short-Circuit Current Rating)

Inlet/Outlet Connections — Mechanical Options

MODEL	STD. SIZE	3" NPT	3" FLG	4" FLG	6" FLG	8" FLG	10" FLG	12" FLG
BW*24 (480-600kW)	4" FLG	○	○		○			
BW*24 (640-1096kW), BW*30	6" FLG			○		○	○	
BW*36	8" FLG			○	○		○	○
BW*42	10" FLG				○	○		○

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

Lochinvar, LLC
300 Maddox Simpson Parkway
Lebanon, Tennessee 37090
P: 615.889.8900 / F: 615.547.1000
Lochinvar.com

DESIGNED ★ ENGINEERED ★ ASSEMBLED USA

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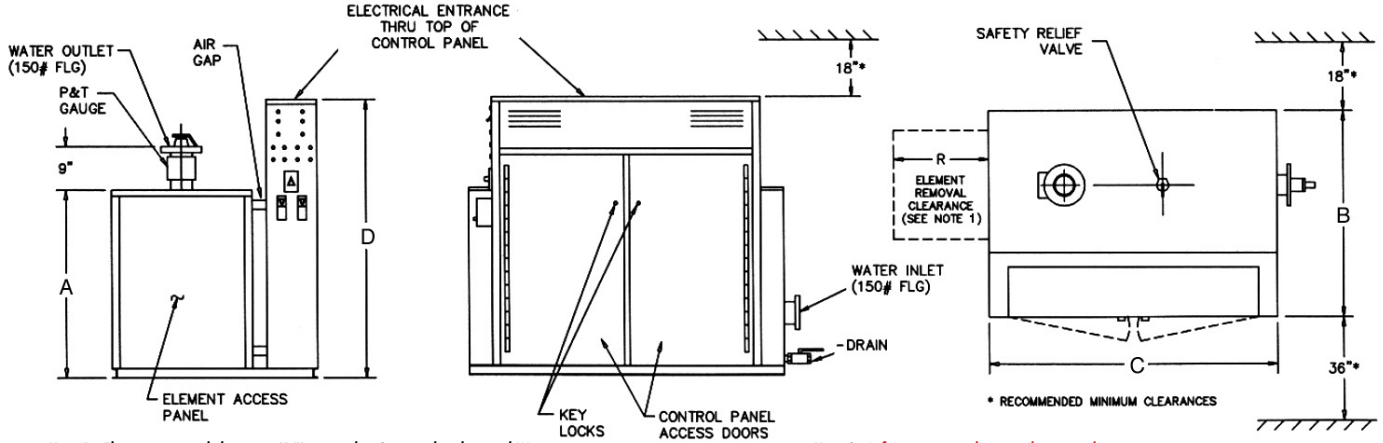
ASME H

Commercial Electric Boiler Dimensions & Specifications

Detailed electrical and dimensional drawings are normally supplied with boiler shipment. Check here: ☐ **HOLD FOR APPROVAL** *if required prior. Additional charges may apply.*



Note 1: Element removal clearance (R") is equal to 2 times the element kW.

Note 2: Optional equipment may change overall boiler dimensions. Please consult factory for dimensional information.

Note 3: Information is subject to change without notice.

Note 4: Dimensions shown are approximate and should not be used for construction purposes.

Model Number	Max Input kW	MBH Per Hour	Max # of Elements	Connection Sizes (NPT) In/Out	Connection Sizes (NPT) Drain	Max. Flow GPM	Tank Dims (In)	Data Vol (Gal)	Dimensions (Inches) A	B	C	D	Weight (lbs.) Ship	Oper.
BW_24	600	2047	30	4" FLG	1-1/4"	470	24x44	70	34"	40"	52"	51"	1,300	1,860
BW_24	920	3139	46	6" FLG	1-1/2"	680	24x44	70	34"	40"	56"	63"	1,500	2,060
BW_30	1560	5323	78	6" FLG	1-1/2"	900	30x48	125	40"	50"	60"	75"	1,900	2,900
BW_36	2000	6824	100	8" FLG	2"	1,170	36x48	165	46"	56"	62"	87"	2,400	3,720
BW_42	3000	10236	150	10" FLG	2"	1,840	42x50	260	54"	76"	64"	77"	3,600	5,760

Model Number	Ratings MBH	Ratings kW	**480 Volts • 3 Ph** (Model Prefix BW**X**) Elements Qty	Elements kW	Circuits	Number of Steps@ kW	Amps	**600 Volts • 3 Ph** (Model Prefix BW**N**) Elements Qty	Elements kW	Circuits	Number of Steps@ kW	Amps
BWX24-480F	1638	480	24	20	12	4@80, 4@40	578	N/A	N/A	N/A	N/A	N/A
BWX24-520F	1774	520	26	20	13	5@80, 3@40	626	N/A	N/A	N/A	N/A	N/A
BWX24-560F	1911	560	28	20	14	6@80, 2@40	674	N/A	N/A	N/A	N/A	N/A
BWX24-600F	2047	600	30	20	15	7@80, 1@40	722	N/A	N/A	N/A	N/A	N/A
BWX24-640F	2184	640	32	20	16	8@80	770	N/A	N/A	N/A	N/A	N/A
BWN24-655F	2236	655	N/A	N/A	N/A	N/A	N/A	28	23.4	14	6@93.6, 2@46.8	630
BWX24-680F	2320	680	34	20	17	7@80, 3@40	818	N/A	N/A	N/A	N/A	N/A
BWX24-720F	2457	720	36	20	18	8@80, 2@40	867	N/A	N/A	N/A	N/A	N/A
BWN24-749F	2555	749	N/A	N/A	N/A	N/A	N/A	32	23.4	16	8@93.6	721
BWX24-760F	2593	760	38	20	19	9@80, 1@40	915	N/A	N/A	N/A	N/A	N/A
BWN24-796F	2715	796	N/A	N/A	N/A	N/A	N/A	34	23.4	17	7@93.6, 3@46.8	766
BWX24-800F	2730	800	40	20	20	10@80	963	N/A	N/A	N/A	N/A	N/A
BWX24-840F	2866	840	42	20	21	9@80, 3@40	1011	N/A	N/A	N/A	N/A	N/A
BWN24-842F	2874	842	N/A	N/A	N/A	N/A	N/A	36	23.4	18	8@93.6, 2@46.8	810
BWX24-880F	3003	880	44	20	22	10@80, 2@40	1059	N/A	N/A	N/A	N/A	N/A
BWX24-900F	3071	900	45	20	22	10@80, 1@60, 1@40	1107	N/A	N/A	N/A	N/A	N/A
BWN24-936F	3194	936	N/A	N/A	N/A	N/A	N/A	40	23.4	20	10@93.6	901
BWN24-1076F	3673	1076	N/A	N/A	N/A	N/A	N/A	46	23.4	23	11@93.6, 1@46.8	1035
BWX30-1000F	3412	1000	50	20	25	1@120, 11@80	1204	N/A	N/A	N/A	N/A	N/A
BWX30-1080F	3685	1080	54	20	27	3@120, 9@80	1300	N/A	N/A	N/A	N/A	N/A
BWX30-1160F	3958	1160	58	20	29	5@120, 7@80	1396	N/A	N/A	N/A	N/A	N/A
BWN30-1170F	3992	1170	N/A	N/A	N/A	N/A	N/A	50	23.4	25	1@140.4, 11@93.6	1126
BWX30-1240F	4231	1240	62	20	31	7@120, 5@80	1493	N/A	N/A	N/A	N/A	N/A
BWN30-1264F	4311	1264	N/A	N/A	N/A	N/A	N/A	54	23.4	27	3@140.4, 9@93.6	1216
BWX30-1320F	4504	1320	66	20	33	9@120, 3@80	1589	N/A	N/A	N/A	N/A	N/A
BWN30-1357F	4631	1357	N/A	N/A	N/A	N/A	N/A	58	23.4	29	5@140.4, 7@93.6	1306
BWX30-1400F	4777	1400	70	20	35	11@120, 1@80	1685	N/A	N/A	N/A	N/A	N/A
BWN30-1451F	4950	1451	N/A	N/A	N/A	N/A	N/A	62	23.4	31	7@140.4, 5@93.6	1396
BWX30-1480F	5050	1480	74	20	37	9@120, 5@80	1781	N/A	N/A	N/A	N/A	N/A
BWX30-1520F	5186	1520	76	20	38	10@120, 4@80	1829	N/A	N/A	N/A	N/A	N/A
BWN30-1544F	5269	1544	N/A	N/A	N/A	N/A	N/A	66	23.4	33	9@140.4, 3@93.6	1486
BWN30-1638F	5589	1638	N/A	N/A	N/A	N/A	N/A	70	23.4	35	11@140.4, 1@93.6	1576
BWN30-1778F	6068	1778	N/A	N/A	N/A	N/A	N/A	76	23.4	38	10@140.4, 4@93.6	1711
BWN30-1825F	6228	1825	N/A	N/A	N/A	N/A	N/A	78	23.4	39	11@140.4, 3@93.6	1756
BWX36-1600F	5459	1600	80	20	40	12@120, 2@80	1926	N/A	N/A	N/A	N/A	N/A
BWX36-1680F	5732	1680	84	20	42	14@120	2022	N/A	N/A	N/A	N/A	N/A
BWX36-1760F	6005	1760	88	20	44	12@120, 4@80	2119	N/A	N/A	N/A	N/A	N/A
BWX36-1840F	6278	1840	92	20	46	14@120, 2@80	2215	N/A	N/A	N/A	N/A	N/A
BWN36-1919F	6547	1919	N/A	N/A	N/A	N/A	N/A	82	23.4	41	13@140.4, 1@93.6	1847
BWX36-1920F	6551	1920	96	20	48	16@120	2311	N/A	N/A	N/A	N/A	N/A
BWX36-2000F	6824	2000	100	20	50	14@120, 4@80	2407	N/A	N/A	N/A	N/A	N/A
BWN36-2059F	7026	2059	N/A	N/A	N/A	N/A	N/A	88	23.4	44	12@140.4, 4@93.6	1981
BWN36-2153F	7345	2153	N/A	N/A	N/A	N/A	N/A	92	23.4	46	14@140.4, 2@93.6	2072
BWN36-2246F	7665	2246	N/A	N/A	N/A	N/A	N/A	96	23.4	48	16@140.4	2161
BWX42-2080F	7097	2080	104	20	52	16@120, 2@80	2503	N/A	N/A	N/A	N/A	N/A
BWX42-2240F	7643	2240	112	20	56	16@120, 4@80	2696	N/A	N/A	N/A	N/A	N/A
BWX42-2400F	8189	2400	120	20	60	20@120	2888	N/A	N/A	N/A	N/A	N/A
BWN42-2527F	8623	2527	N/A	N/A	N/A	N/A	N/A	108	23.4	54	18@140.4	2432
BWX42-2560F	8735	2560	128	20	64	20@120, 2@80	3081	N/A	N/A	N/A	N/A	N/A
BWN42-2714F	9262	2714	N/A	N/A	N/A	N/A	N/A	116	23.4	58	10@140.4, 14@93.6	2612
BWN42-2808F	9581	2808	N/A	N/A	N/A	N/A	N/A	120	23.4	60	12@140.4, 12@93.6	2702
BWN42-3089F	10539	3089	N/A	N/A	N/A	N/A	N/A	132	23.4	66	18@140.4, 6@93.6	2972

ENVISION²®

Envision² Compact 0.75 to 6 Ton

Water Source/Geothermal Heat Pump

WaterFurnace.
Smarter from the Ground Up™

AHRI/ISO 13256-1 PERFORMANCE RATINGS

PSC Motor

AHRI/ASHRAE/ISO 13256-1

English (IP) Units

Model	Capacity Modulation	Flow Rate		Water Loop Heat Pump				Ground Water Heat Pump				Ground Loop Heat Pump			
				Cooling EWT 86°F		Heating EWT 68°F		Cooling EWT 59°F		Heating EWT 50°F		Cooling Full Load 77°F Part Load 68°F		Heating Full Load 32°F Part Load 41°F	
		gpm	cfm	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
009	Single	3.0	350	9,600	14.5	13,200	5.2	10,800	22.2	10,600	4.4	9,800	16.7	7,800	3.4
012	Single	3.5	400	12,300	15.7	14,800	5.1	14,500	25.5	12,300	4.5	13,000	18.0	9,600	3.7
015	Single	4.0	500	14,400	15.9	18,500	5.1	16,700	26.0	15,500	4.5	15,000	18.0	12,000	3.8
018	Single	5.0	600	18,000	15.6	23,000	5.1	21,000	25.5	19,000	4.4	18,500	18.0	14,700	3.8
024	Single	8.0	850	24,800	16.2	29,600	5.0	28,100	24.0	23,900	4.3	26,000	19.2	18,900	3.7
030	Single	8.0	900	27,600	18.2	30,600	5.4	30,800	27.1	24,400	4.7	29,200	21.1	19,800	3.8
036	Single	9.0	1200	34,100	17.6	34,200	5.6	36,300	25.7	28,200	4.7	34,600	19.6	24,100	4.0
042	Single	11.0	1300	40,100	16.6	42,800	5.1	44,600	24.5	34,900	4.3	41,600	18.6	27,500	3.7
048	Single	12.0	1500	46,400	15.5	53,100	4.9	51,600	22.5	43,400	4.2	48,900	17.3	35,000	3.6
060	Single	15.0	1800	61,300	15.4	69,000	5.0	68,700	23.2	55,100	4.4	65,500	18.2	43,200	3.7
070	Single	18.0	2000	67,000	14.5	81,800	4.6	75,900	21.6	66,100	4.0	70,600	17.0	52,000	3.4

3/16/12

Cooling capacities based upon 80.6°F DB, 66.2°F WB entering air temperature
Heating capacities based upon 68°F DB, 59°F WB entering air temperature

ECM and 5-Speed ECM Motor

AHRI/ASHRAE/ISO 13256-1

English (IP) Units

Model	Capacity Modulation	Flow Rate		Water Loop Heat Pump				Ground Water Heat Pump				Ground Loop Heat Pump			
				Cooling EWT 86°F		Heating EWT 68°F		Cooling EWT 59°F		Heating EWT 50°F		Cooling Full Load 77°F Part Load 68°F		Heating Full Load 32°F Part Load 41°F	
		gpm	cfm	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
015	Single	4.0	500	14,400	16.5	18,500	5.3	16,700	27.0	15,500	4.7	15,000	18.8	12,000	4.0
018	Single	5.0	600	18,000	16.5	23,000	5.3	21,000	26.8	19,000	4.7	18,500	19.0	14,700	4.1
024	Single	8.0	800	24,800	17.0	29,600	5.3	28,100	27.5	23,900	4.6	26,000	19.6	18,900	3.8
030	Single	8.0	900	27,800	19.2	30,600	5.7	31,200	29.5	24,400	4.8	29,400	21.9	20,000	4.0
036	Single	9.0	1200	34,900	21.6	34,200	6.0	38,000	30.1	28,200	5.1	35,400	22.4	24,100	4.4
042	Single	11.0	1300	40,800	20.0	42,800	5.7	46,200	29.5	35,000	4.9	42,000	21.8	27,500	4.2
048	Single	12.0	1500	47,300	18.5	53,100	5.4	53,000	26.1	43,400	4.7	49,300	20.1	35,000	3.9
060	Single	15.0	1800	61,300	16.6	69,000	5.3	69,000	24.7	57,000	4.7	65,500	19.2	45,000	4.0
070	Single	18.0	2000	67,000	15.4	81,800	5.0	77,400	23.8	67,000	4.4	70,600	18.0	52,500	3.7
026	Full	8.0	950	26,000	17.3	30,300	5.5	29,000	24.0	25,100	5.0	27,700	20.4	19,500	4.3
	Part	7.0	750	20,000	19.5	22,300	6.4	22,600	32.7	18,300	5.3	22,000	27.9	16,300	4.8
038	Full	9.0	1300	39,000	18.0	40,300	5.4	39,400	24.1	33,600	4.8	40,200	21.0	26,700	4.1
	Part	8.0	1150	28,500	20.3	29,100	6.3	31,500	35.4	24,000	5.1	30,100	30.0	22,000	4.8
049	Full	12.0	1600	50,300	17.1	56,100	5.2	56,200	24.5	46,300	4.6	52,000	20.0	37,400	4.0
	Part	11.0	1400	37,200	19.2	39,800	5.8	41,500	33.0	32,300	4.7	40,600	28.5	30,000	4.6
064	Full	16.0	1800	62,000	16.3	70,600	5.2	70,100	23.9	58,000	4.7	65,100	18.7	47,100	4.0
	Part	14.0	1500	45,000	18.0	50,100	5.8	51,500	29.9	41,300	5.0	50,000	25.9	37,000	4.4
072	Full	18.0	2000	69,000	15.0	81,900	4.8	78,500	22.0	67,500	4.3	71,600	17.0	54,200	3.7
	Part	16.0	1500	52,800	16.0	61,400	5.2	61,000	27.0	49,400	4.4	59,000	23.4	45,000	4.1

3/16/12

Cooling capacities based upon 80.6°F DB, 66.2°F WB entering air temperature
Heating capacities based upon 68°F DB, 59°F WB entering air temperature

BR1022AN 02/15

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ENVISION² COMPACT

Envision² Compact products offer the industry-leading efficiencies of full-size units in a much smaller footprint. The compact cabinet makes this heat pump system the perfect solution for commercial retrofit and boiler/tower applications. Available in a wide selection of capacities (009-072), the Envision² Compact carries many of our most advanced features—including the Aurora generation of controls. Options include a factory-installed 24V motorized on/off water valve option for VFD pumping with automatic internal water flow control; hot gas bypass and reheat; and high-efficiency PSC, 5-Speed ECM, or variable speed ECM motors to fit your efficiency and comfort needs. Envision² Compact units are more than twice as efficient as the ASHRAE 90.1 standard and utilize environmentally friendly R410A refrigerant.

Industry-leading efficiencies in a small footprint for unmatched flexibility in geothermal and boiler/tower installations.

KEY FEATURES

COMPRESSOR: Copeland K-5 Scroll™ or LG rotary (single speed) and Copeland Scroll UltraTech™ (dual capacity) in commercial voltages mounted on a double isolation system.

WATER LINES: Copper FPT waterline connections, securely mounted flush to cabinet corner post.

COAXIAL HEAT EXCHANGER: Oversized and convoluted with copper inner tube (optional cupronickel) and steel outer tube, designed for maximum heat transfer at normal and low water flow rates to minimize pressure drop.

ALUMINUM AIR COIL: An aluminum air coil is featured in all Envision² Compact units to provide exceptional durability and high efficiencies. Added protection is also available with an optional AlumiSeal™ coating.

CABINET: The cabinets utilize a compact form and are constructed of heavy gauge environmentally responsible galvanized steel for maximum corrosion resistance. Units are available with a durable white powder coat finish or unpainted. All interior surfaces are lined with 1/2" thick, foil lined acoustic type fiber insulation, applied in a manner that prevents the introduction of glass fibers into the air stream. Multiple knockouts in various sizes facilitate power and low voltage wiring.

REFRIGERANT CIRCUIT: Units utilize R410A refrigerant in sealed circuits. Metering accomplished with a bi-flow thermostatic expansion valve to deliver optimum flow over a wide range of conditions without troublesome check valves. Four-way solenoid activated reversing valve defaults to heating and is "cool brazed" at the factory.

FILTER RACK/RAIL: Redesigned filter rack includes a standard 1" filter rail with a MERV 4 filter. Options include a 1" or 2" four-sided filter rack suitable for ducted applications, or a 2" filter rail with MERV 13 filters for non-ducted applications.

CONTROLS: Aurora Base Control is standard. Optional Universal Protocol Converter featuring N2, LonWorks, and BACnet compatibility.

BLOWER MOTOR: PSC blower motors provide high efficiency while allowing quiet operation and wide range of airflow selections. Optional 5-Speed ECM and variable speed ECM blower motors are available for improved efficiency and comfort.

FLOW REGULATOR: Optional factory installed internal water flow regulator.

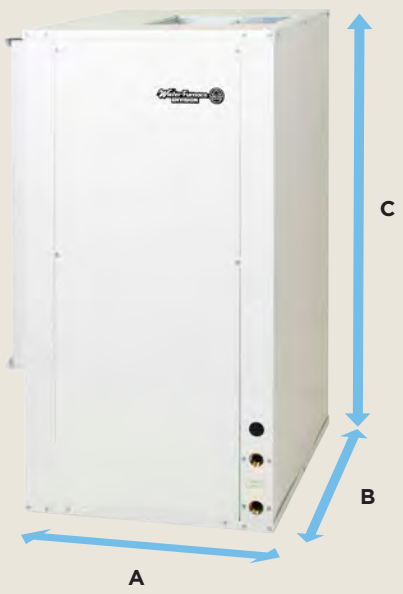
WATER VALVE: Optional factory installed internal 24V on/off 2-way water valve for VFD pumping applications.

HOT WATER GENERATOR: Optional factory installed heat exchanger with field mounted external pump.

ADDITIONAL OPTIONS:

- **Hot Gas Reheat & Bypass (015-072)**
- **460V models with X-13 motor option do not require the additional neutral wire**
- **Sound kits for Quiet Operation**
- **Factory installed disconnect, Phase Guard and IntelliStart soft start**
- **Composite or Stainless Steel drain pans with Secondary drain connections**
- **Extended range coaxial heat exchanger and piping insulation**

ENVISION² COMPACT VERTICAL 0.75 to 6 Ton



Left Return

Model	A	B	C
009 - 012	22.5	22.2	30.2
015 - 018	22.5	26.2	40.2
024 - 030	22.5	26.2	44.2
036 - 038	25.5	31.2	44.2
042 - 049	25.5	31.2	48.2
060 - 072	25.5	31.2	52.2

More than twice as efficient as the ASHRAE 90.1 standard

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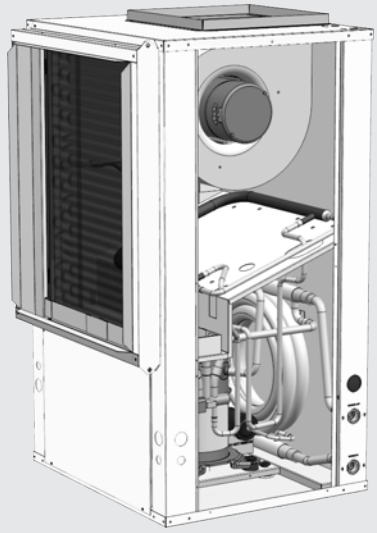
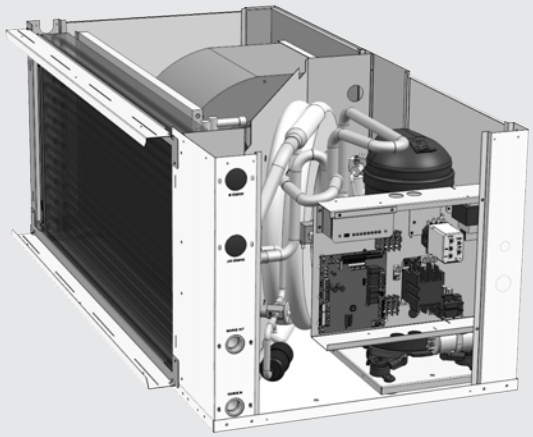
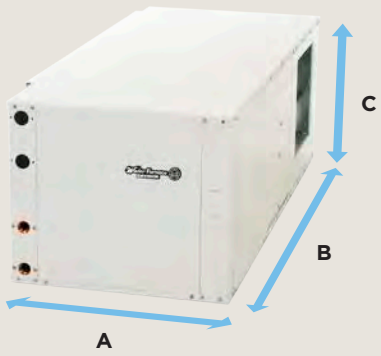


ENVISION² COMPACT HORIZONTAL 0.75 to 6 Ton





Left Return

Model	A	B	C
009 - 012	22.5	35.0	17.2
015 - 018	22.5	42.0	19.2
024 - 030	22.5	45.0	19.2
036 - 038	22.5	48.0	21.2
042 - 049	25.5	53.0	21.2
060-064	25.5	61.0	21.2
070-072	25.5	68.0	21.2