Farnsworth GROUP

Engineers | Architects | Surveyors | Scientists

IGNACIO HIGH SCHOOL

Retro-Commissioning Report_DRAFT 2

November 2024

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Scope of Effort

The purpose of this study is to evaluate the facility to:

1. Assess the condition of the major systems in this building.
2. Identify key issues contributing to de-rate and required maintenance of the facility with recommended corrective action.
3. Support Ignacio School District in documenting present and future needs in regard to maintenance, repair, capital improvements, and energy conservation opportunities.

Component Priority

1. **SAFETY –** Situations or conditions which pose an immediate danger to life, limb, or property, if the deficiency is not corrected. Matches the Health and Safety Hazard operational criteria used in the CM evaluation scoring process.
2. **DAMAGE/WEAR OUT –** Potential for serious damage to the building or the building components if the deficiency is not corrected. Matches the Disruption Operations (Agency Programs) operational criteria used in the CM evaluation scoring process.
3. **CODES/STANDARDS –** Building codes and/or institutional standards were not met during construction or renovation. Condition may or may not represent an urgent situation if deficiency is not corrected.
4. **ENVIRONMENTAL IMPROVEMENTS –** Correctable deficiencies that will improve system operations and increase the comfort level of the building occupants. Matches the causing damage or deterioration operational criteria used in the CM evaluation scoring process.
5. **ENERGY CONSERVATION –** Amelioration or upgrading of the operating systems to reduce energy consumption or increase energy efficiency in the building.

SYSTEM CONDITION RATING	CONDITION RATING
Acceptable or Needs maintenance: No deficiencies noted or additional routine or minor maintenance needed.	A
Major Maintenance: The recurring need to keep in good repair building systems or components which have known maintenance cycles of greater than one year.	B
Remodel: Reworking of spaces in a building.	C
Extensive Renovation: Major replacement, alteration, or upgrading of building systems or components that is necessitated by facility obsolescence.	D
Demolition: Unsatisfactory and cannot be renovated; replace building.	F

Executive Summary

Building Condition Assessment (B-)

Overall, the facility appears to be in fair condition and well maintained. A planned capital improvements process for systems and equipment replacement will help keep the facility in good working condition. Individual systems were analyzed for deficiencies and potential improvements with an emphasis on reducing maintenance requirements. Individual components of these systems for which repairs or replacements have been recommended are recorded in greater detail in this report.

Each component of the major MEP systems in the high school was assessed and given an observed condition rating between "A" and "F". The main concern of Ignacio School District was the disproportional number of repairs required at the water source heat pumps, given the relatively recent installation of the heat pumps. The power distribution, domestic hot water, interior lighting, and snow melt systems were given overall observed condition ratings.

The table below reflects the system conditions observed during the assessment.

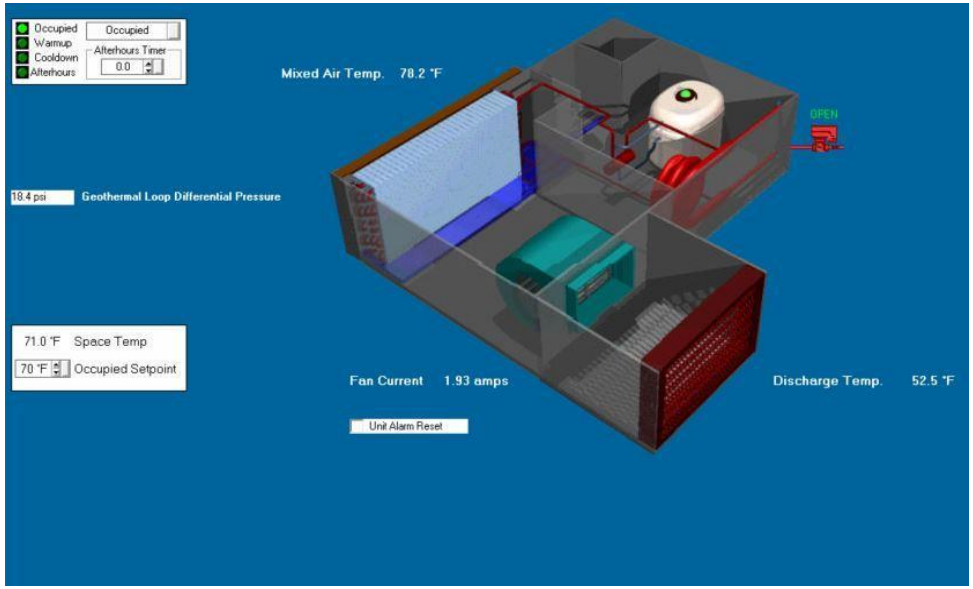
BUILDING	SYSTEM NAME	DISCIPLINE	OBSERVED CONDITION	SYSTEM CONDITION GRADE
High School	Interior Lighting	Electrical	Good	A-
High School	Power Distribution	Electrical	Good	A
High School	Fluid Cooler	Mechanical	Good	A
High School	Heat Pumps	Mechanical	Fair	B-
High School	Heating Hot Water System	Mechanical	Fair	C+
High School	Kitchen Air Systems	Mechanical	Poor	D
High School	Snow Melt	Mechanical	Good	A
High School	Domestic Hot Water	Plumbing	Good	C
High School	DDC_Direct Digital Controls	Controls	Fair	C-

Executive Summary (continued)

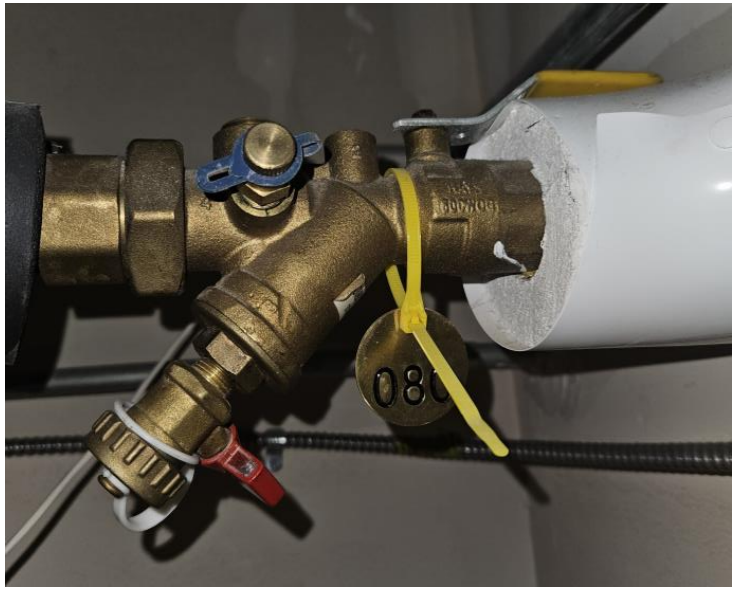
High Priority Recommendations

High priority recommendations pertaining to the High School building recorded include the following:

- Replace defective or removed heat pump control valves with Belimo control valves and actuators.
- Replace all heat pump autoflow valve orifices to meet recommend flow rates as indicated in Appendix A.
- Re-program pump sequence to run pumps in a lead/lag configuration and reset hydronic loop differential pressure setpoint from 17 psi to 6-8psi.
- Clean all strainers in the hydronic system twice per year.
- Implement occupied/unoccupied building schedule in BAS for ERVs. Eliminate night setbacks of space temperature setpoints.
- Add position points for all hydronic heating and cooling 3-way valves on the heating hot water system graphic.
- Add fan and compressor failure/alarm points to all heat pump graphics for diagnostics.
- Distribution pumps are in alarm. Recommend controls contractor investigate and clear alarms.
- Secondary pumps operate in parallel. Recommend re-sequencing to configure pumps to operate in a lead/lag configuration.



Typical Heat Pump graphic



Typical strainer – clean out twice per year

Building Description

Building Overview

The assessed building is a high school that consists of two gymnasiums, locker rooms, classrooms, an auditorium, office space, classrooms, and restrooms. The building is approximately 97,000 square feet. The building was constructed originally in the 1950's and has been renovated multiple times. Multiple additions have been constructed since the original construction.

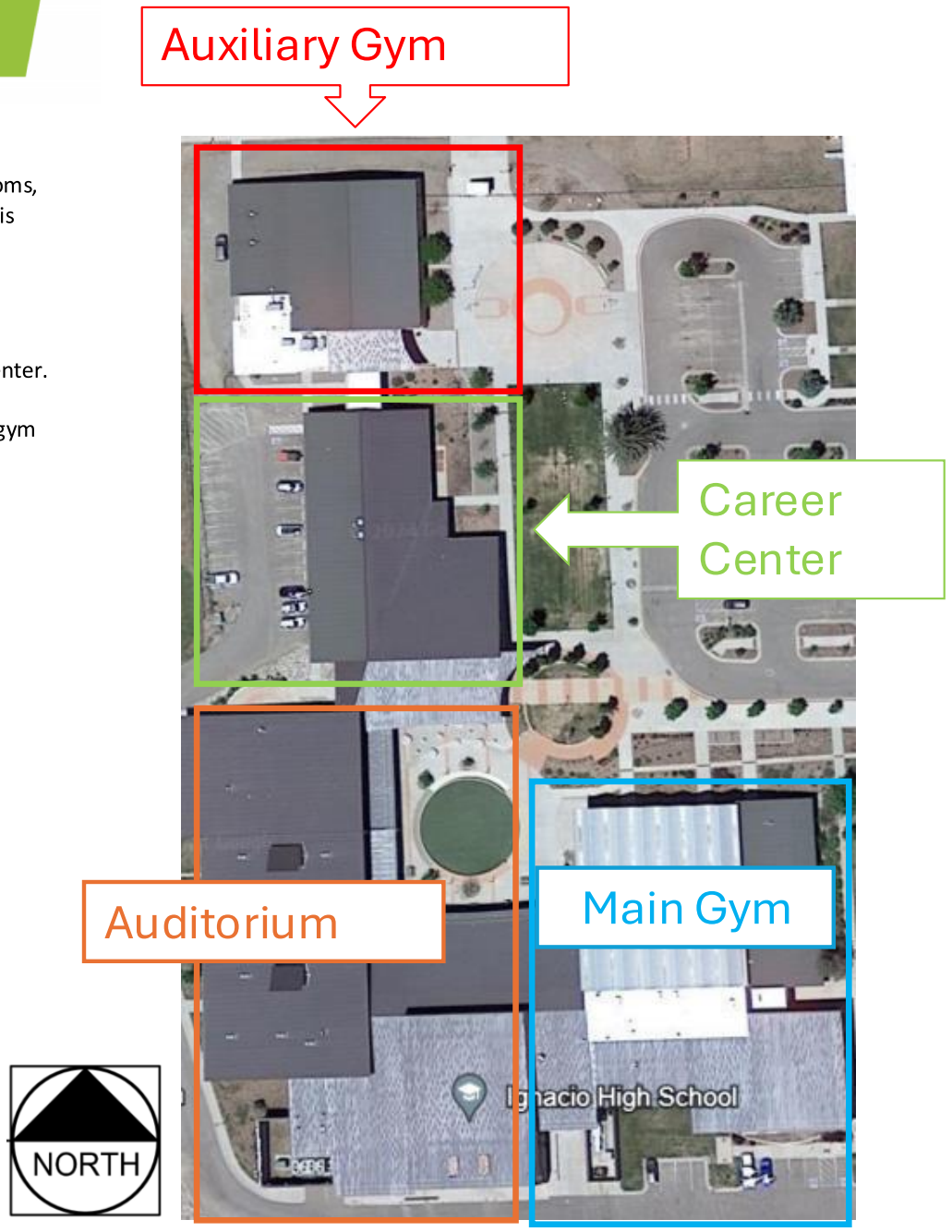
The high school has four distinct areas. The north area consists of an auxiliary gymnasium. Immediately south of the auxiliary gym area is the career center. The southwest area contains main mechanical space, the auditorium, and additional classrooms. The southeast wing of the building contains the main gym and locker rooms.

The HVAC system is a water-source heat pump system served by two natural gas-fired boilers and an evaporative fluid cooler.

The electrical distribution system has two utility transformers, which feed two different service entry switchboards. From there the power steps down through interior transformers to various panels for use throughout the building. There are two electrical meters for the building, whose data were combined for energy consumption analysis.

The domestic hot water system is served by two gas-fired hot water heaters and two circulating pump.

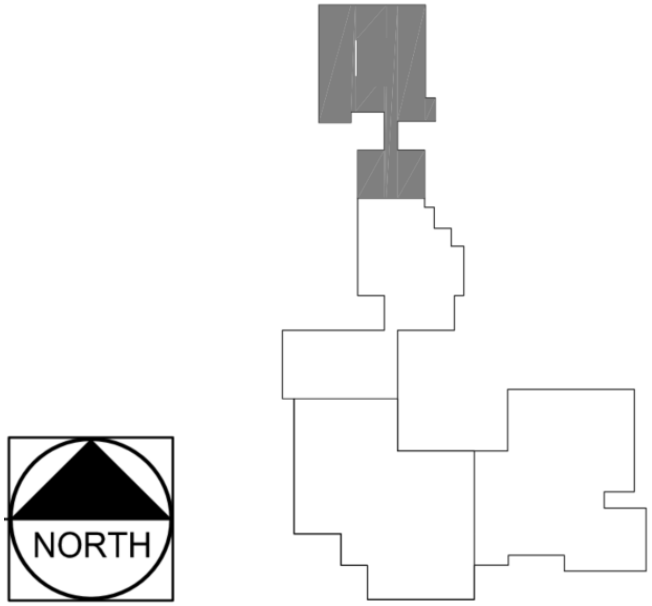
There are two snow melt systems which tie into the heating hot water system.

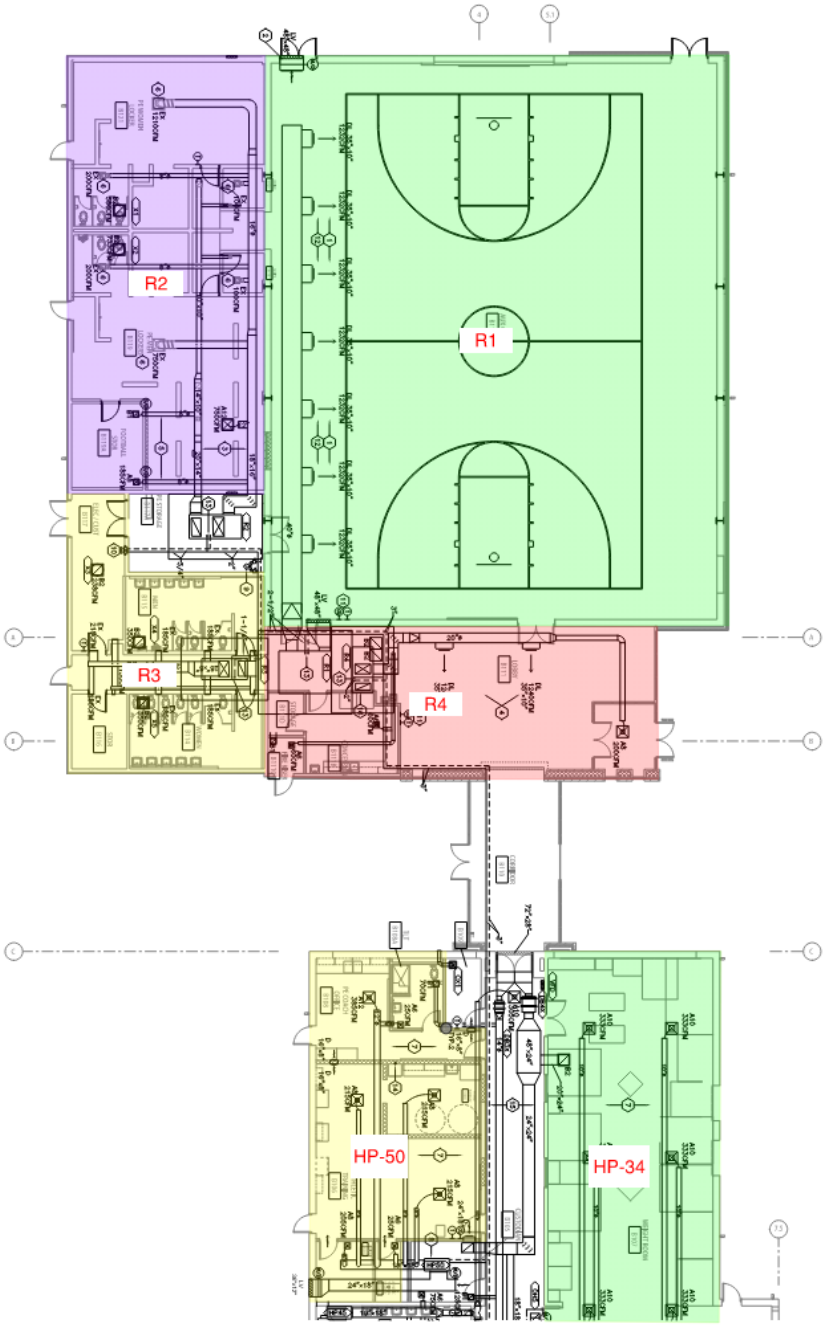


HVAC Zoning Plans

Zoning Plans

The following plans reflect the existing HVAC zones labelled with the heat pumps serving each zone. These plans are intended to be a reference for the maintenance team. This zoning plan reflects the northernmost gymnasium area and surrounding spaces.

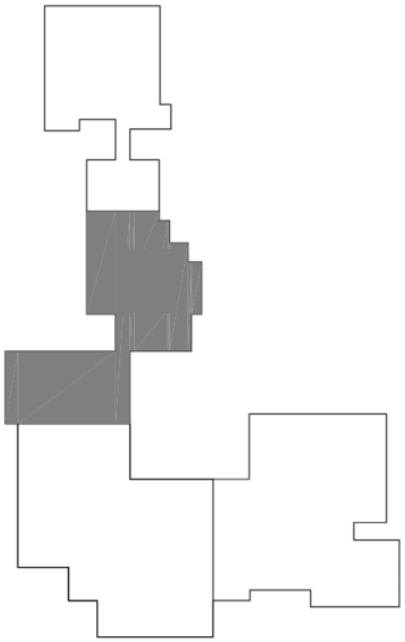


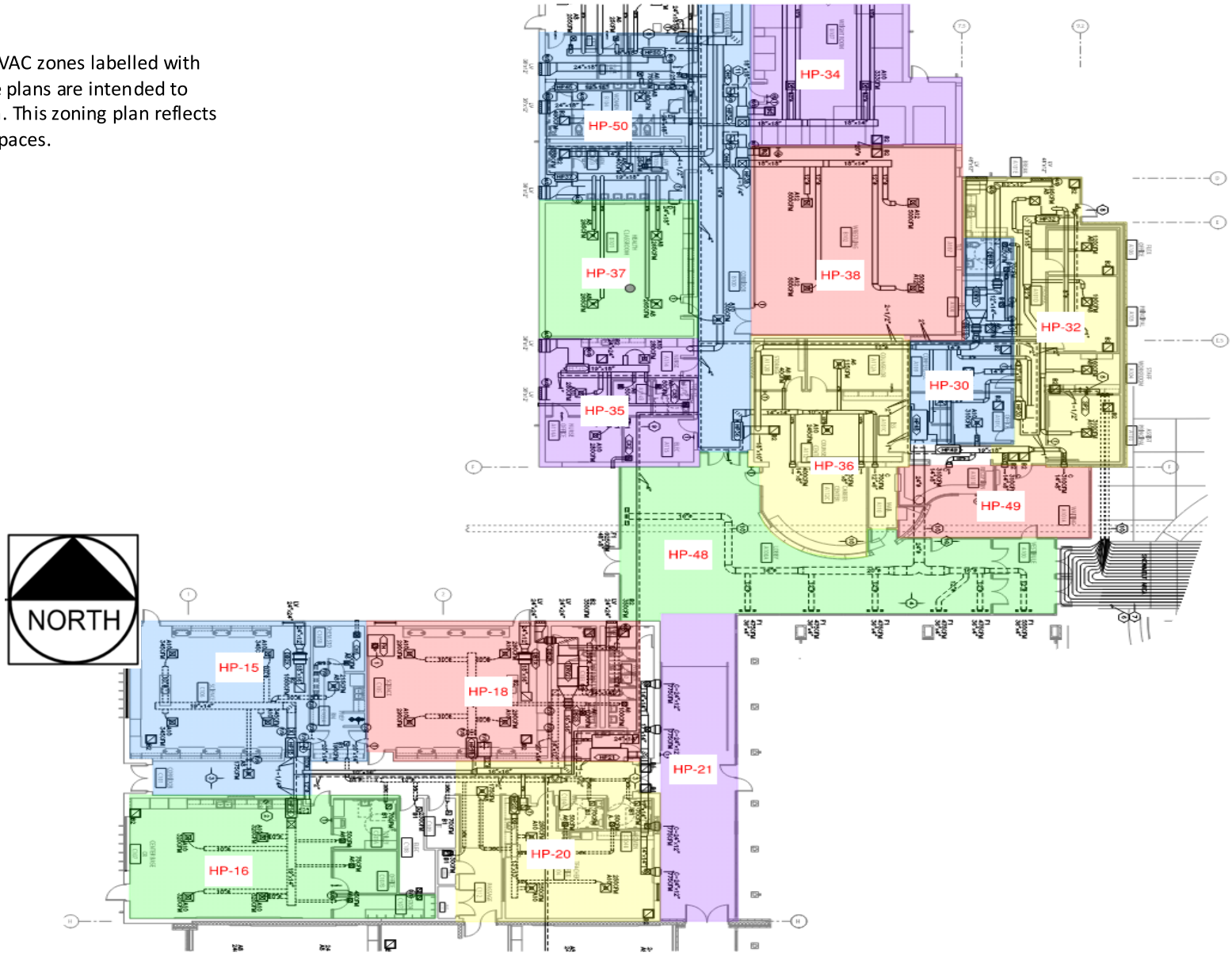


HVAC Zoning Plans

Zoning Plans

The following plans reflect the existing HVAC zones labelled with the heat pumps serving each zone. These plans are intended to be a reference for the maintenance team. This zoning plan reflects the career center area and surrounding spaces.

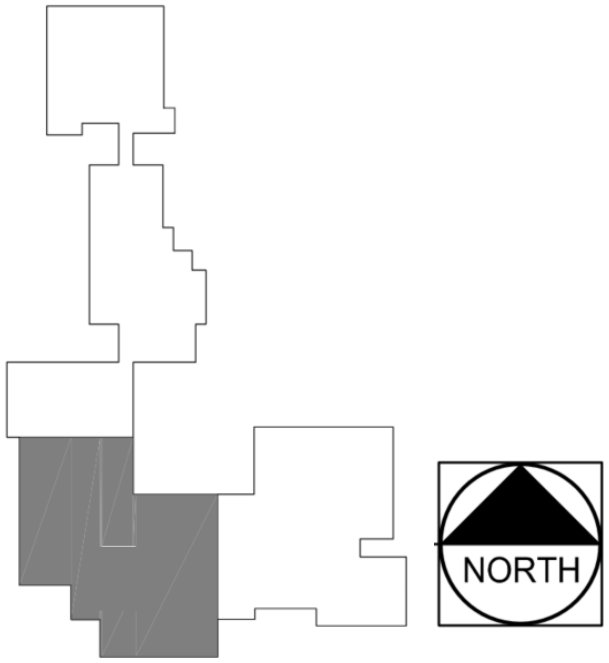




HVAC Zoning Plans

Zoning Plans

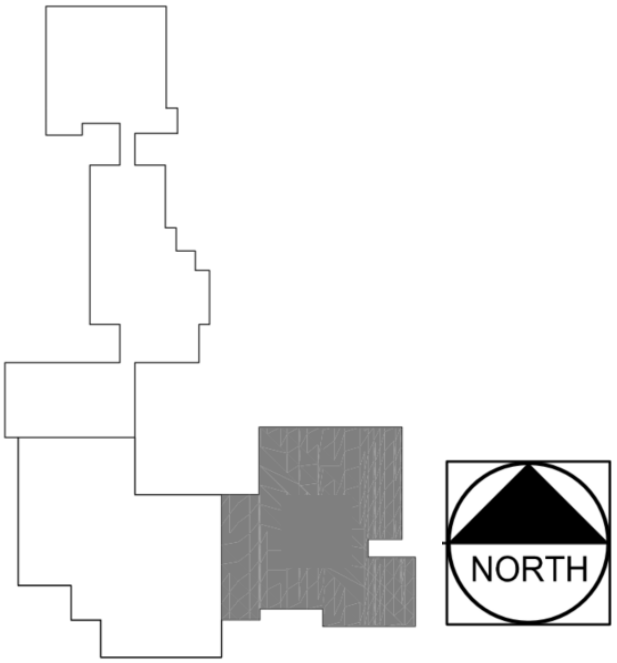
The following plans reflect the existing HVAC zones labelled with the heat pumps serving each zone. These plans are intended to be a reference for the maintenance team. This zoning plan reflects the auditorium area and surrounding spaces.

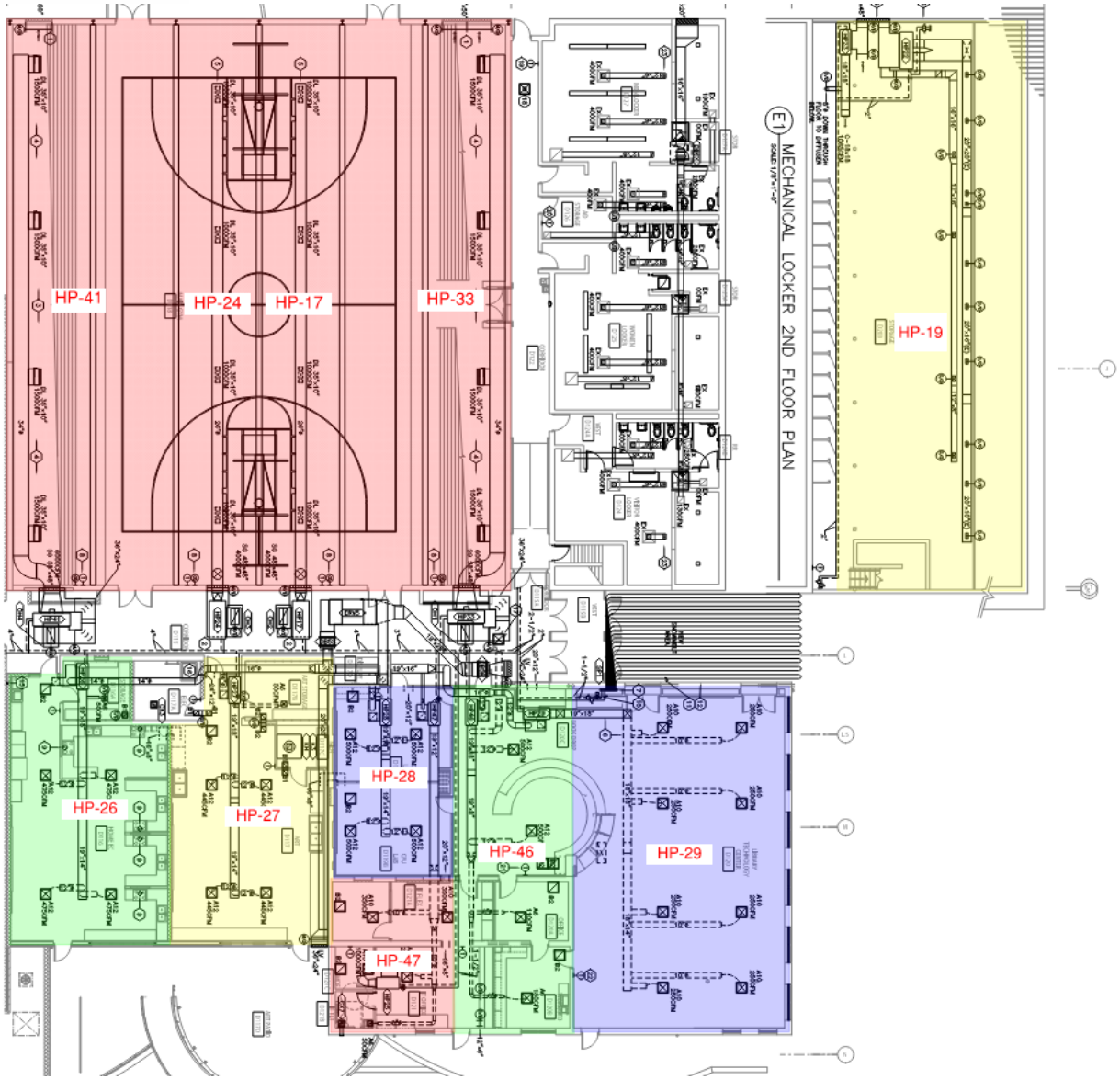


HVAC Zoning Plans

Zoning Plans

The following plans reflect the existing HVAC zones labelled with the heat pumps serving each zone. These plans are intended to be a reference for the maintenance team. This zoning plan reflects the main gymnasium area and surrounding spaces.





HVAC DDC System Assessment

Overall Condition: Fair (C-)

The DDC system is Envision for BACtalk V3.0. V3.0 is the latest available version of this software. The system reflects the ERV's, heat pumps, heating hot water plant, fluid cooler, and multiple exhaust fans. The DDC system is functional but incomplete. The control points that are installed are linked and operational. The BAS does not reflect data from the plumbing or electrical systems.

System Expandability:

The kitchen exhaust fans are not integrated into the BAS. We recommend that all available control points for exhaust fans K1 and K2 be shown on the graphic for the MAU.

Recommended Replacement/Capital Improvement:

The heat pumps a controlled in a "daisy-chain" fashion. This leaves the heat pumps vulnerable to a global failure upon failure of one "master" heat pump. We recommend wiring a redundant controls wire to the last heat loop in the chain to decrease chances of a global failure.

Recommended Repair:

Multiple graphics are missing, or the points are reflected in incorrect pages. Specific details are listed below.

Energy Conservation Opportunity:

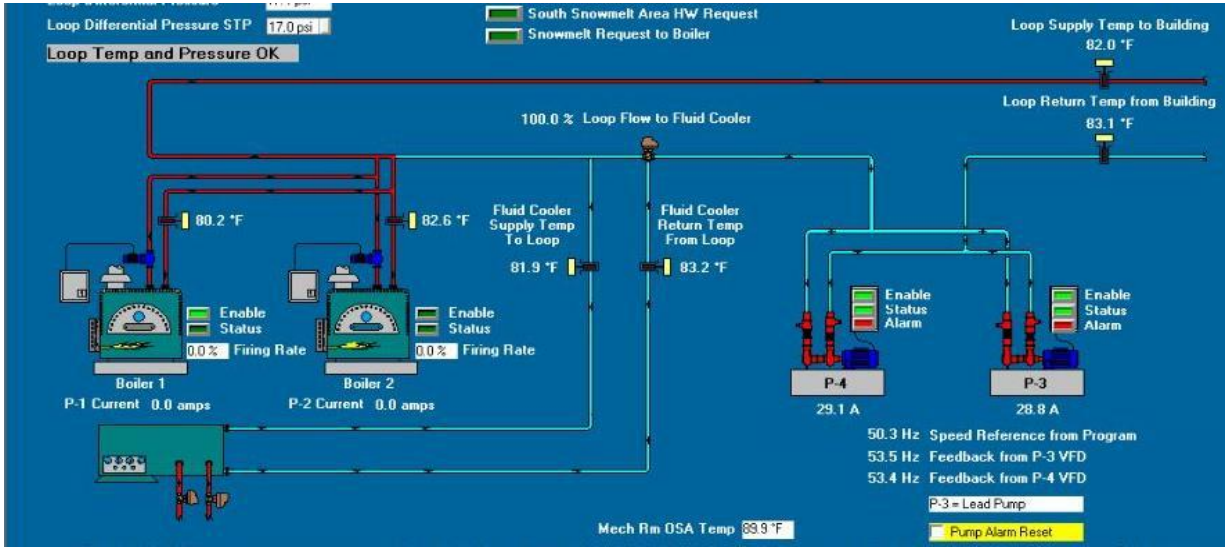
Unoccupied mode is not typically enabled during unoccupied hours. Recommend implementing unoccupied mode for all ERVs. Ventilation is not required during occupied hours. Eliminating all night setbacks with the space temperature setpoints will reduce energy consumption during morning warmup and allow for more stable operations. Aggressive night setbacks can be counterproductive to energy savings as more energy is required to heat the building back up to occupied temperatures than what was saved overnight through setbacks of the space temperature.

NAME	DESCRIPTION	ASSET	PRIORITY	STATUS
CHK-3-3	HS - X-1-5 fans graphic does not reflect a command or status. Recommend adding.	Digital Direct Controls	Codes/Standards	Replacement/Capital Improvement
CHK-3-2	HS - There is no graphic for CX-1, CX-2, DBX-1, DBX-2. Recommend adding graphics for fans.	Digital Direct Controls	Codes/Standards	Repair
CHK-3-1	HS - Exhaust fans are shown on ERV graphics. Recommend adding exhaust fans page.	Digital Direct Controls	Codes/Standards	Replacement/Capital Improvement
CHK-24-3	Recommend adding kitchen range hood exhaust fan and dishwasher exhaust fans to the MAU graphic.	Digital Direct Controls	Codes/Standards	Replacement/Capital Improvement
CHK-11-5	Fan status is reflected on the graphics as an amperage. Recommend on/off status for clarity.	Digital Direct Controls	Codes/Standards	Maintenance

HVAC DDC System Assessment

NAME	DESCRIPTION	ASSET	PRIORITY	STATUS
CHK-7-2	P-3 is regularly in alarm and both pumps 3 and 4 are running in parallel. Recommend implementing a lead/standby pump configuration for redundancy and energy conservation.	Digital Direct Controls	Damage/Wear Out	Energy Conservation Opportunity
CHK-17-2	HS - MAU/Kitchen exhaust fans are not represented on BAS graphics. Recommend integrating standalone kitchen controller with BAS graphics.	Digital Direct Controls	Damage/Wear Out	Replacement/Capital Improvement
CHK-18-3	High School - Appears DB8x and DB7x have never operated. There is also no graphic present at BAS . Appears programming was never completed or functionality tested. Recommend a controls contractor program DBX to operate with building. occupancy or RTU interlock. Also, recommend including a purge mode for DB8x Auditorium exhaust. This would help improve air turnover in the space.	Digital Direct Controls	Damage/Wear Out	Repair
CHK-15-2	High School - R-3: OA damper does not close when oat is less than 35. Programming needs to be corrected.	Digital Direct Controls	Environmental Improvements	Repair
CHK-2-4	Implement unoccupied schedule for all HVAC equipment, including ERV's and heat pumps. Unoccupied space temperature septoints should be set to +-3 degrees F deviation from occupied space temperature setpoints.	DDC_Digital Direct Controls	Energy Conservation Opportunity	Repair

Heating Hot Water and Fluid Cooler System Assessment



Overall Condition: Fair (C+)

The heating hot water plant is located in the mechanical space near the southwest corner of the building. It consists of two 3500 MBH condensing, gas-fired boilers with in-line boiler pumps. Two base-mounted pumps provide heating and cooling water distribution to water source heat pumps. A 250-ton evaporative fluid cooler provides cooling and ties into the distribution system via a three-way valve.

System Expandability:

The system is likely not expandable without the addition of another distribution pump to meet differential pressure setpoint.

To accommodate higher flow rates through heat pumps as recommended in the Appendix, it is recommended that the existing sequence of operation for the secondary pumps be edited to operate in a lead/lag configuration to provide additional capacity and redundancy. Reset the distribution loop differential pressure setpoint to between 6-8 psi.

Recommended Replacement/Capital Improvement:

A scheme check was performed on the heating water and distribution system against drawings provided by Mechanical, Electrical, & Environmental Engineering Inc. dated 12/9/2013. No pressure/temperature ports are installed within the mechanical space. Recommend installing p/t ports at locations provided in design drawings.

Heating Hot Water and Fluid Cooler System Assessment

Recommended Maintenance and Repairs:

Maintain routine boiler inspection schedule provided by manufacturer, check pump belt tensions/alignment, provide pump belt replacement schedule, provide user interface for on-site maintenance control of space set-points, develop consistent nomenclature for service and tracking.

Regularly inspect fluid cooler for water clarity and cleanliness, fan alignment, and spray pump operation.

Energy Conservation Opportunities:

During the assessment, both secondary pumps were operating in unison at approximately 80% capacity. One pump was manually disabled, and the lead pump was able to maintain 17 psi differential pressure setpoint. It is recommended that the sequence of operation for the pumps be adjusted to a lead/standby configuration to provide redundancy and energy savings.

EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION	YEAR INSTALLED
HS-B1	Heating Hot Water System	Mechanical	Good	2014
HS-B2	Heating Hot Water System	Mechanical	Good	2014
HS-P1	Heating Hot Water System	Mechanical	Good	2014
HS-P2	Heating Hot Water System	Mechanical	Good	2014
HS-P3	Heating Hot Water System	Mechanical	Fair	2014
HS-P4	Heating Hot Water System	Mechanical	Fair	2014

Heat Pump System Assessment

Overall Condition: Fair (B-)

The main source for heating and cooling in the high school is handled by 55 water source heat pumps. The heating hot water system and fluid cooler system temper the building loop water that is distributed to each water source heat pump.
The heat pumps are the ClimateMaster Tranquility series water to air heat pumps that include two stage scroll compressors, ECM variable fan motors, and microprocessor controls. Each heat pump maintains the room temperature at each room mounted thermostat by cycling the compressors and control valve. Heat pumps R-1 thru R-5 are the Tranquility Rooftop units that include an economizer section.

A diagrammatic scheme check was performed on more than 25% of the heat pumps as a sample size. The heat pump installations were reviewed against drawings provided by Mechanical, Electrical, & Environmental Engineering Inc. dated 12/9/2013. Several heat pumps that were problematic as identified by the O&M staff were also a focus in the on-site assessment. The equipment conditions were reviewed, known issues documented, and installation conditions reviewed as part of the assessment. The following is a summary and includes recommendations for improvements.

Recommended Maintenance:

Maintain routine filter changes, clean strainers as necessary, and routinely check amperage draws of compressor and fans.

Recommended Repair:

Several heat pumps show signs of corrosion and degradation at coil connections.

OA dampers on R1-R4 were not operational in economizer or minimum ventilation. Recommend temperature controls contractor correct OA damper modulation for minimum operation and during economizer events.

Several HP have failed compressors. On 7/9/24, HP-33 failed resulting in several heat pumps to discharge 90 °F air when in a call for cooling.

Energy Conservation Opportunities:

Correcting the economizer damper operation of the gym units will provide energy savings.

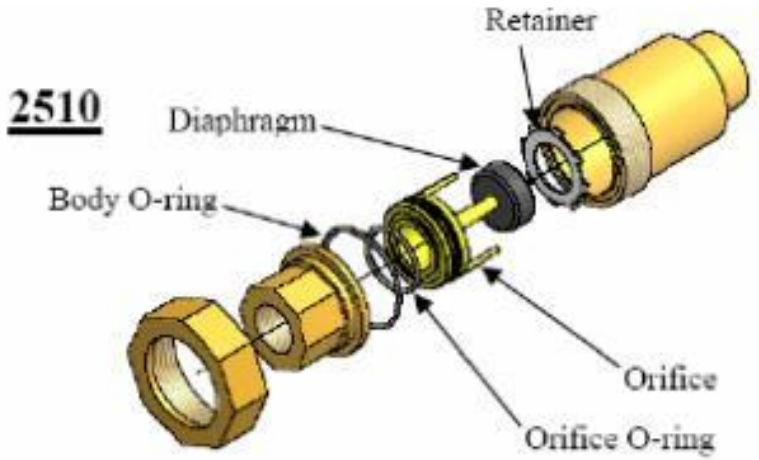
Recommended Replacement/Capital Improvement:

Access to the heat pumps above ceiling is difficult.

The ladder access to mechanical mezzanine for HP-42 and EFs is unsafe. The ladder does not extend above opening and there is no rail around opening. Recommend installing a rail around opening and ladder extension to improve access and for safety.

The scheduled flow rate for the heat pumps appears to be based on the calculated cooling capacity. The installed heat pump in most cases is a nominal size larger than the calculated capacity. Many of the heat pump flow rates are less than 3 gpm/ton. Increasing the flow rate to each individual heat pump will improve reliability, function, and equipment durability.

See figure below. The flow to each heat pump is limited by a Hays autoflow valve. The diaphragm and orifice are set from the factory to the designated flow rate. To increase the flow output of each valve the diaphragm and orifice can be replaced by a new factory set cartridge at the higher flow rate. Farnsworth Group recommends increasing the flow rate to all heat pumps by replacing the flow cartridge to the recommended flow rate listed in the Appendix.



Kitchen Ventilation and Exhaust System Assessment

Overall Condition: Poor (D)

The kitchen hood fan and the make-up air unit are interlocked and enable upon enabling of the gas range in the kitchen. The exhaust fan VFD increases the fan speed when additional burners enable.

Recommended Maintenance and Repair:

Maintain routine filter changes, check belt tensions/alignment, routine cleaning of grease hood and ductwork.

Kitchen exhaust and makeup air system is not displayed or operated through the graphical user interface. Recommend integrating kitchen controls with BAS for operability by maintenance team.

Kitchen pressurization was tested with a manometer. Kitchen exhaust and ventilation air system produce a net positive pressurization of the kitchen if fewer than four gas range burners are on. Recommend re-sequencing exhaust fan to operate at 100% capacity any time range is enabled.

Recommended Replacement/Capital Improvement:

Kitchen MAU is in relatively poor condition. Reznor MAU specified in 2013 design drawings was never installed. Recommend replacing MAU within five years.

EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION
HS-K1	Kitchen Air Systems	Mechanical	Fair
HS-K2	Kitchen Air Systems	Mechanical	Fair
HS-MAU	Kitchen Air Systems	Mechanical	Poor

Energy Recovery Ventilator System Assessment

Overall Condition: Fair (B-)

The energy recovery ventilators provide ventilation air to the distributed water to air heat pumps throughout the school. There are five (5) ERVs with aluminum flat plate heat exchangers, motorized dampers and supply and exhaust fans.

System Expandability:

Limited with current sizing of fans and ductwork.

Recommended Maintenance:

Maintain routine filter changes, check belt tensions/alignment, implement routine cleaning of cotton build-up on intakes, set OA minimums.

Access is a problem to most equipment, causing filter replacements to be labor intensive. Recommend replacing the ERV filters more frequently to lesson filter loading on HPs downstream.

Many of the supply fan and exhaust fans were in alarm due to difficult access.

Recommended Repair:

A rebalance of ERV is recommended to ensure minimum outside air requirements are being met.

Recommended Replacement/Capital Improvement:

The supply and exhaust fan motors are belt driven without a soft start. The O&M staff replace belts often. Recommend providing VFDs for supply and exhaust fans for a soft start function and for future air balancing.

Energy Conservation Opportunities:

The ERVs were not on an occupancy schedule and appear to operate 24/7. Recommend putting ERVs on a schedule to disable during unoccupied hours. This will result in fan energy savings.

EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION
HS-ERV-1	HVAC Air Systems	Mechanical	Fair
HS-ERV-2	HVAC Air Systems	Mechanical	Fair
HS-ERV-3	HVAC Air Systems	Mechanical	Fair
HS-ERV-4	HVAC Air Systems	Mechanical	Fair
HS-ERV-5	HVAC Air Systems	Mechanical	Fair

Domestic Hot Water System Assessment

Overall Condition: Fair (C)

The domestic hot water (DHW) system consists of (2) 200 kbtu/h 97% efficient gas fired water heater with 100 gallons of storage each, installed in 2014. The DHW has Point-Of-Use thermostatic mixing valves set at 105 deg F for non-kitchen plumbing fixtures, cold water at 50 deg F and hot water at 140 deg F. Recirculation of the 140 deg F and 105 deg F system is accomplished through a DHW circulator controlled by an aquastat.

Note: distribution system is provided with Circuit Setters through-out.

Recommended Repair:

A test to run hot water from a fixture furthest from the domestic hot water heater failed. Shower water in the boys locker room did not heat up after two minutes of continual running. Circuit setters in other areas of the building may be reset in order to allow for domestic hot water to flow to these fixtures. Further investigation will be conducted upon a follow-up visit to determine if there is a cross-connection between domestic hot and cold water.

EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION	YEAR INSTALLED
HS-WH1	Domestic Hot Water	Plumbing	Good	2014
HS-WH2	Domestic Hot Water	Plumbing	Good	2014
HS-RP	Domestic Hot Water	Plumbing	Good	2014

Snow Melt System Assessment

Overall Condition: Good (A)

There are two snow melt systems in the building; one which serves the east entrance and one which serves the south entrance. Both snow melt systems consist of two (2) 1/8 hp pumps, a flat plate heat exchanger, a glycol feeder, an expansion tank, and piping accessories. The snow melt piping manifolds are downstream of the in-line pumps. The supply and return piping is tied into the heating hot water mains. The snow melt temperature sensors are located within the concrete slabs and enable the snow melt systems when the slab temperature is below 35 deg F.

Recommended Maintenance:

Periodic inspection of glycol levels within the glycol feeder tanks will mitigate reduction in glycol within the heating hot water system.

Electrical Distribution and Lighting System Assessment

Overall Condition: Good (A-)

The electrical distribution system has 2 utility transformers, which feed two different service entry switchboards, one is 600 amp and the other is 2,000 amp. The voltage of the switchboards are both 480Y277V. The 480/277V services larger mechanical and plumbing systems and the general lighting loads. The distribution system also uses 480V-208Y/120V step down transformers, feeding multiple interior panels. The 208V panels are used for the small mechanical and plumbing loads, task lighting and receptacle loads.

System expandability:

There is approximately 500 amps of load which may be served by a future photovoltaic array.

Recommended Maintenance:

We recommend that the electrical panels be thermally scanned and that all feeders be re-torqued.

Perform routine electrical maintenance on all disconnects check movement of disconnects as lubricate/exercise as needed, tighten all conductors which land on lugs - entering and exiting the disconnects.

Test batteries of all interior and exterior emergency fixtures.

Recommended Replacement/Capital Improvement:

Add a surge protection device to protect the building from outages during severe lighting storms.

Recommended Repair:

Occupancy sensor in classroom C129 is not working. There are no indicators lights on the sensor in the ceiling. Manual switches in the space are functional. Recommend the occupancy sensor be replaced.

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-15-5	Ladder access to mechanical mezzanine for HS-HP-42, and EFs is unsafe. Ladder needs to be lengthened with a safety hatch.	HS-HP42	HVAC_Air Systems_HS	Ignacio High School	Safety	Replacement/ Capital Improvement
CHK-13-2	Water temperature in the showers by the main gym remains cold after 2 minutes. According to the client, the water never heats up. It is recommended that the issue be further investigated.	Domestic Hot Water	PLBG_Domestic Hot Water_HS	Ignacio High School	Damage/Wear Out	Maintenance
CHK-12-1	Occupancy sensor in classroom C129 is not working. There are no light indicators on the sensor on the ceiling. However, they can be manually turned on at both zones. Recommend the sensor be replaced.	Interior Lighting	ELEC_Interior Lighting_HS	Ignacio High School	Damage/Wear Out	Repair
CHK-17-1	Scheduled Reznor MAU never installed. Greasemaster MAU installed is in fair to poor condition and operable. Recommend replacement of MAU and interlocking with kitchen hood within 5 years.	HS-MAU	HVAC_Kitchen Air Systems_HS	Ignacio High School	Damage/Wear Out	Replacement/ Capital Improvement
CHK-15-6	HP-43: some signs of coil piping corrosion.	HS-HP43	HVAC_Air Systems_HS	Ignacio High School	Damage/Wear Out	Repair
CHK-18-2	Observed HS DB2X has a broken fan belt. This is the only DBX that is belt drive all others are direct drive.	HS-DB2X	HVAC_Air Systems_HS	Ignacio High School	Damage/Wear Out	Maintenance
CHK-18-1	ERVs HS: Fan belts are showing signs of wear, from start/stop. Recommend adding a VFD for soft start purposes to increase fan motor longevity and reduce O&M hours to replace belts.	HVAC Air Systems	HVAC_Air Systems_HS	Ignacio High School	Damage/Wear Out	Replacement/ Capital Improvement

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-15-4	HS HP-20: has a failed compressor. Recommend replacing.	HS-HP20	HVAC_Air Systems_HS	Ignacio High School	Damage/ Wear Out	Repair
CHK-15-3	HP-10: showing signs of corrosion on coil inlet and outlet. Recommend replacing piping before failure.	HS-HP10	HVAC_Air Systems_HS	Ignacio High School	Damage/ Wear Out	Repair
CHK-15-1	R-3: Observed compressors are enabled, HP is in cooling mode but was discharging 74 deg. Unit was in a fault.	HS-R3	HVAC_Air Systems_HS	Ignacio High School	Damage/ Wear Out	Repair
CHK-15-10	During HP-33-unit failure, HP-41 called for 100% cooling, but discharge air temperature was between 90- and 130-degrees F.	HS-HP41	HVAC_Air Systems_HS	Ignacio High School	Environmental Improvements	Repair
CHK-15-9	During HP-33-unit failure, HP-24 called for 100% cooling, but discharge air temperature was between 90- and 130-degrees F.	HS-HP24	HVAC_Air Systems_HS	Ignacio High School	Environmental Improvements	Repair
CHK-15-8	During HP-33-unit failure, HP-17 called for 100% cooling, but discharge air temperature was between 90- and 130-degrees F.	HS-HP17	HVAC_Air Systems_HS	Ignacio High School	Environmental Improvements	Repair
CHK-15-7	On 7/9/2024, HP-33 failed. Space temperature in the main gym was approximately 90 degrees F. Unit was nonresponsive and requires repair by Farmington Heating and Cooling.	HS-HP33	HVAC_Air Systems_HS	Ignacio High School	Environmental Improvements	Repair
CHK-6-2	Fixture at furthest point of building from Hot Water Source is taking too long to produce warm/hot water. Test hot water at fixture furthest from DHW heater. Recommend further investigation during follow-up visit to determine whether re-balancing of system may produce hot water at the showers, or if there is a cross-connection.	Domestic Hot Water	PLBG_Domestic Hot Water_HS	Ignacio High School	Environmental Improvements	Repair

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-14-5	Hydronic piping installation in supply side of P-4 is inefficient. Recommend piping supply side straight vertical and tapping into hydronic supply main.	Heating Hot Water System	HVAC_Heating Hot Water System_HS	Ignacio High School	Energy Conservation	Replacement/ Capital Improvement
CHK-14-4	HS - No pressure/temperature ports are installed at secondary pump inlets and outlets. Recommend adding P/T ports per diagram A1/M501.	Heating Hot Water System	HVAC_Heating Hot Water System_HS	Ignacio High School	Codes/ Standards	Replacement/ Capital Improvement
CHK-14-1	Manual air vents are not installed within the mechanical space. Recommend installing air vents per detail A1/M501.	Heating Hot Water System	HVAC_Heating Hot Water System_HS	Ignacio High School	Codes/ Standards	Replacement/ Capital Improvement

Energy Consumption Summary

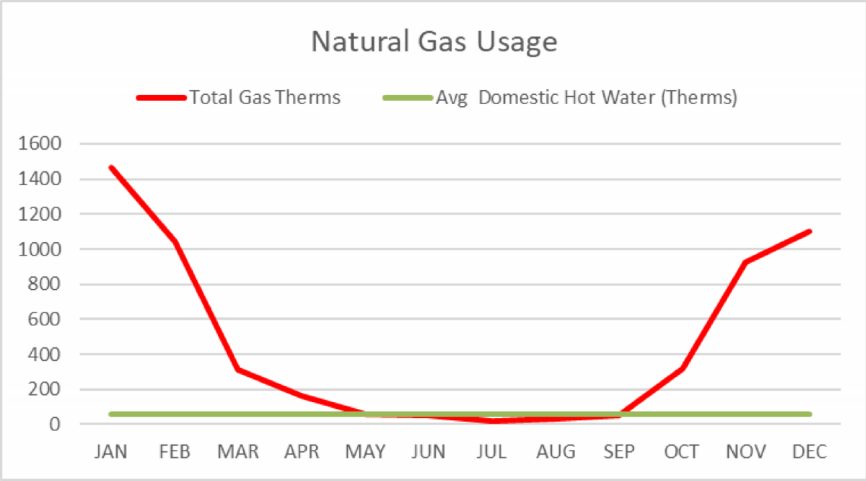
Energy Consumption Grade: B

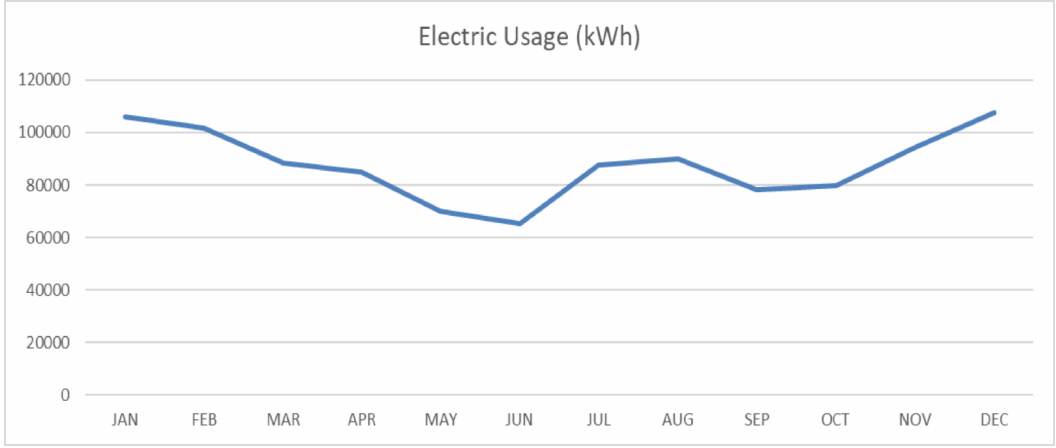
Overall energy consumption at the HS exceeds expectations, with a site EUI of approximately 43 kbtu/sf/yr over the last (2) 12-month periods. A typical similar school could be expected to have a site EUI of 62 kbtu/sf/yr according to Energy Star. Overall energy cost at this facility is slightly better than average at $1.23/sf/yr over the last two years.

The average electric purchase rate over the last three years is $0.1085/kWh, which meets expectations. Electricity is steadily trending more expensive with the last 12 months: averaging $0.115/kWh. We recommend projecting a blended rate of $0.115/kWh, with a 3% per year escalation. Electricity consumption peaks in the winter and is lower in the summer months when school is not in session. This is a typical trend for electricity consumption within a school.

The average gas rate over the last three years is $0.94/therm, though for the last 12 months the rate has been $0.925/therm and trending downward. Since September of last year, the cost of natural gas has averaged $0.405/therm. Our observations have been that gas prices have been falling precipitously across multiple markets. Conservatively, we recommend projecting a natural gas purchase rate of $0.925/therm. Natural gas only consists of approximately 6% of the annual energy consumption and 3% of the annual energy cost in the high school building.

	IGNACIO HS BUILDING	BENCHMARK FACILITY
Natural Gas Usage (kBtu/Year)	555,135	2,827,008
Natural Gas Cost ($/Year)	$5,222	$26,592
Natural Gas EUI (kBtu/SF/Year)	6	29
Natural Gas ECI ($/SF/Year)	$0.05	$0.27
Natural Gas blended rate ($/therm)	$0.9406	-
Electric Usage (kBtu/Year)	3,593,336	3,175,132
Electric Cost ($/Year)	$114,077	$100,771
Electrical EUI (kBtu/SF/Year)	37	32.7
Electrical ECI ($/SF/Year)	$1.17	$1.04
Electrical blended rate ($/kwh)	$0.1083	-
Combined EUI (kBtu/SF/Year)	43	62
Combined Energy Cost	$119,299	$127,363
Combined ECI ($/SF/Year)	$1.23	$1.31





Appendix

Recommended heat pump flow rates

The following table reflects the designed flow rates through the heat pumps and the increased flow rates recommended by FGI. The recommended flow rate is approximately 3 gpm/ton of cooling.

UNIT	MODEL	INSTALLED COOLING MBH	INSTALLED NOMINAL TONNAGE	INSTALLED GPM/TON	DESIGN COOLING MBH	DESIGN NOMINAL TONNAGE	DESIGN/ INSTALLED GPM	DESIGN GPM/TON	GPM/TON DEFICIENCY	RECOMMENDED FLOW RATE
HP 01	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 02	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 03	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 04	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 05	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 06	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 07	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 08	TTH026	26	2.2	2.08	12.0	1.0	4.5	4.5	-2.4	**6.5**
HP 09	TTH064	64	5.3	2.34	38.0	3.2	12.5	3.9	-1.6	**16.0**
HP 10	TTHO49	49	4.1	2.45	45.0	3.8	10.0	2.7	-0.2	**12.3**
HP 11	TTH038	38	3.2	2.37	30.0	2.5	7.5	3.0	-0.6	**9.5**
HP 12	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP 13	TTH049	49	4.1	2.45	43.0	3.6	10.0	2.8	-0.3	**12.3**
HP 14	TTH038	38	3.2	2.37	33.0	2.8	7.5	2.7	-0.4	**9.5**
HP 15	TTH064	64	5.3	2.34	58.0	4.8	12.5	2.6	-0.2	**16.0**
HP 16	TTH049	49	4.1	2.45	35.0	2.9	10.0	3.4	-1.0	**12.3**
HP 17	TCH120	120	10.0	2.25	107.0	8.9	22.5	2.5	-0.3	**30.0**
HP 18	TTH049	49	4.1	2.45	40.0	3.3	10.0	3.0	-0.6	**12.3**
HP 19	TTH026	26	2.2	2.08	15.0	1.3	4.5	3.6	-1.5	**6.5**
HP20	TTH038	38	3.2	2.37	18.0	1.5	7.5	5.0	-2.6	**9.5**
HP21	TCH072	72	6.0	2.50	61.0	5.1	15.0	3.0	-0.5	**18.0**
HP22	TCV160	160	13.3	2.55	96.0	8.0	34.0	4.3	-1.7	**40.0**
HP23	TTH049	49	4.1	2.45	42.0	3.5	10.0	2.9	-0.4	**12.3**
HP24	TCH120	120	10.0	2.25	107.0	8.9	22.5	2.5	-0.3	**30.0**
HP25	TTH038	38	3.2	2.37	33.0	2.8	7.5	2.7	-0.4	**9.5**

Appendix

UNIT	MODEL	INSTALLED COOLING MBH	INSTALLED NOMINAL TONNAGE	INSTALLED GPM/TON	DESIGN COOLING MBH	DESIGN NOMINAL TONNAGE	DESIGN/ INSTALLED GPM	DESIGN GPM/TON	GPM/TON DEFICIENCY	RECOMMENDED FLOW RATE
HP26	TTH064	64	5.3	2.34	48.0	4.0	12.5	3.1	-0.8	**16.0**
HP27	TTH064	64	5.3	2.34	47.0	3.9	12.5	3.2	-0.8	**16.0**
HP28	TTH064	64	5.3	2.34	45.0	3.8	12.5	3.3	-1.0	**16.0**
HP29	TTH064	64	5.3	2.34	45.0	3.8	12.5	3.3	-1.0	**16.0**
HP30	TTH038	38	3.2	2.37	18.0	1.5	7.5	5.0	-2.6	**9.5**
HP31	TTH064	64	5.3	2.34	38.0	3.2	12.5	3.9	-1.6	**16.0**
HP32	TTHO38	38	3.2	2.37	18.0	1.5	7.5	5.0	-2.6	**9.5**
HP33	TCV240	240	20.0	2.50	215.0	17.9	50.0	2.8	-0.3	**60.0**
HP34	TTV064	64	5.3	2.34	55.0	4.6	12.5	2.7	-0.4	**16.0**
HP35	TTH038	38	3.2	2.37	18.0	1.5	7.5	5.0	-2.6	**9.5**
HP36	TTH038	38	3.2	2.37	32.0	2.7	7.5	2.8	-0.4	**9.5**
HP37	TTH038	38	3.2	2.37	29.0	2.4	7.5	3.1	-0.7	**9.5**
HP38	TTV064	64	5.3	2.34	34.0	2.8	12.5	4.4	-2.1	**16.0**
HP39	TTH064	64	5.3	2.34	38.0	3.2	12.5	3.9	-1.6	**16.0**
HP40	TTH064	64	5.3	2.34	47.0	3.9	12.5	3.2	-0.8	**16.0**
HP41	TCV240	240	20.0	2.50	215.0	17.9	50.0	2.8	-0.3	**60.0**
HP42	TCV160	160	13.3	2.55	166.0	13.8	34.0	2.5	0.1	**40.0**
HP43	TCV240	240	20.0	2.50	207.0	17.3	50.0	2.9	-0.4	**60.0**
HP44	TTH064	64	5.3	2.34	49.0	4.1	12.5	3.1	-0.7	**16.0**
HP45	TTH038	38	3.2	2.37	29.0	2.4	7.5	3.1	-0.7	**9.5**
HP46	TTH064	64	5.3	2.34	49.0	4.1	12.5	3.1	-0.7	**16.0**
HP47	TTH038	38	3.2	2.37	23.0	1.9	7.5	3.9	-1.5	**9.5**
HP48	TCH096	96	8.0	2.50	80.0	6.7	20.0	3.0	-0.5	**24.0**
HP49	TTH038	38	3.2	2.37	26.0	2.2	7.5	3.5	-1.1	**9.5**
HP50	TTH038	38	3.2	2.37	33.0	2.8	7.5	2.7	-0.4	**9.5**
HP51	TTH038	38	3.2	2.37	33.0	2.8	7.5	2.7	-0.4	**9.5**
R-1	TRE 240	240	20.0	2.50	210.0	17.5	50.0	2.9	-0.4	**60.0**
R-2	TRE 120	120	10.0	2.50	78.0	6.5	25.0	3.8	-1.3	**30.0**
R-3	TRE 60	60	5.0	2.50	38.0	3.2	12.5	3.9	-1.4	**15.0**
R-4	TRE 72	72	6.0	3.33	59.0	4.9	20.0	4.1	-0.7	**18.0**