CHIMACUM SCHOOL DISTRICT

HIGH SCHOOL, MIDDLE SCHOOL, AND CCP

COVID-19 ENGINEERING CONTROLS REPORT

1/20/22

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MENG ANALYSIS

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

INTRODUCTION

This COVID-19 Engineering Controls Report has been prepared for Chimacum School District to assist in the operation of Chimacum Main Campus and Chimacum Creek Primary (CPP) School during the ongoing COVID-19 pandemic. The engineering controls strategies contained herein focus on ventilation, air filtration, and mechanical HVAC controls and sequences to assist in the minimization of airborne pathogen transmission. Although other methods such as plumbing fixtures and physical barriers may also be employed, they are not part of this scope.

The analysis performed in this report was conducted to facilitate the operation of the Main Campus and Primary School with reference to guidelines provided from resources such as ASHRAE COVID-19 Guidance, ASHRAE Standard 62 as well as the Harvard School of Health's Risk Reduction Strategies for Reopening Schools and the Washington Department of Health (DOH) K-12 reopening guidance, were utilized in ventilation analysis and the production of this report.

Our primary guidelines are published by ASHRAE, on which many other guidelines are based, with emphasis on improving ventilation and air filtration to reduce airborne contagion risk. HVAC improvement should be part of a larger COVID-19 Plan including Administrative, Custodial, Individual (PPE), and other Engineering Controls, such as occupant traffic separation, sneeze-guards and plumbing fixtures for sanitation and hydration.

A sampling approach was used for specified rooms identified by the District. These rooms were chosen as a representative set of rooms to allow for cost-effective analysis. General recommendations have been made based on the data set of sampled rooms with several individual rooms, such as the health and COVID Isolation rooms receiving individual analysis.

COVID-19 ENGINEERING CONTROLS TEAM AND PROCESS

The COVID-19 Engineering Controls analysis was conducted by a team consisting of professional engineers, certified commissioning professionals, engineering technicians, and NEBB certified Test, Adjust, and Balancing (TAB) providers.

The following criteria are described by both Washington DOH School Reopening Guidelines [1] and ASHRAE Guidelines [2]:

- MERV 13 or greater filtration in HVAC systems.
- Outside air (OA) equal to or greater than code minimum at time of HVAC design (noting WA State code minimum is based largely on ASHRAE Standard 62) with higher quantities of outside air if possible.

- All HVAC components must be operated and maintained (O&M) as designed.
- Air distribution and building pressure are adequate.
- HVAC operating schedules are tailored to meet occupancy requirements.

SUMMARY

The following is a summary of key findings and high-level recommendations to reduce COVID-19 risk at Chimacum School District facilities. Some of these recommendations may provide lasting benefit beyond COVID-19 through long-term indoor air quality (IAQ) improvement.

Key Findings

- Current available outside air volume supplied by air handlers does not meet ASHRAE 62.1 or Washington DOH guidelines for minimum ventilation rates.
- Total unit airflow is low on multiple air handlers, resulting in low airflow, hence poor or marginal air distribution, to served spaces.
- Some spaces do not meet the desired six air-changes per hour supply air performance metric.
- Building pressure relief is inadequate in several locations to allow for proper ventilation airflow.
- COVID Isolation rooms should have dedicated exhaust systems to maintain a negatively pressurized space.
- All air handlers are currently equipped with required MERV-13 filters.

Recommendations

- Increase air handler fan speeds to deliver design supply airflow.
- Rebalance supply registers to +/-10% of design values for Administration and Health rooms.
- Position outside air dampers to supply minimum ventilation rates per ASHRAE guidelines; however, consider increasing outside air damper positions beyond the minimum, sustainability protocols typically suggest 30% additional outside air, to the extent HVAC equipment is able to maintain occupant comfort, noting this may increase energy usage. Any increased outside air may be reduced back to minimum, when the Covid-19 pandemic is past.
- Provide alternate method of building pressure relief in Office 424.
- Provide dedicated exhaust systems for COVID Isolation rooms to negatively pressurize the spaces and avoid contamination of adjacent spaces.
- Provide supplemental filtration (portable air purifiers) for areas without a combined six air-changes per hour of fresh outside air or filtered air.
- Set schedules to flush air before and after occupancy.
- Maintain temperature and humidity setpoints.

Wildfire Smoke

This COVID-19 report is focused on COVID-19 risk reduction from airborne contagion, which may be contrary to actions for wildfire smoke events. COVID-19 risk reduction requires increased outdoor air ventilation, whereas wildfire smoke response requires reduced outdoor air ventilation. However, improved air filtration to at least MERV-13 both reduces COVID-19 risk and wildfire smoke particle contaminants. During wildfire smoke events, at-risk facilities should sharply reduce operations to the bare minimum, with no large group events.

Energy

Modifications recommended in this report, including increased outside air flow above minimum design, increasing air handler fan speeds to meet design, use of portable air purifiers, pre & post-event building air flush, and continued use of MERV-13 filters, will all increase energy consumption, but are necessary to reduce COVID-19 risk.

To mitigate Covid-19 engineering controls energy increase, consider applying for a WA State Clean Building program early adopter financial incentive, which is available for certain commercial buildings, even when less than 50,000 sf.

Future Considerations

While the current COVID-19 pandemic may pass in 2022, future pandemics, seasonal flu, and other indoor air quality concerns may arise, including increased summer & fall wildfire smoke. Many actions taken now to reduce COVID-19 risk may apply to these future risks. Increased outdoor air and MERV-13 filters work well to reduce risk from many types of airborne contagion. MERV-13 filters also work well to reduce wildfire smoke particles. Actions taken to reduce energy use make Chimacum schools more future-ready considering ever increasing carbon constraints and taxes.

Disclaimer

COVID-19 is a novel and potentially deadly contagion. While MENG Analysis has followed national guidelines, MENG Analysis provides no guarantee against sickness or death related to COVID-19 exposure at this facility.

II. PROJECT DESCRIPTION

Project Information

Location:
Chimacum Main Campus
91 W Valley Rd
Chimacum WA 98325

Chimacum Creek Primary School
313 Ness' Corner Rd
Port Hadlock-Irondale WA 98339

Occupancy:
900 Staff and Students

Description:

Chimacum Main Campus is a combined school with original construction in 1978 with additions and renovations completed in 1991, 1998, 2014, and 2019. The HVAC system consists of roof top heat pump air handling units, most with full economizers, and exhaust fans serving restrooms. Several heat recovery units serve the gymnasium areas (heat recovery units were not analyzed). Hydronic fan coil units are used on the south of the building with split Dx heat pumps in the NW wing.

Chimacum Primary School was constructed in 1998. The HVAC system consists of ducted heat pump units with full economizers located in the mechanical attic space. Exhaust fans serve the restrooms.

III. ENGINEERING CALCULATIONS

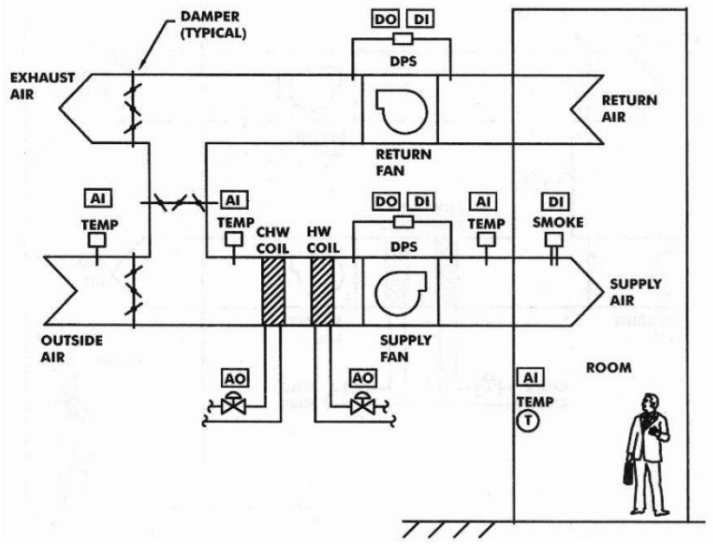
The following definitions relate to the engineering calculations and measurements throughout this report. There are four classes of air described throughout the report which effect the indoor air quality of the building. Figure 1 shows the locations of each defined air class for reference.

Outside Air (OA) - defined as the amount of outside air brought into the air handling unit through the outside air damper opening(s).

Return Air (RA) – defined as all stale air returned from occupied space and drawn back to the air handler.

Supply Air (SA) – defined as the total airflow provided from the air handler through the supply air duct (OA + RA = SA).

Exhaust Air (EA) – defined as stale air that is expelled to the outside of the building.



OA, RA, and SA rates have been provided by a NEBB certified TAB provider. See the Appendix for the full TAB report. Minimum ventilation rate calculations and natural ventilation (NV) percentages have been calculated using accepted methods per ASHRAE Standard 62.1 and Washington State Mechanical Code. Building occupancy rates were provided by Chimacum School District staff. Required supplemental filtration has been calculated based on the difference between measured actual outside air cubic feet per minute (CFM) versus code required outside air CFM.

Based on the TAB Report, conditioned air in each space is not well distributed throughout areas served by associated units. Uneven distribution produces an

environment where air is not adequately exchanged in each space. Recommendations have been provided to correct the imbalance and provide adequate ventilation throughout the building.

The filters were replaced prior to TAB work to ensure accurate airflow readings with the intended MERV-13 filters. MERV-8 filters are 20% efficient at removing particulate sizes between 1 µm and 3 µm (microns). According to ASHRAE guidelines, the 20% air cleaning capability of these filters results in the equivalent of 20% more outside air added to the system. In contrast, the recommended, and currently installed, MERV-13 filters are 85% efficient at removing particulate sizes between 1 µm and 3 µm, resulting in a 65% increase in the amount of equivalent fresh air delivered to the spaces. Although air changes per hour (ACH) is not a requirement per ASHRAE guidelines, the ACH metric is a good indicator of air quality.

According to NIH [3], typical COVID-19 respiratory droplets range in size from 1.6 µm to 140 µm. This places MERV-13 filters squarely in the range to capture respiratory droplets produced during speech, coughing, and sneezing.

Table 1 illustrates the increased ACH delivered by a MERV-13 filter versus a MERV-8 filter.

Table 1 - ACH for MERV-8 vs MERV-13 filters

Filter Type	Fresh Outside Air ACH	Filtered Fresh Air Added Equivalent ACH	Total ACH
MERV-8	2	1	3
MERV-13	2	5	7

*Based on a 1000 sf area with 8 ft ceilings, 1000 cfm delivered, and 20% outdoor air damper position. MERV-13 = 85% eff, MERV-8 = 20% eff for 1 µm to 3 µm particles.

IV. DETAILED SPACE ANALYSIS

Air distribution throughout a space is required to ensure proper mixing of new air with the air already in the space. The air distribution effectiveness is largely based on proper balancing of supply and return grills, registers & diffusers (GRDs) throughout the space. The analysis performed identified the airflow pathways to determine if air was being adequately mixed. This was done through a combination of visual on-site inspection of the HVAC system and air flow measurements through GRDs by a certified TAB contractor.

Table 2 shows the results from the analysis and provides room names and numbers corresponding to provided mechanical and architectural drawings. Annotated floor plans have been provided in the Appendix for reference. Required Outside Air CFMs have been calculated based on information provided by Chimacum School District staff on expected occupancy of each space. Measured Outside Airflow numbers per area are derived from total airflow to each space as provided by the TAB contractor in conjunction with measured outside airflow rates from the air handler.

The mechanical design drawings show design airflow rates for each supply and exhaust diffuser throughout the building as well as AHU total airflow rates. TAB measurements were used to compare the design airflow rates to current measured OA, SA, and EA airflow rates to validate that original airflow rates are being met.

The required OA equivalent provided is the difference between the required OA cfm per ASHRAE 62.1 and the measured outside airflow cfm. The remaining value is the current deficit of required fresh air in each space. Any deficit must be made up through a combination of mechanical control adjustments and/or additional filtration units, which may include portable HEPA filters. Backup data and intermediate calculations are available upon request.

Table 2 Heading Definitions

- **OA ACH –** Outside Air Changes per Hour, a measure of the outside air exchange rate in the room.
- **Combined ACH** – OA ACH combined with the recirculation air passed through a filter with a cleaning coefficient applied (85% for MERV-13 filters).
- **Required OA CFM per ASHRAE 62.1** – Required outside air cubic feet per minute as defined by current ASHRAE Standard 62.1. # Occupants x OA Rate (cfm/person) + Space Floor Area (sf) x OA Rate (cfm/sf) = Required OA
- **Measured OA CFM** – Actual airflow measured by TAB contractor during inspection.
- **Required Additional OA Equivalent (CFM)** – the amount of additional outside air or outside air equivalent required to bring the space up to ASHRAE 62.1 minimum outside airflow rates. Positive values indicate additional outside air is required; Parenthesis indicate a surplus of outside airflow to the zone. Required OA CFM – measured OA CFM = Required OA Equivalent (CFM)

Table 2 - As-Found Airflow Rates

Room #	Room Name	Air System	OA ACH	Combined ACH	Required OA CFM per ASHRAE 62.1	Measured OA CFM	Required Additional OA Equivalent CFM	Notes
	Facility:	**CCP**						
601	CCP COVID Iso	HP-021	0.4	3.3	36	5	31	4
303	CCP North Wing Classroom	HP-008	0.6	7.1	408	77	331	4
207	CCP West Wing Classroom	HP-014	0.8	6.1	416	114	302	4
105	CCP Health	HP-020	0.3	6.5	72	8	64	4
	Facility:	**Main Campus**						
115	100A Classroom	HP-102A	2.2	7.2	398	268	130	4
150	100A Admin	HP-117	0.0	3.7	78	0	78	2, 4
201	100A Classroom	MZ-RTU	0.0	9.3	373	0	373	2, 4

Room #	Room Name	Air System	OA ACH	Combined ACH	Required OA CFM per ASHRAE 62.1	Measured OA CFM	Required Additional OA Equivalent CFM	Notes
202	100A Classroom	HP-112	2.2	9.0	398	270	128	4
203	100A Classroom	MZ-RTU	0.0	9.7	401	0	401	2, 4
205	100A Classroom	MZ-RTU	0.0	6.7	399	0	399	2, 4
207	100A Classroom	MZ-RTU	0.0	8.9	401	0	401	2, 4
208	100A Classroom	MZ-RTU	0.0	6.6	401	0	401	2, 4
209	100A Classroom	MZ-RTU	0.0	6.5	399	0	399	2, 4
144	100A Covid Iso Room	HP-120	0.0	0.0	53	0	53	2, 3, 4
101	100A County Health Room	HP-114	1.3	5.0	122	78	44	4
108	100A Life Skills	HP-002	2.1	10.2	430	336	94	4
732	100A Auditorium	Auditorium Unit	0.0	4.9	341	0	341	2, 4
424	100B Office	HP-208	2.2	7.7	6	35	6	4
700	100B Commons	HP-206	0.5	3.7	164	311	0	1
701	100B Band	HP-204	1.1	4.1	410	486	0	1
703	100B Choir	HP-214	1.9	4.3	391	729	0	1
720	100B Office	HP-202	0.6	5.9	12	18	0	1
722	100B Principal	HP-203	0.4	3.7	13	13	0	1

Room #	Room Name	Air System	OA ACH	Combined ACH	Required OA CFM per ASHRAE 62.1	Measured OA CFM	Required Additional OA Equivalent CFM	Notes
731	100B Library	HP-205	0.0	2.0	212	0	212	2, 4
404	200 Classroom	SF-2	0.0	10.5	404	0	404	2, 4
408	200 Classroom	HP-210	1.0	8.3	398	126	272	4
506	200 Classroom	SF-2	0.0	8.0	407	0	407	2, 4
602	200 Classroom	SF-2	0.0	7.4	407	0	407	2, 4

Notes:
1. Outside air provided to space is acceptable but Combined ACH is below 6 ACH threshold.
2. Outdoor air damper fully closed.
3. Unit was not operating at time of testing.
4. Outside air quantity is insufficient.

V. RECOMMENDED UPGRADES AND MAINTENANCE

The COVID-19 Engineering Controls analysis provides an independent assessment of existing HVAC controls. The following recommendation and maintenance should improve indoor air quality and reduce COVID-19 exposure risk, when combined with other health measures recommended by the Center for Disease Control (CDC).

Some recommendations are interdependent; hence, it is recommended to implement all the following measures together (outside air damper position, air filters, supplemental filtration, HVAC schedules, rebalancing, and temperature and humidity control). This will ensure a balanced approach to providing proper air quality in conjunction with energy efficiency and contagion mitigation.

Figure 2 illustrates a typical air handling unit for reference in the following recommendations.

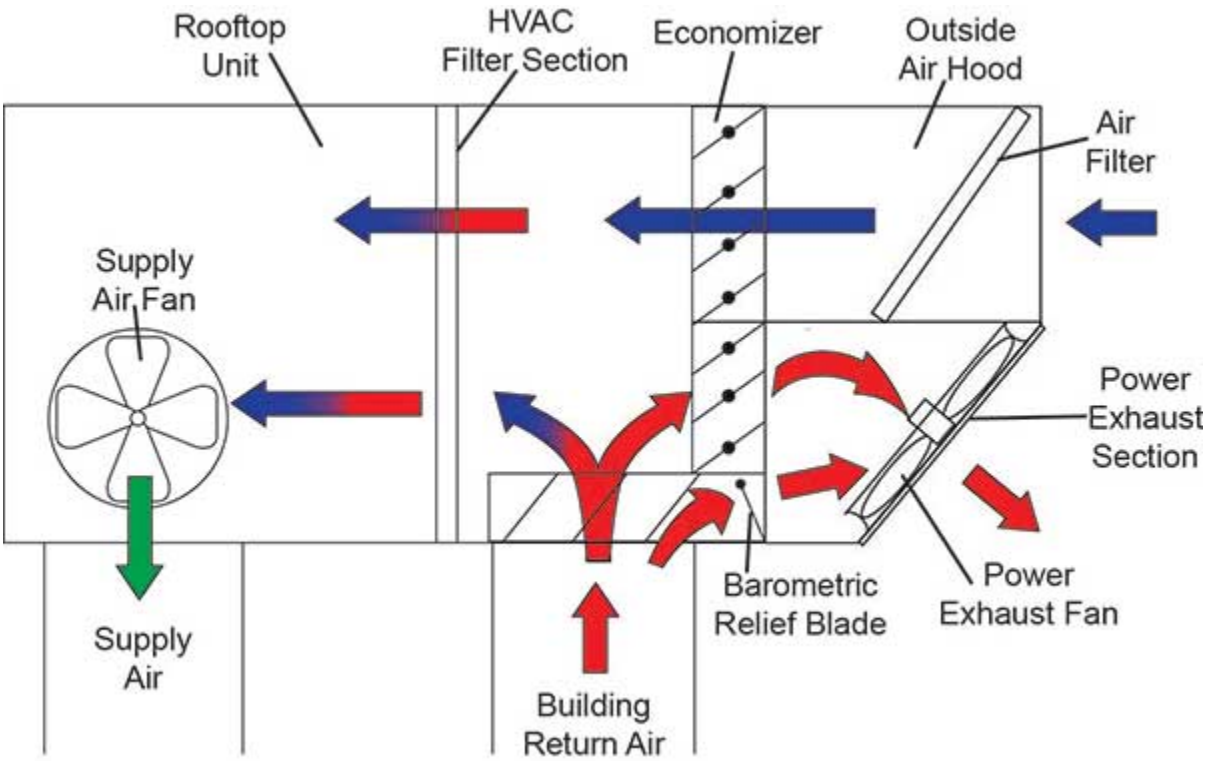


Figure 2 - Typical air handling unit

1) AIR HANDLING UNITS

Air handling units, as shown in Figure 2, are designed to pull air from the served space, mix the return air with outside air, filter and condition the air, and finally, supply the conditioned and filtered air to the served space and occupants. Not all air handling equipment was tested as selected sample rooms provided a representative set of air handling units. As is shown in Table 3, many units need their total airflow increased to bring the units up to design airflow values. Several of the rooms, to include the COVID Isolation rooms, have half to no airflow provided. Further diagnosis by a qualified mechanical contractor as to why the below design units are producing less air than design is recommended for occupant comfort, however, outside air flow rates may be achieved by simply increasing the outside air damper minimum position in many cases.

Table 3 - Air Handling Unit Airflows

Unit #	Area Served	Design Airflow (CFM)	Measured Total Unit Airflow (CFM)	Percent of Design	Notes
Facility:	**CCP**				
HP-021	CCP COVID Iso	1,600	907	56%	1
HP-008	CCP Room 303	1,200	1,114	92%	-
HP-014	CCP Room 201	1,200	1,027	85%	1
HP-020	CCP Health	1,600	948	59%	1
Facility:	**Main Campus**				
HP-102A	100A Room 115	1,200	985	82%	1
HP-117	100A Admin 150	1,500	1,425	95%	-
MZ-RTU	100A 200 Classroom Wing	7,200	6,639	92%	-
HP-112	100A Classroom 202	1,200	1,259	104%	-
HP-120	100A COVID ISO	930	0	0%	3
HP-114	100A County Health	1,200	780	65%	1
HP-002	100A Room 108	2,280	1,895	83%	1
Auditorium Unit	Auditorium	12,000	10,901	90%	2
HP-208	100B Office 424	800	703	87%	1
HP-205	100B Commons	5600	2,903	54%	4
HP-202	100B Office 720	1,300	1,446	111%	-

Unit #	Area Served	Design Airflow (CFM)	Measured Total Unit Airflow (CFM)	Percent of Design	Notes
HP-203	100B Principal's Office	1,800	1,488	82%	1
HP-206	100B Library	1200	1,046	87%	1
HP-210	200 Classroom 408	1,200	1,178	98%	-
HP-214	100B Choir	2,400	1,803	75%	1
HP-204	100B Band	2,400	2,133	88%	1

Notes:
1. Bring total airflow up to design prior to implementing further recommendations.
2. Total design airflow unable to be determined from original drawings. Assumed design supply airflow used.
3. Unit not operational at time of testing.
4. One duct run had 0 cfm. Smoke damper may be closed.

2) REBALANCING

Building wide air balancing is an integral part of a healthy building, providing the building with a well distributed air system with proper air mixing and particulate dilution. Design documents were used to determine initial design airflows. Acceptable measured airflow values for a well distributed system fall within +/- 10% of design. This criteria falls within ASHRAE ventilation verification guidelines.

Table 4 shows design airflow compared to total measured airflow. Any room with a balanced percentage below 90% or above 110% is out of design specifications, indicating uneven airflow distribution throughout the building. An unbalanced system may stem from multiple causes to include, poor original balancing, comfort balancing during occupancy, or programmatic and building modifications which did not take into account HVAC design. As discussed in the Air Handling recommendations in the previous section, many of the air handlers are not producing sufficient airflow. As most of the rooms tested are served by a single AHU, many of the balancing issues are observed on both the air handling level as well as the individual room level. An analysis of the individual supply grill registers shows primarily proportioned systems with several requiring rebalancing or additional relief airflow paths to provide proper airflow. In particular, the COVID Isolations rooms appear to have been repurposed rooms. Those rooms are positively pressurized with no return airpath. As the COVID Isolation rooms deal with active contagions, these rooms need to be negatively pressurized with all

exhaust air provided by a dedicated system so as to not contaminate adjacent spaces.

Table 4 - Airflow distribution and balancing

Room #	Room Name	Associated HVAC Unit	Design CFM	Measured Total Airflow CFM	Balanced Percent	Notes
Facility:	**CCP**					
601	CCP COVID Iso	HP-021	110	50	45%	1, 2, 7
303	CCP North Wing Classroom	HP-008	1,200	1,114	93%	-
207	CCP West Wing Classroom	HP-014	1,200	1,027	86%	7
105	CCP Health	HP-020	270	204	76%	2, 7
Facility:	**Main Campus**					
115	100A Classroom	HP-102A	1,200	985	82%	7
150	100A Admin	HP-117	600	571	95%	-
201	100A Classroom	MZ-RTU	1,200	998	83%	7
202	100A Classroom	HP-112	1,200	1,259	105%	-
203	100A Classroom	MZ-RTU	1,200	1,439	120%	7
205	100A Classroom	MZ-RTU	1,200	964	80%	7
207	100A Classroom	MZ-RTU	1,200	1,321	110%	-
208	100A Classroom	MZ-RTU	1,200	973	81%	7
209	100A Classroom	MZ-RTU	1,200	944	79%	7
144	100A Covid Iso Room	HP-120	150	0	0%	3, 7

Room #	Room Name	Associated HVAC Unit	Design CFM	Measured Total Airflow CFM	Balanced Percent	Notes
101	100A County Health Room	HP-114	520	337	65%	7
108	100A Life Skills	HP-002	2,280	1,895	83%	7
732	100A Auditorium	Auditorium Unit	12000	10,901	90.8%	4
424	100B Office	HP-208	70	140	50%	5, 7
700	100B Commons	HP-205	5,600	2,903	52%	6, 7
701	100B Band	HP-204	2,400	2,133	89%	7
703	100B Choir	HP-214	2,400	1,803	75%	7
720	100B Office	HP-202	160	200	125%	7
722	100B Principal	HP-203	200	135	68%	7
731	100B Library	HP-206	1,200	1,046	87%	7
404	200 Classroom	SF-2	1,200	1,606	134%	7
408	200 Classroom	HP-210	1,200	1,178	98%	-
506	200 Classroom	SF-2	1,200	1,256	105%	-
602	200 Classroom	SF-2	1,200	1,162	97%	-

Notes:

1. No return air in the space. COVID Iso room should be negatively pressurized.
2. Supply diffusers are poorly proportioned.
3. Unit not functioning during testing.
4. Design Airflow unable to be determined. Assumed design value used.
5. Transfer grill required for proper airflow through room.
6. One duct has no airflow.
7. Airflow out of design specifications.

3) OUTSIDE AIR (ECONOMIZER) DAMPER POSITIONS

Outside air damper position directly relates to the amount of fresh air supplied to the HVAC system and delivered to each space that is served by the unit. The outside air damper for each air handler must be positioned to allow the minimum amount of ventilation required by occupants when no demand control ventilation (DCV) feature (such as active CO_2-control) is present.

Nearly all of the outside air dampers for the AHUs are set well below the minimum threshold to supply the spaces with minimum ventilation. Each damper minimum position will need to be increased to supply the minimum outside air design cfm for the maximum number of occupants in the space.

Table 5 details the current outside airflow by each HVAC unit and the minimum required airflow which the outside air damper will need to be positioned for to supply adequate ventilation air to served spaces. Consider increasing outside air damper positions beyond the minimum, sustainability protocols typically suggest 30% additional outside air, to the extent HVAC equipment is able to maintain occupant comfort, noting this may increase energy usage. Any increased outside air may be reduced back to minimum, when the Covid-19 pandemic is past.

Table 5 – Air Handler Measured outside air CFM vs. required outside air CFM

Area Served	HVAC Unit Number	Measured OA CFM	Required OA CFM	Note
Facility:	**CCP**			
CCP COVID Iso	HP-021	92	576	1
CCP Room 303	HP-008	77	444	1
CCP Room 201	HP-014	114	444	1
CCP Health	HP-020	38	464	1
Facility:	**Main Campus**			
100A Room 115	HP-102A	268	432	1
100A Admin 150	HP-117	0	300	1
100A 200 Classroom Wing	MZ-RTU	0	2,400	1, 2
100A Classroom 202	HP-112	270	396	1
100A COVID ISO	HP-120	0	316	1, 3
100A County Health	HP-114	180	396	1
100A Room 108	HP-002	336	456	1
Auditorium	Auditorium Unit	0	3,960	1
100B Office 424	HP-208	174	200	1
100B Commons	HP-206	311	812	1
100B Office 720	HP-202	129	325	1
100B Principal's Office	HP-203	141	450	1
100B Library	HP-205	0	1,072	1
200 Classroom	SF-2	0	420	1
200 Classroom 408	HP-210	126	396	1
100B Choir	HP-214	729	600	-
100B Band	HP-204	486	600	1

Notes:

1. Outside air flow lower than required minimum. Adjust minimum outside air damper position to supply required outside air cfm.
2. Unit supplied multiple smaller units. Minimum outdoor air for each sub-unit should be 400 cfm with the parent unit supplying a total of 2400 cfm.
3. Unit not operational at time of testing.

4) PRESSURE RELIEF

Pressure relief is a critical component to proper air exchange and ventilation. A properly sized and implemented return and relief system is needed to avoid over pressurization of the conditioned space. Several spaces were observed to have no or poor pressure relief for the rooms served. A transfer grill, allowing air to pass through to the adjacent space for building 100B office 424 served by HP-208 should be installed for adequate ventilation to be achieved.

Similarly, Chimacum Creek Primary room 601 (COVID Isolation Room) has no relief air pathway. Presently, a small amount of air is allowed to leak under the door but the current undercut is insufficient to meet the room airflow needs. In addition, since this is an isolation room, a dedicated exhaust system should be utilized to draw a negative pressure on the space and exhaust contaminated air out the building without contaminating adjacent spaces. Installing a dedicated exhaust system is recommended for all COVID isolation rooms. As a sampling method was performed, it is recommended to verify relief pathways for all spaces as well as identify any change of use of spaces, such as the conversion of a small office into and isolation room, to better serve the needs of the occupants.

As shown in Figure 3, a relief pathway to allow stale air to be displaced by fresh outside air is required for proper ventilation. If no pathway is provided, an over pressurized space is created and no fresh air will be allowed into the space.

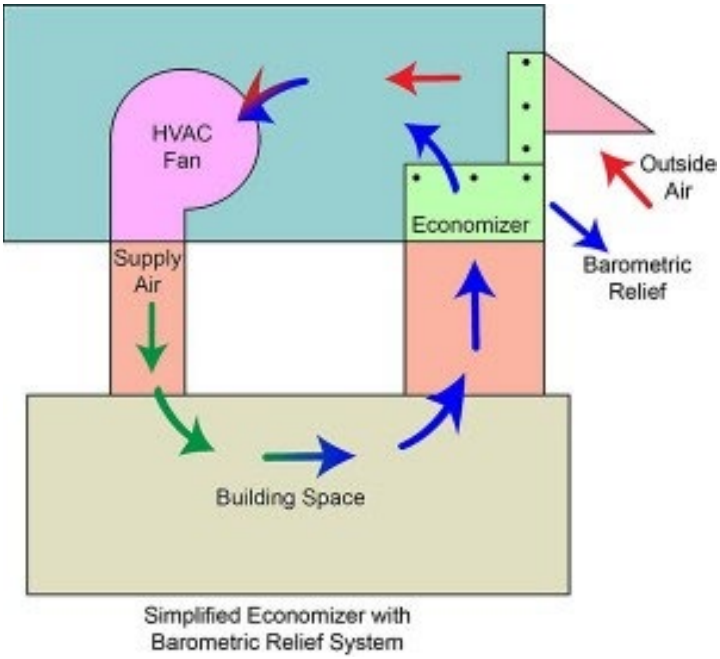


Figure 3 - Proper HVAC pressure relief

5) AIR FILTERS

ASHRAE COVID-19 recommendations prescribe a minimum of MERV-13 filter for adequate air filtration during the ongoing pandemic. At present, each of the air handling devices have MERV-13 filters installed. These should be changed quarterly in accordance with the suggested schedule provided in ASHRAE COVID-19 guidance. More frequent changes have not been shown to significantly further reduce risk, so quarterly filter changes are sufficient. If filters are not fully seated, the resulting "filter bypass" means air filtration will be reduced. During filter changes, ensuring a proper fit is important to minimize the amount of unfiltered air which bypasses the filters, thereby increasing the equivalent clean air changes per hour. Proper protective equipment should be used during filter changes with the knowledge that filtration is designed to capture contagions and contaminants.

6) SUPPLEMENTAL FILTRATION AND AIR TREATMENT

Supplemental filtration may be required to supplement existing outside air sources and/or to provide clean air when no fresh outside air is present or feasible. Supplemental filtration and air treatment may be provided through either High Efficiency Particulate Air (HEPA) filter or an approved UV-C germicidal irradiation device. It should be noted that limited data exists on the effectiveness of portable UV-C against the COVID-19 virus; however, data does show permanent UV-C technology specifically developed for HVAC systems is effective. UV-C technology is complex and costly to implement for smaller systems, especially when compared to increasing outside air and/or filtration.

Several of the tested rooms showed lower than desired air changes per hour (ACH). Desired ACH as defined by the Department of Health as well as Harvard studies as 5-6 ACH [4, 5]. When the previous recommendations for AHU airflows, economizer damper position, and balancing recommendations are implemented, most rooms will achieve or exceed these ACH values with the exception of those rooms identified in Table 6. These rooms will need supplemental filtration to meet minimum ACH guidelines as prescribed in DOH guidelines. Data in Table 6 assumes that mechanical control methods have already been performed in accordance with Table 4 and Table 5 to reduce the amount of additional filtration necessary. A properly sized portable HEPA unit will provide a total cleaned airflow rate greater than or equal to the additional clean air CFM value shown in the Additional Clean Air CFM to Achieve 6 ACH column.

Table 6 - Rooms Requiring Supplemental Filtration

Room #	Room Name	ACH with Identified Mechanical Adjustments	Additional Clean Air CFM to Achieve 6 ACH	Final ACH with Additional Filtration
150	100A Admin	3.8	290	6.0
144	100A Covid Iso Room	4.9	30	6.0
732	100A Auditorium	5.2	1,563	6.0
701	100B Band	4.2	808	6.0
703	100B Choir	5.2	323	6.1
722	100B Principal	5.3	23	6.0
731	100B Library	2.2	1,657	6.0

7) HVAC SCHEDULES

HVAC operating schedules are a necessary and integral part of air quality in the building. ASHRAE guidance for building reopening indicates the HVAC system should be run for a minimum time required to provide at least three air changes or equivalent filtration to each space, both before and after occupancy.

For several building spaces, the above guidelines suggest a minimum startup time prior to occupancy of between 30 – 60 minutes. A two-hour startup time is suggested to provide a safety factor of 2. The startup time should be followed regardless of the number of people occupying the space. The systems should be started up two-hours prior to arrival of operations staff and should remain in occupied mode, without any occupancy setbacks, until 2-hours past occupancy. Following the prescribed schedule will more than satisfy the requirements for a building flush as defined in AEA requirements.

8) CO_2 MONITORS

Carbon dioxide (CO_2) monitoring provides a good proxy for indoor air quality in human occupied spaces. In occupied buildings, acceptable maximum carbon dioxide levels fall within the range of 900 - 1000 parts per million (ppm, absolute scale) when the air is well-mixed. Concentrations above these values normally require exchange of the air in the measured space with fresh outside air.

A system with properly implemented CO_2 monitoring will allow a demand control ventilation (DCV) strategy to be implemented, thereby reducing the amount of necessary outside air during optimal times and providing more outside air when occupancy requires it. This control strategy will save energy but should be carefully considered and properly programed to allow override capability for airborne contagion and wildfire smoke control. Although some systems may be equipped with demand control ventilation, this was not readily apparent during inspections. Any present demand control ventilation should have the minimum ventilation rate increased as defined in Table 6 and the setpoint reduced to a maximum of 800 ppm absolute. Alternately, the DCV function may be disabled, and the units allowed to run with their necessary minimum airflows as defined in Table 6.

For areas without current CO2 monitoring, it is recommended to install standalone monitors and data loggers. The monitors should record maximum concentrations and if the concentration is above 1000ppm, the outside air damper position should be increased. Suggested locations are as follows:

- Auditorium
- Library
- Commons
- Lunchrooms
- High use and high-density classrooms

9) HUMIDITY AND TEMPERATURE CONTROL

Temperature and humidity controls should also be considered as part of the overall engineering control strategy against COVID-19. Temperature and humidity both affect the human immune system, with low temperatures and humidity possibly allowing viruses to more easily infect persons via dry soft tissues. We suggest dehumidification to 50% in the summer utilizing built-in air conditioning, and humidification to 40% in the winter. Portable humidity and temperature sensors can be used to measure current indoor environmental conditions. Suggested temperature setpoints are 70 degrees F for heating and 75 degrees F for cooling with occupant adjustability of +/- 2 degrees.

VI. FURTHER CONSIDERATIONS

The analysis performed was based on a sampling approach. A sampling approach allows a broad analysis to be performed on the entire building with the intent of identifying systemic issue and is not meant to provide a room-by-room description of changes which should be implemented. The recommendations made in the above report may be used to assist in general corrections throughout the facilities. The sampling approach identified the following adjustments which should be made across all air handling equipment to increase indoor air quality for occupants:

1) **Increase outside air damper position** – At present, insufficient outside air has been provided to occupants. The outside air damper position should be increased to the maximum possible position to maintain a comfortable temperature.
2) **Verify adequate airflow pathways for supply and return air** – A visual verification that supply and return air pathways are installed and unobstructed should be performed on each room. This will allow the maximum ACH to each space to be achieved.
3) **Verify mechanical operability –** Verify each piece of HVAC equipment is fully operable and properly controlled. Dampers should move freely and rotate in the proper direction when commanded by the control system. Verify proper economizer operation.
4) **Ensure proper filtration is provided** – Verify each unit has a MERV-13 filter installed, or the highest possible filter rating. Verify each filter properly seals to avoid filter bypass.
5) **Confirm operation schedule** - Start up all HVAC units two hours prior to occupancy and maintain occupied operation until 2 hours after occupancy.
6) **Confirm operational setpoints** – Verify temperature setpoints are maintained for each unit in the 70-degree range and the humidity is controlled to between 40% and 50% to the extent possible.

VII. REFERENCES

[1] Health, Washington Department of. (2022, 01 10). *K-12 COVID-19 Requirements for Summer 2021 and the 2021-2022 School Year*. Retrieved from Washington State Department of Health: https://www.doh.wa.gov/Portals/1/Documents/1600/coronavirus/820-105-K12Schools2021-2022.pdf

[2] ASHRAE. (2021, September 20). *Filtration / Disinfection*. Retrieved from ASHRAE Technical Resources: https://www.ashrae.org/technical-resources/filtration-disinfection#mechanical

[3] Lee, B. U. (2020). Minimum Sizes of Respiratory Particles Carrying SARS-CoV-2 and the Possibility of Aerosol Generation. *International Journal of Environmental Research and Public Health*, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7579175/.

[4] Washington State Department of Health. (2022, 01 10). *Ventilation and Air Quality for Reducing Transmission of COVID-19*. Retrieved from Washington Department of Health: https://www.doh.wa.gov/Portals/1/Documents/1600/coronavirus/VentilationGuidance.pdf

[5] Harvard T.H. Chan. (2022, 01 10). *Risk Reduction Strategies for Reopening Schools*. Retrieved from Schools for Health: https://schools.forhealth.org/risk-reduction-strategies-for-reopening-schools/

VIII. APPENDIX

- COVID-19 Engineering Controls Analysis Team
- Annotated Floor Plans
- Photo Log
- Test Adjust and Balance Report

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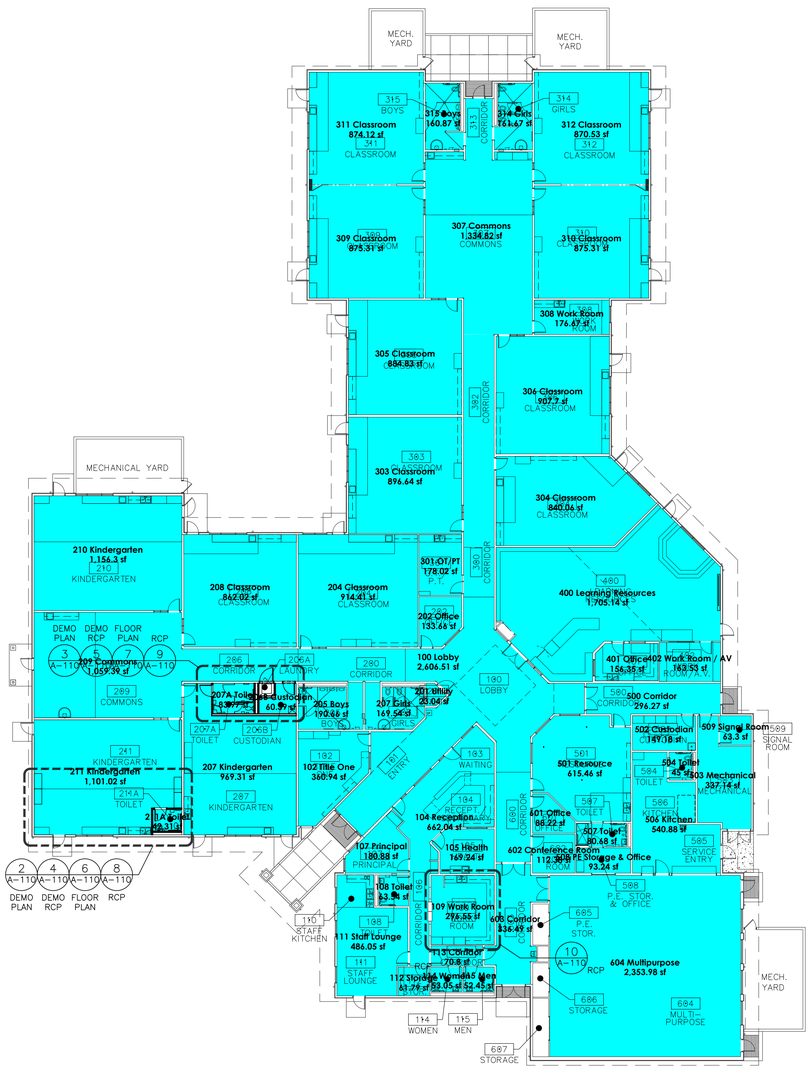
ANNOTATED FLOOR PLANS



1 KEY PLAN, PRIMARY
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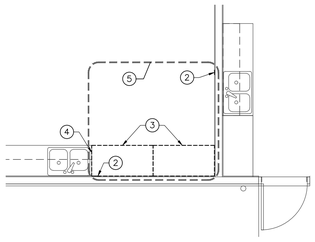
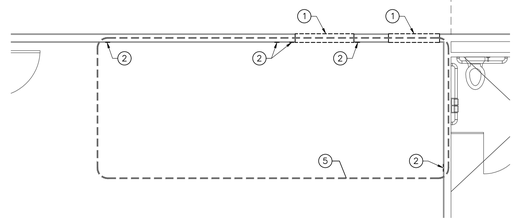
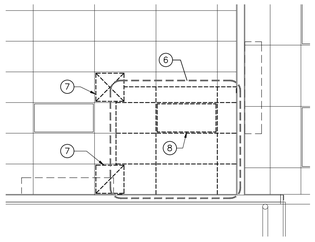


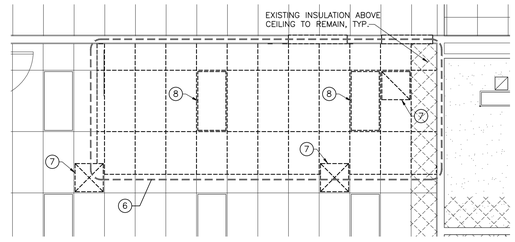
2 DEMOLITION PLAN AT 211
SCALE: 1/4"=1'-0"



3 DEMOLITION PLAN AT 207
SCALE: 1/4"=1'-0"
0 2' 4' 8'



4 DEMOLITION RCP AT 211
SCALE: 1/4"=1'-0"



5 DEMOLITION RCP AT 207
SCALE: 1/4"=1'-0"

DEMOLITION LEGEND

③ KEYNOTE TAG

---------- ITEMS TO BE DEMOLISHED FOR REMOVAL OR SALVAGE. SEE NOTES.

SLAB DEMOLITION NOTE

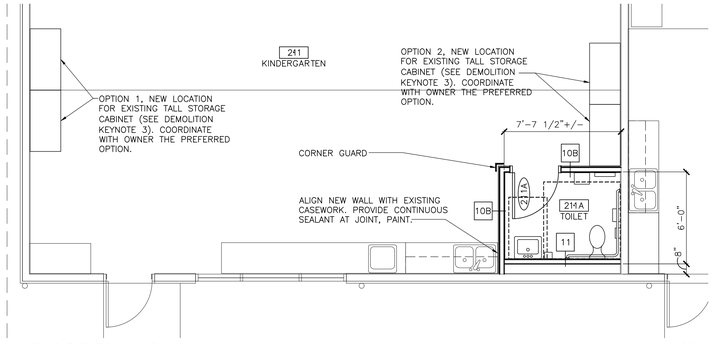
SAWCUTTING OF THE EXISTING SLAB WILL BE REQUIRED FOR INSTALLATION OF NEW UNDERSLAB UTILITIES. SEE DRAWING 1/M-101 FOR APPROXIMATE AREA OF SAWCUTTING AND STRUCTURAL FOR CONCRETE INFILL REQUIREMENTS.

DEMOLITION KEYNOTES (FLOOR & RCP)

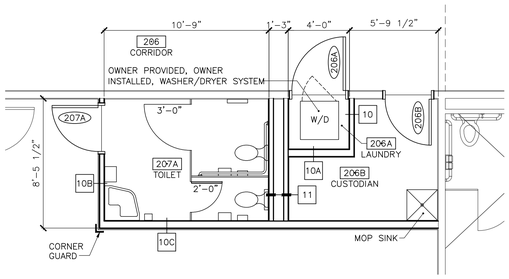
1. DEMO AND REMOVE OPENING IN EXISTING WALL AS REQUIRED TO PROVIDE FRAMING FOR NEW DOOR SYSTEM. SEE PLANS FOR DIMENSIONAL REFERENCES.
2. DEMO AND REMOVE GWB AS REQUIRED TO RECEIVE STUDS OF NEW WALL SYSTEM. SEE PLANS FOR DIMENSIONAL REFERENCES.
3. DEMO AND SALVAGE CASEWORK UNITS FOR RELOCATION. SEE PLANS FOR NEW LOCATION.
4. DEMO AND REMOVE COUNTERTOP AS REQUIRED TO RECEIVE NEW WALL SYSTEM.
5. DEMO AND REMOVE FLOORING THIS ZONE TO RECEIVE NEW ROOM(S). SEE PLANS FOR DIMENSIONAL REFERENCES.
6. DEMO AND REMOVE CEILING SYSTEM THIS AREA TO ACCOMMODATE NEW ROOM(S). COORDINATE ADDITIONAL REMOVAL AS REQUIRED TO WORK WITH EXISTING SUSPENDED CEILING SYSTEM. SEE PLANS FOR DIMENSIONAL REFERENCES.
7. DEMO AND SALVAGE HVAC DIFFUSER/RETURN GRILL FOR RELOCATION. SEE PLANS AND MECHANICAL FOR NEW LOCATIONS.
8. DEMO AND SALVAGE LIGHT FIXTURE FOR RELOCATION. SEE PLANS AND ELECTRICAL FOR NEW LOCATIONS.

FLOOR PLAN NOTES

SEE SHEET A-710 FOR WALL ASSEMBLIES



6 FLOOR PLAN, 211A
SCALE: 1/4"=1'-0"



7 FLOOR PLAN, 206A/206B/207A
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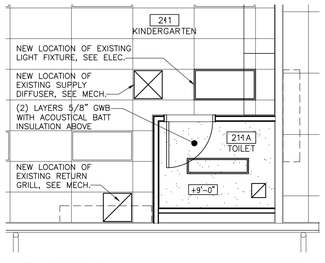

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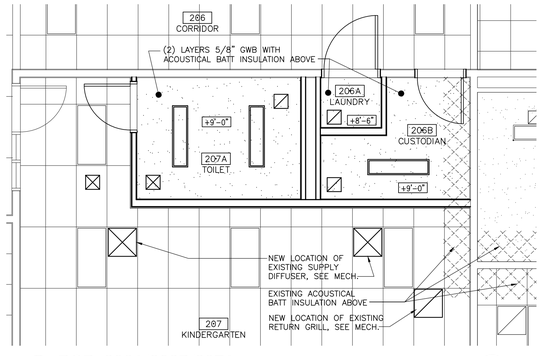

9 RCP, 206A/206B/207A
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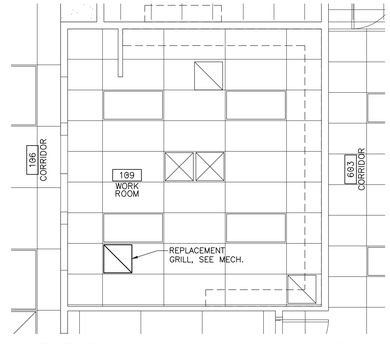


10 RCP, 109
SCALE: 1/4"=1'-0"

INT. ELEV. SCHEDULE

RM #	DESCRIPTION	DRWG/SHT
206B	CUSTODIAN	1/A-710
207A	TOILET	2/A-710
211A	TOILET	3/A-710
211	KINDERGARTEN (CLASSROOM)	4/A-710

RCP LEGEND

ACOUSTICAL TILE CEILING SYSTEM

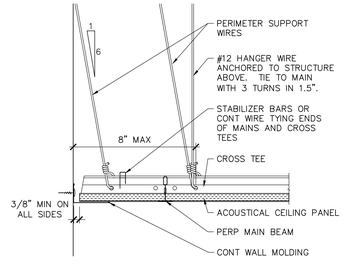
GYPSUM CEILING

LIGHT FIXTURE

CEILING DIFFUSER / GRILLE, SEE MECH.

RCP NOTES:

1. UNLESS NOTED OTHERWISE ON RCP PLANS, MAINTAIN THE EXISTING CEILING HEIGHT OF ALL SPACES.
2. SEE DETAILS 11, 12, & 13 THIS SHEET FOR TYPICAL SUSPENDED GRID CEILING DETAILS.



11 TYP. CEILING GRID EDGE DETAIL
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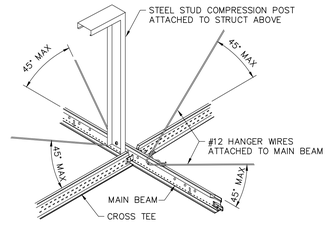

12 TYP. CEILING GRID COMPRESSION POST
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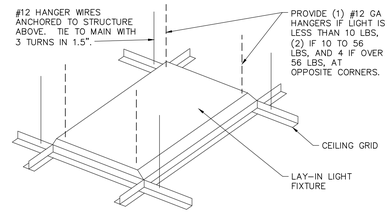

13 TYP. CLNG. GRID FIXTURE SUPPORTS
SCALE: 3" = 1'- 0"

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Chimacum School District

TITLE

CHIMACUM SCHOOL DISTRICT

TENANT IMPROVEMENTS

91 WEST VALLEY ROAD
CHIMACUM, WA 98325

STAMP

6181 REGISTERED ARCHITECT
CHARLES STRAZZARA
STATE OF WASHINGTON

KEY PLAN

PROJECT NUMBER
18106

ISSUED FOR:	DATE:
PERMIT SET	5/30/19
BID SET	6/6/19

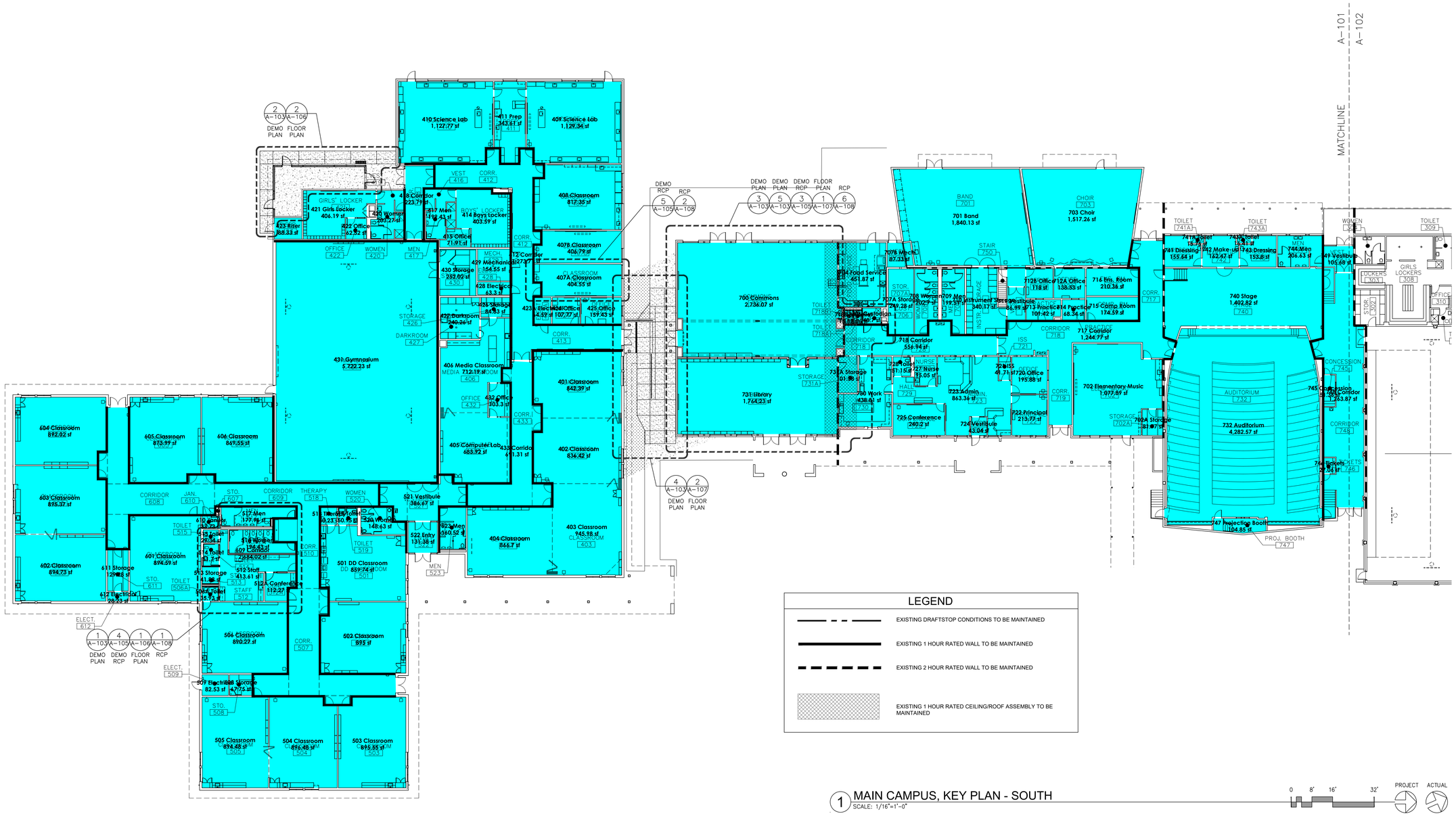
PLAN APPROVAL
DRAWN BY: BKD
CHECKED: DLE

SHEET CONTENTS

PRIMARY: KEY PLAN, DEMO PLANS/RCPS, FLOOR PLANS/RCPS

SHEET NUMBER

A-110



LEGEND

- EXISTING DRAFTSTOP CONDITIONS TO BE MAINTAINED
- EXISTING 1 HOUR RATED WALL TO BE MAINTAINED
- EXISTING 2 HOUR RATED WALL TO BE MAINTAINED
- EXISTING 1 HOUR RATED CEILING/ROOF ASSEMBLY TO BE MAINTAINED

1 MAIN CAMPUS, KEY PLAN - SOUTH
SCALE: 1/16"=1'–0"

0 8' 16' 32' PROJECT ACTUAL

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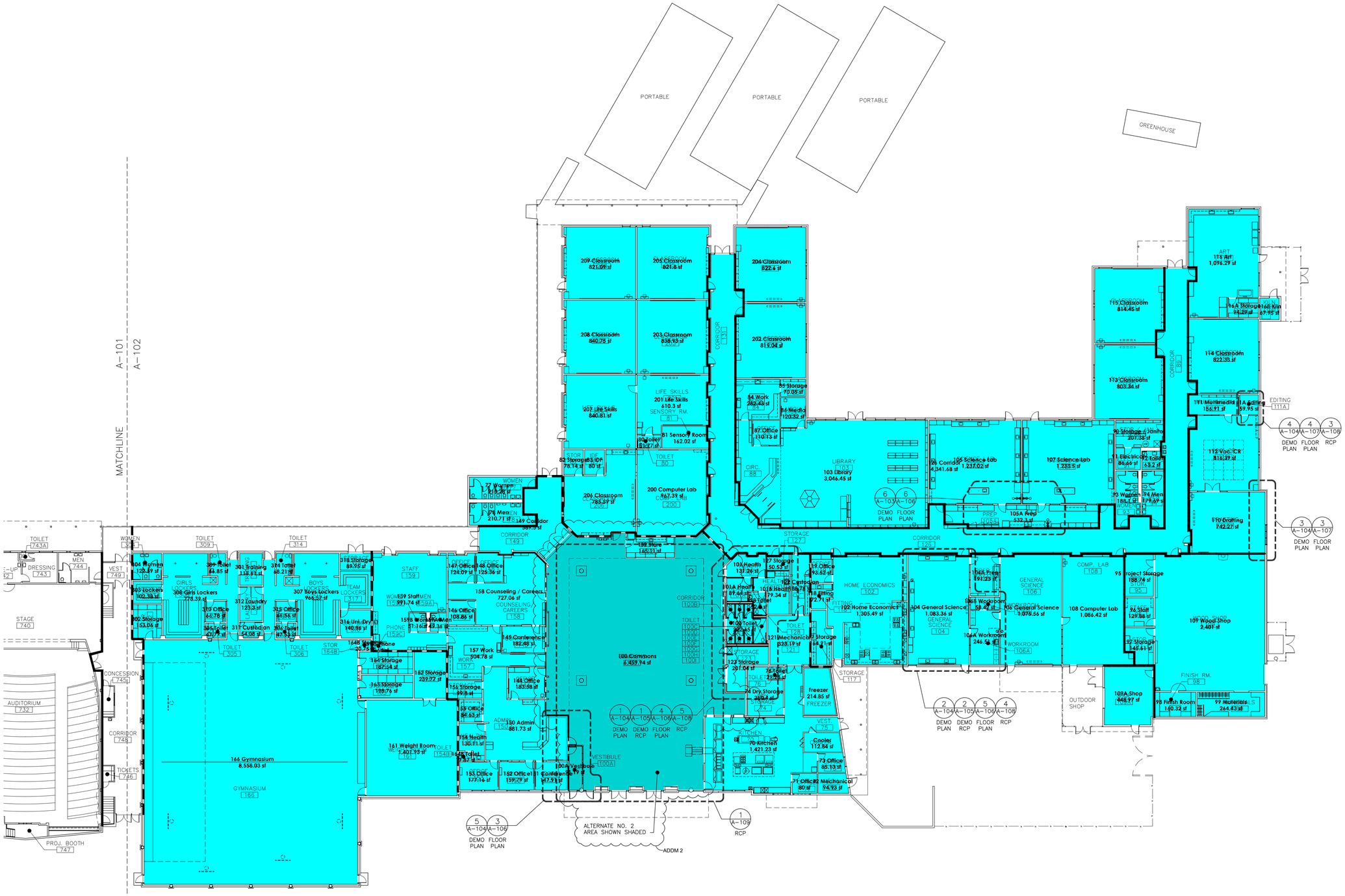
PERMIT SET	5/30/19
BID SET	6/6/19

PLAN APPROVAL

DRAWN BY: BKD
CHECKED: DLE

SHEET CONTENTS
MAIN: KEY PLAN, SOUTH

SHEET NUMBER
A–101



LEGEND

- EXISTING DRAFTSTOP CONDITIONS TO BE MAINTAINED
- EXISTING 1 HOUR RATED WALL TO BE MAINTAINED
- EXISTING 2 HOUR RATED WALL TO BE MAINTAINED
- EXISTING 1 HOUR RATED CEILING/ROOF ASSEMBLY TO BE MAINTAINED

1 MAIN CAMPUS, KEY PLAN - NORTH
SCALE: 1/16"=1'-0"

0 8' 16' 32' PROJECT ACTUAL

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STAMP

KEY PLAN

PROJECT NUMBER

18106

ISSUED FOR:	DATE:
PERMIT SET	5/30/19
BID SET	6/6/19

PLAN APPROVAL

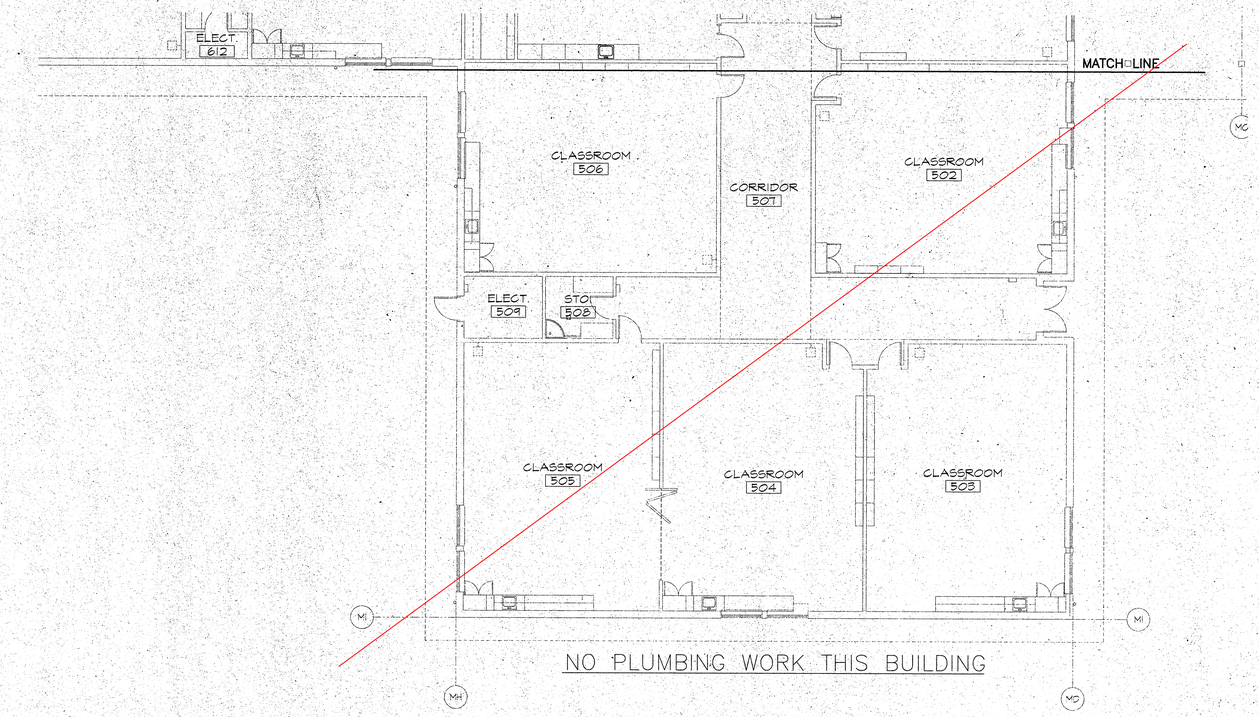
DRAWN BY: BKD
CHECKED: DLE

SHEET CONTENTS

MAIN: KEY PLAN, NORTH

SHEET NUMBER

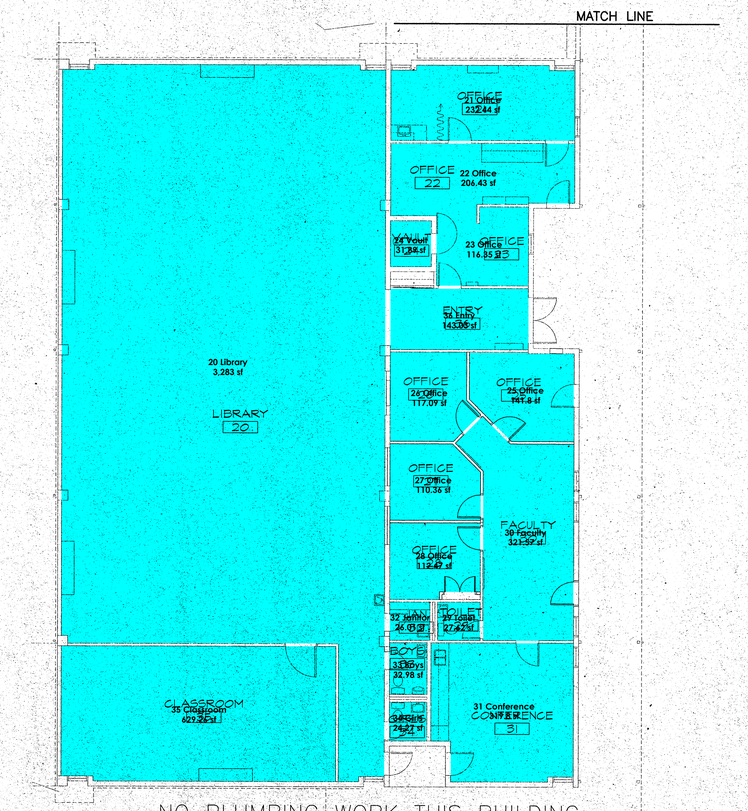
A–102



NO PLUMBING WORK THIS BUILDING

PARTIAL FLOOR PLAN: MIDDLE SCHOOL

SCALE: 1/8" = 1'-0"

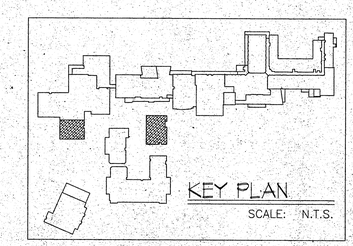


NO PLUMBING WORK THIS BUILDING

MATCH LINE

FLOOR PLAN: K-8 LIBRARY

SCALE: 1/8" = 1'-0"



PLOT DATE: 5/5/98

DRAWING NAME:

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506 South 11th Street Suite 2
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CHIMACUM SCHOOL
DISTRICT NO. 49

MODERNIZATION AND ADDITIONS
CHIMACUM SCHOOLS
91 WEST VALLEY ROAD
CHIMACUM, WASHINGTON 98325

project no.
179701

date
4/28/98

revisions

RICHARD A. HULTZ
STATE OF WASHINGTON
9979
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 8-14-98

sheet title
PARTIAL
FLOOR PLANS

sheet
M3.5

GENERAL NOTES:

1. FOR PIPING SIZES TO INDIVIDUAL PLUMBING FIXTURES SEE "PLUMBING FIXTURE SCHEDULE", SHEET M1.1.
2. PROVIDE WALL CLEANOUT BENEATH COUNTERS FOR ALL SINKS.

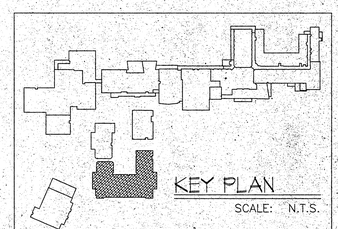
BUBBLE NOTES:

(1) CONNECT CW/HW AT SAME LOCATIONS WHERE EXISTING TAKE-OFFS WERE REMOVED. PROVIDE NEW FITTINGS AND INSULATION.

PARTIAL FLOOR PLAN: ELEM. SCHOOL

SCALE: 1/8" = 1'-0"

NORTH



PLOT DATE: 02/10/98 DRAWING NAME:

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CHIMACUM SCHOOL DISTRICT NO. 49

MODERNIZATION AND ADDITIONS
CHIMACUM SCHOOLS

91 WEST VALLEY ROAD
CHIMACUM, WASHINGTON 98325

project no.
179701

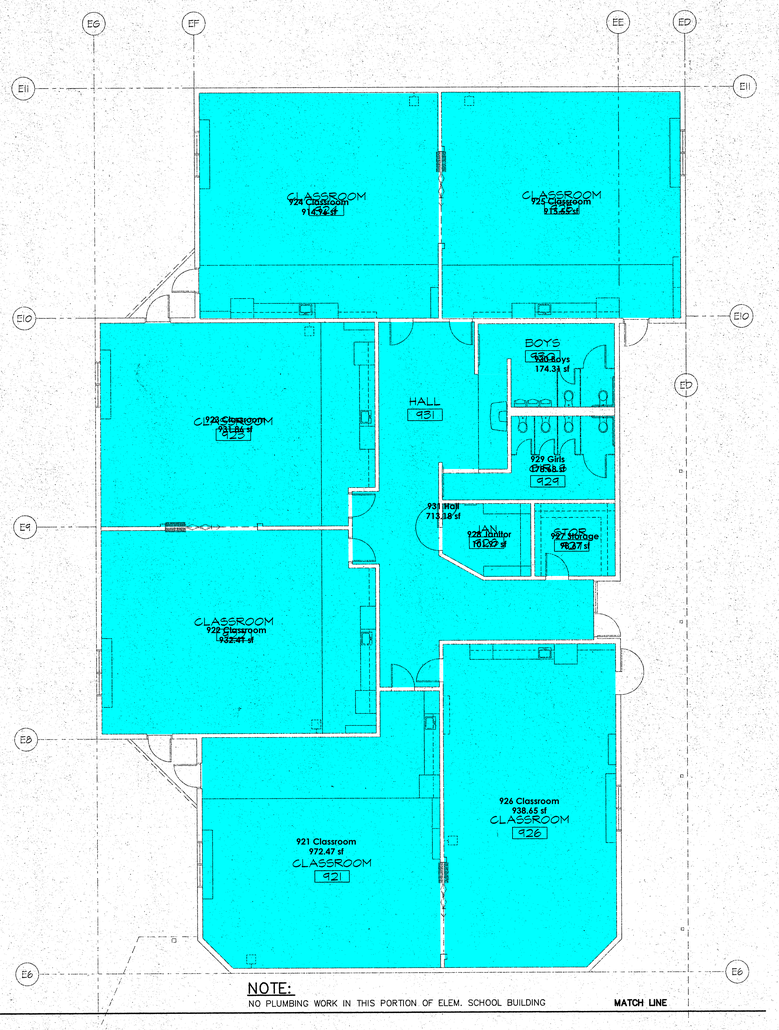
date
4/28/98

revisions

RICHARD A. HULTZ STATE OF WASHINGTON 1979 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 8-14-98

sheet title
PARTIAL FLOOR PLAN ELEM. SCHOOL

sheet
M3.6



NOTE:
NO PLUMBING WORK IN THIS PORTION OF ELEM. SCHOOL BUILDING

MATCH LINE

PARTIAL FLOOR PLAN: ELEM. SCHOOL

SCALE: 1/8"= 1'-0"

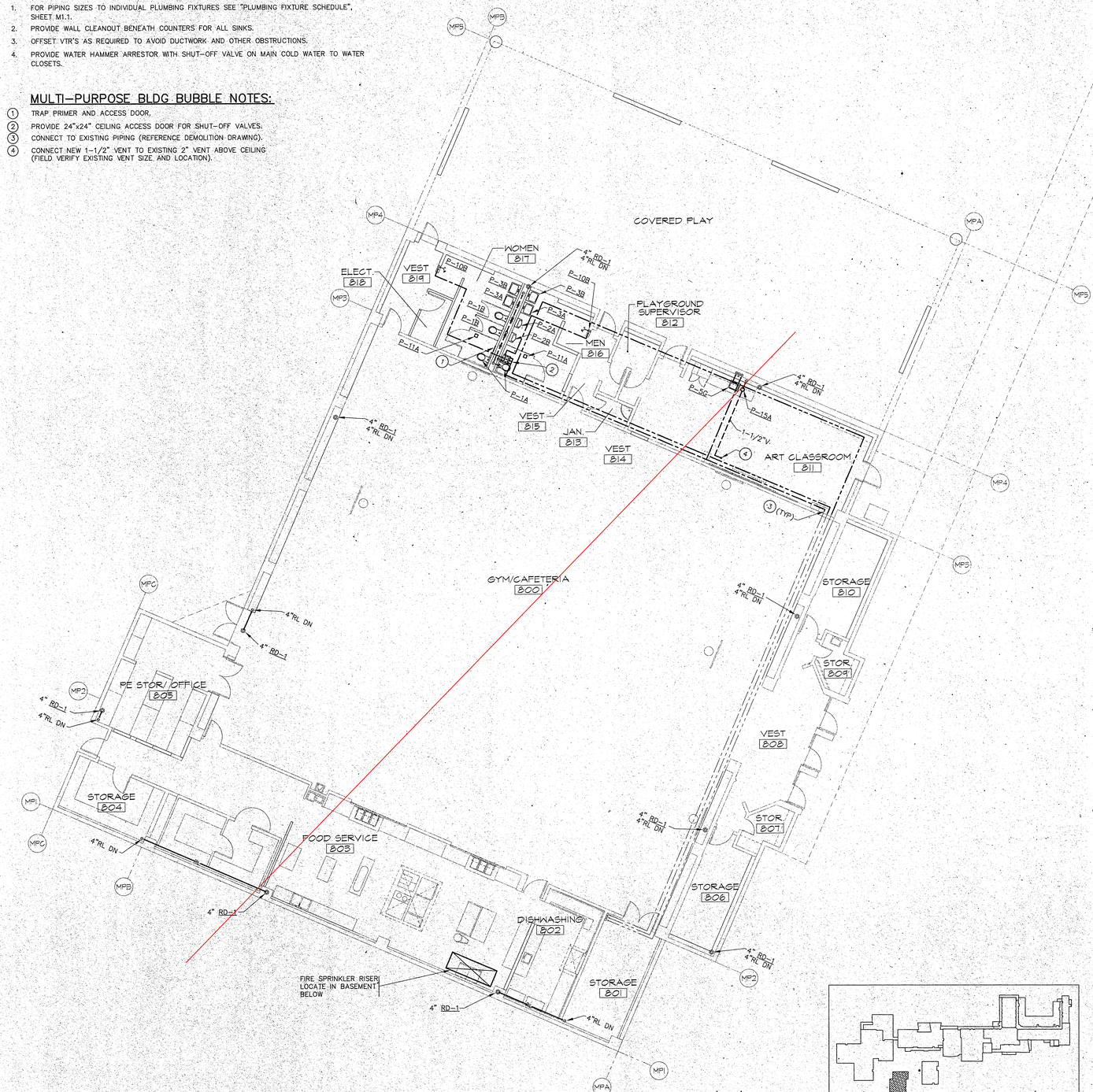
NORTH

MULTI-PURPOSE BLDG GENERAL NOTES:

1. FOR PIPING SIZES TO INDIVIDUAL PLUMBING FIXTURES SEE "PLUMBING FIXTURE SCHEDULE", SHEET M1.1.
2. PROVIDE WALL CLEANOUT BENEATH COUNTERS FOR ALL SINKS.
3. OFFSET VTR'S AS REQUIRED TO AVOID DUCTWORK AND OTHER OBSTRUCTIONS.
4. PROVIDE WATER HAMMER ARRESTOR WITH SHUT-OFF VALVE ON MAIN COLD WATER TO WATER CLOSETS.

MULTI-PURPOSE BLDG BUBBLE NOTES:

1. TRAP PRIMER AND ACCESS DOOR.
2. PROVIDE 24"x24" CEILING ACCESS DOOR FOR SHUT-OFF VALVES.
3. CONNECT TO EXISTING PIPING (REFERENCE DEMOLITION DRAWING).
4. CONNECT NEW 1-1/2" VENT TO EXISTING 2" VENT ABOVE CEILING (FIELD VERIFY EXISTING VENT SIZE AND LOCATION).



FLOOR PLAN: MULTI-PURPOSE BLDG.

SCALE: 1/8"= 1'-0"

NORTH

SCALE: N.T.S.

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seattle, washington 98101
(206) 682-5000

HULTZ & ASSOCIATES
CONSULTING ENGINEERS
508 South 11th Street, Suite 2
Tacoma, WA 98402 - (253) 383-3257

CHIMACUM SCHOOL DISTRICT NO. 49

MODERNIZATION AND ADDITIONS
CHIMACUM SCHOOLS
91 WEST VALLEY ROAD
CHIMACUM, WASHINGTON 98325

project no.
179701

date
4/28/98

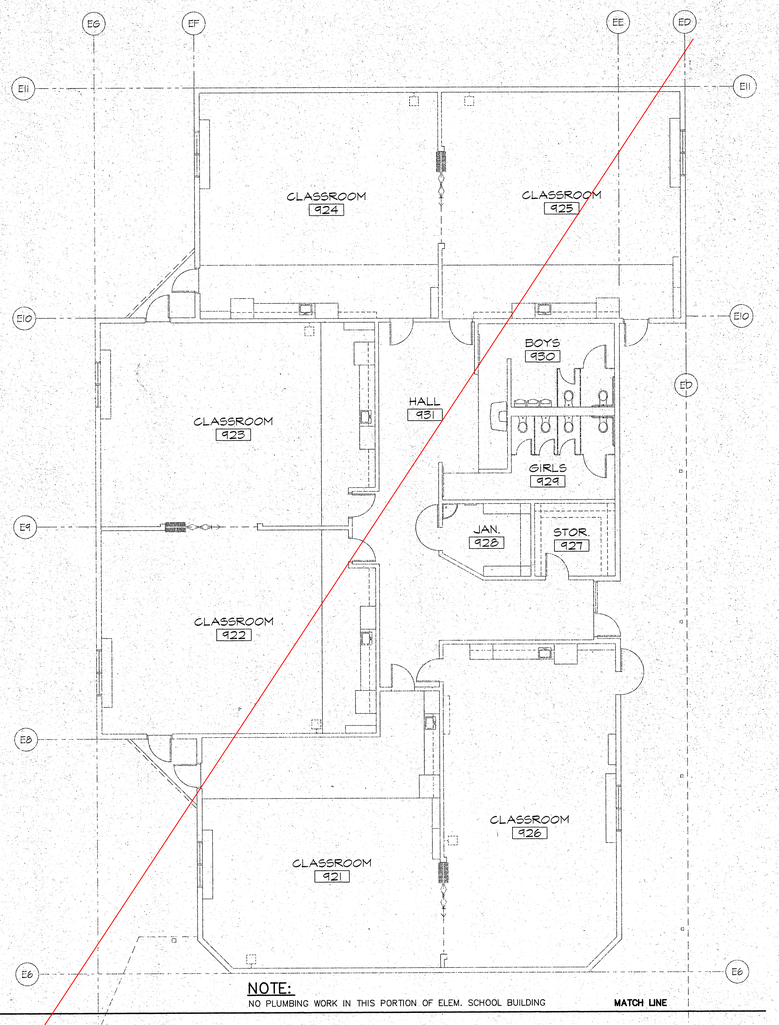
revisions

RICHARD A. HULTZ
STATE OF WASHINGTON
2989
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 8-14-98

sheet title
PARTIAL FLOOR PLANS ELEM./ M-P

sheet
M3.7

PLOT DATE: 02/10/98 DRAWING NAME:



NOTE:
NO PLUMBING WORK IN THIS PORTION OF ELEM. SCHOOL BUILDING

MATCH LINE

PARTIAL FLOOR PLAN: ELEM. SCHOOL

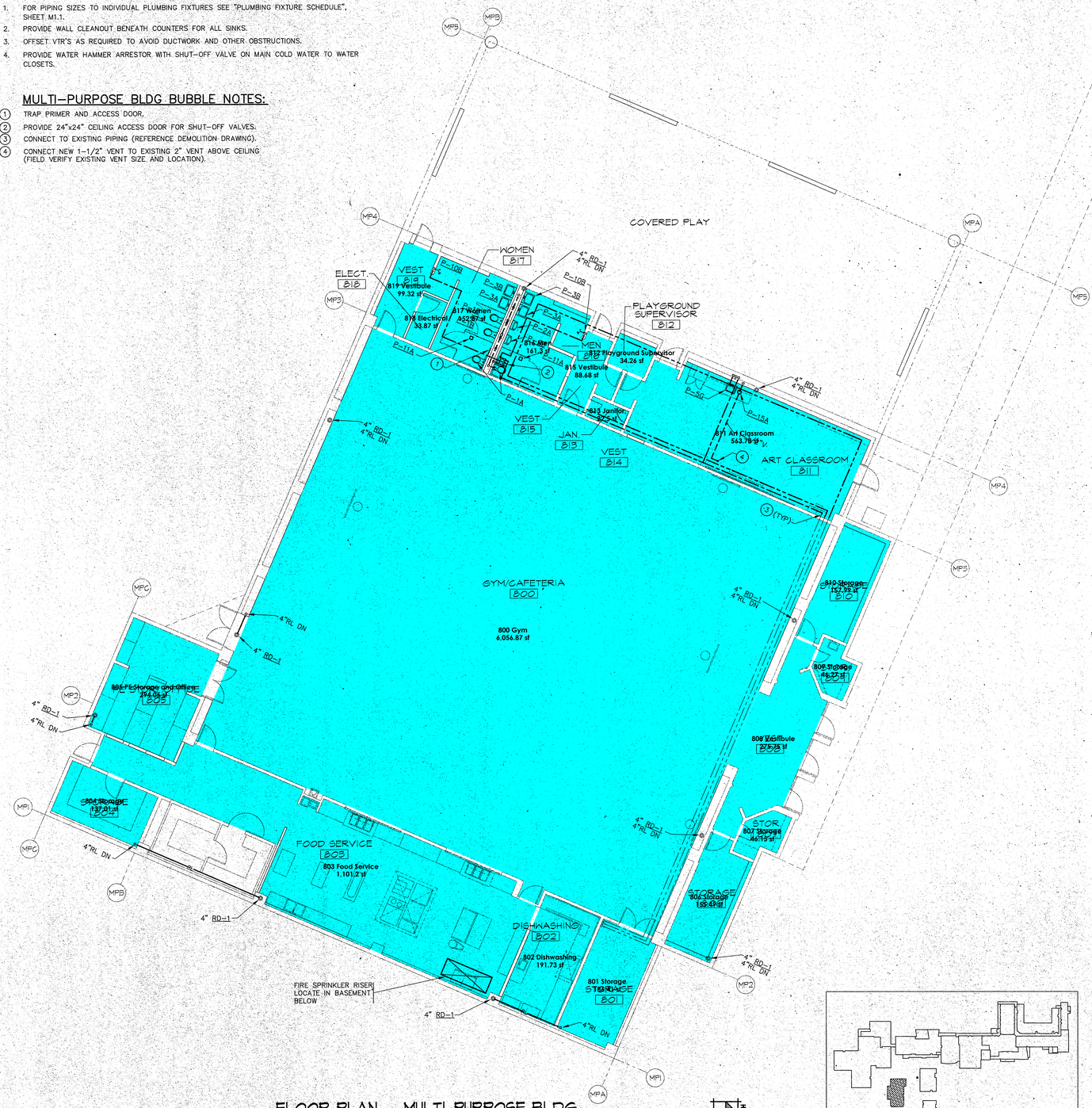
SCALE: 1/8"= 1'-0"

MULTI-PURPOSE BLDG GENERAL NOTES:

1. FOR PIPING SIZES TO INDIVIDUAL PLUMBING FIXTURES SEE "PLUMBING FIXTURE SCHEDULE", SHEET M1.1.
2. PROVIDE WALL CLEANOUT BENEATH COUNTERS FOR ALL SINKS.
3. OFFSET VTR'S AS REQUIRED TO AVOID DUCTWORK AND OTHER OBSTRUCTIONS.
4. PROVIDE WATER HAMMER ARRESTOR WITH SHUT-OFF VALVE ON MAIN COLD WATER TO WATER CLOSETS.

MULTI-PURPOSE BLDG BUBBLE NOTES:

1. TRAP PRIMER AND ACCESS DOOR.
2. PROVIDE 24"x24" CEILING ACCESS DOOR FOR SHUT-OFF VALVES.
3. CONNECT TO EXISTING PIPING (REFERENCE DEMOLITION DRAWING).
4. CONNECT NEW 1-1/2" VENT TO EXISTING 2" VENT ABOVE CEILING (FIELD VERIFY EXISTING VENT SIZE AND LOCATION).



FLOOR PLAN: MULTI-PURPOSE BLDG.

SCALE: 1/8"= 1'-0"

KEY PLAN
SCALE: N.T.S.

PLOT DATE: 02/10/98
DRAWING NAME:

CORNERSTONE
architectural group, p.s.
1904 third avenue
suite 220
seattle, washington 98101
(206) 682-5000

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PARTIAL FLOOR PLANS ELEM./ M-P

sheet
M3.7

PHOTO LOG

Typical classroom roof top unit

Large multizone rooftop unit

Individual classroom room inside of multizone unit

Auditorium air handling unit

TEST ADJUST AND BALANCE REPORT

UNITED
TEST & BALANCE, INC.
Independent, Certified and Accurate

Chimacum School District

Airflow Audits

91 W Valley Rd, Chimacum, WA 98325

Submission of

Airflow Audit Report

November 22, 2021

Commissioning Firm: MENG Analysis
2001 Western Ave, Ste 200, Seattle, WA 98121

TAB Firm: United Test & Balance, Inc.
7013 Flagler Rd, Nordland, WA 98358

Table Of Contents

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

Report Summary/Remarks

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

Scope of Work

Includes

The Test and Balance (TAB) scope of work consist of auditing the existing buildings HVAC systems at the direction of the commissioning authority.

General Remarks

Remark 1

The systems were measured in accordance with the drawings at the back of the report. There were areas that were measured by area, and others that were associated with their respective units.

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: Auditorium

Final Airflow (CFM)	
Actual Total CFM	10901
Actual Grille Total CFM	Not Applicable
Actual Return Air CFM	10901
Actual Min O/A CFM	0
Fan CFM Test Method	Traverse Total
OA Method/Instrument	Not Applicable
OA Ak (sq ft)	-

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

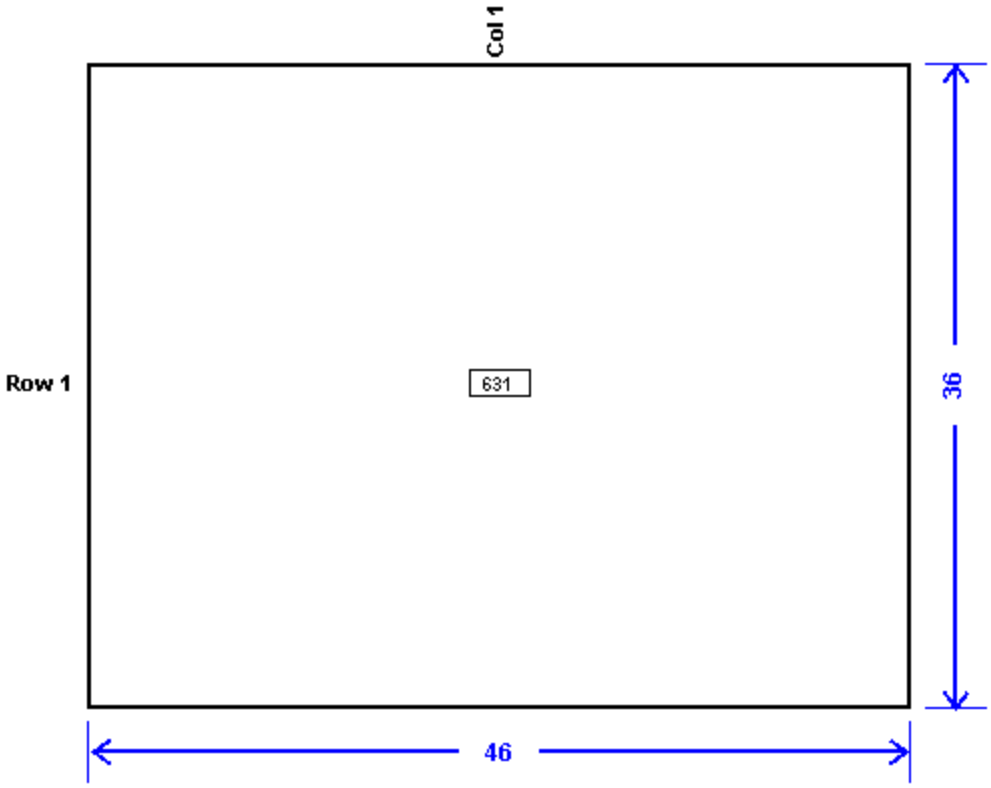
SYSTEM/UNIT: Auditorium/Traverse 1

Unit Design Data	
Location	Supply Duct

Traverse Data	
Duct Shape	Rectangular
Duct Width (in)	46
Duct Height (in)	36
Inner Dimensions (in)	46x36
AK (sq ft)	11.500

Test Data	
Actual Airflow (CFM)	7257
Average Velocity (FPM)	631
Probe	Airfoil
Instrument	ADM
Number Of Rows	1
Readings Per Row	1
Total Readings	1

Traverse Data Points



Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

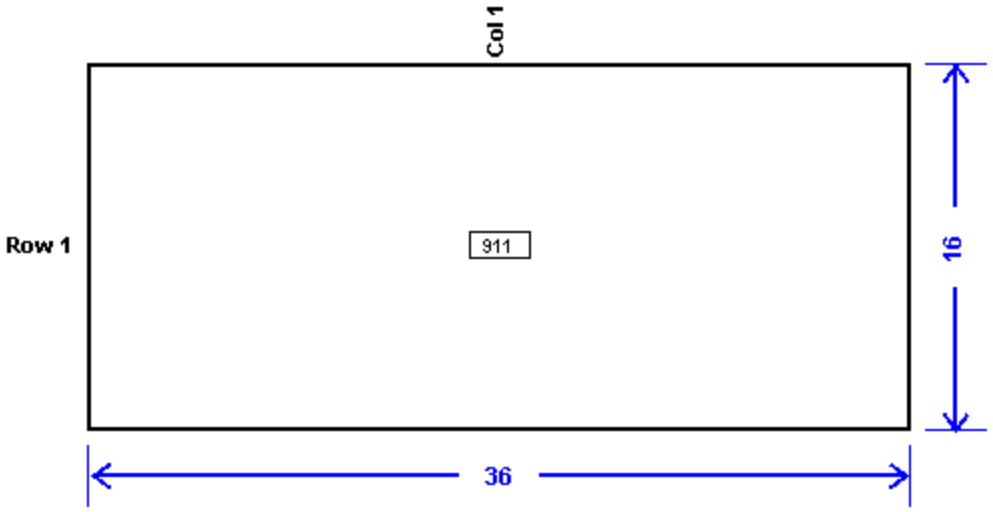
SYSTEM/UNIT: Auditorium/Traverse 2

Unit Design Data	
Location	Supply Duct

Traverse Data	
Duct Shape	Rectangular
Duct Width (in)	36
Duct Height (in)	16
Inner Dimensions (in)	36x16
AK (sq ft)	4.000

Test Data	
Actual Airflow (CFM)	3644
Average Velocity (FPM)	911
Probe	Airfoil
Instrument	ADM
Number Of Rows	1
Readings Per Row	1
Total Readings	1

Traverse Data Points



SYSTEM/UNIT: County Health

Log: County Health — Unable to determine the unit that serves this area from the drawings.

County Health Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Health 101	CD			143	143		Flow Hood	1.000	1.000	143
S-02	Storage 127	CD			43	43		Flow Hood	1.000	1.000	43
S-03	Health 101A	CD			104	104		Flow Hood	1.000	1.000	104
S-04	Health 101B	CD			90	90		Flow Hood	1.000	1.000	90
	Totals:	**-**	**-**	**0**	**380**	**380**	**0**	**-**	**-**	**-**	**-**

County Health Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Health 101B	CD			125	125		Flow Hood	1.000	1.000	125
	Totals:	**-**	**-**	**0**	**125**	**125**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: COVID Iso Rm

Log: COVID Iso Rm — Unable to determine the unit that serves this area from the drawings.

COVID Iso Rm Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01 HP-120	Office 144	CD			0	0		Flow Hood	1.000	1.000	0
S-02	Admin 150	CD			113	113		Flow Hood	1.000	1.000	113
S-03	Admin 150	CD			273	273		Flow Hood	1.000	1.000	273
S-04	Admin 723	CD			185	185		Flow Hood	1.000	1.000	185
	Totals:	**-**	**-**	**0**	**571**	**571**	**0**	**-**	**-**	**-**	**-**

COVID Iso Rm Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01 HP-120	Office 144	CD			0	0		Flow Hood	1.000	1.000	0
R-02	Admin 150	CD			611	611		Flow Hood	1.000	1.000	611
	Totals:	**-**	**-**	**0**	**611**	**611**	**0**	**-**	**-**	**-**	**-**

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-002
AREA: Life Skills 108

Final Airflow (CFM)	
Actual Total CFM	1895
Actual Grille Total CFM	1895
Actual Return Air CFM	1559
Actual Min O/A CFM	336
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	32x18

HP-002 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 108	CD			233	233		Flow Hood	1.000	1.000	233
S-02	Rm 108	CD			258	258		Flow Hood	1.000	1.000	258
S-03	Rm 108	CD			211	211		Flow Hood	1.000	1.000	211
S-04	Rm 108	CD			234	234		Flow Hood	1.000	1.000	234
S-05	Rm 108	CD			239	239		Flow Hood	1.000	1.000	239
S-06	Rm 108	CD			263	263		Flow Hood	1.000	1.000	263
S-07	Rm 108	CD			218	218		Flow Hood	1.000	1.000	218
S-08	Rm 108	CD			239	239		Flow Hood	1.000	1.000	239
	Totals:	**-**	**-**	**0**	**1895**	**1895**	**0**	**-**	**-**	**-**	**-**

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-008

Final Airflow (CFM)	
Actual Total CFM	1114
Actual Grille Total CFM	1114
Actual Return Air CFM	1037
Actual Min O/A CFM	77
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	20x18

HP-008 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 303	CD		300	281	281	94	Flow Hood	1.000	1.000	281
S-02	Rm 303	CD		300	297	297	99	Flow Hood	1.000	1.000	297
S-03	Rm 303	CD		300	239	239	80	Flow Hood	1.000	1.000	239
S-04	Rm 303	CD		300	297	297	99	Flow Hood	1.000	1.000	297
	Totals:	-	-	**1200**	**1114**	**1114**	**93**	-	-	-	-

HP-008 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Rm 303	CD			825	825		Flow Hood	1.000	1.000	825
	Totals:	-	-	**0**	**825**	**825**	**0**	-	-	-	-

HP-008 Exhaust Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
Relief	Rm 303	CD			0	0		Flow Hood	1.000	1.000	0
	Totals:	-	-	**0**	**0**	**0**	**0**	-	-	-	-

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-014

Final Airflow (CFM)	
Actual Total CFM	1027
Actual Grille Total CFM	1027
Actual Return Air CFM	914
Actual Min O/A CFM	113
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	20x20

HP-014 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 201	CD			162	162		Flow Hood	1.000	1.000	162
S-02	Rm 201	CD			174	174		Flow Hood	1.000	1.000	174
S-03	Rm 201	CD			187	187		Flow Hood	1.000	1.000	187
S-04	Rm 201	CD			131	131		Flow Hood	1.000	1.000	131
S-05	Rm 201	CD			185	185		Flow Hood	1.000	1.000	185
S-06	Rm 201	CD			188	188		Flow Hood	1.000	1.000	188
	Totals:	**-**	**-**	**0**	**1027**	**1027**	**0**	**-**	**-**	**-**	**-**

HP-014 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Rm 207	CD			780	780		Flow Hood	1.000	1.000	780
	Totals:	**-**	**-**	**0**	**780**	**780**	**0**	**-**	**-**	**-**	**-**

HP-014 Exhaust Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
Relief	Rm 207	CD			0	0		Flow Hood	1.000	1.000	0
	Totals:	**-**	**-**	**0**	**0**	**0**	**0**	**-**	**-**	**-**	**-**

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-020

Final Airflow (CFM)	
Actual Total CFM	948
Actual Grille Total CFM	948
Actual Return Air CFM	910
Actual Min O/A CFM	38 Approx
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Return Grilles
OA Ak (sq ft)	24x12

Log:				
	HP-020	11/22/2021	William Clayton	Unable to directly measure outside air, damper appears closed.

HP-020 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Library 103	CD			210	210		Flow Hood	1.000	1.000	210
S-02	Library 103	CD			75	75		Flow Hood	1.000	1.000	75
S-03	Library 103	CD			239	239		Flow Hood	1.000	1.000	239
S-04*	Lab 105	CD			204	204		Flow Hood	1.000	1.000	204
S-05	Lab 107	CD			324	324		Flow Hood	1.000	1.000	324
S-06	Corridor 89	CD			80	80		Flow Hood	1.000	1.000	80
	Totals:	**-**	**-**	**0**	**1132**	**1132**	**0**	**-**	**-**	**-**	**-**

Log:		
	HP-020/S-04	Outlets S-04 thru S-06 may be served by a different unit, not included in unit calculation.

HP-020 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Library 103	CD			910	910		Flow Hood	1.000	1.000	910
	Totals:	**-**	**-**	**0**	**910**	**910**	**0**	**-**	**-**	**-**	**-**

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-021

Final Airflow (CFM)	
Actual Total CFM	907
Actual Grille Total CFM	907
Actual Return Air CFM	815
Actual Min O/A CFM	92
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Return Grilles
OA Ak (sq ft)	-

HP-021 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 501	CD			231	231		Flow Hood	1.000	1.000	231
S-02	Rm 501	CD			220	220		Flow Hood	1.000	1.000	220
S-03	Rm 501	CD			224	224		Flow Hood	1.000	1.000	224
S-04	Rm 601	CD			50	50		Flow Hood	1.000	1.000	50
S-05	Rm 508	CD			80	80		Flow Hood	1.000	1.000	80
S-06	Rm 602	CD			102	102		Flow Hood	1.000	1.000	102
	Totals:	**-**	**-**	**0**	**907**	**907**	**0**	**-**	**-**	**-**	**-**

HP-021 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Rm 506	CD			815	815		Flow Hood	1.000	1.000	815
	Totals:	**-**	**-**	**0**	**815**	**815**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: HP-102A
AREA: Mezzanine

Final Airflow (CFM)	
Actual Total CFM	985
Actual Grille Total CFM	985
Actual Return Air CFM	717
Actual Min O/A CFM	268
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

HP-102A Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 115	CD			235	235		Flow Hood	1.000	1.000	235
S-02	Rm 115	CD			250	250		Flow Hood	1.000	1.000	250
S-03	Rm 115	CD			260	260		Flow Hood	1.000	1.000	260
S-04	Rm 115	CD			240	240		Flow Hood	1.000	1.000	240
	Totals:	**-**	**-**	**0**	**985**	**985**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: HP-112

Final Airflow (CFM)	
Actual Min O/A CFM	270
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

SYSTEM/UNIT: HP-114

Final Airflow (CFM)	
Actual Min O/A CFM	180
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-202
AREA: Office 720

Final Airflow (CFM)	
Actual Total CFM	1466
Actual Grille Total CFM	1466
Actual Return Air CFM	1337
Actual Min O/A CFM	129
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

HP-202 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01		CD			279	279		Flow Hood	1.000	1.000	279
S-02	Office 720	CD			200	200		Flow Hood	1.000	1.000	200
S-03		CD			79	79		Flow Hood	1.000	1.000	79
S-04		CD			107	107		Flow Hood	1.000	1.000	107
S-05		CD			220	220		Flow Hood	1.000	1.000	220
S-06		CD			110	110		Flow Hood	1.000	1.000	110
S-07		CD			174	174		Flow Hood	1.000	1.000	174
S-08		CD			139	139		Flow Hood	1.000	1.000	139
S-09		CD			158	158		Flow Hood	1.000	1.000	158
	Totals:	**-**	**-**	**0**	**1466**	**1466**	**0**	**-**	**-**	**-**	**-**

HP-202 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01		CD			39	39		Flow Hood	1.000	1.000	39
R-02	Pract 713	CD			98	98		Flow Hood	1.000	1.000	98
R-03		CD			150	150		Flow Hood	1.000	1.000	150
R-04	Office 720	CD			112	112		Flow Hood	1.000	1.000	112
R-05		CD			220	220		Flow Hood	1.000	1.000	220
R-06		CD			110	110		Flow Hood	1.000	1.000	110
R-07		CD			139	139		Flow Hood	1.000	1.000	139
R-08		CD			174	174		Flow Hood	1.000	1.000	174
	Totals:	**-**	**-**	**0**	**1042**	**1042**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: HP-203
AREA: Office 722

Final Airflow (CFM)	
Actual Total CFM	1488
Actual Grille Total CFM	1488
Actual Return Air CFM	1347
Actual Min O/A CFM	141
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

HP-203 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 721	CD			76	76		Flow Hood	1.000	1.000	76
S-02	Admin 723	CD			39	39		Flow Hood	1.000	1.000	39
S-03	Admin 723	CD			157	157		Flow Hood	1.000	1.000	157
S-04	Admin 723	CD			167	167		Flow Hood	1.000	1.000	167
S-05	Admin 723	CD			92	92		Flow Hood	1.000	1.000	92
S-06	Princ 722	CD			135	135		Flow Hood	1.000	1.000	135
S-07	Corridor 719	CD			69	69		Flow Hood	1.000	1.000	69
S-08		CD			233	233		Flow Hood	1.000	1.000	233
S-09		CD			90	90		Flow Hood	1.000	1.000	90
S-10		CD			225	225		Flow Hood	1.000	1.000	225
S-11		CD			145	145		Flow Hood	1.000	1.000	145
S-12		CD			60	60		Flow Hood	1.000	1.000	60
	Totals:	-	-	**0**	**1488**	**1488**	**0**	-	-	-	-

HP-203 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Admin 723	CD			669	669		Flow Hood	1.000	1.000	669
R-02	Princ 722	CD			211	211		Flow Hood	1.000	1.000	211
R-03		CD			223	223		Flow Hood	1.000	1.000	223
R-04		CD			91	91		Flow Hood	1.000	1.000	91
	Totals:	-	-	**0**	**1194**	**1194**	**0**	-	-	-	-

SYSTEM/UNIT: HP-204

Final Airflow (CFM)	
Actual Min O/A CFM	486
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-205
AREA: Library

Final Airflow (CFM)	
Actual Total CFM	1046
Actual Grille Total CFM	1046
Actual Return Air CFM	1046
Actual Min O/A CFM	0
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	38x24

HP-205 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 731	CD			241	241		Flow Hood	1.000	1.000	241
S-02	Rm 731	CD			290	290		Flow Hood	1.000	1.000	290
S-03	Rm 731	CD			250	250		Flow Hood	1.000	1.000	250
S-04	Rm 731	CD			265	265		Flow Hood	1.000	1.000	265
	Totals:	**-**	**-**	**0**	**1046**	**1046**	**0**	**-**	**-**	**-**	**-**

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-206
AREA: Commons 700

Final Airflow (CFM)	
Actual Total CFM	2903
Actual Grille Total CFM	2903
Actual Return Air CFM	2592
Actual Min O/A CFM	311
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	34x24

HP-206 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 700	CD			300	300		Flow Hood	1.000	1.000	300
S-02	Rm 700	CD			260	260		Flow Hood	1.000	1.000	260
S-03	Rm 700	CD			236	236		Flow Hood	1.000	1.000	236
S-04	Rm 700	CD			189	189		Flow Hood	1.000	1.000	189
S-05	Rm 700	SW			641	641		Flow Hood	1.000	1.000	641
S-06	Rm 700	SW			526	526		Flow Hood	1.000	1.000	526
S-07	Rm 700	SW			416	416		Flow Hood	1.000	1.000	416
S-08	Rm 700	SW			335	335		Flow Hood	1.000	1.000	335
S-09*	Rm 700	SW			0	0		Flow Hood	1.000	1.000	0
S-10	Rm 700	SW			0	0		Flow Hood	1.000	1.000	0
S-11	Rm 700	SW			0	0		Flow Hood	1.000	1.000	0
S-12	Rm 700	SW			0	0		Flow Hood	1.000	1.000	0
	Totals:	-	-	**0**	**2903**	**2903**	**0**	-	-	-	-

Log:

HP-206/S-09	11/21/2021	William Clayton	There was no airflow out of the center run of the duct, possible fire smoke damper closed?

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: HP-208

Final Airflow (CFM)	
Actual Total CFM	703
Actual Grille Total CFM	703
Actual Return Air CFM	529
Actual Min O/A CFM	174
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

HP-208 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Corridor	CD			196	196		Flow Hood	1.000	1.000	196
S-02	Rm 423A	CD			53	53		Flow Hood	1.000	1.000	53
S-03	Rm 424	CD			140	140		Flow Hood	1.000	1.000	140
S-04	Rm 425	CD			107	107		Flow Hood	1.000	1.000	107
S-05	Corridor	CD			207	207		Flow Hood	1.000	1.000	207
	Totals:	**-**	**-**	**0**	**703**	**703**	**0**	**-**	**-**	**-**	**-**

HP-208 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Corridor	CD			502	502		Flow Hood	1.000	1.000	502
	Totals:	**-**	**-**	**0**	**502**	**502**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: HP-210
AREA: Bldg 200

Final Airflow (CFM)	
Actual Total CFM	1178
Actual Grille Total CFM	1178
Actual Return Air CFM	1052
Actual Min O/A CFM	126
Fan CFM Test Method	Supply Outlet Total
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

HP-210 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Room 408	CD	10	300	305	305	102	Flow Hood	1.000	1.000	305
S-02	Room 408	CD	10	300	298	298	99	Flow Hood	1.000	1.000	298
S-03	Room 408	CD	10	300	287	287	96	Flow Hood	1.000	1.000	287
S-04	Room 408	CD	10	300	288	288	96	Flow Hood	1.000	1.000	288
	Totals:	**-**	**-**	**1200**	**1178**	**1178**	**98**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: HP-214

Final Airflow (CFM)	
Actual Min O/A CFM	729
OA Method/Instrument	Traverse
OA Ak (sq ft)	24x18

Air Apparatus

PROJECT: Chimacum School District Audit
LOCATION: Chimacum, WA
PROJECT #: 21336

DATE: 11/22/2021
CONTACT: Steve Burns

SYSTEM/UNIT: MZ-RTU

Final Airflow (CFM)	
Actual Total CFM	6639
Actual Grille Total CFM	6639
Actual Return Air CFM	6639
Actual Min O/A CFM	0
Fan CFM Test Method	Supply Outlet Total

Log:

MZ-RTU	11/22/2021	William Clayton	This unit is running at 100% return, no outside air.

MZ-RTU Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 209	CD			271	271		Flow Hood	1.000	1.000	271
S-02	Rm 209	CD			238	238		Flow Hood	1.000	1.000	238
S-03	Rm 209	CD			219	219		Flow Hood	1.000	1.000	219
S-04	Rm 209	CD			216	216		Flow Hood	1.000	1.000	216
S-05	Rm 205	CD			220	220		Flow Hood	1.000	1.000	220
S-06	Rm 205	CD			270	270		Flow Hood	1.000	1.000	270
S-07	Rm 205	CD			268	268		Flow Hood	1.000	1.000	268
S-08	Rm 205	CD			206	206		Flow Hood	1.000	1.000	206
S-09	Rm 208	CD			213	213		Flow Hood	1.000	1.000	213
S-10	Rm 208	CD			254	254		Flow Hood	1.000	1.000	254
S-11	Rm 208	CD			228	228		Flow Hood	1.000	1.000	228
S-12	Rm 208	CD			278	278		Flow Hood	1.000	1.000	278
S-13	Rm 203	CD			340	340		Flow Hood	1.000	1.000	340
S-14	Rm 203	CD			368	368		Flow Hood	1.000	1.000	368
S-15	Rm 203	CD			388	388		Flow Hood	1.000	1.000	388
S-16	Rm 203	CD			343	343		Flow Hood	1.000	1.000	343
S-17	Rm 207	CD			316	316		Flow Hood	1.000	1.000	316
S-18	Rm 207	CD			340	340		Flow Hood	1.000	1.000	340
S-19	Rm 207	CD			335	335		Flow Hood	1.000	1.000	335
S-20	Rm 207	CD			330	330		Flow Hood	1.000	1.000	330
S-21	Rm 201	CD			271	271		Flow Hood	1.000	1.000	271
S-22	Rm 201	CD			257	257		Flow Hood	1.000	1.000	257
S-23	Rm 201	CD			292	292		Flow Hood	1.000	1.000	292
S-24	Rm 201	CD			178	178		Flow Hood	1.000	1.000	178
	Totals:	-	-	**0**	**6639**	**6639**	**0**	-	-	-	-

SYSTEM/UNIT: Room 202

Log:

Room 202	Unable to determine the unit that serves this area from the drawings.

Room 202 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 202	CD			310	310		Flow Hood	1.000	1.000	310
S-02	Rm 202	CD			300	300		Flow Hood	1.000	1.000	300
S-03	Rm 202	CD			330	330		Flow Hood	1.000	1.000	330
S-04	Rm 202	CD			319	319		Flow Hood	1.000	1.000	319
	Totals:	-	-	**0**	**1259**	**1259**	**0**	-	-	-	-

SYSTEM/UNIT: Room 404

Log:

Room 404	Unable to determine the unit that serves this area from the drawings.

Room 404 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 404	CD			527	527		Flow Hood	1.000	1.000	527
S-02	Rm 404	CD			546	546		Flow Hood	1.000	1.000	546
S-03	Rm 404	CD			533	533		Flow Hood	1.000	1.000	533
	Totals:	-	-	**0**	**1606**	**1606**	**0**	-	-	-	-

SYSTEM/UNIT: Room 506

Log:

Room 506	Unable to determine the unit that serves this area from the drawings.

Room 506 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 506	CD			418	418		Flow Hood	1.000	1.000	418
S-02	Rm 506	CD			433	433		Flow Hood	1.000	1.000	433
S-03	Rm 506	CD			405	405		Flow Hood	1.000	1.000	405
	Totals:	**-**	**-**	**0**	**1256**	**1256**	**0**	**-**	**-**	**-**	**-**

Room 506 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Rm 506	CD			304	304		Flow Hood	1.000	1.000	304
	Totals:	**-**	**-**	**0**	**304**	**304**	**0**	**-**	**-**	**-**	**-**

SYSTEM/UNIT: Room 602

Log:

Room 602	Unable to determine the unit that serves this area from the drawings.

Room 602 Supply Outlet Summary

System/Unit	Area Served	Type	Size / Area (in)	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
S-01	Rm 602	CD			77	77		Flow Hood	1.000	1.000	77
S-02	Rm 602	CD			567	567		Flow Hood	1.000	1.000	567
S-03	Rm 602	CD			518	518		Flow Hood	1.000	1.000	518
	Totals:	**-**	**-**	**0**	**1162**	**1162**	**0**	**-**	**-**	**-**	**-**

Room 602 Return Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
R-01	Rm 602	CD			245	245		Flow Hood	1.000	1.000	245
	Totals:	**-**	**-**	**0**	**245**	**245**	**0**	**-**	**-**	**-**	**-**

Room 602 Exhaust Inlet Summary

System/Unit	Area Served	Type	Size inches	Design CFM	Prelim CFM	Final CFM	% Final	Instrument	Ak	Open (sq ft)	Final FPM
Relief	Rm 602	CD			256	256		Flow Hood	1.000	1.000	256
	Totals:	**-**	**-**	**0**	**256**	**256**	**0**	**-**	**-**	**-**	**-**

Instrument Calibration

Air Pressure Measurement					
Instrument Type:	ADM	**Date of Calibration:**	9/21/2020	**Measured Units**	in wg
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	9/21/2021	**Accuracy**	+/- 2%
Model:	S-PVF-1	**Range:**	+/- 60 in wg	**Resolution**	0.0001 in wg
Serial:	2000087			*Corrects local bar. press. to standard cond.	
Air Volume Measurement / Balometer					
Instrument Type:	CH-15D	**Date of Calibration:**	5/4/2021	**Measured Units**	CFM
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	5/4/2022	**Accuracy**	+/- 2%
Model:	CH-15D	**Range:**	25-1500 CFM (Exhaust) 24-2500 CFM (Supply)	**Resolution**	1 CFM
Serial:	2100145				
Direct Air Velocity Measurement					
Instrument Type:	RVA	**Date of Calibration:**	7/21/2021	**Measured Units**	FPM
Manufacturer:	Extech	**Due for Calibration:**	7/21/2022	**Accuracy**	+/- 3%
Model:	AN300	**Range:**	80 - 5,900 FPM	**Resolution**	1 FPM
Serial:	1014966				
Electrical Measurement					
Instrument Type:	V/A Meter	**Date of Calibration:**	7/21/2021	**Measured Units**	Volts / Amperes
Manufacturer:	Fluke	**Due for Calibration:**	7/21/2022	**Accuracy**	1% / 2%
Model:	323	**Range:**	0 - 600.0V / 0 - 600.0A	**Resolution**	0.1 V / 0.1 A
Serial:	42060652WS				
Humidity WB/DB Measurement					
Instrument Type:	RH Meter	**Date of Calibration:**	7/20/2021	**Measured Units**	WB / %RH
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	7/20/2022	**Accuracy**	+/- 1°F / 2.5%RH
Model:	S-H-3-5"	**Range:**	-4 to 140°F 0% - 100%RH	**Resolution**	0.1°F / .1 %RH
Serial:	1800201				
Hydronic Pressure Measurement					
Instrument Type:	HDM	**Date of Calibration:**	7/21/2021	**Measured Units**	psi, Ft, inches
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	7/21/2022	**Accuracy**	+/- 2%
Model:	S-DP-250	**Range:**	0.01 - 250 psi	**Resolution**	0.01 psi
Serial:	2000157			*For use w/ADM	
Rotation Measurement					
Instrument Type:	Tachometer	**Date of Calibration:**	7/21/2021	**Measured Units**	RPM
Manufacturer:	Shimpo	**Due for Calibration:**	7/21/2022	**Accuracy**	+/- 1 RPM
Model:	DT-207LR	**Range:**	0.01 - 250 psi	**Resolution**	1 RPM
Serial:	D1930110R				
Temperature Measurement (Immersion)					
Instrument Type:	Temperature	**Date of Calibration:**	8/19/2021	**Measured Units**	°F
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	8/19/2022	**Accuracy**	+/- .05%
Model:	PR-T-4-6	**Range:**	−40°F to 500°F	**Resolution**	0.1°F
Serial:	2100227				
Temperature Measurement (Surface)					
Instrument Type:	Temperature	**Date of Calibration:**	8/19/2021	**Measured Units**	°F
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	8/19/2022	**Accuracy**	+/- .05%
Model:	PR-T-2	**Range:**	−40°F to 500°F	**Resolution**	0.1°F
Serial:	2100238				
Temperature Measurement Meter					
Instrument Type:	Temperature	**Date of Calibration:**	7/20/2021	**Measured Units**	°F
Manufacturer:	Evergreen Telemetry	**Due for Calibration:**	7/20/2022	**Accuracy**	+/- .05%
Model:	RM-T-1	**Range:**	−40°F to 500°F	**Resolution**	0.1°F
Serial:	1700293			*For use w/Imm./Sur.	

Proof of Calibration

Air Pressure Measurement

EVERGREEN TELEMETRY

Certificate of Calibration

United Test & Balance

Manufacturer	Evergreen Telemetry	Calibration Environment		
Product	Pressure / Velocity Module	Temperature	78	°F
Model	S-PVF-1	Rel. Humidity	48	%
SN	1800346	Bar. Pressure	28.7	In Hg

☒ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument
Barometric Pressure (in Hg)	Spec		-2% - 0.1	+ 2% + 0.1	
	1	20.0			20.1
	2	28.7			28.7
	3	33.0			33.0
Differental Pressure (in wc)	Spec		-2%-.001	+2%+.001	
	1	10.00			9.985
	2	2.000			2.005
	3	0.5000			0.4990
	4	0.0500			0.0500
	5	-10.00			-10.047
	6	-0.0500			-0.0499
Low Velocity (FPM)	Spec		-3% - 7	+ 3% + 7	
	1	107			107
	2	509			508
Airflow (°F)	Spec		-3% - 7	+ 3% + 7	
	1	100			UPON
	2	500			REQUEST

Indicates out of tolerance condition

NIST-Traceable Lab Calibration Standards

Variable	System ID	Calibration Last	Calibration Due
Pressure	7481227	5-Feb-20	5-Feb-22
Pressure	7568470	4-Feb-20	4-Feb-22
Pressure	1208000080	10-Jan-20	10-Jan-22
Velocity	2100190A	29-Mar-21	29-Mar-23

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By: [signature] Calibration Date: 20-Jul-2021 Date Due: 20-Jul-2023

624 S. Perry Ln. #102, Tempe AZ 85281 • 602-574-6192 • info@evergreentelemetry.com • www.evergreentelemetry.com

Air Volume Measurement / Balometer

EVERGREEN TELEMETRY

Certificate of Calibration

United Test and Balance

Manufacturer	Evergreen Telemetry	Calibration Environment		
Product	Capture Hood	Temperature	74	°F
Model	CH-15D	Rel. Humidity	16	%
SN	2100145	Bar. Pressure	28.9	In Hg

☐ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument
Airflow (CFM)	Spec		-3% - 7	+3%-7	
	1	2012			2013
	2	1032			1034
	3	154			155
	4	-538			-535
	5				

Indicates out of tolerance condition

NIST-Traceable Calibration Lab Standards

Variable	System ID	Calibration Last	Calibration Due
Pressure	7481227	5-Feb-20	5-Feb-22
Pressure	7568470	4-Feb-20	4-Feb-22
Pressure	1208000080	10-Jan-20	10-Jan-22
Velocity	2100190A	29-Mar-21	29-Mar-23

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By: [signature] Calibration Date: May 4, 2021

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Direct Air Velocity Measurement

MICRO PRECISION

Certificate of Calibration

Date: Jun 21, 2021 **Cert No.** 651220084355886

Customer:
UNITED TEST AND BALANCE INC

		Work Order #:	TX-8022378
		Purchase Order #:	CC
MPC Control #:	DT1778	Serial Number:	1014066
Asset ID:	N/A	Department:	N/A
Gage Type:	THERMO ANEMOMETER	Performed By:	JAMES FERRIS
Manufacturer:	EXTECH	Received Condition:	IN TOLERANCE
Model Number:	AN300	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 21, 2021
Temp/RH:	71.0°F / 45.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 21, 2022

Calibration Notes:

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
CD6300	THERMAL ANEMOMETER	CF8670	55970388	ALNOR	Jul 9, 2021	[illegible]
CE6546	WIND TUNNEL	NMN	NSN	PAXTON AIRRESEARCH	Jul 8, 2022	[illegible]

Procedures Used in this Event

Procedure Name	Description
THERMOANEMOMETER407112 Rev. VERSI	Extech Thermo Anemometer 407112 Operation Manual

Calibrating Technician: [signature] JAMES FERRIS

QC Approval: [signature] MICHAEL RODRIGUEZ

Page 1 of 1

Electrical Measurement

MICRO PRECISION

Certificate of Calibration

Date: Jun 21, 2021 **Cert No.** 651220084356986

Customer:
UNITED TEST AND BALANCE INC

		Work Order #:	TX-8022378
		Purchase Order #:	CC
MPC Control #:	DP4748	Serial Number:	42060652WS
Asset ID:	N/A	Department:	N/A
Gage Type:	CLAMP METER	Performed By:	JAMES FERRIS
Manufacturer:	FLUKE	Received Condition:	IN TOLERANCE
Model Number:	323	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 21, 2021
Temp/RH:	72.0°F / 44.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 21, 2022

Calibration Notes:

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
DC8176	CALIBRATOR	5500A	6670009	FLUKE	Nov 25, 2021	[illegible]
DC8496	50-TURN CURRENT COIL	5500A	20080712	FLUKE	Sep 29, 2035	[illegible]

Procedures Used in this Event

Procedure Name	Description
FLUKE 323/324/325	Clamp Meter , Fluke 323/324/325, Feb-01-2013

Calibrating Technician: [signature] JAMES FERRIS

QC Approval: [signature] MICHAEL RODRIGUEZ

Page 1 of 1

Proof of Calibration

Humidity WB/DB Measurement

EVERGREEN TELEMETRY

Certificate of Calibration

United Test & Balance

Manufacturer	Evergreen Telemetry	Calibration Environment		
Product	Humidity Sensor	Temperature	76	°F
Model	S-H-3-5"	Rel. Humidity	48	%
SN	1800201	Bar. Pressure	28.7	in Hg

☐ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument	
Temperature (°F)	Spec					
	1	40.3	-1.0	1.0	40.0	
	2	79.6	-1.0	1.0	79.1	
	3	85.3	-1.0	1.0	85.2	
	4	128.8	-2.0	2.0	128.4	
Barometric Pressure (in Hg)	Spec		-2% - 0.1	+ 2% + 0.1		
	1	28.7			28.7	
Humidity %RH 10 to 90%	Spec		-3	3		
	1	11.0			14.0	
	2	24.0			26.7	
	3	66.4			66.0	
	4	78.5			75.8	

Indicates out of tolerance condition ——|

Calibration Standard

Variable	System ID	Calibration Last	Calibration Due
Temperature	15171149	10-Jan-20	10-Jan-22
Pressure	1208000080	10-Jan-20	10-Jan-22
Humidity	20052171	13-Jan-20	13-Jan-22

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Temperature accuracy (dry bulb) varies across the operating range:

Temperature over 32-100F +/- 1.0 F
Temperature over 100-188F +/- 2.0 F

Calibrated By — 20-Jul-2021 Calibration Date — 20-Jul-2022 Date Due

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Hydronic Pressure Measurement

EVERGREEN TELEMETRY

Certificate of Calibration

TAB Technologies

Manufacturer	Evergreen Telemetry	Calibration Environment		
Product	Water Pressure Sensing Module	Temperature	76	°F
Model	S-DP-250	Rel. Humidity	53	%
SN	2000157	Bar. Pressure	28.6	in Hg

☒ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Specification +/- 2% +/- last digit	Cal Std	Sensor 1 Diff Pres	Difference	Cal Std	Sensor 2 Gage Lo	Diff
Approx Set Point			(%)			%
PSI	(ftwc)	(ftwc)		(ftwc)	(ftwc)	
0.13	0.3	0.3	0	0.3	0.3	0
0.434	1.0	1.0	0	1.0	1.0	0
0.867	2.0	2.0	0	2.0	2.0	0
2.168	5.0	5.0	0	5.0	5.0	0
	PSI	PSI		PSI	PSI	
10	10.0	10.0	0.0	10.0	10.0	0.0
40	40.0	40.0	0.0	40.0	40.0	0.0
80	80.0	80.5	0.8	80.0	80.4	0.5
120	120.0	120.0	0.0	120.0	120.1	0.1
240	240.0	240.2	0.1	240.0	240.3	0.1

Conversion

PSI	ftwc	inwc
1.00	2.307	27.68
0.434	1.00	12.00

Indicates out of tolerance condition ——|

NIST-Traceable Calibration Lab Standards

Variable	System ID	Calibration Last	Calibration Due
Pressure	3015172	10-Jan-20	10-Jan-22
Temperature	15171149	10-Jan-20	10-Jan-22

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By — 21-Jul-2021 Calibration Date — 21-Jul-2022 Date Due

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Rotation Measurement

MICRO PRECISION

Certificate of Calibration

Date: Jun 21, 2021 **Cert No.** 551220084365966

Customer:
UNITED TEST AND BALANCE INC

		Work Order #	TX-6022378
		Purchase Order #:	CC
MPC Control #	DT1774	Serial Number:	DT930110R
Asset ID:	N/A	Department:	N/A
Gage Type:	TACHOMETER	Performed By:	JAMES FERRIS
Manufacturer:	NIDEC	Received Condition:	IN TOLERANCE
Model Number:	DT-207LR	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 21, 2021
Temp/RH:	72.9°F / 44.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 21, 2022

Calibration Notes:

Standards Used to Calibrate Equipment

ID	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
DA6226	SYNTHESIZER FUNCTION GENERATOR	3325A	2852425991	AGILENT	Sep 29, 2021	551220089025990

Procedures Used in this Event

Procedure Name	Description
33654-609.1	Hand Tachometers, Single And Multi Range, Oct-30-2016

Calibrating Technician: JAMES FERRIS QC Approval: MICHAEL RODRIGUEZ

Page 1 of 1 (CERT, Rev 7)

Temperature Measurement (Immersion)

EVERGREEN TELEMETRY

Certificate of Calibration

United Test and Balance

Manufacturer	Evergreen Telemetry			Calibration Environment		
Temperature Product		Module	Probe	Temperature	76	°F
Model			PR-T-4-6	Rel. Humidity	45	%
SN			2100227	Bar. Pressure	28.6	in Hg

☐ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument	
Cal Lab Module & Test Probe	Spec					
Temperature (°F)	1	78.8	-0.3	+0.3	78.7	
	2	243.3	-2.8	+2.6	242.7	
	3	-42.8	-1.6	+1.6	-42.7	

Indicates out of tolerance condition ——|

Calibration Standard SN & Dates

Variable	System ID	Calibration Last	Calibration Due
Temperature	15171149	10-Jan-20	10-Jan-22

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By — 19-Aug-2021 Calibration Date — 19-Aug-2023 Date Due

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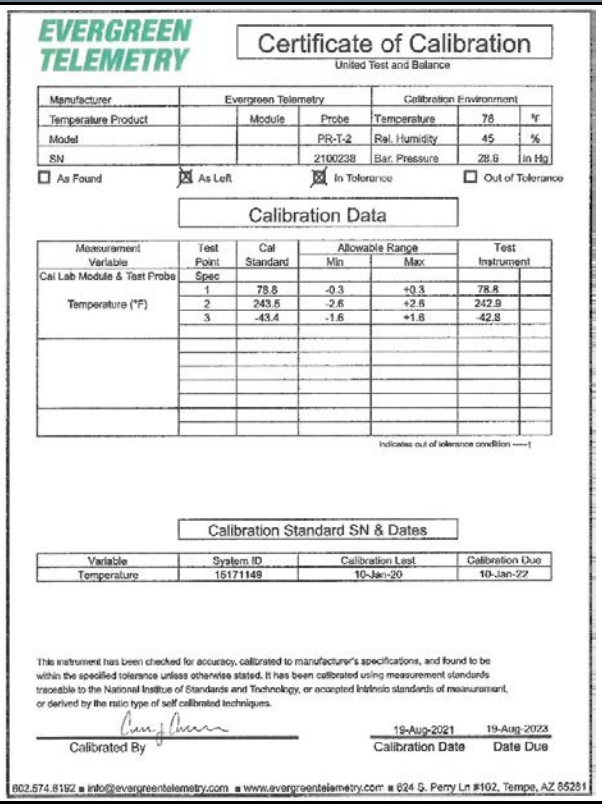
Proof of Calibration

Temperature Measurement (Surface)	Temperature Measurement Meter



EVERGREEN TELEMETRY

Certificate of Calibration

United Test and Balance

Manufacturer	Evergreen Telemetry			Calibration Environment		
Temperature Product		Module	Probe	Temperature	76	°F
Model			PR-T-2	Rel. Humidity	45	%
SN			2100238	Bar. Pressure	28.6	in Hg

☐ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument	
Cal Lab Module & Test Probe	Spec					
Temperature (°F)	1	78.8	-0.3	+0.3	78.8	
	2	243.5	-2.6	+2.6	242.9	
	3	-43.4	-1.6	+1.6	-42.8	

Indicates out of tolerance condition ----!

Calibration Standard SN & Dates

Variable	System ID	Calibration Last	Calibration Due
Temperature	15171149	10-Jan-20	10-Jan-22

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By — 19-Aug-2021 Calibration Date — 19-Aug-2023 Date Due

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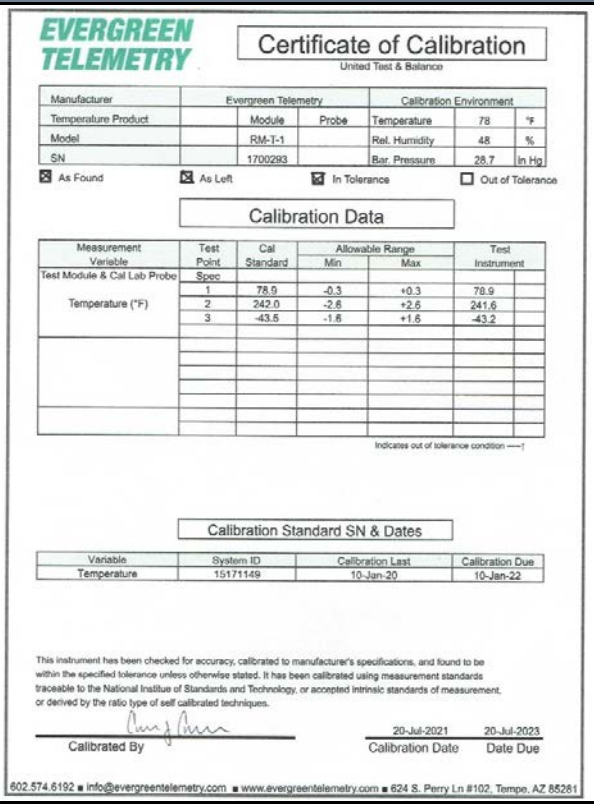

EVERGREEN TELEMETRY

Certificate of Calibration

United Test & Balance

Manufacturer	Evergreen Telemetry			Calibration Environment		
Temperature Product		Module	Probe	Temperature	78	°F
Model		RM-T-1		Rel. Humidity	48	%
SN		1700293		Bar. Pressure	28.7	in Hg

☒ As Found ☒ As Left ☒ In Tolerance ☐ Out of Tolerance

Calibration Data

Measurement Variable	Test Point	Cal Standard	Allowable Range Min	Allowable Range Max	Test Instrument	
Test Module & Cal Lab Probe	Spec					
Temperature (°F)	2	242.0	-2.6	+2.6	241.6	
	3	-43.5	-1.6	+1.6	-43.2	

Indicates out of tolerance condition ----!

Calibration Standard SN & Dates

Variable	System ID	Calibration Last	Calibration Due
Temperature	15171149	10-Jan-20	10-Jan-22

This instrument has been checked for accuracy, calibrated to manufacturer's specifications, and found to be within the specified tolerance unless otherwise stated. It has been calibrated using measurement standards traceable to the National Institue of Standards and Technology, or accepted intrinsic standards of measurement, or derived by the ratio type of self calibrated techniques.

Calibrated By — 20-Jul-2021 Calibration Date — 20-Jul-2023 Date Due

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Terms & Abbreviations

AHU	AIR HANDLING UNIT
AC OR ACU	AIR CONDITIONER UNIT
ACCU	AIR COOLED CONDENSING UNIT
ADJ P.D.	ADJUSTED PITCH DIAMETER
AMP	AMPERE
AVG	AVERAGE
B.H.P.	BRAKE HORSEPOWER
C.D.	CEILING DIFFUSER
CFM	CUBIC FEET PER MINUTE
C.E.	CEILING EXHAUST
CH	CHILLER
CHWR	CHILLED WATER RETURN
CHW OR CHWS	CHILLED WATER SUPPLY
C.R.	CEILING RETURN
CT	COOLING TOWER
CWR	CONDENSER WATER RETURN
CW OR CWS	CONDENSER WATER SUPPLY
DB	DRY BULB
D.D.	DIRECT DRIVE
D.P.	DIFFERENCE, NET DECREASE OR INCREASE
DIA	DIAMETER
D.N.A.	DATA NOT AVAILABLE
D.N.L	DATA NOT LISTED
EAT	ENTERING AIR TEMPERATURE
EDC	ELECTRIC DUCT COIL
EDH	ELECTRIC DUCT HEALER
EF	EXHAUST FAN
EMCS	ENERGY MANAGEMENT CONTROL SYSTEM
EWT	ENTERING WATER TEMPERATURE
FCU	FAN COIL UNIT
FH	FUME HOOD
FG	FLOOR GRILLE
F.E.	FLOOR EXHAUST OR RETURN
F.L.A	FULL LOAD AMPERAGE
FPB	FAN POWERED BOX
FPM	FEET PER MINUTE
F.S.	FLOOR SUPPLY
F.S.R	FLOOR SUPPLY REGISTER
FT. HD	FEET OF HEAD
GPM	GALLONS PER MINUTE
GFH	GAS FIRED HEATER
HC	HEATING COIL
HEATER O.L.	THERMAL OVERLOAD PROTECTION FOR MOTORS LOCATED AT THE MOTOR STARTER
HEPA	HIGH EFFICIENCY PARTICULATE AIR
H.F.	HEPA FILTER
HOA	HAND/OFF/AUTO SWITCH
H.P.	HORSEPOWER
HPS	HIGH PRESSURE STEAM
HRC	HEAT RECOVERY COIL OR HEAT RECLAIM COIL
HVAC	HEATING , VENTILATION AND AIR CONDITIONING
HWR	HOT WATER RETURN OR HEATING WATER RETURN
HWS	HOT WATER SUPPLY OR HEATING WATER SUPPLY
HX	HEAT EXCHANGER
I.D.	INSIDE DIAMETER
LAT	LEAVING AIR TEMPERATURE
L.D.	LINEAR SUPPLY DIFFUSER
LPS	LOW PRESSURE STEAM
L.T.	LIGHT TROFFER
LWG	LOW WALL GRILLE
LWR	LOW WALL RETURN
LWT	LEAVING WATER TEMPERATURE
MAU/MUA	MAKE UP AIR UNIT
MBH	1,000 BTU'S PER HOUR
N.A.	NOT ACCESSIBLE
N.I.	NOT INSTALLED
N.T.	NOT TAKEN
N.V.L	NO VALID LOCATION
N.Z.	NOZZLE
O.D.	OUTSIDE DIAMETER
OPEN	NO TERMINAL DEVICE INSTALLED
O.S.A. MIN	OUTSIDE AIR MINIMUM
OAT	OUTSIDE AIR TEMPERATURE
PF	POWER FACTOR
PHC	PREHEAT COIL
PH	PHASE(S)
PMP	CIRCULATING PUMP
PSI	POUNDS PER SQUARE INCH
P.T.	PITOT TRAVERSE
RA	RETURN AIR
RF	RETURN AIR FAN
R.G.	RETURN GRILLE
RHC	REHEAT COIL
RPM	REVOLUTIONS PER MINUTE
SA	SUPPLY AIR
SAT	SUPPLY AIR TEMPERATURE
S.D.	SUPPLY DIFFUSER
SEF	SMOKE EXHAUST FAN
SF (AIR)	SUPPLY FAN
S.F. (ELECT)	SERVICE FACTORS
SHC	STEAM HEATING COIL
S.P. "W.C."	STATIC PRESSURE RESISTANCE, MEASURED IN INCHES OF WATER COLUMN
S.W.E.	SIDEWALL EXHAUST
S.W.R.	SIDEWALL RETURN
S.W.S.	SIDEWALL SUPPLY
TAB	TESTING, ADJUSTING, AND BALANCING
TSP	TOTAL STATIC PRESSURE
UH	UNIT HEATER
V	VOLTS
VAV	VARIABLE AIR VOLUME
VD	VOLUME DAMPER
VFD	VARIABLE FREQUENCY DRIVE
VP	VELOCITY PRESSURE
W	WATTS
WB	WET BULB
W.G.	WATER GAUGE
°F	DEGREES FAHRENHEIT
ΔP	DIFFERENTIAL (DELTA) PRESSURE OR PRESSURE DROP
ΔT	DIFFERENTIAL (DELTA) TEMPERATURE, NET TEMPERATURE DECREASE OR INCREASE

Warranty Page

United TAB provides a one-year warranty for the Test and Balance work associated with this project. The warranty period is one year from the date of this report and/or warranty page. Within the warranty period if the systems tested and reported show evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective test and balance workmanship; United TAB will repair and/or replace defective work or materials if responsibility is solely identified as related to the TAB work. Any evidence of the following will be deemed as not a material work defect caused by tested and balance 1) evidence of improper materials, improper installation or failed control operations 2) evidence of controls, mechanical or commissioning contractor's failure to perform specified project requirements 3) evidence of the owner or occupant's failure to maintain mechanical systems.

If the warranty issue is found to be attributed to mechanical equipment, control or maintenance related failure, or any other cause not related to the TAB work, the return trip may be subject to a service charge. Important: United TAB reserves the right to resolve TAB issues and correct any errors or omissions in test data. If any third-party or competing agency (TAB or Commissioning) tests or adjust any equipment or fluid flows, ALL PROJECT WARRANTY IS VOIDED.

United TAB needs written notice for any TAB warranty item. Notice should be specific, itemized, and include any issues or concerns, including the specific location or system. After receiving written notice, United TAB will Assign a Project Manager to address the warrant issue. United TAB recommends an owner representative is on-site for the warrant visit.

For any balancing issues or concerns that arise, United TAB will return to the project site to address the issue or concern. United TAB will check and corroborate that the tested systems adhere with the reported data. This work will be performed at no charge.

United TAB's warranty covers comfort balancing for occupants at a maximum of one year or two warranty comfort balance visits.

As a default, TAB work is performed with systems configured for total design flow condition for both cooling and heating modes regardless of OA ambient temperature. Therefore, unless otherwise noted, this TAB report fulfills any Opposite Season requirements.

United TAB keeps an electronic file of all test documents through the end of the warranty period. During that time electronic copies of the report are provided at no charge. Extra paper copies may be subject to a fee. Building owners should keep all documentation for future reference. All documentation about this project will be destroyed in accordance with our record retention schedule.

Chimacum SD 2021 Covid-19
Engineering Controls (HVAC)
Study Areas 9/13/21

Bldg 200, CR 408

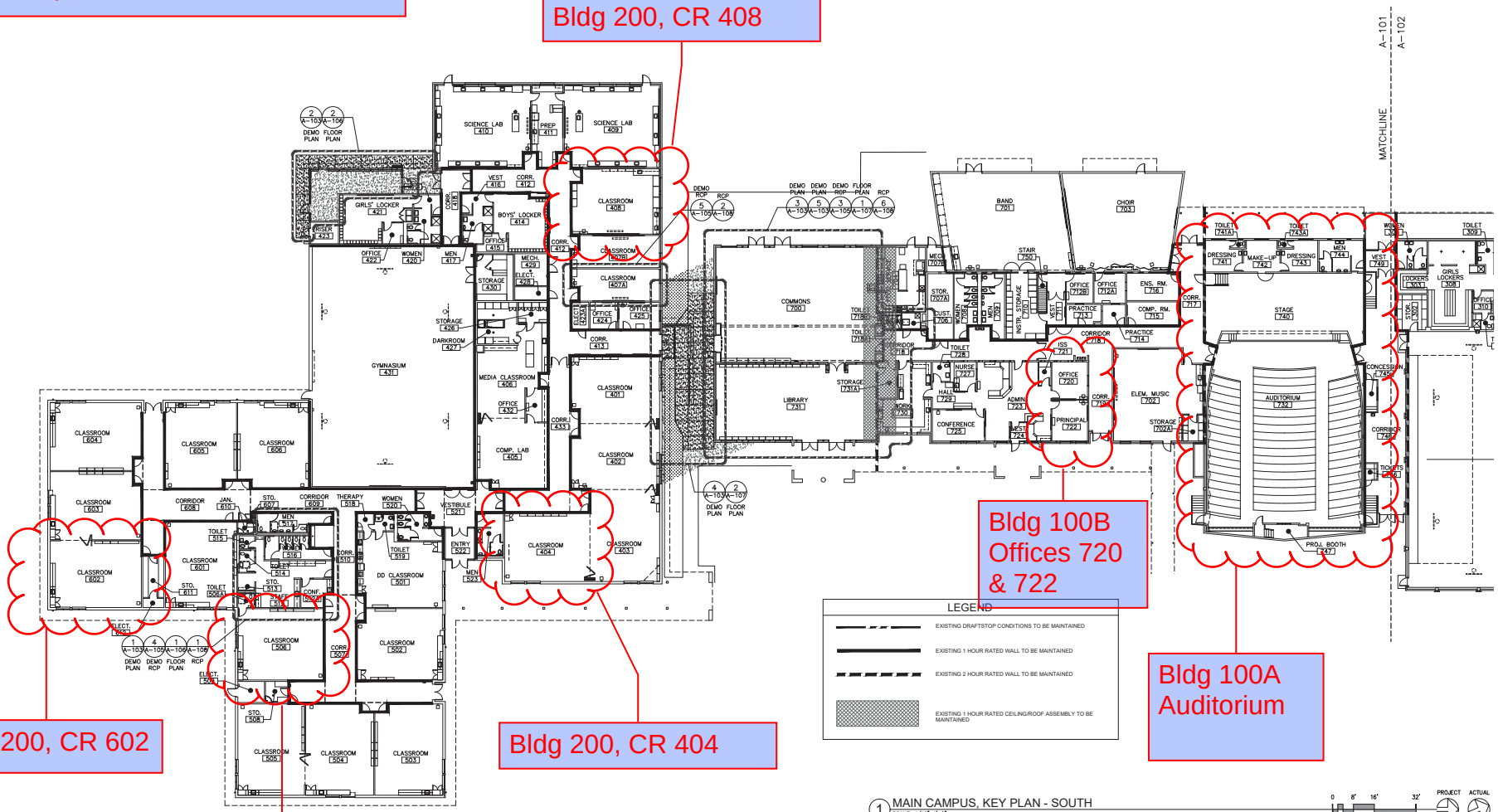
Bldg 100B
Offices 720
& 722

Bldg 100A
Auditorium

Bldg 200, CR 602

Bldg 200, CR 404

Bldg 200, CR 506



1 MAIN CAMPUS, KEY PLAN - SOUTH
SCALE: 1/16"=1'-0"

0 8' 16' 32' PROJECT ACTUAL

studioMENG STRAZZARA

Chimacum School District

TITLE

CHIMACUM SCHOOL DISTRICT

TENANT IMPROVEMENTS

91 WEST VALLEY ROAD
CHIMACUM, WA 98325

STAMP

6181 REGISTERED ARCHITECT
CHARLES STRAZZARA
STATE OF WASHINGTON

KEY PLAN

PROJECT NUMBER
18106

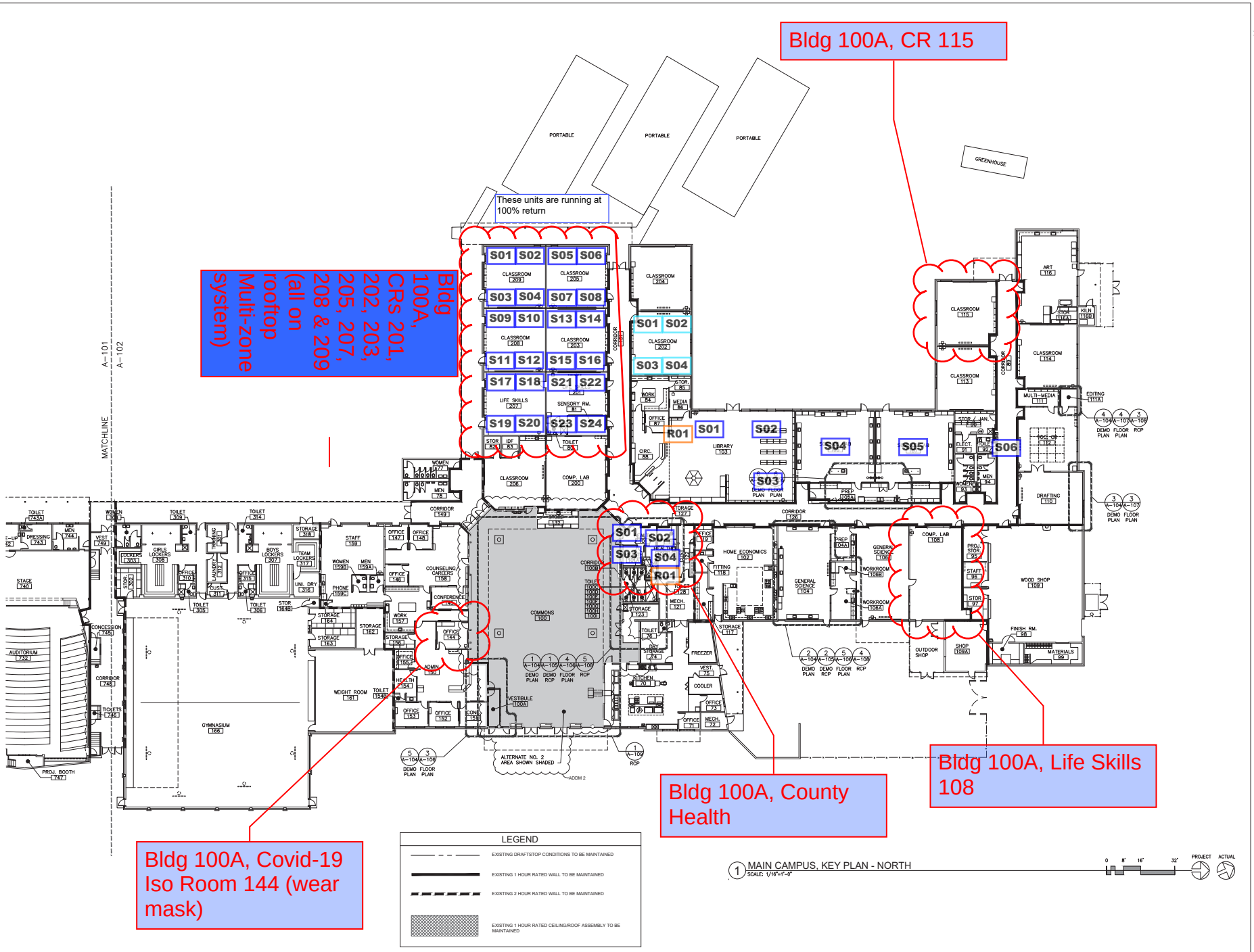
ISSUED FOR:	DATE:
PERMIT SET	5/30/19
BID SET	6/6/19

PLAN APPROVAL

DRAWN BY: BKD
CHECKED: DLE

SHEET CONTENTS
MAIN: KEY PLAN, SOUTH

SHEET NUMBER
A-101



studio MENG STRAZZARA

Chimacum School District

TITLE

CHIMACUM SCHOOL DISTRICT

TENANT IMPROVEMENTS

91 WEST VALLEY ROAD
CHIMACUM, WA 98325

STAMP

KEY PLAN

PROJECT NUMBER
18106

ISSUED FOR:	DATE:
PERMIT SET	5/30/19
BID SET	6/6/19

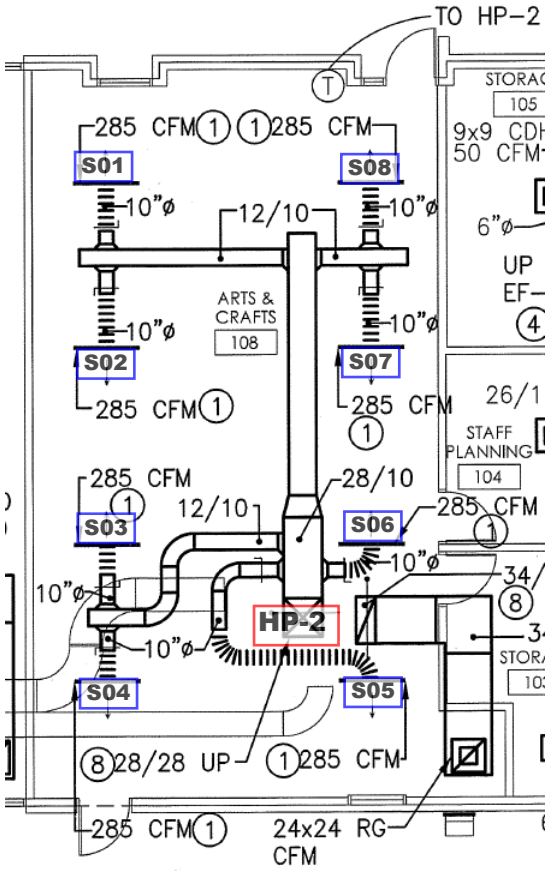
PLAN APPROVAL

DRAWN BY: BKD
CHECKED: DLE

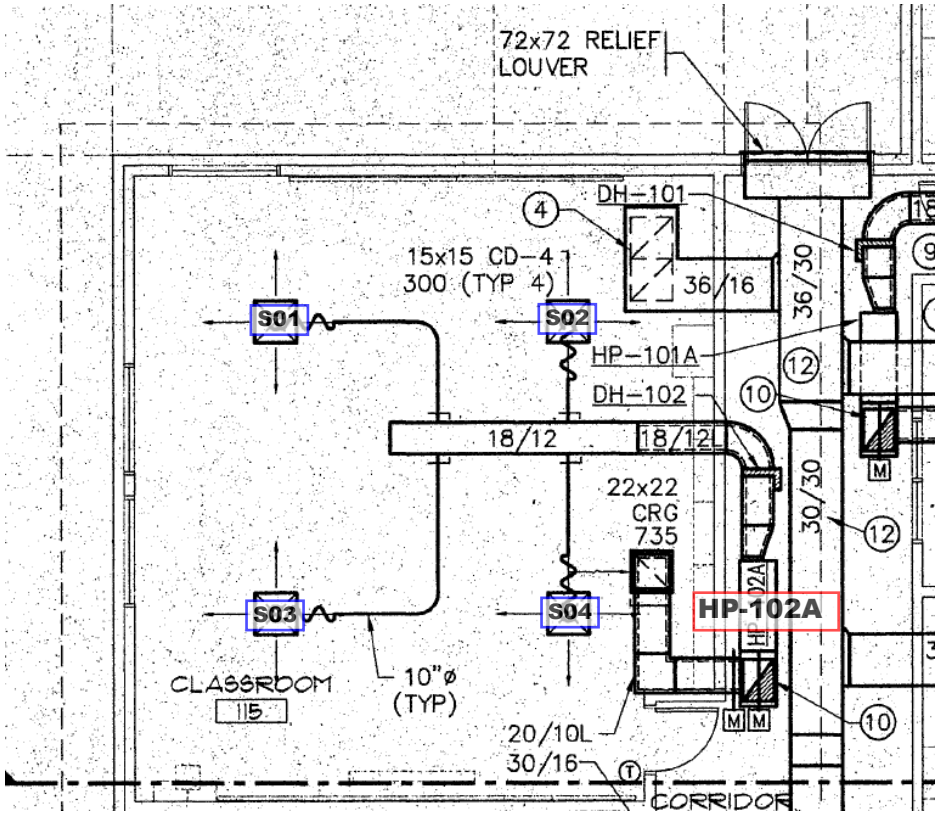
SHEET CONTENTS
MAIN: KEY PLAN, NORTH

SHEET NUMBER
A-102

Bldg 100A – Life Skills 108 (Rooftop Unit HP-2, a new package heat pump)

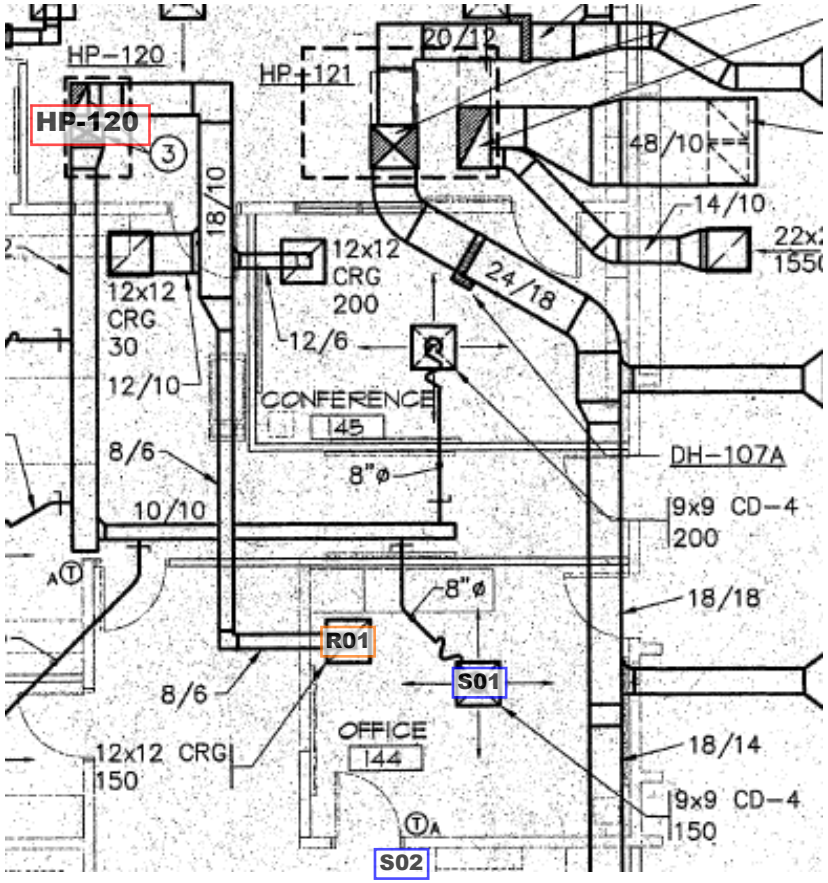


Bldg 100A – CR 115 (HP-102A at Mezzanine, and older split-Dx system)



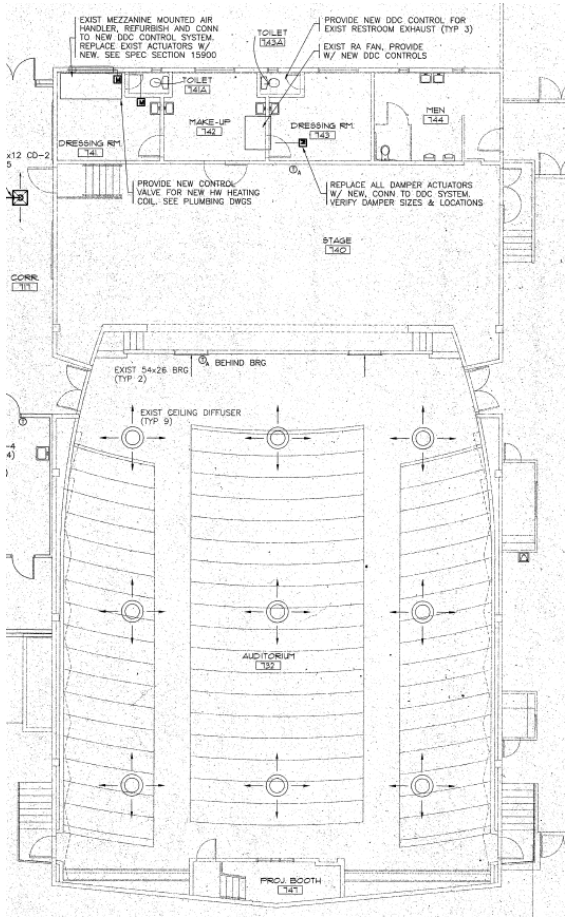
Bldg 100A - CRs 201 to 209 with newer rooftop Multi-zone unit, but no plans so far; if 202 is included, this is a separate older packaged HP RTU system

Bldg 100A – Office 144 (older rooftop HP-120, serving multiple adjacent spaces)

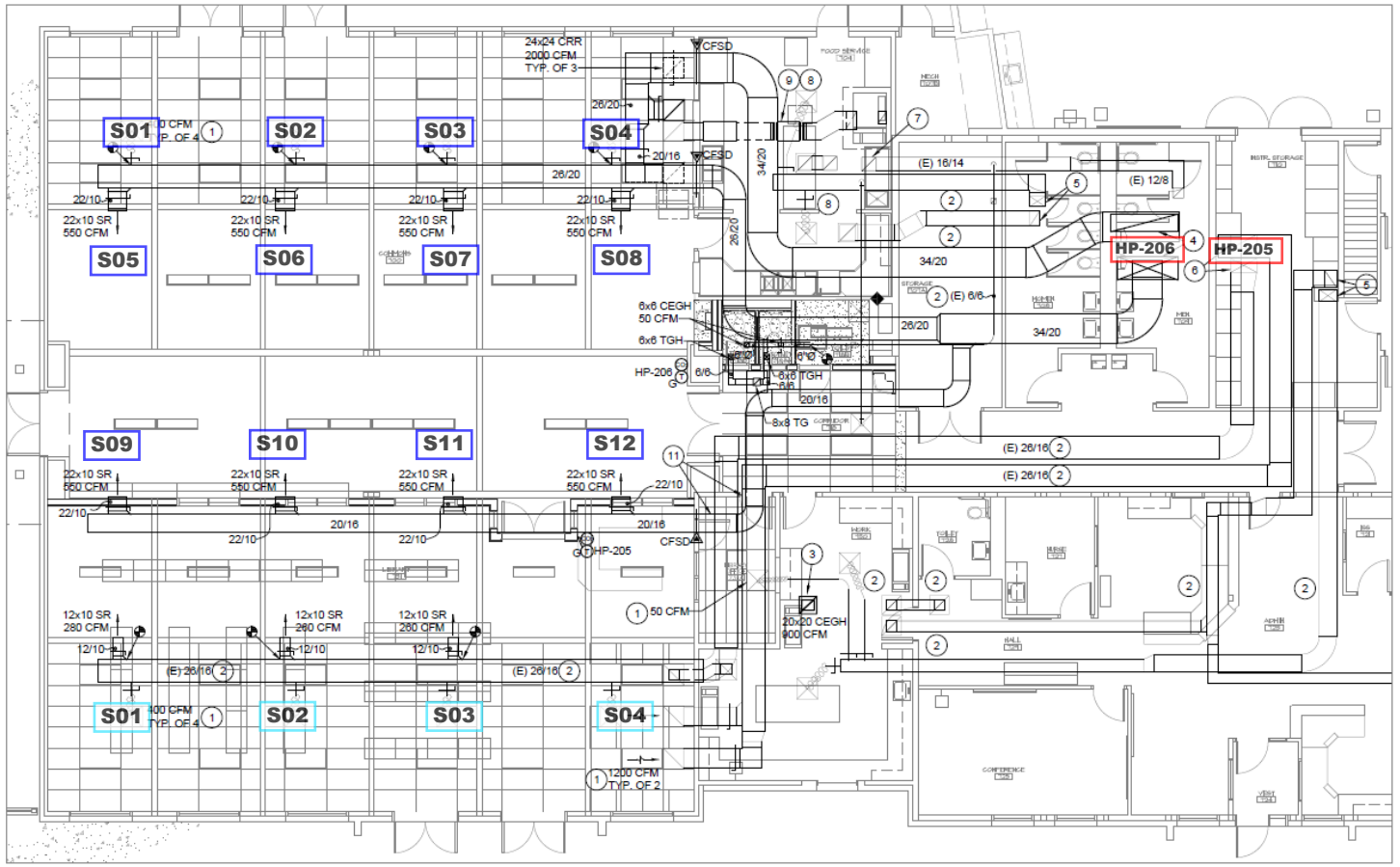


Bldg 100A – Auditorium – no plans other than this one – may require brief field as-builting

36x46 11.5 631 7265 CFM
36x16 4.0 911 3644 CFM
Total CFM 10909
this unit is running 0% OSA



Bldg 100B – Commons 700 & Library 701 with rooftop heat pump units

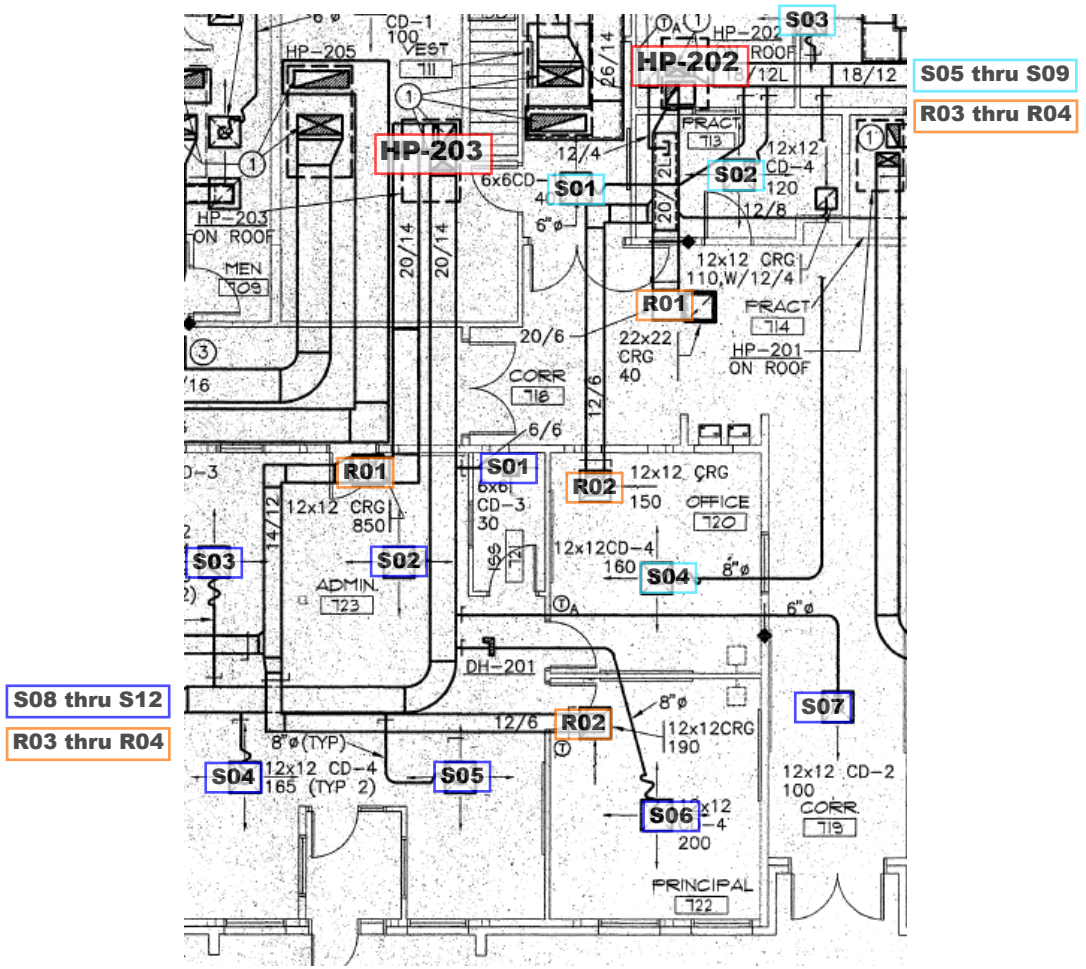


5 HVAC PLAN COMMONS AND LIBRARY
SCALE: 1/8"=1'-0"

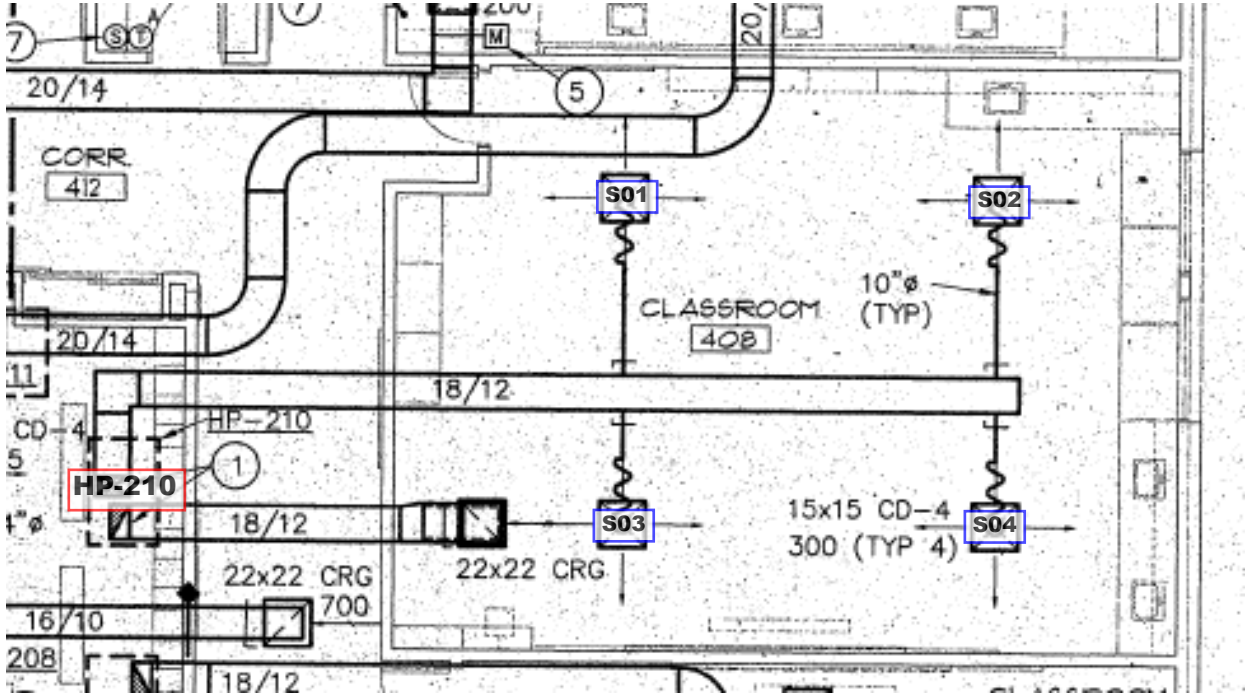
0 4' 8' 16'

PROJECT ACTUAL

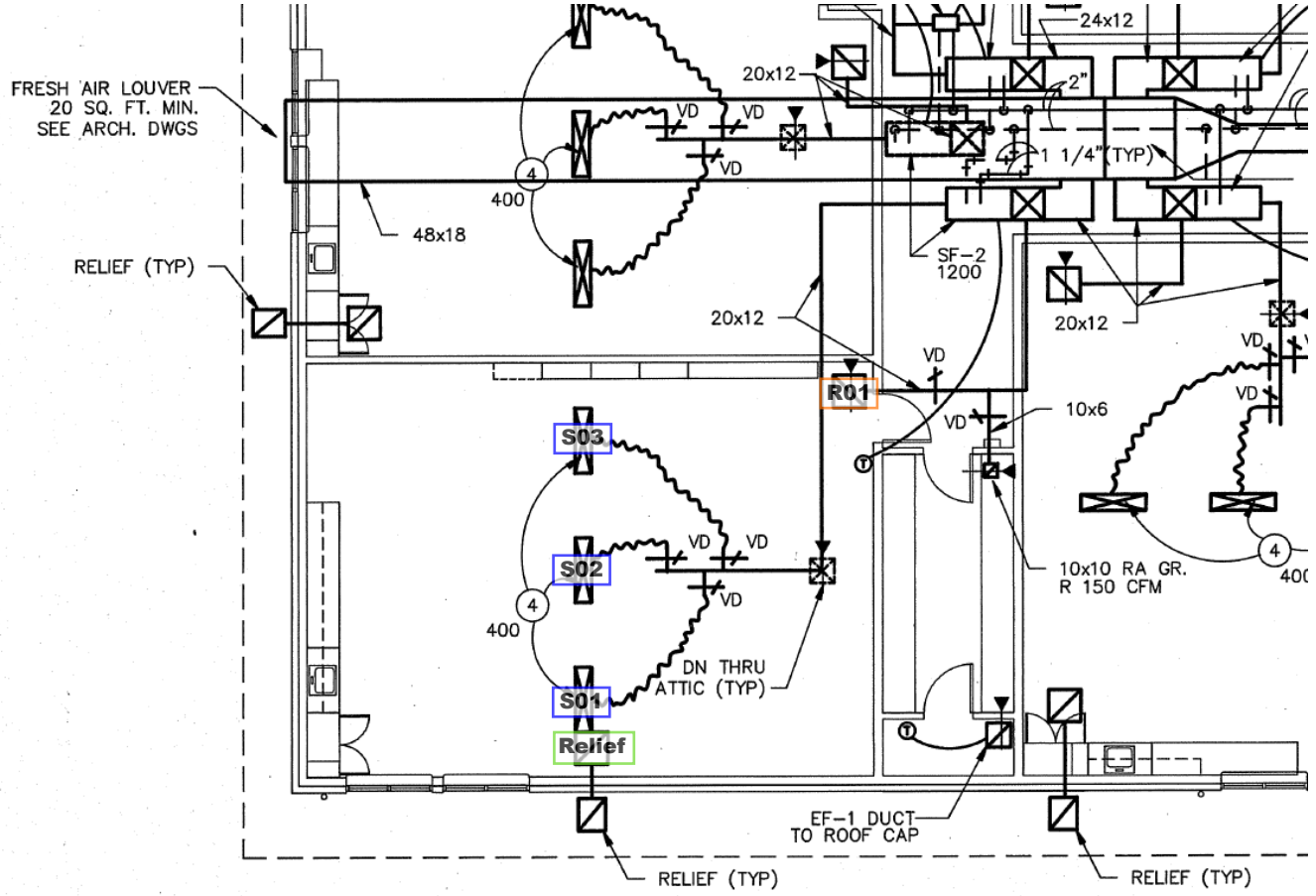
Bldg 100B – Offices 720 & 722 (older rooftop HP units – HP-202 for Office 720, and HP-203 for Office 722)



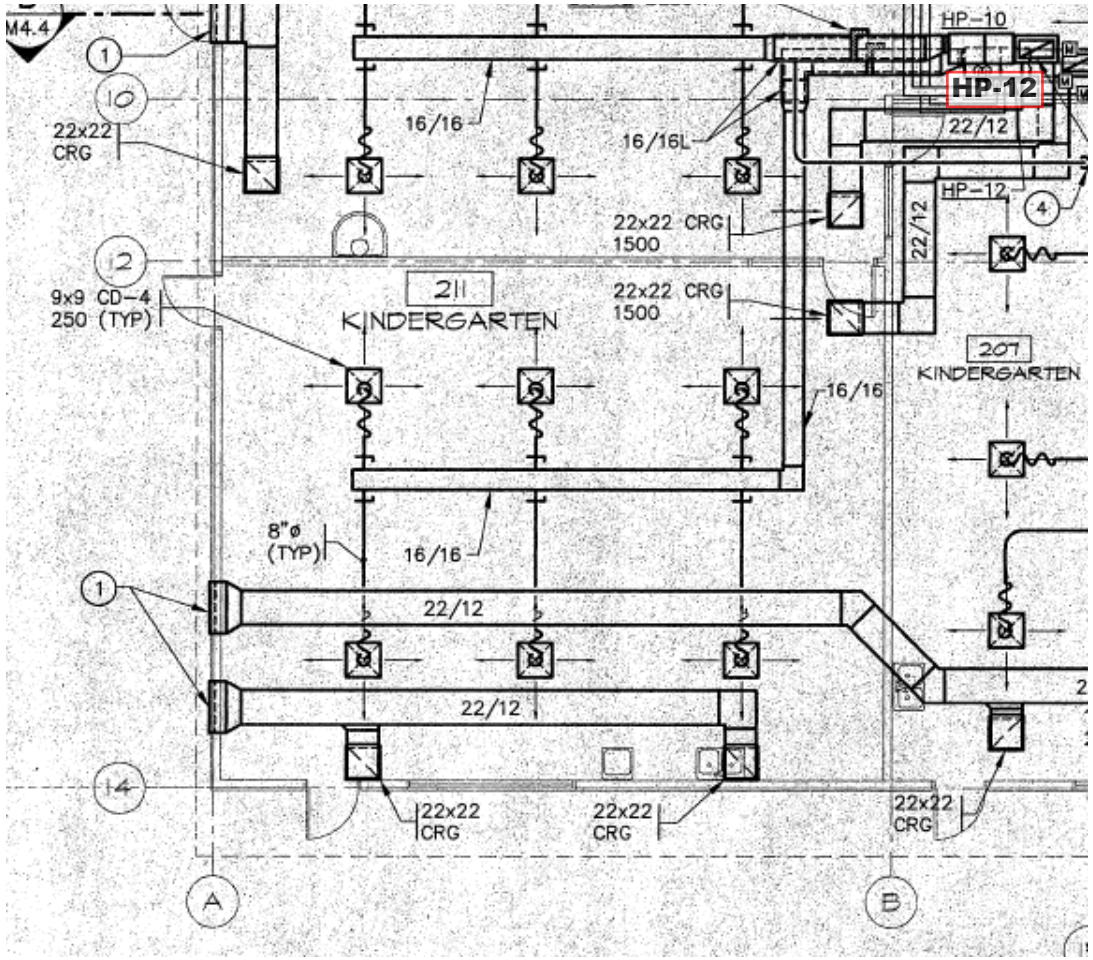
Bldg 200 – CR 408 with aging HP-~~408~~



Bldg 200 – CR 602 attic hydronic FCA with full economizer; CRs 404 & 506 are nearly identical.



CP Bldg – Kinder 211 in West Wing with attic split-Dx heat pump HP-12; nearly identical to North Wing CR 509; and somewhat similar to Health.



(O.S.A) CHINACUM HIGH SCHOOL

602, 506, 404

602 RETURN READING.

M. 424 SUPPLY CFM. 140 CFM

Rm 404 RETURN. -345 / TRANSFER - 349

RM 506 " " - 320 / " " - 315

RM 602 " " - 226 / " " - 256

083 FPM AVG. VEL (58) 3 SF.
(174 CFM)

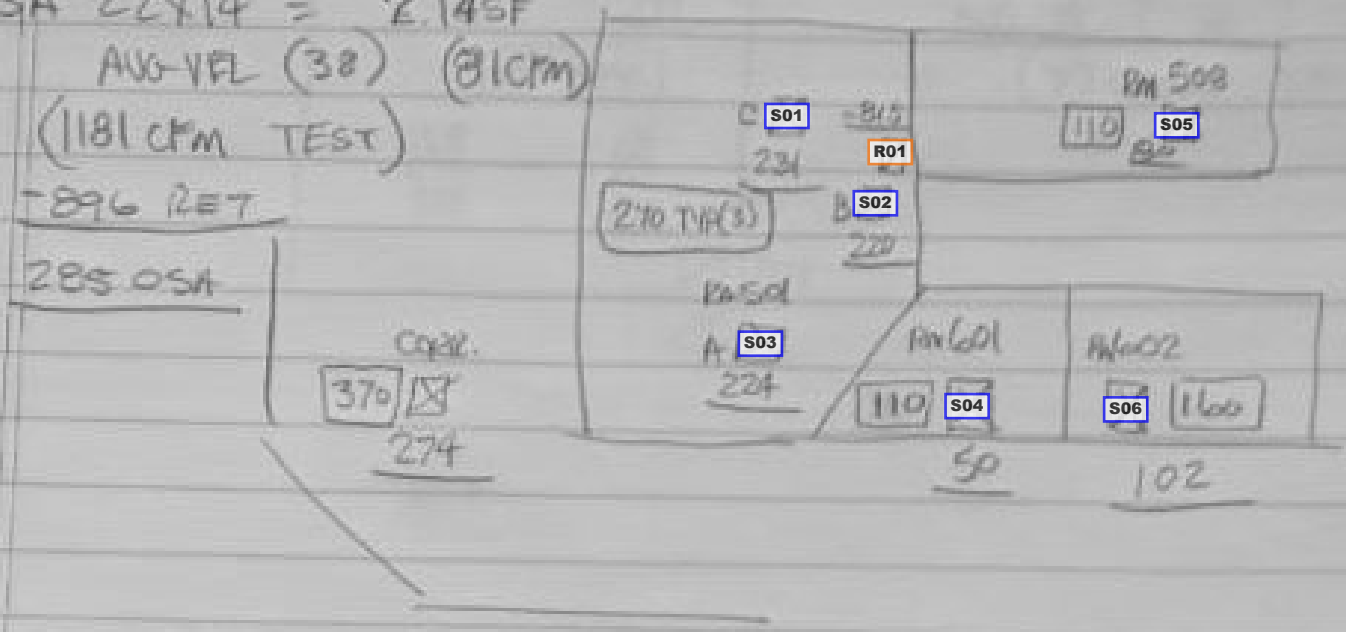
CHIMACUM CREEK PRIMARY

10/22/21

AREA "B"
(HP-21) ADD UNIT!

NOTES
- OSA SHOULD BE 285 CFM OR LESS.
- NO PROPER OSA MEASUREMENT.
- OSA DAMPER APPEARS TO BE CLOSED.

OSA 22X14 = 2.14SF
AVG VEL (38) (81CFM)
(1181 CFM TEST)
-896 RET
285 OSA



(HP-20)

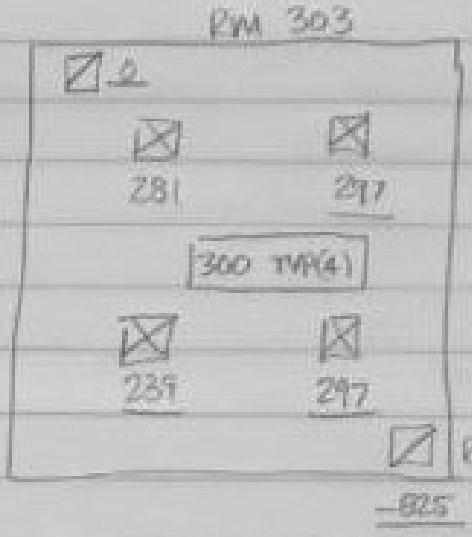
948 CFM
-910 RET
(38 OSA) 5%

OSA
24X12 = 2.0 SF
AVG VEL ( )
CFM

NOTES
- NO PROPER OSA MEASUREMENT
- OSA DAMPER APPEARS TO BE CLOSED

CHIMACUM CREEK PRIMARY

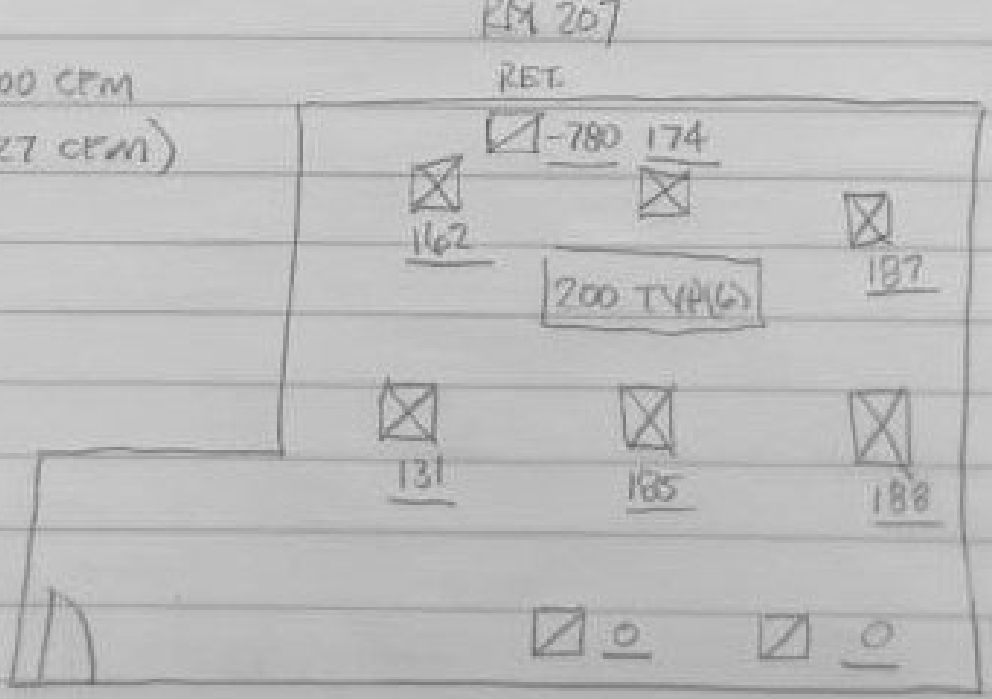
AREA "A"
HP-08



(1114 CFM)

D.S.A
20 X 18 = 2.5 SF
ANG VEL (31)
(77 CFM) 7%

AREA "B"
HP-14



1200 CFM
(1027 CFM)

O.S.A
20X20 = 2.77SF
ANG VEL (40)
(113 CFM)