Farnsworth GROUP

Engineers | Architects | Surveyors | Scientists

IGNACIO ELEMENTARY SCHOOL

Retro-Commissioning Report_DRAFT 2

November 2024

Table of Contents

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 regarding 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 components 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 system.	F

Executive Summary

Building Condition Assessment (C+)

Overall, the facility appears to be in generally good condition and well maintained, despite consistent maintenance and repair requirements for the heat pumps and poor kitchen ventilation. 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 elementary 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 mechanical systems, power distribution, domestic hot water, interior lighting, and snow melt systems were given overall observed condition ratings.

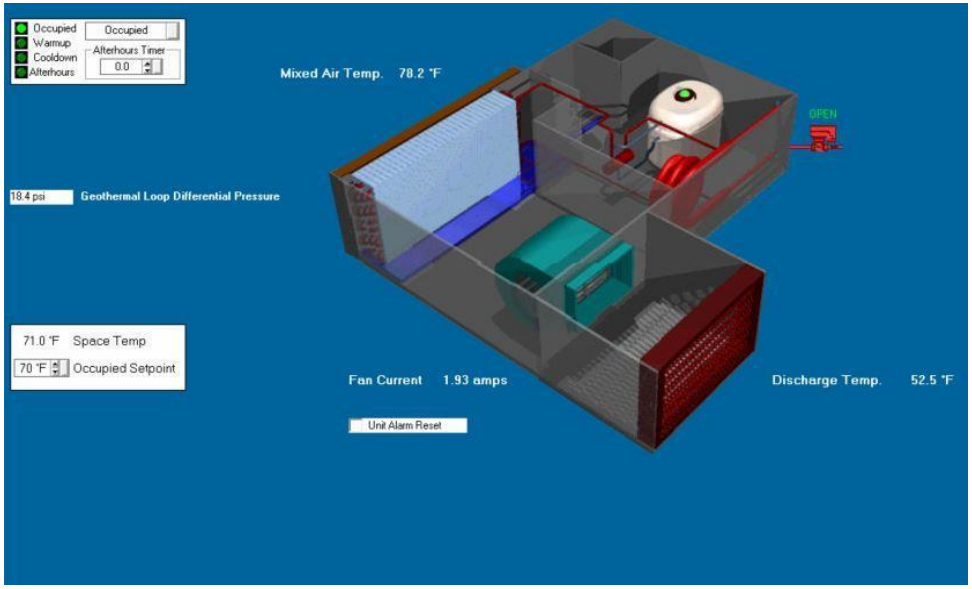
The table below reflects the system conditions observed during the assessment.

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

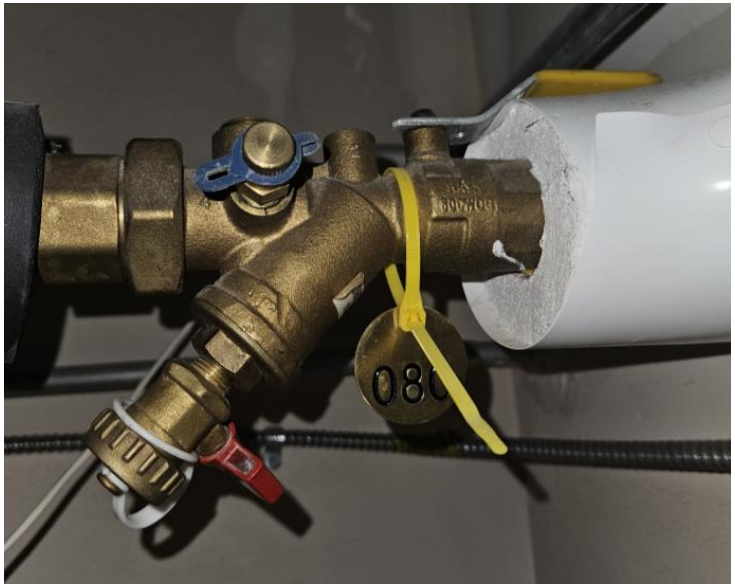
High Priority Recommendations:

High priority recommendations pertaining to the Elementary 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.
- Replace existing distribution pumps with Bell and Gossett Model 1510-3AC pumps, 6" impeller, or equivalent pump selection. Operate pumps at 3500 RPM for 515 gpm and 100 ft hd.
- 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 an elementary school that consists of a gymnasium, a cafeteria, K-5th grade classrooms, office space, and restrooms. The building is approximately 69,000 square feet. The building was constructed originally in 2014.

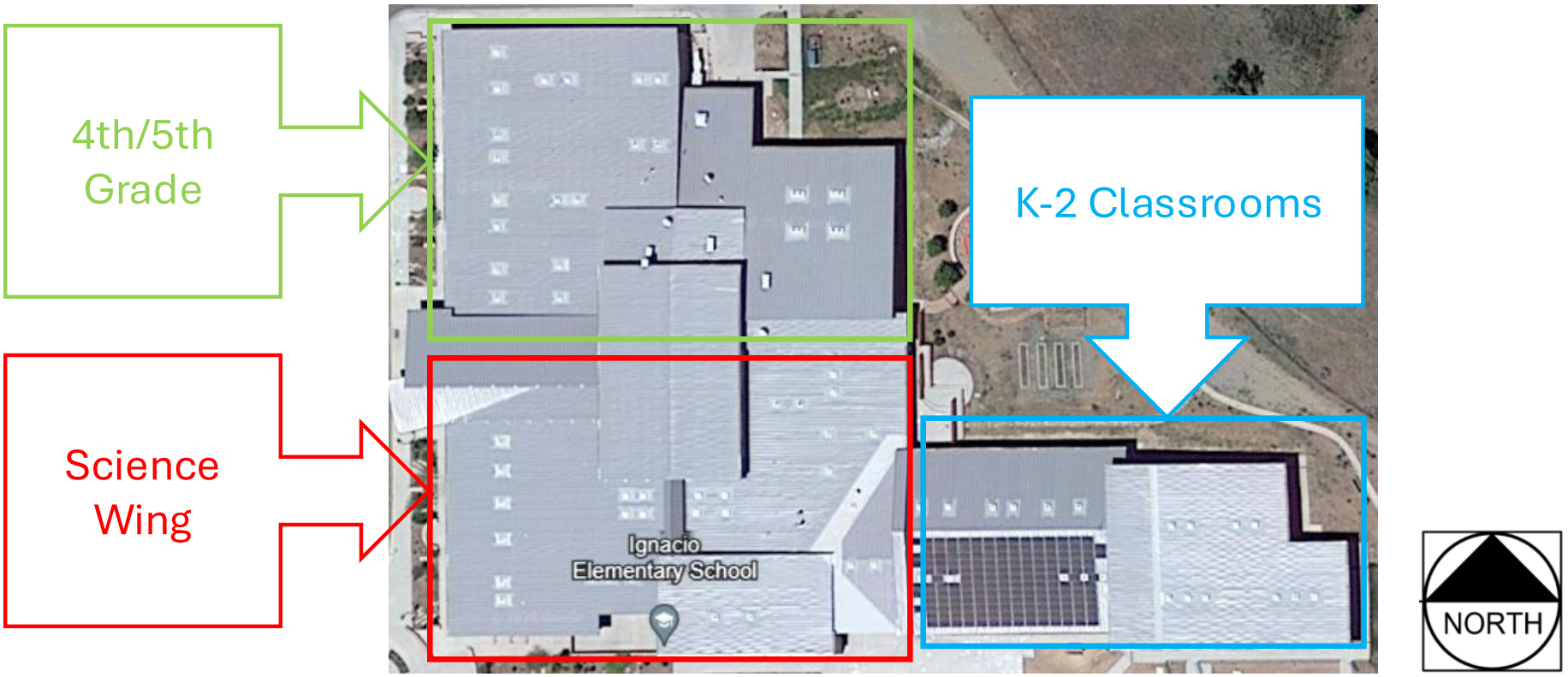
The school has three distinct areas. The north area consists of the 4th/5th grade classroom wing and the cafeteria space. Immediately south this area is the science wing of the building. The southeast area contains Kindergarten through 2nd grade classrooms.

The HVAC system is a ground-source heat pump system with an auxiliary natural gas-fired boiler.

The electrical distribution system consists of a utility transformer, which feeds a 1,200 Amp service entry switchboard. From there the power steps down through interior transformers to various panels for use throughout the building. The building also includes a photovoltaic array, inverters and separate disconnects.

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

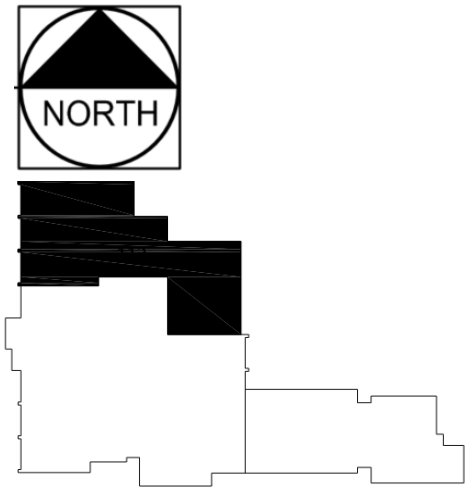
There are two snow melt systems which tie into the heating hot water system.

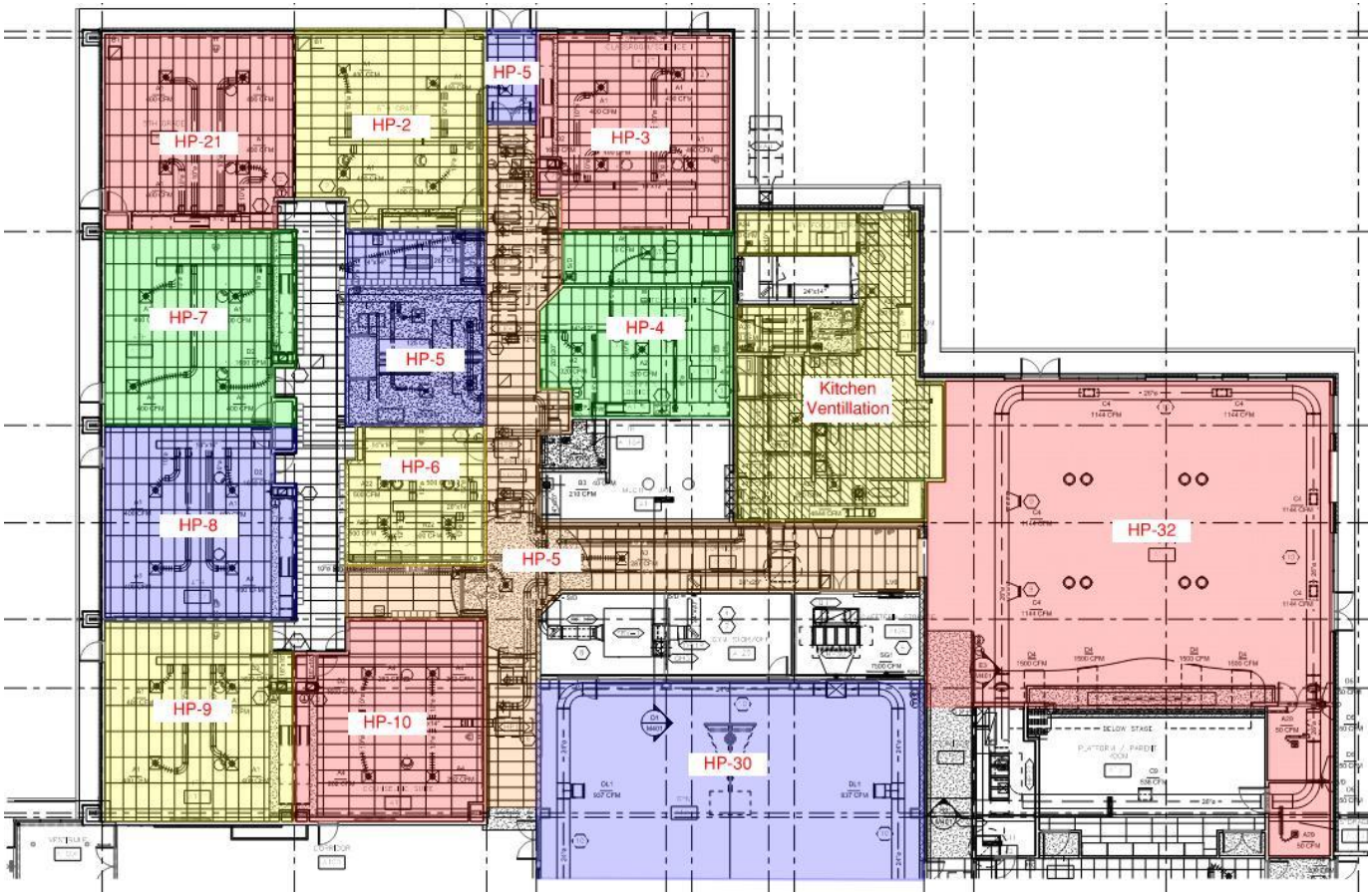


HVAC Zoning Plans

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 4th/5th grade wing of the building.

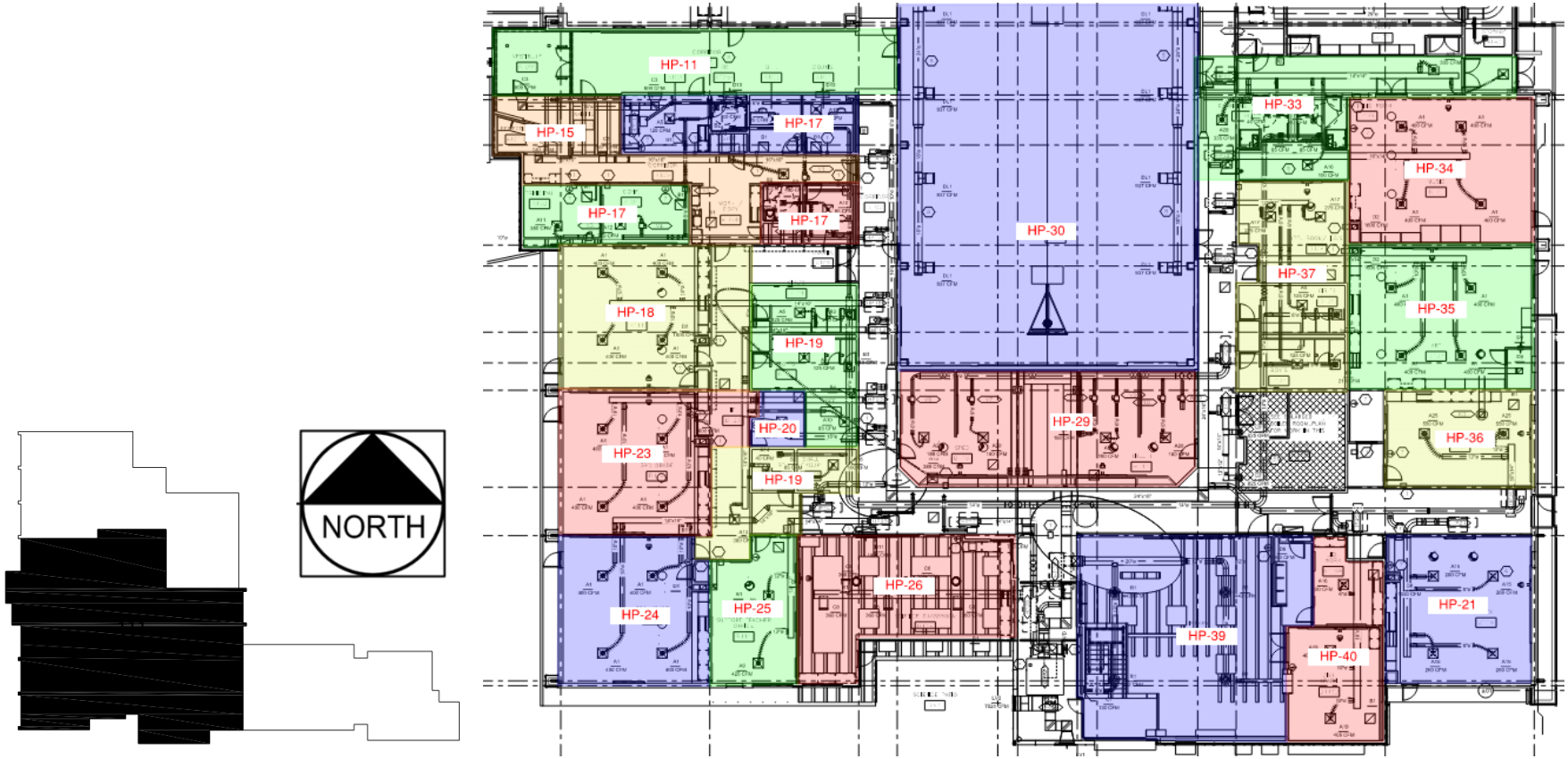




HVAC Zoning Plans

Zoning Plans

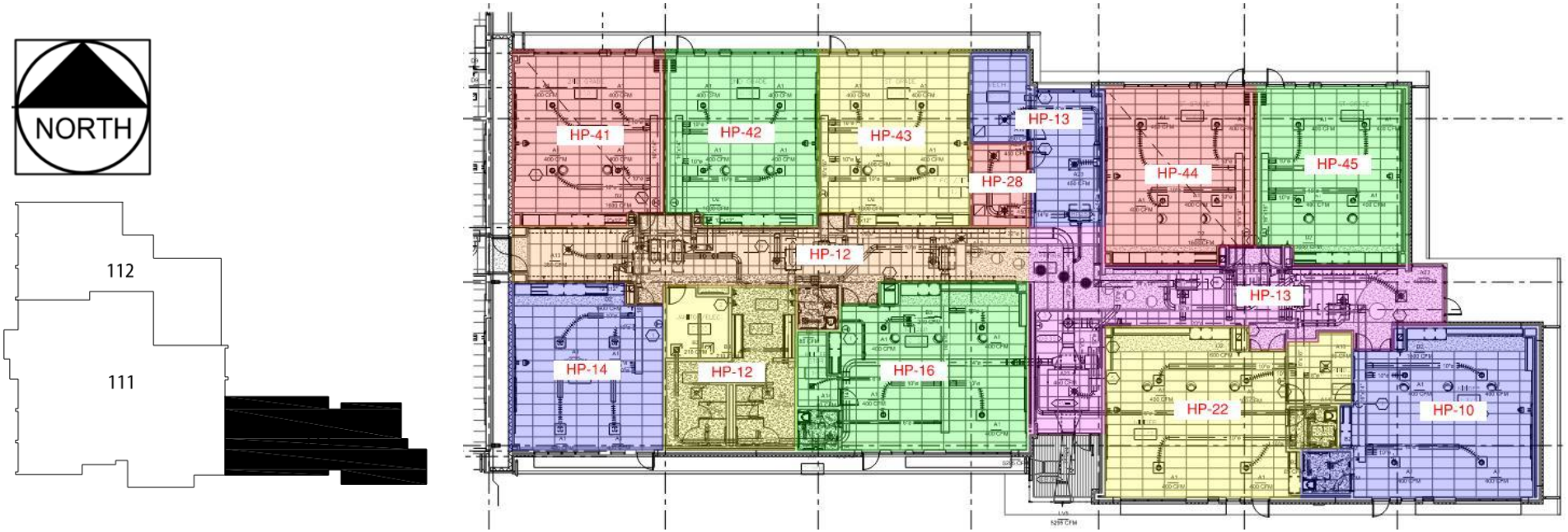
The following plans reflect the existing HVAC zones labelled with the heat pumps serving each zone. These plans are intended to be a reference for the maintenance team. This zoning plan reflects the science wing of the building.



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 K-2 classrooms in the east wing of the building.



HVAC DDC System Assessment

Overall Condition: Good (B+)

The DDC system reflects the ERV's, heat pumps, heating hot water plant, and multiple exhaust fans. The DDC system does not reflect any information regarding the ground loop for geothermal temperature control. The DDC system is dated, but functional. The control points are linked and operational. Trend and energy data is not accessible from the BAS. Multiple systems instances of mechanical equipment are missing from the BAS. The BAS does not reflect data from the plumbing or electrical systems.

System Expandability:

The kitchen MAU and kitchen exhaust fans are not integrated into the BAS. We recommend that all available MAU control points and control points for exhaust fans K1 and K2. We recommend that the snow-melt pump status and status alarm be added to the BAS graphics to notify the maintenance team. This will allow for the maintenance team to be notified if the slab temperature sensor is not calling for snow melt system enable during a snow event.

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:

P-3 is in constant alarm. No issues were noted with the operation of this pump during the assessment. Recommend clearing alarm.

Energy Conservation Opportunity:

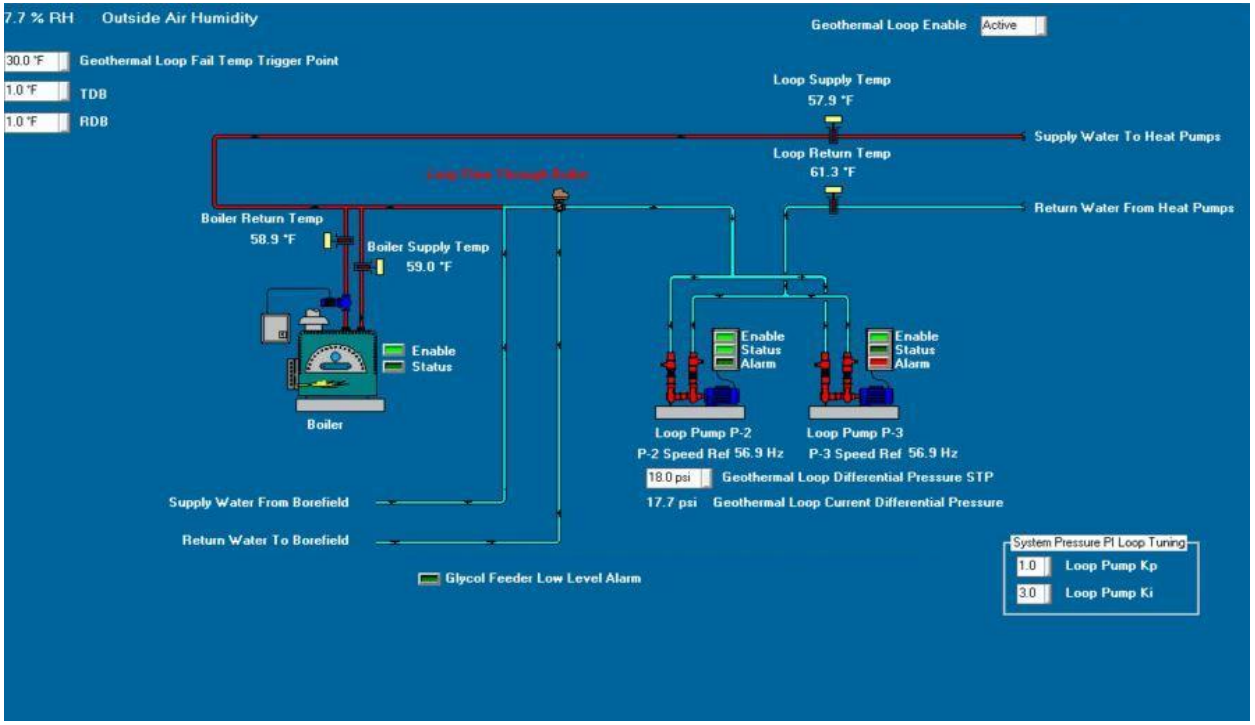
Unoccupied mode is not typically enabled during unoccupied hours. Recommend implementing unoccupied mode for all ERVs. Ventilation is not required during occupied hours. Eliminating all night setbacks with the space temperature setpoints will reduce energy consumption during morning warm up and allow for 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	SYSTEM(S)	BUILDING	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.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Damage/Wear Out	Maintenance
CHK-30-3	Observed many of the installed autoflow valves are sized at around 2 gpm/ton of cooling on each HP. Engineers often undersize the flow to each individual heat pump to save cost on larger distribution pumps. This however causes HPs to work harder and often short cycle due to the lower flow. This leads to increased compressor replacements and wear on the HPs in general.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Damage/Wear Out	Replacement/ Capital Improvement
CHK-2-3	Building pressure setpoint is not on graphics. Recommend adding setpoint on new exhauster graphic page.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Repair

HVAC DDC System Assessment

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-11-5	Fan status is reflected on the graphics as an amperage. Recommend on/off status for clarity.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-2-2	Recommend adding three-way valve position point to elementary school boiler central plant graphics.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Replacement/ Capital Improvement
CHK-2-1	Building pressure and roof exhauster data is located on the snowmelt page. Recommend adding graphic page for exhausters and building pressure.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Replacement/ Capital Improvement
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	DDC_Digital Direct Controls	Ignacio Elementary School	Energy Conservation Opportunity	Repair

Heating Hot Water and Geothermal System Assessment



Overall Condition: Good (B-)

The geothermal system consists of 7-pipe supply and return groundwater manifolds. The ground loop is the primary source of heating and cooling for the building.
The heating hot water plant is located in a mechanical space and is operated as a supplemental heating source to the closed loop geothermal system. The boiler piping ties into the main distribution piping via a three-way valve. The valve modulates to maintain the heating water supply temperature setpoint. The plant consists of one 3500 MBH condensing, gas-fired boiler with an in-line boiler pump. Two base-mounted pumps provide heating and cooling water distribution to water source heat pumps.

System Expandability:

Additional boilers and pumps may be installed and easily tied into the existing system, if desired. However, heating capacity has not been a significant recorded issue in this building. According to the maintenance staff, the existing auxiliary boiler rarely enables.

After replacement of control valves and autoflow valve orifices as recommended, reset distribution loop differential setpoint to 6-8psi.

Recommended Replacement/Capital Improvement:

To accommodate higher flow rates through heat pumps as recommended in the Appendix, it is recommended that the existing Bell and Gossett model 1510-2.5AB distribution pumps be replaced with Bell and Gossett Model 1510-3AC pumps. Size pumps for 515 gpm at 100 ft. HD. Program new pumps to operate in a lead/lag configuration.

A scheme check was performed on the heating water and distribution system against drawings provided by mechanical, electrical, and environmental engineering Inc. dated 12/9/2013. Minor non-conformances were noted but will likely not cause significant issues within the system. No pressure/temperature ports are installed within the mechanical space. Recommend installing p/t ports at locations provided in design drawings.

Recommended Maintenance and Repairs:

Maintain routine boiler inspection schedule provided by manufacturer, check pump belt tensions/alignment, provide pump belt replacement schedule.

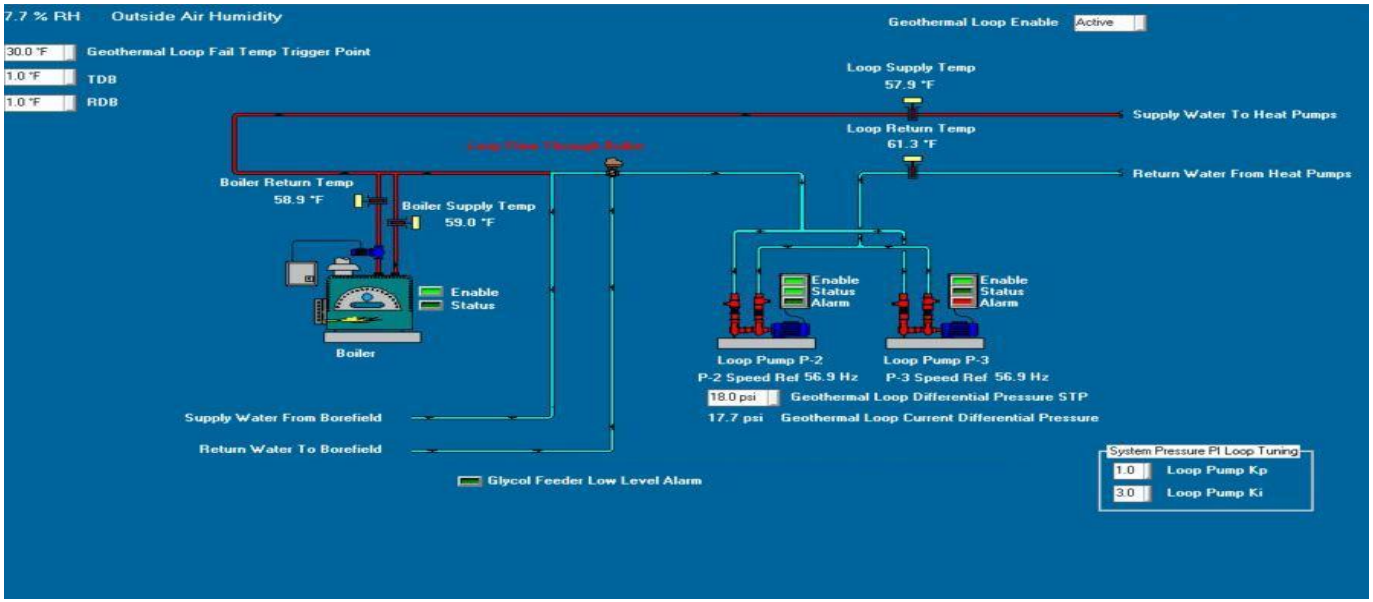
The pressure gauge at P-1 inlet is not operational. Recommend repair or replacement of gauge.

Energy Conservation Opportunities:

The distribution pumps operate in parallel. It is recommended that the sequence of operation for the pumps be adjusted to a lead/standby configuration to provide redundancy and energy savings.

Multiple piping fittings and accessories were not insulated. Recommend installing insulation at all pipe fittings and accessories.

EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION	YEAR INSTALLED
ES-P1	HVAC_Heating Hot Water System	Mechanical	Good	2014
ES-P2	HVAC_Ground Loop Distribution System	Mechanical	Good	2014
ES-P3	HVAC_Ground Loop Distribution System	Mechanical	Good	2014
ES-B1	HVAC_Heating Hot Water System	Mechanical	Good	2014



Heat Pump System Assessment

Overall Condition: D

The main source for heating and cooling in the high school is handled by 46 water source heat pumps. A ground source heat exchanger 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.

A diagrammatic scheme check was performed on more than 25% of the heat pumps. 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.

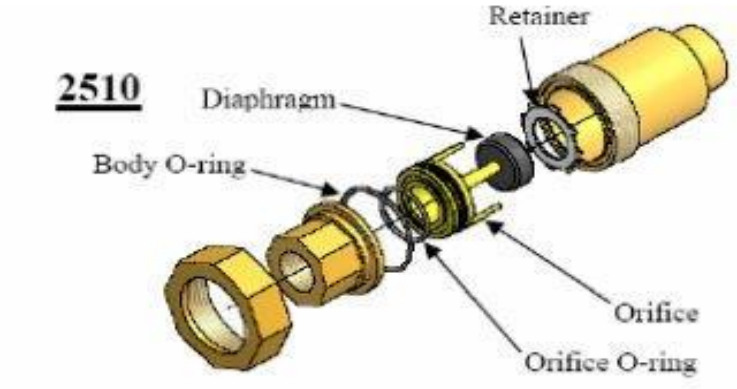
Recommended Maintenance:

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

Recommended Replacement/Capital Improvement:

The elementary school has experienced continuous issues with heat pump compressor, coil, reversing valve, and board failures.

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 the optimal 3 gpm/ton. Many of the heat pumps in the elementary school are less than 2 gpm/ton. Increasing the flow rate to each individual heat pump will improve reliability, function, and equipment durability. This can be accomplished by replacing the orifice or entire flow cartridge with the desired flow rate as determined by the manufacturer. See figure. 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 each heat pump by replacing the flow cartridge of all heat pumps in the elementary school. RE Appendix A for recommended flow rates.



Kitchen Ventilation and Exhaust System Assessment

Overall Condition: Poor (F)

The hood and dishwasher exhaust fans are operable. The GreaseMaster MAU is not operable. The exhaust fan VFD increases the fan speed when additional burners enable.

Recommended Maintenance and Repair:

Check belt tensions/alignment, routine cleaning of grease hood and ductwork. Range hood and dishwasher 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.

Recommended Replacement/Capital Improvement:

Reznor MAU specified in 2013 design drawings was never installed. Recommend replacing existing MAU as soon as possible.

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

Energy Recovery Ventilator System Assessment

Overall Condition: Fair (C+)

The energy recovery ventilators provide ventilation air to the distributed water to air heat pumps throughout the school. There are three (3) 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. Recommend replacing the ERV filters more frequently to lesson filter loading on HPs downstream.

Recommended Repair:

A rebalance of the ERVs 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
ES-ERV-1	HVAC Air Systems	Mechanical	Fair
ES-ERV-2	HVAC Air Systems	Mechanical	Fair
ES-ERV-3	HVAC Air Systems	Mechanical	Fair

Domestic Hot Water System Assessment

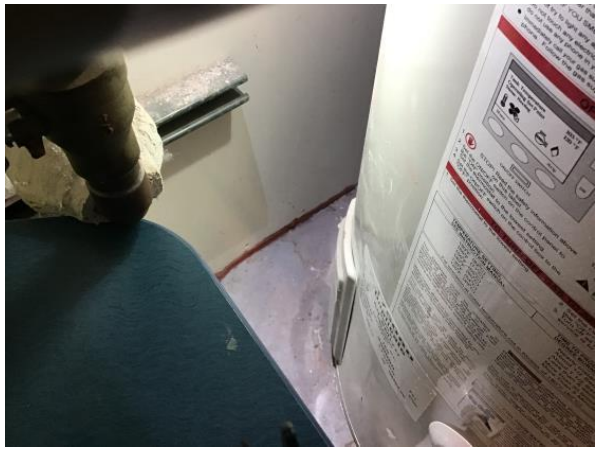
Overall Condition: Fair (C)

The domestic hot water (DHW) system consists of (2) 200 kbtu/h 97% efficient gas fired water heater with 100 gallons of storage each. The DHW system, WH-1 was installed in 2014 and the other, WH-2 was installed in 2012. 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 120 deg F. Recirculation of the 120 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. Gang sinks in the 1st grade wing took longer than 2 minutes to produce hot water. 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.

There is a sewer smell coming from the fifth-grade wing. The odor only occurs during the spring and fall when classes are in session. Order goes away when building is vacant. Recommend investigating. Lower access panel on WH-1 is turned facing the wall with less than a minimum of 20- inch clearance.



EQUIPMENT NAME	SYSTEM	DISCIPLINE	OBSERVED CONDITION	YEAR INSTALLED
ES-WH1	Domestic Hot Water	Plumbing	Good	2012
ES-WH2	Domestic Hot Water	Plumbing	Good	2014
ES-RP	Domestic Hot Water	Plumbing	Good	2014

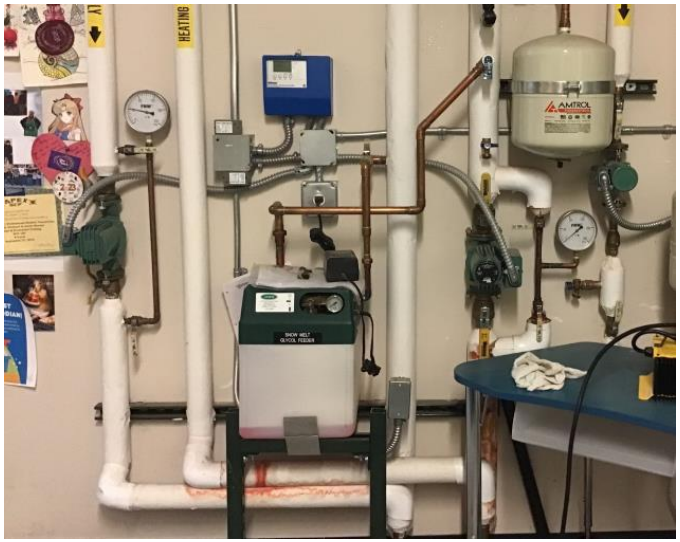
Snow Melt System Assessment

Overall Condition: Good (A+)

There is one snow melt system in the building; one which serves the east entrance and one which serves the south entrance. The snow melt system consists 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 slab 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 1 utility transformer, which feeds a 1,200 Amp service entry switchboard. The voltage of the switchboard is 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. Power is also supplied from a 40kW-Photovoltaic Array, 10kW Inverters and (2) 100 Amp disconnects.

System expandability:

Per a review of the service size and existing panel loads, there does not appear to be room available for additional PV. However, with disclosure from the utility provider of the peak electrical demand, expansion of the PV array is likely allowable. Future PV array may be tied into the (4) 400-amp spaces available in the Main Distribution Panel. It is estimated that an additional 330 kW PV array would offset the building's current electrical consumption. Net metering is not currently available and should be explored with the utility provider. Further review with the utility company serving the school district may be necessary.

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.

Solar panels usually do not require substantial maintenance but may require periodic light cleaning making sure dirt and debris does not obstruct the sun's rays. The electrical connections should be inspected making sure they are not loose or corroded. The inverters should have the cooling fans inspected for dust buildup and proper ventilation.

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.

Emergency exit signs were found to be missing in classroom 107 over exterior door labeled 17 and classroom 302, over exterior door labeled 2. The emergency exit sign in the gymnasium, east wall – far right door, is flickering and not solid illumination. There is also an exit sign not illuminated in classroom 111 over exterior door labeled 18.

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-6-3	There is a sewer smell coming from the fifth-grade wing. The odor only occurs during the spring and fall when classes are in session. Order goes away when building is vacant. Recommend investigating .	Ignacio Elementary School	PLUMB_Waste and Vent	Ignacio Elementary School	Safety	Repair
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.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Damage/ Wear Out	Maintenance
CHK-30-3	Observed many of the installed autoflow valves are sized at around 2 gpm/ton of cooling on each HP. Engineers often undersize the flow to each individual heat pump to save cost on larger distribution pumps. This however causes HPs to work harder and often short cycle due to the lower flow. This leads to increased compressor replacements and wear on the HPs in general.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Damage/ Wear Out	Replacement/ Capital Improvement
CHK-11-1	Observed the ERV fans (supply and exhaust) are not provided with soft start. There is evidence of wear on fans and motor shafts. These are belt-driven fans and the O&M staff is constantly replacing belts. There is evidence of rubber dust from belts around motors. Adding a VFD for soft start would help increase the life of the motors and fans while eliminating O&M man hours.	HVAC_Air Systems_ES	HVAC_Air Systems_ES	Ignacio Elementary School	Damage/ Wear Out	Replacement/ Capital Improvement
CHK-30-2	ES-HP-11: Signs of corrosion and condensation on iron pipe, possible electrolysis	ES-HP-11	HVAC_Air Systems_ES	Ignacio Elementary School	Damage/ Wear Out	Repair
CHK-30-1	ES- HP-5 is missing insulation on water inlets and outlets. Replacing insulation will help with condensation developing in plenum space.	ES-HP-5	HVAC_Air Systems_ES	Ignacio Elementary School	Damage/ Wear Out	Repair

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-7-1	ES - Pressure gauge at P-1 is not functional, needle is stuck under 0 psig. Recommend replacement.	ES-P1	HVAC_Heating Hot Water System_ES	Ignacio Elementary School	Damage/ Wear Out	Repair
CHK-11-4	ERV-2 is loud at the exhaust air discharge. 7400 cfm through 3'x4' louver free area around 7sf. Close to 1000fpm. Unclear if fan is even operating at design cfm. Recommend performing a tab effort and installing vfds on fans to reduce airflow if TAB readings are greater than design.	ES-ERV-2	HVAC_Air Systems_ES	Ignacio Elementary School	Environmental Improvements	Repair
CHK-11-3	Access to the heat pumps is a huge concern for most of these schools. However, ERVs are more easily accessible. Replacing the OA filters on the ERV units more often would improve indoor air quality and reduce the frequency to replace HP filters as the ERVs provide fresh air to the HPs.	HVAC_Air Systems_ES	HVAC_Air Systems_ES	Ignacio Elementary School	Environmental Improvements	Maintenance
CHK-7-3	The ground loop manifold and pipe fittings are not insulated. Condensation accumulated on the exposed piping during the assessment.	HVAC_Heating Hot Water System_ES	HVAC_Heating Hot Water System_ES	Ignacio Elementary School	Energy Conservation	Repair
CHK-2-3	Building pressure setpoint is not on graphics. Recommend adding setpoint on new exhauster graphic page.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Repair
CHK-11-5	Fan status is reflected on the graphics as an amperage. Recommend on/off status for clarity.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-2-2	Recommend adding 3-way valve position point to elementary school boiler central plant graphics.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Replacement/ Capital Improvement

Identified Deficiencies

NAME	DESCRIPTION	ASSET	SYSTEM(S)	BUILDING	PRIORITY	STATUS
CHK-2-1	Building pressure and roof exhauster data is located on the snowmelt page. Recommend adding graphic page for exhausters and building pressure.	DDC_Digital Direct Controls	DDC_Digital Direct Controls	Ignacio Elementary School	Codes/ Standards	Replacement/ Capital Improvement
CHK-19-1	In classroom B124 Tech, there is no exit sign over exterior door 12.	ELEC_Interior Lighting_ES	ELEC_Interior Lighting_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-6-4	Lower access panel on WH-1 is turned facing the wall with less than a minimum of 20- inch clearance.	PLBG_Domestic Hot Water_ES	PLBG_Domestic Hot Water_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-5-5	Classroom 107 in the first-grade wing, has a missing exit light over exterior door 17.	ELEC_Interior Lighting_ES	ELEC_Interior Lighting_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-5-4	Room 111, in the first-grade wing, has an exit sign that is not illuminated over exterior door 18.	ELEC_Interior Lighting_ES	ELEC_Interior Lighting_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-5-3	Emergency exit sign in gymnasium, east wall-far right door is flickering and not solid illumination.	ELEC_Interior Lighting_ES	ELEC_Interior Lighting_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-5-2	Room 302 does not have an illuminated exit sign over exterior door 2.	ELEC_Exterior Lighting_ES	ELEC_Exterior Lighting_ES	Ignacio Elementary School	Codes/ Standards	Maintenance
CHK-10-1	Makeup air unit is not installed. Existing MAU at grade level is abandoned in place and not operational. No power to existing MAU. Recommend replacing MAU to provide ventilation to kitchen. Test, Adjust, and Balance airflow with kitchen hood operational to provide net negative pressure in kitchen.	ES-MAU	HVAC_Kitchen Air Systems_ES	Ignacio Elementary School	Codes/ Standards	Replacement/ Capital Improvement

Energy Consumption Summary

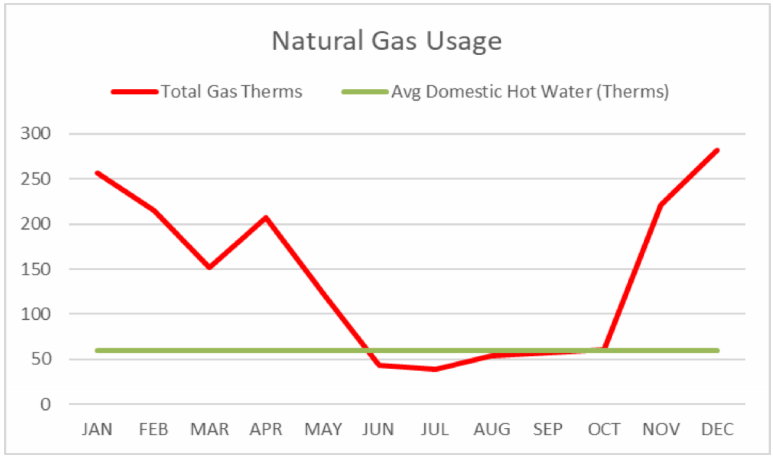
Energy Consumption Grade: A+

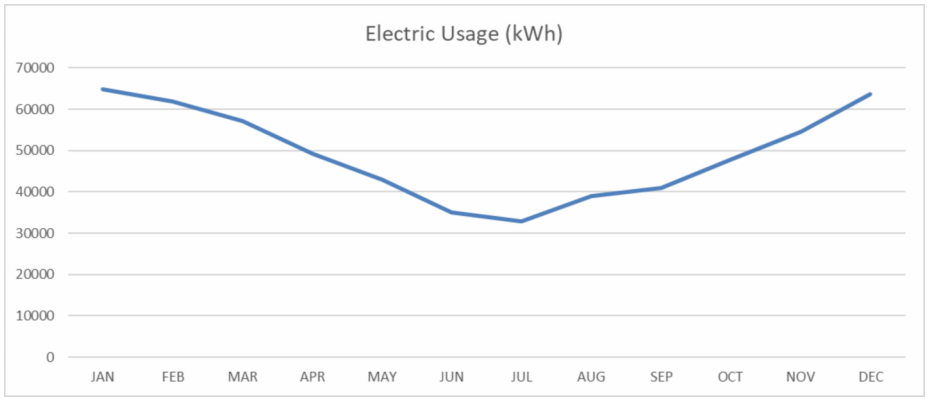
Overall energy consumption at the Elementary School exceeds expectations, with a site EUI of approximately 32 kbtu/sf/yr over the last (2) 12-month periods. A typical similar school could be expected to have a site EUI of 55 kbtu/sf/yr according to Energy Star. Energy cost at this facility is much better than average at $0.92/sf/yr over the last two years.

The average electric purchase rate over the last three years is $0.1042/kWh, which meets expectations. Electricity is steadily trending more expensive with the rate since January averaging $0.112/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 $1.14/therm, though for the last 12 months the rate has been trending downward. Since September of last year, the cost of natural gas has averaged $0.58/therm. Our observations have been that gas prices have been falling precipitously across multiple markets.
We recommend projecting a natural gas purchase rate of $0.925/therm. Natural gas only consists of approximately 3% of the annual energy consumption and 8% of the annual energy cost in the elementary school.

	IGNACIO ELEMENTARY SCHOOL BUILDING	BENCHMARK FACILITY
Natural Gas Usage (kBtu/Year)	170,893	1,784,207
Natural Gas Cost ($/Year)	$1,951	$20,374
Natural Gas EUI (kBtu/SF/Year)	2	26
Natural Gas ECI ($/SF/Year)	$0.03	$0.30
Natural Gas blended rate ($/therm)	$1.1419	-
Electric Usage (kBtu/Year)	2,013,444	2,003,918
Electric Cost ($/Year)	$61,502	$61,194
Electrical EUI (kBtu/SF/Year)	29	29.1
Electrical ECI ($/SF/Year)	$0.89	$0.89
Electrical blended rate ($/kwh)	$0.1042	-
Combined EUI (kBtu/SF/Year)	32	55
Combined Energy Cost	$63,454	$81,567
Combined ECI ($/SF/Year)	$0.92	$1.18





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 MODEL	INSTALLED COOLING MBH	INSTALLED NOMINAL TONNAGE	INSTALLED GPM/TON	DESIGN COOLING MBH	DESIGN TONNAGE	DESIGN/ INSTALLED GPM	DESIGN GPM/TON	GPM/TON DEFICIENCY	RECOMMENDED FLOW RATE (GPM)
HP01	NBH049	TTH049	49	4.08	1.96	25.0	2.1	8.0	3.8	-1.9	12.3
HP02	NBH049	TTH049	49	4.08	1.96	24.0	2.0	8.0	4.0	-2.0	12.3
HP03	NBH049	TTH049	49	4.08	1.96	25.0	2.1	8.0	3.8	-1.9	12.3
HP04	NBH026	TTH026	26	2.17	2.31	17.0	1.4	5.0	3.5	-1.2	6.5
HP05	NBH049	TTH049	49	4.08	1.96	35.0	2.9	8.0	2.7	-0.8	12.3
HP06	NBH064	TTH064	64	5.33	2.25	40.0	3.3	12.0	3.6	-1.4	16.0
HP07	NBH049	TTH049	49	4.08	1.96	25.0	2.1	8.0	3.8	-1.9	12.3
HP08	NBH049	TTH049	49	4.08	1.96	25.0	2.1	8.0	3.8	-1.9	12.3
HP09	NBH049	TTH049	49	4.08	1.96	25.0	2.1	8.0	3.8	-1.9	12.3
HP10	NBH038	TTH038	38	3.17	2.21	22.0	1.8	7.0	3.8	-1.6	9.5
HP11	NBH049	TTH049	49	4.08	1.96	27.0	2.3	8.0	3.6	-1.6	12.3
HP12	NBH038	TTH038	38	3.17	2.21	23.0	1.9	7.0	3.7	-1.4	9.5
HP13	NBH049	TTH049	49	4.08	2.20	38.0	3.2	9.0	2.8	-0.6	12.3
HP14	NBH049	TTH049	49	4.08	1.96	44.0	3.7	8.0	2.2	-0.2	12.3
HP15	NBH049	TTH049	49	4.08	1.96	24.0	2.0	8.0	4.0	-2.0	12.3
HP16	NBH049	TTH049	49	4.08	1.96	43.0	3.6	8.0	2.2	-0.3	12.3

Appendix

UNIT	MODEL	INSTALLED MODEL	INSTALLED COOLING MBH	INSTALLED NOMINAL TONNAGE	INSTALLED GPM/TON	DESIGN COOLING MBH	DESIGN TONNAGE	DESIGN/ INSTALLED GPM	DESIGN GPM/TON	GPM/TON DEFICIENCY	RECOMMENDED FLOW RATE (GPM)
HP17	NBH038	TTH038	38	3.17	2.21	19.0	1.6	7.0	4.4	-2.2	9.5
HP18	NBH049	TTH049	49	4.08	1.96	26.0	2.2	8.0	3.7	-1.7	12.3
HP19	NBH038	TTH038	38	3.17	2.21	23.0	1.9	7.0	3.7	-1.4	9.5
HP20	NBH026	TTH026	26	2.17	2.31	22.0	1.8	5.0	2.7	-0.4	6.5
HP20	NBH026	TTH026	26	2.17	1.85	22.0	1.8	4.0	2.2	-0.3	6.5
HP21	NBH049	TTH049	49	4.08	1.96	36.0	3.0	8.0	2.7	-0.7	12.3
HP22	NBH049	TTH049	49	4.08	1.96	33.0	2.8	8.0	2.9	-0.9	12.3
HP23	NBH049	TTH049	49	4.08	1.96	26.0	2.2	8.0	3.7	-1.7	12.3
HP24	NBH049	TTH049	49	4.08	1.96	28.0	2.3	8.0	3.4	-1.5	12.3
HP25	NBH026	TTH026	26	2.17	1.85	12.0	1.0	4.0	4.0	-2.2	6.5
HP26	NBH064	TTH064	64	5.33	2.25	47.0	3.9	12.0	3.1	-0.8	16.0
HP27	NBH026	TTH026	26	2.17	1.85	14.0	1.2	4.0	3.4	-1.6	6.5
HP29	NBH038	TTH038	38	3.17	2.21	26.0	2.2	7.0	3.2	-1.0	9.5
HP30	NXV240	TCV240	240	20.00	1.50	222.0	18.5	30.0	1.6	-0.1	60.0
HP31	NBH038	TTH038	38	3.17	1.89	24.0	2.0	6.0	3.0	-1.1	9.5
HP32	NXV240	TCV240	240	20.00	1.50	241.0	20.1	30.0	1.5	0.0	60.0
HP33	NBH038	TTH038	38	3.17	2.21	19.0	1.6	7.0	4.4	-2.2	9.5
HP34	NBH049	TTH049	49	4.08	1.96	33.0	2.8	8.0	2.9	-0.9	12.3
HP35	NBH049	TTH049	49	4.08	1.96	26.0	2.2	8.0	3.7	-1.7	12.3
HP36	NBH038	TTH038	38	3.17	2.21	15.0	1.3	7.0	5.6	-3.4	9.5
HP37	NBH026	TTH026	26	2.17	1.85	17.0	1.4	4.0	2.8	-1.0	6.5
HP38	NBH026	TTH026	26	2.17	2.77	31.0	2.6	6.0	2.3	0.4	6.5
HP39	NBH064	TTH064	64	5.33	1.88	46.0	3.8	10.0	2.6	-0.7	16.0
HP40	NBH038	TTH038	38	3.17	2.21	19.0	1.6	7.0	4.4	-2.2	9.5
HP41	NBH049	TTH049	49	4.08	1.96	24.0	2.0	8.0	4.0	-2.0	12.3
HP42	NBH049	TTH049	49	4.08	1.96	24.0	2.0	8.0	4.0	-2.0	12.3
HP43	NBH049	TTH049	49	4.08	1.96	27.0	2.3	8.0	3.6	-1.6	12.3
HP44	NBH049	TTH049	49	4.08	1.96	23.0	1.9	8.0	4.2	-2.2	12.3
HP45	NBH049	TTH049	49	4.08	1.96	24.0	2.0	8.0	4.0	-2.0	12.3
HP46	NBH049	TTH049	49	4.08	1.96	32.0	2.7	8.0	3.0	-1.0	12.3