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TECHNICAL MEMORANDUM

Client #	MRV Architects/Craig School District	**Date**	March 25, 2021
PDC #	21028JN	**Prepared by**	Doug Murray, PE
Project Name	Craig Schools - Elementary Ventilation Systems		
Subject	Assessment Report		

Topic	Discussion
Introduction	The Craig School District is interested in providing the Elementary School with an upgraded ventilation system in the interest in modernization and to provide a healthier indoor environment. The following report describes the existing mechanical ventilation conditions with their respective system service life left and will provide recommendations for upgrade with potential rough order magnitude cost estimates.
Executive Summary	The elementary school has a small mechanical ventilation unit that serves the administration area and adjacent offices, but the rest of the school does not have mechanical ventilation, but rather has operable windows and doors that provide natural ventilation (when utilized). The school does not have adequate ventilation systems. **Recommend installation of a modern ventilation system to supply the necessary outside air to all occupied areas with modern direct digital automatic controls**. Exhaust fans do serve toilet rooms, but they have reached their service lives and should be replaced. Kitchen Hood Exhaust system is old and should be modernized with up to date fire suppression and make-up air. **Recommend the exhaust air systems be modernized with one exhaust system serving all areas required for exhaust including copy rooms.** Recommend kitchen hood exhaust be replaced and makeup air be added. The existing electric controls are old, antiquated, and are limited in their ability for scheduling and monitoring. **Recommend a new direct digital controls system to replace the existing electron controls. The new controls would control, monitor, and provide trending for the heating plant, heating units, and ventilation/exhaust systems.**

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Background	The Craig Elementary School was constructed in 1981. It is a single-story wood framed building with a basement maintenance shop and attic storage for about 15,000 square feet total. An existing PACE air-handling unit with mixing damper and 2-inch filters with a capacity of 800 cfm is hung in the basement Maintenance Room and provides ventilation to the administration area offices. The rest of the school rooms have no mechanical ventilation but rather rely on natural ventilation from operable windows and doors. Exhaust fans EF-1 and EF-2 exhaust air from the two sets of toilet rooms and two adjacent Janitor rooms. The fans are cabinet fans located in the ceiling space above the Janitor rooms. The exhaust fans are original construction. The kitchen has a Type 1 hood with grease type exhaust fan on roof. No make-up air is provided and thus the system pulls a negative pressure whenever the hood system operates. Automatic controls have been upgraded from pneumatic to electric controls some time in the past.
Analysis	The administration ventilation and exhaust systems are over 40 years old and have reached the end of their service life. The classrooms do not have mechanical ventilation and thus unless the windows are opened there is no ventilation in these areas. Much of the school season is held during colder weather when the occupants admittedly are not opening the windows. The kitchen hood system is beyond its service life and should be replaced. A make-up air unit must be installed to provide outside air make-up for the kitchen hood and provide a neutral pressure relationship in the kitchen and cafeteria. Automatic controls operating the mechanical systems are antiquated and should be replaced with direct digital controls for better scheduling of operations, increased efficiency of the ventilation systems, and trending and monitoring capabilities. According to the EPA - Upgrading to a MERV-13 rated filter, or the highest-rated filter that your HVAC system fan and filter slot can accommodate, could improve the system's efficacy in removing viruses from circulated air. Additional measures could include HEPA filtration and ultraviolet germicidal irradiation (UVGI) as a supplemental treatment, but modern ventilation and MERV 13 filters would be a minimum start for an adequate

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	mechanical systems environment for protection against viruses. See Research Section below for information. Adding additional mechanical ventilation to the school will mean additional heating loads due to increased outside being drawn into the facility. The additional heating load will most likely mean and upsizing in the biomass heat exchanger located in the Mechanical room and replacing circulation pumps.
Recommendations	Install a new school wide ventilation system, new exhaust air systems, and new automatic direct digital controls. A new ventilation system will increase the heating load due to outside air heating to meet the code required occupant outside air. Replace the Kitchen hood exhaust system and install a fuel fired (propane) make-up air unit. Replace the building controls with modern DDC type. Upsize the biomass boiler heat exchanger with a larger one to handle the increased heating load from OSA. **A concept level cost estimate with a healthy contingency for the ventilation work described above is $1,500,000.** See spreadsheet for concept level cost estimate breakdown.
Research	***From the Centers for Disease Control and Prevention Web Site and their article Ventilation in Buildings updated Feb 9, 2021.*** SARS-CoV-2 viral particles spread between people more readily indoors than outdoors. When outdoors, the concentration of viral particles rapidly reduces with the wind, even a very light wind. When indoors, ventilation mitigation strategies help to offset the absence of natural wind and reduce the concentration of viral particles in the indoor air. The lower the concentration, the less likely some of those viral particles can be inhaled into your lungs; contact your eyes, nose, and mouth; or fall out of the air to accumulate on surfaces. Protective ventilation practices and interventions can reduce the airborne concentration, which reduces the overall viral dose to occupants. https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html Below is a list of ventilation interventions that can help reduce the concentration of virus particles in the air, such as SARS-CoV-2. They

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Research, Continued	represent a list of "tools in the mitigation toolbox," each of which can be effective on their own. Implementing multiple tools at the same time is consistent with CDC mitigation strategies and increases overall effectiveness. These ventilation interventions can reduce the risk of exposure to the virus and reduce the spread of disease, but they will not eliminate risk completely. Consider ventilation system upgrades or improvements and other steps to increase the delivery of clean air and dilute potential contaminants. Obtain consultation from experienced Heating, Ventilation and Air Conditioning (HVAC) professionals when considering changes to HVAC systems and equipment. Some of the recommendations below are based on Guidance for Building Operations During the COVID-19 Pandemic.pdf from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). In addition to buildings, ventilation considerations are also important when you have multiple persons within vehicles, including public transportation (buses, subways, trains, school buses, carpools, and rideshares). Not all considerations are applicable for all scenarios. Ventilation improvements may include some or all of the following considerations: • Increase outdoor air ventilation, using caution in highly polluted areas. • When weather conditions allow, increase fresh outdoor air by opening windows and doors. Do not open windows and doors if doing so poses a safety or health risk (e.g., risk of falling, triggering asthma symptoms) to occupants in the building. • Use fans to increase the effectiveness of open windows. To safely achieve this, fan placement is important and will vary based on room configuration. Avoid placing fans in a way that could potentially cause contaminated air to flow directly from one person over another. One helpful strategy is to use a window fan, placed safely and securely in a window, to exhaust room air to the outdoors. This will help draw fresh air into room via other open windows and doors without generating strong room air currents. • Decrease occupancy in areas where outdoor ventilation cannot be increased. • Ensure ventilation systems operate properly and provide acceptable indoor air quality for the current occupancy level for each space. • Increase airflow to occupied spaces when possible. • Turn off any demand-controlled ventilation (DCV) controls that reduce air supply based on occupancy or temperature during occupied hours. In homes and buildings where the HVAC fan operation can be controlled at the thermostat, set the fan to the "on" position instead of "auto," which

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Research, Continued	will operate the fan continuously, even when heating or air-conditioning is not required.
	• Open outdoor air dampers beyond minimum settings to reduce or eliminate HVAC air recirculation. In mild weather, this will not affect thermal comfort or humidity. However, this may be difficult to do in cold, hot, or humid weather.
	• Improve central air filtration:
	    o Increase air filtration to as high as possible without significantly reducing design airflow.
	    o Inspect filter housing and racks to ensure appropriate filter fit and check for ways to minimize filter bypass.
	    o Check filters to ensure they are within their service life and appropriately installed.
	• Ensure restroom exhaust fans are functional and operating at full capacity when the building is occupied.
	• Inspect and maintain local exhaust ventilation in areas such as kitchens, cooking areas, etc. Operate these systems any time these spaces are occupied. Consider operating these systems, even when the specific space is not occupied, to increase overall ventilation within the occupied building.
	• Consider portable high-efficiency particulate air (HEPA) fan/filtration systems to help enhance air cleaning (especially in higher risk areas such as a nurse's office or areas frequently inhabited by persons with higher likelihood of COVID-19 and/or increased risk of getting COVID-19).
	• Generate clean-to-less-clean air movement by re-evaluating the positioning of supply and exhaust air diffusers and/or dampers (especially in higher risk areas).
	• Consider using ultraviolet germicidal irradiation (UVGI) as a supplement to help inactivate SARS-CoV-2, especially if options for increasing room ventilation are limited. Upper-room UVGI systemspdf icon can be used to provide air cleaning within occupied spaces, and in-duct UVGI systems can help enhance air cleaning inside central ventilation systems.
	• In non-residential settings, consider running the HVAC system at maximum outside airflow for 2 hours before and after the building is occupied.
	
	*Note: The ventilation intervention considerations listed above come with a range of initial costs and operating costs which, along with risk assessment parameters such as community incidence rates, facemask compliance expectations and room occupant density, may affect considerations for which interventions are implemented.

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Research, Continued	***Can COVID-19 be transmitted through HVAC (ventilation) systems?*** https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html The risk of spreading the virus that causes coronavirus disease 2019 (COVID-19) through ventilation systems is not well-known at this time. Viral RNA has reportedly been found on return air grilles, in return air ducts, and on heating, ventilation, and air conditioning (HVAC) filters, but detecting viral RNA alone does not imply that the captured virus was capable of transmitting disease. Once the basics above are covered *(disinfecting frequently touched surfaces, more hand sanitizers, shut down food prep and warming areas, close or post warning signs at water fountains, and practicing social distancing),* a few actions related to HVAC systems are suggested, in case some spread of the virus can be affected: • Increase outdoor air ventilation (use caution in highly polluted areas); with a lower population in the building, this increases the effective dilution ventilation per person. • Disable demand-controlled ventilation (DCV). • Further open minimum outdoor air dampers, as high as 100%, thus eliminating recirculation (in the mild weather season, this need not affect thermal comfort or humidity, but clearly becomes more difficult in extreme weather). • Improve central air filtration to the MERV-13or the highest compatible with the filter rack, and seal edges of the filter to limit bypass. • Keep systems running longer hours, if possible 24/7, to enhance the two actions above. • Consider portable room air cleaners with HEPA filters. • Consider UVGI (ultraviolet germicidal irradiation), protecting occupants from radiation, particularly in high-risk spaces such as waiting rooms, prisons and shelters. *Like all hazards, risk can be reduced but not eliminated, so be sure to communicate the limitations of the HVAC system and our current state of knowledge about the virus and its spread.*

End of Report

Craig School District, Elementary School Ventilation System Renovation
Craig, Alaska **Concept Design Cost Estima**
March 25, 2021

Cost Element		Quantity	Rate	Subtotal	Total
01	**Architectural Work**				
011	Cutting and Patching for Demo and Install	1 ls	$40,000 ls	$40,000	
012	Roof Pentrations for Air Caps	1 ls	$12,000 ls	$12,000	
013	Painting related to HVAC Work	1 ls	$6,000 ls	$6,000	
	Total				$58,000
02	**Structural Work**				
021	Headers and Framing for louvers and Roof Caps	1 ls	$20,000 ls	$20,000	
022	Housekeeping Pads for AHU, RF	1 ls	$5,000 ls	$5,000	
	Total				$25,000
02	**Mechanical Work**				
031	Demolish Ventilation/Exhaust Systems	1 ls	$8,000 ls	$8,000	
032	Ventilation AHU and Return Fan, 8800 cfm, 6000 cfm RF	1 ls	$100,000 ls	$100,000	
033	Exhaust Fan EF-1 sized for Total School Exhaust Req'd.	1 ls	$10,000 ls	$10,000	
034	Heating System Upsize for new AHU coil	1 ls	$100,000 ls	$100,000	
035	Ventilation and Exhaust Air Ductwork, GRD's	12,500 ft2	$20 ft2	$250,000	
036	Kitchen hood, EF, and Fuel Fired Make-up Air Unit MAU 2000 cfm	1 ls	$32,000 ls	$32,000	
036	Controls (DDC)	55 pts	$2,000 pts	$110,000	
037	Testing and Balancing	1 ls	$20,000 ls	$20,000	
038	Start Ups and Testing	1 ls	$15,000 ls	$15,000	
	Total				$645,000
05	**Electrical**				
041	Demo AHU, (2) EF,and Controls Circuits	4 ea	$2,500 ea	$10,000	
042	AHU, RF, EF, Controls Electrical Circuits	4 ea	$4,500 ea	$18,000	
042	FA connection for Smoke Detectors	1 ea	$3,000 ea	$3,000	
043	Kitchen Hood, EF, and MAU	3 ea	$4,000 ea	$12,000	
043		ea	ea	$0	
					$43,000
05	**General**				
051	Mob/Demob, Travel Costs	1 ls	ls	$20,000	
052	General Adminstration	1 ls	ls	$40,000	
053	Agency Coordination	1 ls	ls	$2,500	
	Total		.		$62,500
124	Profit & Overhead		30%	$250,050	
	Total				$292,550
13	**Contingencies**				
131	Estimating Contingency		20%	$216,710	
132	Escalation to 2022		10%	$130,026	
	Total				$346,736
	TOTAL ESTIMATED CONSTRUCTION COST:				**$1,472,786**

Note: Prelim Cost above does not include design services or construction administration