AMERESCO

# Airflow Testing Report

Prepared for

Portland Public Schools

August 2021

9700 SW Capitol Hwy, Suite 110
Portland, OR 97219
ameresco.com

## PROJECT OVERVIEW

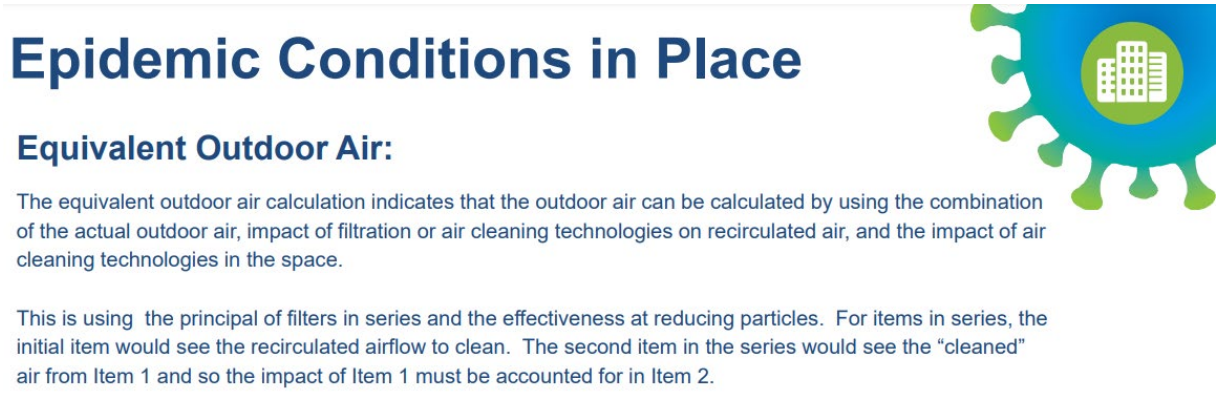
As part of the continuing process to ensure a safe return to in-person learning, Portland Public Schools has contracted with Ameresco to test the airflow and ventilation of all educational and office spaces in each school. The data is reviewed by both Ameresco and PPS personnel to identify any potential shortcomings in the airflow from the HVAC systems. To accomplish this task, Ameresco has partnered with a local NEBB certified Test-Adjust-Balance (TAB) firm, Neudorfer Engineers, who will measure the airflow to each zone with calibrated measurement equipment in accordance with current testing standards and procedures. As part of this effort, HVAC professionals will review the operation of the HVAC equipment serving every educational and office space in each school.

Ameresco is pleased to have partnered with PPS over the last decade as the district's Energy Services Company (ESCO) on six energy efficiency construction projects, four service projects, and numerous energy audits. Our partnership has resulted in reducing over 3,000 tons of $CO_2$ and other GHG emissions and over $1,000,000 in utility cost savings per year. Ameresco appreciates this opportunity to play a small role in the safe reopening of schools.

About Ameresco, Inc.
Founded in 2000, Ameresco, Inc. (NYSE:AMRC) is a leading cleantech integrator and renewable energy asset developer, owner and operator. Our comprehensive portfolio includes energy efficiency, infrastructure upgrades, asset sustainability and renewable energy solutions delivered to clients throughout North America and the United Kingdom. Ameresco's sustainability services in support of clients' pursuit of Net Zero include upgrades to a facility's energy infrastructure and the development, construction, and operation of distributed energy resources. Ameresco has successfully completed energy saving, environmentally responsible projects with Federal, state and local governments, healthcare and educational institutions, housing authorities, and commercial and industrial customers. With its corporate headquarters in Framingham, MA, Ameresco has more than 1,000 employees providing local expertise in the United States, Canada, and the United Kingdom. For more information, visit www.ameresco.com.

**Explanation of ASHRAE Total Effective Air Changes per Hour (ACH_e) Calculation**

ASHRAE has been updating their Building Readiness document to reflect the most current understanding in the engineering community for how to operate and maintain buildings during the pandemic. Their update on 4/27/2021 provided an explanation of the impact air filters and air cleaning devices have on the air in buildings. They provided the methodology, formulas, and an Excel-based tool for determining the equivalent outside air a space is receiving by having a mix of outside air, filtered recirculated air, and additional air filtration or cleaning devices in the room. Here is the explanation from ASHRAE:




As part of the airflow testing project that Portland Public Schools has partnered with Ameresco to complete, we are including the calculation of the Total Effective Air Changes per Hour (ACH_e) to show the impact of the air filtration that is active in nearly all spaces in the PPS schools. The formula for doing so is:

$$\mathrm{ACH_e} = \left(ACH_{oa} + ACH_f\right) * E_Z + ACH_ir$$

where:

- $\mathrm{ACH_{oa}}$ = air changes per hour of outside air = outside airflow in cubic feet per minute * 60 minutes per hour / room volume in cubic feet
- $\mathrm{ACH_f}$ = air changes per hour of clean air from filtered recirculated air with filters of the specified MERV rating as determined by ASHRAE
- $E_z$ = Zone Air Distribution Effectiveness = how effective the HVAC system is at circulating and mixing the air to distribute the clean air throughout the room
- ACH_ir = the air changes per hour of clean air from portable air filters in the room = number of filters * CADR * 60 minutes per hour / room volume in cubic feet
    - CADR = Clear Air Delivery Rate = the CFM of clean air as specified by the manufacturer of the air filter

In order to include these calculations in the airflow testing reports, Ameresco and PPS have made the following assumptions as not all the variables are known:

1. PPS is in process of upgrading the air filters in their HVAC systems to MERV 13 and plans to be complete with that project for the start of the ’21-’22 school year. In this report and for the sake of the ACH_e calculation, we are using the filters that are in place at the time of the measurements, so some of them are still MERV 8.
2. ASHRAE has guidelines for what should be used for the Zone Air Distribution Effectiveness ($E_z$) based on the HVAC system configuration, but they do not provide a value for every HVAC system and room configuration. For the majority of PPS rooms, an $E_z$ of 0.8 – 1.0 would be most appropriate, so we have made the conservative assumption of using 0.8 for every space as that yields the lower ACH_e.
3. The CADR for a given air filter is from manufacturer ratings and is based on certain conditions (fan speed, particulate size, filter cleanliness, etc.) that change with operating conditions.

# NEUDORFER ENGINEERS INC.

**TEST REPORT TYPE:**
**SURVEY REPORT**

# Portland Public Schools Airflow Testing
# Buckman ES
# 320 SE 16th Ave, Portland, OR 97214

Job Number: 2021-0297

**Project Completion Date:** **09/02/21**
**Revision Date:** **-** **Revision Number:** **-**








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**Portland Public Schools Airflow Testing**
**Buckman ES**

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Neudorfer Engineers, Inc.
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# REPORT TITLE

## CERTIFIED TEST: SURVEY REPORT

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**Project:** Portland Public Schools Airflow Testing
Buckman ES

**NEI Job#:** 2021-0297

**Mechanical Engineer:** NA

**Architect:** NA

**HVAC Contractor:** NA

**TAB Firm:** Neudorfer Engineers Inc
**Test Engineer:** Zach Mayer







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# CERTIFICATION

## Portland Public Schools Airflow Testing

The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. Any variances from design quantities, which exceed NEBB tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

Significant / Noteworthy Remarks are noted on the General Remarks and General Field Notes pages. Other remarks are noted on individual test sheets.

Noted deficiencies are not the TAB firms responsibility to repair. Prior to issuance of this report, Deficiency Reports are forwarded to our contracted agent.

Warranty is limited to one year from date of this report. Within that time, any discrepancies, ambiguities, or omissions found in this report will be retested, adjusted, or balanced as needed. A written notification will be required.

**Submitted and Certified by:**

| | |
|---|---|
| NEBB TAB Firm: | **Neudorfer Engineers Inc** |
| Certification No: | **3414** |
| Expiration Date: | **March 31, 2023** |
| Certification Date: | **March 31, 2021** |
| *(Date completed)* | *Signed and Sealed by:* |
| NEBB Supervisor: | **Mike Vawter P.E.** |
| NEBB Supervisor: | **Eric Stotts** |






# TERMS AND ABBREVIATIONS

**Project: Portland Public Schools Airflow Testing**

| | |
|---|---|
| **AC or ACU** | Air Conditioner or Air Conditioning Unit |
| **AH or AHU** | Air Handler or Air Handling Unit |
| **AVG** | Average |
| **BHP** | Brake Horsepower |
| **CAV** | Constant Air Volume |
| **CBV** | Calbirated Balancing Valve (Circuit Setter) |
| **CC** | Cooling Coil |
| **CD** | Ceiling Diffuser |
| **CFM** | Cubic Feet per Minute |
| **CH** | Chiller |
| **CHWS** | Chilled Water Supply |
| **CHWR** | Chilled Water Return |
| **CP** | Circulating Pump |
| **CR** | Ceiling Register |
| **CRAC** | Computer Room Air Conditioner |
| **CRU** | Computer Room Unit |
| **CT** | Cooling Tower |
| **CU** | Condenser Unit |
| **CUH** | Cabinet Unit Heater |
| **CWS** | Condenser Water Supply |
| **CWR** | Condenser Water Return |
| **DAT** | Discharge Air Temperature |
| **DB** | Dyr Bulb |
| **DD** | Direct Drive |
| **DDC** | Direct Digital Controls: EMS Control System for the HVAC |
| **Des.** | Design |
| **Dia.** | Diameter |
| **Disch.** | Discharge |
| **EA** | Exhaust Air |
| **EAT** | Entering Air Temperature |
| **Economizer** | Controls and components that allow an air handler to logically utilize outdoor air for cooling as opposed to the use of mechanical cooling. |
| **EF** | Exhaust Fan |
| **EG** | Exhaust Grille |
| **EMCS** | Energy Management Control System |
| **ERU** | Energy Recovery Unit |
| **E.S.P.** | External Static Pressure |
| **HRC** | Heat Recovery Coil |
| **EWT** | Entering Water Temperature |
| **FCU** | Fan Coil Unit |
| **FD** | Fire Damper |
| **FLA** | Full Load Amperage: Maximum amperage a motor can draw. |
| **Flow Hood** | Instrument that captures air and converts the reading to CFM. |
| **FHT** | Fume Hood Test |
| **FPB** | Fan Powered Box |
| **FPM** | Feet per Minute |
| **FR** | Field Report |
| **FT** | Foot, Feet |
| **FTU** | Fan Terminal Unit |
| **GPM** | Gallons per Minute |
| **HC** | Heating Coil |
| **TDH** | Pressure Difference across the entering and leaving side of a pump. |
| **HEPA** | High Efficiency Particulate Arrestance |
| **HP** | Horsepower |
| **HVAC** | Heating Ventilation and Air Conditioning |
| **HWS** | Heating Water Supply |
| **HWR** | Heating Water Return |
| **HX** | Heat Exchanger |
| **HZ** | Hertz, cycle per second |
| **in.** | inches |
| **in.w.g.** | inches of water gauge |
| **Kfactor** | Correction factor to the free area need to calculate CFM. |
| **KW** | Kilowatts |
| **LAT** | Leaving Air Temperature |
| **LWG** | Low Wall Grille |
| **LWR** | Low Wall Register |
| **LWT** | Leaving Water Temperature |
| **MAU** | Make-up Air Hangling Unit |
| **MBH** | 1,000 BTUH |
| **N/A** | Not Applicable |
| **OSA** | Outside Air |
| **OBD** | Opposed Blade Damper |
| **∆P** | Pressure Drop. |
| **PH** | Phase |
| **PSI** | Pounds per Square Inch |
| **RA** | Return Air |
| **RAD** | Radiator |
| **RAT** | Return Air Temperature |
| **RF** | Return Fan |
| **RH** | Relative Humidity |
| **RHC** | Reheat Coil |
| **RPM** | Revolutions per Minute |
| **RTU** | Roof Top Unit |
| **SA** | Supply Air |
| **SAT** | Supply Air Temerature |
| **S.F.** | Service Factor |
| **SF** | Supply Fan |
| **SFD** | Smoke/Fire Damper |
| **SP** | Static Pressure |
| **sq.ft.** | square feet |
| **Suct.** | Suction |
| **SWG** | Sidewall Grille |
| **SWR** | Sidewall Register |
| **TAB** | Test; Adjust; and Balance |
| **TSP** | Total Static Pressure: Difference between the entering and leaving static pressure of a fan. |
| **UH** | Unit Heater |
| **VAV** | Variable Air Volume; box that contains a motorized damper that modulates airflow. |
| **VD** | Volume Damper |
| **VFD** | Variable Frequency Drive |
| **Velgrid** | Instrument that reads used to read velocity in feet per minute. |
| **VVT** | Variable Volume Terminal |
| **WC** | Water Column |
| **W.G.** | Water Gauge |
| **WB** | Wet Bulb |

# INSTRUMENT CALIBRATIONS

## Portland Public Schools Airflow Testing

| | | | |
|---|---|---|---|
| **Instrument Type** | Air Data Meter with Flowhood | Instrument Serial # | **M00475** |
| **Instrument Manufacturer** | **Shortridge** | Calibration Date | **11/4/2020** |
| **Instrument Model Number** | **ADM 870** | Calibration Due | **11/4/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Differential Pressure Water Meter | Instrument Serial # | **W14090** |
| **Instrument Manufacturer** | **Shortridge** | Calibration Date | **10/16/2020** |
| **Instrument Model Number** | **HDM-250** | Calibration Due | **10/16/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Psychrometer | Instrument Serial # | **8084305** |
| **Instrument Manufacturer** | **Extech** | Calibration Date | **10/13/2020** |
| **Instrument Model Number** | **RH390** | Calibration Due | **10/13/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Tachometer | Instrument Serial # | **B185B5022P** |
| **Instrument Manufacturer** | **Nidec** | Calibration Date | **10/11/2020** |
| **Instrument Model Number** | **MT-200** | Calibration Due | **10/11/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Amp Probe | Instrument Serial # | **33380179WS** |
| **Instrument Manufacturer** | **Fluke** | Calibration Date | **10/9/2020** |
| **Instrument Model Number** | **323 Clamp Meter** | Calibration Due | **10/9/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Digital Thermometer | Instrument Serial # | **45400509WS** |
| **Instrument Manufacturer** | **Fluke** | Calibration Date | **10/9/2020** |
| **Instrument Model Number** | **52 II** | Calibration Due | **10/9/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Manometer | Instrument Serial # | **M00475** |
| **Instrument Manufacturer** | **Shortridge** | Calibration Date | **11/4/2020** |
| **Instrument Model Number** | **ADM 870** | Calibration Due | **11/4/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Thermal Anemometer | Instrument Serial # | **AVM440742003** |
| **Instrument Manufacturer** | **Alnor Instruments** | Calibration Date | **11/9/2020** |
| **Instrument Model Number** | **AVM 440** | Calibration Due | **11/9/2021** |

| | | | |
|---|---|---|---|
| **Instrument Type** | Ultrasonic Flow Meter | Instrument Serial # | **N5K1435T** |
| **Instrument Manufacturer** | **Fuji** | Calibration Date | **10/14/2020** |
| **Instrument Model Number** | **Portaflow-C** | Calibration Due | **10/14/2021** |

PROJECT Portland Public Schools Airflow Testing
LOCATION Buckman ES; 320 SE 16th Ave, Portland, OR 97214

# REPORT SUMMARY

This project has been surveyed per plans and specifications using the National Environmental Balancing Bureau (NEBB) standards and procedures.

The scope of work for this project was to assess the current airflows for each classroom, office, and special purpose space. Air changes per hour were calculated along with the % of OSA for the spaces and any deficiencies found for each piece of equipment has been noted in the following report.

All ventilation equipment was commanded to run by the BMS system. Ventilation units were measured with a flowhood on the supply outlets. Outside air was recorded with a flowhood on the OSA louvre where accessible. AK factors were calculated from flowhood readings. The remaining OSA values were recorded with a velgrid. AHU supply air was recorded by a summation of the outlets as recorded by flowhood or velgrid when appropriate. Outside air was recorded with a velgrid or airfoil and calculated by the free area method.

The measured airflows in this report represent the performance of the equipment at the time of measurement, which vary over time based on operating conditions. There are factors outside the control of Neudorfer that impact airflow, and variance in those factors is expected and normal. One significant factor is the MERV rating and condition of the air filters on the equipment. During the summer of 2021, PPS began upgrading the filters on all their fan systems to MERV 13. Those upgraded filters are more effective at capturing particles but also impact the amount of airflow from the equipment. These filter changes were occurring while the airflow measurement project was happening, so some schools had the new filters, and some had the old filters at the time of measurement. On the data page included this report, there is a line stating whether or not the upgraded filters were in place at the time of measurement.

**AIRFLOW SURVEY REPORT**

Project: Portland Public Schools Airflow Testing
Location: Buckman ES; 320 SE 16th Ave, Portland, OR 97214
Filter Status: Not Upgraded

| Room Floor Plan # (Actual #) | Equipment Info | | Room Dimensions | | | | | Airflow Measurements | | | Calculated ACH | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Served By | Equipment Type | Room Length | Room Width | Room Area | Room Height | Room Volume | Total CFM Supply | OA CFM Supply | OA % | Air Changes per Hour (supply) | Air Changes per Hour (OA) | # of Portable Filters | Total Effective Air Changes per Hour (ACH_e) with Portable Filter | Total Effective Air Changes per Hour (ACH_e) without Portable Filter | |
| First Floor | | | | | | | | | | | | | | | | |
| Office 05D | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 04 | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 05 | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 05A | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 05B | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 05C | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 06 | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 06A | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 06B | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| 06C | AHU-2 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Used as a storage area now. Not Read. |
| First Floor | | | | | | | | | | | | | | | | |
| Rm 100 | AHU-1 | AHU | 41.4 | 32.5 | 1,346 | 10.3 | 13,859 | 805 | 97 | 12% | 3.5 | 0.4 | 1 | 2.8 | 1.7 | |
| Rm 101 | AHU-1 | AHU | 30.3 | 22.9 | 694 | 12.3 | 8,535 | 330 | 40 | 12% | 2.3 | 0.3 | 1 | 3.0 | 1.1 | Room is under construction. |
| Rm 102 | AHU-1 | AHU | 30.4 | 22.8 | 693 | 12.2 | 8,456 | 320 | 38 | 12% | 2.3 | 0.3 | 1 | 3.0 | 1.1 | |
| Rm 103 | AHU-1 | AHU | 30.4 | 22.9 | 696 | 12.2 | 8,493 | 305 | 37 | 12% | 2.2 | 0.3 | 1 | 2.9 | 1.0 | |
| Rm 104 | AHU-1 | AHU | 30.3 | 22.9 | 694 | 12.3 | 8,535 | 230 | 28 | 12% | 1.6 | 0.2 | 1 | 2.6 | 0.8 | |
| Rm 105 | AHU-1 | AHU | 30.4 | 22.8 | 693 | 12.3 | 8,525 | 545 | 65 | 12% | 3.8 | 0.5 | 1 | 3.7 | 1.9 | Room is Under construction. |
| Rm 106 | AHU-1 | AHU | 30.4 | 22.9 | 696 | 12.3 | 8,563 | 320 | 38 | 12% | 2.2 | 0.3 | 1 | 2.9 | 1.1 | |
| Rm 107 | AHU-1 | AHU | 30.5 | 22.9 | 698 | 12.3 | 8,591 | 345 | 41 | 12% | 2.4 | 0.3 | 1 | 3.0 | 1.2 | |
| Rm 108 | AHU-1 | AHU | 30.4 | 22.8 | 693 | 12.2 | 8,456 | 360 | 43 | 12% | 2.6 | 0.3 | 1 | 3.1 | 1.2 | |
| Rm 109 | AHU-1 | AHU | 30.4 | 22.5 | 684 | 12.2 | 8,345 | 265 | 32 | 12% | 1.9 | 0.2 | 1 | 2.8 | 0.9 | |
| Rm 110 | AHU-1 | AHU | 61.0 | 22.4 | 1,366 | 12.2 | 16,670 | 950 | 114 | 12% | 3.4 | 0.4 | 1 | 2.6 | 1.7 | Library is being used as a classroom. |
| RM 112 | AHU-1 | AHU | 21.0 | 18.0 | 378 | 12.2 | 4,612 | 550 | 66 | 12% | 7.2 | 0.9 | 1 | 6.9 | 3.5 | |
| Rm 113 | AHU-1 | AHU | 25.0 | 23.0 | 575 | 10.0 | 5,750 | 395 | 47 | 12% | 4.1 | 0.5 | 1 | 4.7 | 2.0 | |

Date: 5/5/2021 Readings By: TD / PV

**AIRFLOW SURVEY REPORT**

Project: Portland Public Schools Airflow Testing
Location: Buckman ES; 320 SE 16th Ave, Portland, OR 97214
Filter Status: Not Upgraded

| Room Floor Plan # (Actual #) | Equipment Info | | Room Dimensions | | | | | Airflow Measurements | | | Calculated ACH | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Served By | Equipment Type | Room Length | Room Width | Room Area | Room Height | Room Volume | Total CFM Supply | OA CFM Supply | OA % | Air Changes per Hour (supply) | Air Changes per Hour (OA) | # of Portable Filters | Total Effective Air Changes per Hour (ACH_e) with Portable Filter | Total Effective Air Changes per Hour (ACH_e) without Portable Filter | |
| First Floor | | | | | | | | | | | | | | | | |
| Rm 111 (114) | AHU-1 | AHU | 30.6 | 21.1 | 646 | 8.6 | 5,553 | 560 | 67 | 12% | 6.1 | 0.7 | 1 | 5.8 | 2.9 | |
| South Gym | AHU-1 | AHU | - | - | 2,563 | 24.5 | 62,794 | - | - | - | 0 | 0 | 1 | 0.2 | 0.0 | **Note #2**, Ventilation is served from adjacent space. |
| Office 100C | AHU-1 | AHU | 7.7 | 6.9 | 53 | 10.4 | 553 | - | - | - | 0 | 0 | 1 | 28.2 | 0.0 | **Note #1** |
| Conf Rm 106C | AHU-1 | AHU | 12.7 | 15.5 | 197 | 12.4 | 2,441 | 145 | 17 | 12% | 3.6 | 0.4 | 1 | 8.1 | 1.7 | |
| Conf Rm 108A | RAD | RAD | 15.9 | 23.4 | 372 | 12.4 | 4,614 | 340 | 41 | 12% | 4.4 | 0.5 | 1 | 5.5 | 2.2 | Radiators |
| Office 108B | AHU-1 | AHU | 15.6 | 12.6 | 197 | 12.4 | 2,437 | 80 | 10 | 12% | 2.0 | 0.2 | 1 | 7.4 | 1.0 | |
| Office 115A | AHU-1 | AHU | 10.9 | 8.3 | 90 | 13.5 | 1,221 | - | - | - | 0 | 0 | 0 | N/A | 0.0 | **Note #3** |
| 101A | AHU-1 | AHU | 30.6 | 22.3 | 682 | 9.0 | 6,141 | 1,065 | 128 | 12% | 10.4 | 1.2 | 1 | 7.6 | 5.1 | |
| 101D | AHU-1 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | Walk in refrigerator in space, not read. |
| 107A | AHU-1 | AHU | 23.4 | 15.9 | 372 | 12.4 | 4,614 | 100 | 12 | 12% | 1.3 | 0.2 | 1 | 4.0 | 0.6 | |
| Cafeteria 116 | AHU-1 | AHU | 71.9 | 65.6 | 4,717 | 17.7 | 83,485 | 13,295 | 1,595 | 12% | 9.6 | 1.1 | 1 | 4.8 | 4.7 | |
| Stage 116A | AHU-1 | AHU | - | - | - | - | - | - | - | - | 0 | 0 | 0 | N/A | 0.0 | **Note #3** |
| 117 | AHU-1 | AHU | 21.7 | 22.2 | 482 | 9.0 | 4,336 | 110 | 13 | 12% | 1.5 | 0.2 | 1 | 4.3 | 0.7 | |
| Second Floor | | | | | | | | | | | | | | | | |
| Rm 201 | AHU-1 | AHU | 30.6 | 23.0 | 704 | 12.3 | 8,657 | 425 | 51 | 12% | 2.9 | 0.4 | 1 | 3.2 | 1.4 | |
| Rm 202 | AHU-1 | AHU | 30.4 | 22.5 | 684 | 12.3 | 8,413 | 345 | 41 | 12% | 2.5 | 0.3 | 1 | 3.1 | 1.2 | |
| Rm 203 | AHU-1 | AHU | 30.4 | 23.0 | 699 | 12.3 | 8,600 | 485 | 58 | 12% | 3.4 | 0.4 | 1 | 3.5 | 1.6 | |
| Rm 204 | AHU-1 | AHU | 30.3 | 23.0 | 697 | 12.3 | 8,572 | 410 | 49 | 12% | 2.9 | 0.3 | 1 | 3.2 | 1.4 | |
| Rm 205 | AHU-1 | AHU | 30.4 | 22.4 | 681 | 12.3 | 8,376 | 340 | 41 | 12% | 2.4 | 0.3 | 1 | 3.0 | 1.2 | |
| Rm 206 | AHU-1 | AHU | 30.5 | 23.4 | 714 | 12.4 | 8,850 | 400 | 48 | 12% | 2.7 | 0.3 | 1 | 3.1 | 1.3 | |
| Rm 207 | AHU-1 | AHU | 30.4 | 22.9 | 696 | 12.3 | 8,563 | 415 | 50 | 12% | 2.9 | 0.3 | 1 | 3.2 | 1.4 | |
| Rm 208 | AHU-1 | AHU | 36.8 | 21.7 | 799 | 12.3 | 9,822 | 380 | 46 | 12% | 2.3 | 0.3 | 1 | 2.7 | 1.1 | |
| Rm 210 | AHU-1 | AHU | 30.0 | 23.0 | 690 | 12.4 | 8,556 | 310 | 37 | 12% | 2.2 | 0.3 | 1 | 2.9 | 1.1 | |
| Rm 211 | AHU-1 | AHU | 31.7 | 23.0 | 729 | 12.4 | 9,041 | 340 | 41 | 12% | 2.3 | 0.3 | 1 | 2.8 | 1.1 | |

Date: 5/5/2021 Readings By: TD / PV

**AIRFLOW SURVEY REPORT**

Project: Portland Public Schools Airflow Testing
Location: Buckman ES; 320 SE 16th Ave, Portland, OR 97214
Filter Status: Not Upgraded

| Room Floor Plan # (Actual #) | Equipment Info | | Room Dimensions | | | | | Airflow Measurements | | | Calculated ACH | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Served By | Equipment Type | Room Length | Room Width | Room Area | Room Height | Room Volume | Total CFM Supply | OA CFM Supply | OA % | Air Changes per Hour (supply) | Air Changes per Hour (OA) | # of Portable Filters | Total Effective Air Changes per Hour (ACH_e) with Portable Filter | Total Effective Air Changes per Hour (ACH_e) without Portable Filter | |
| Second Floor | | | | | | | | | | | | | | | | |
| Rm 212 | AHU-1 | AHU | 30.5 | 22.5 | 686 | 12.3 | 8,441 | 370 | 44 | 12% | 2.6 | 0.3 | 1 | 3.1 | 1.3 | |
| Rm 213 | AHU-1 | AHU | 30.4 | 24.0 | 730 | 12.4 | 9,047 | 380 | 46 | 12% | 2.5 | 0.3 | 1 | 3.0 | 1.2 | |
| Rm 214 | AHU-1 | AHU | 30.4 | 24.0 | 730 | 12.4 | 9,047 | 415 | 50 | 12% | 2.8 | 0.3 | 1 | 3.1 | 1.3 | |
| Rm 215 | AHU-1 | AHU | 30.5 | 22.3 | 680 | 12.3 | 8,366 | 370 | 44 | 12% | 2.7 | 0.3 | 1 | 3.2 | 1.3 | |
| Rm 216 | AHU-1 | AHU | 30.5 | 23.0 | 702 | 12.4 | 8,699 | 460 | 55 | 12% | 3.2 | 0.4 | 1 | 3.3 | 1.5 | |
| Office 209 | AHU-1 | AHU | 15.5 | 12.9 | 200 | 12.4 | 2,479 | 70 | 8 | 12% | 1.7 | 0.2 | 1 | 7.1 | 0.8 | |

Date: 5/5/2021 Readings By: TD / PV

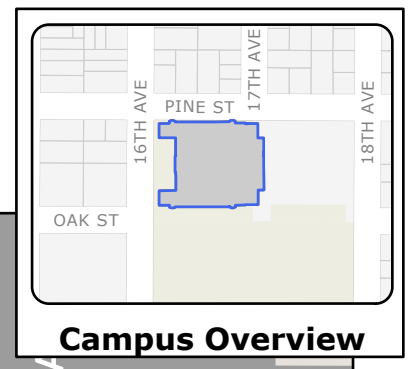
Project: Portland Public Schools Airflow Testing
Location: Buckman ES; 320 SE 16th Ave, Portland, OR 97214

| NOTE # | NOTE DESCRIPTION |
|---|---|
| 1 | Air is from adjoining areas. There is a radiator in the room. |
| 2 | Room is a gym that is currently being used as a gym. |
| 3 | Room is being used as a storage space. No visible grilles. |
| | Return visit 7/20/21 -ZM |

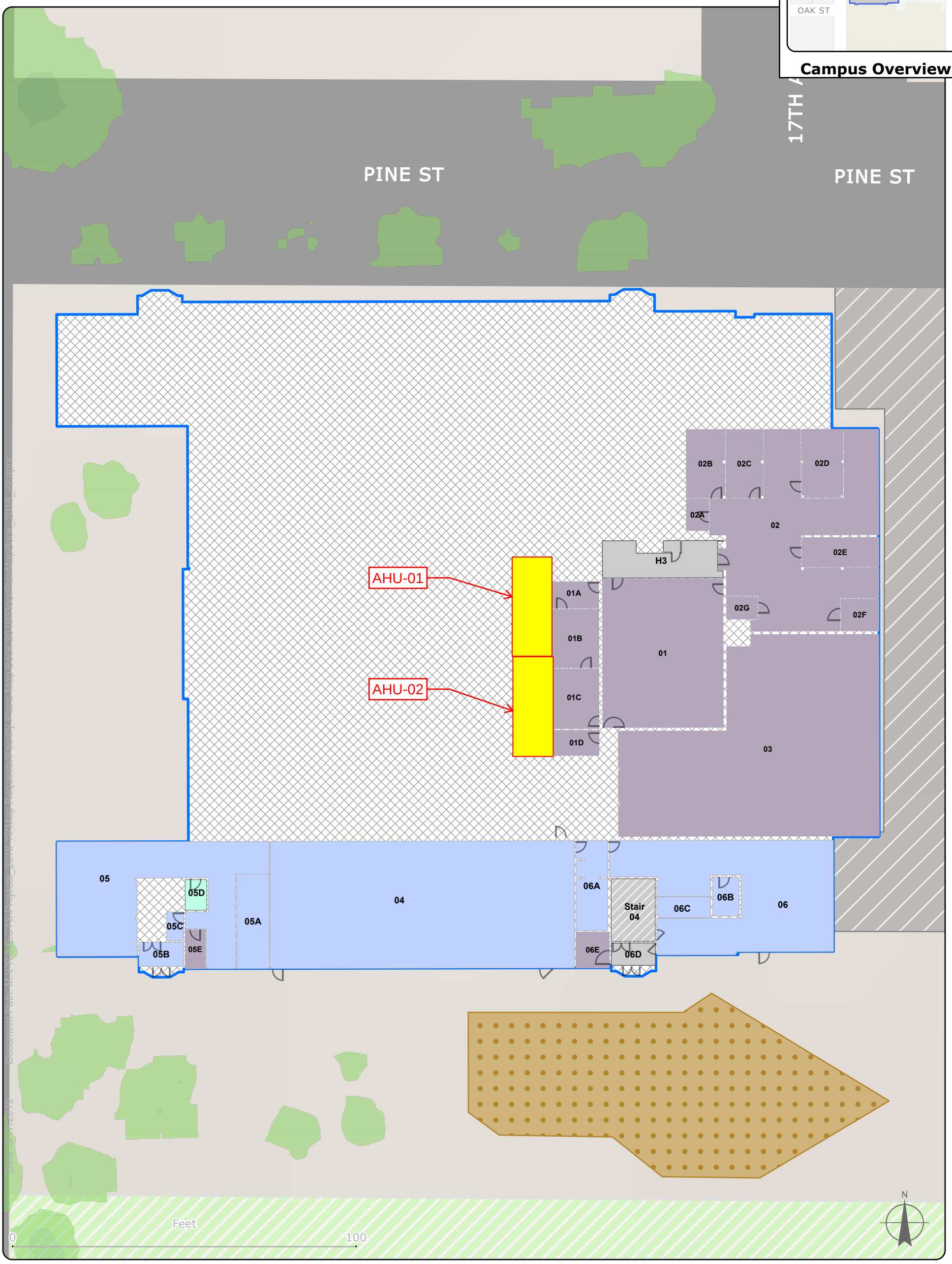
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# BUCKMAN: Lower Level 1




Campus Overview




**Space Use**

- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

**School Grounds**

- Campus Footprints
- Athletic Field
- Playground: Paved
- Playground: Unpaved
- Streets
- Doors

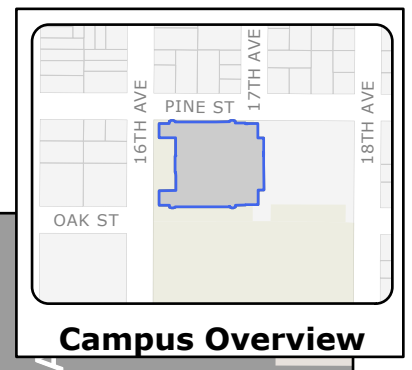
## Total Number Of Rooms By Classification

| | |
|---|---|
| Classrooms: 0 | Special Purpose: 9 |
| Office Spaces: 1 | Storage: 8 |

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# BUCKMAN: First Floor




Campus Overview

PINE ST

17TH AVE

PINE ST

CR Reg Rm 105 SqFt: 744

CR Reg Rm 104 SqFt: 745

CR Reg Rm 103 SqFt: 745

CR Reg Rm 102 SqFt: 745

CR Reg Rm 101 SqFt: 746

100C

100B

CR Art Rm 100 SqFt: 1429

100A RR Unisex

CR Reg Rm 106 SqFt: 699

104A RR Girls

104B RR Boys

117

101E

101D

101C RR Unisex

101B

101A

115

Conf. Room 106C

106A RR Unisex

106B RR Unisex

115B

115A

115C

116

Cafeteria

Stage 116A

108B

108C-IT

108D RR Unisex

108E

Conf. Room 108A

107A

109A RR Girls

109B RR Boys

111A

114

CR Perfm Rm 111 SqFt: 721

114

South Gym

CR Reg Rm 107 SqFt: 700

CR Reg Rm 108 SqFt: 743

CR Reg Rm 109 SqFt: 742

110

CR Reg Rm 112 SqFt: 539

CR Reg Rm 113 SqFt: 784

Feet

0

100

N

**Space Use**

- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

**School Grounds**

- Campus Footprints
- Athletic Field
- Playground: Paved
- Playground: Unpaved
- Streets
- Doors

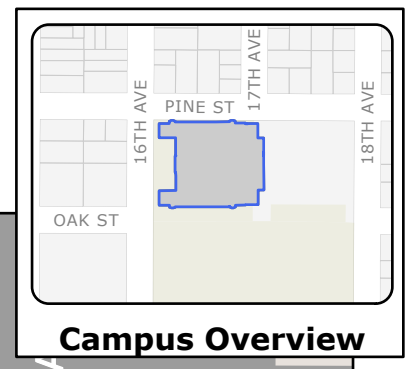
## Total Number Of Rooms By Classification

| | |
|---|---|
| Classrooms: 13 | Special Purpose: 7 |
| Office Spaces: 5 | Storage: 9 |

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# BUCKMAN: Second Floor




Campus Overview

PINE ST

17TH A

PINE ST

CR Reg Rm 206 SqFt: 752

Stair 02

CR Reg Rm 205 SqFt: 747

CR Reg Rm 204 SqFt: 747

CR Reg Rm 203 SqFt: 747

CR Reg Rm 202 SqFt: 740

Stair 03

CR Reg Rm 201 SqFt: 761

207B RR Fac Uni

204A RR Boys

204B RR Girls

207A

CR Reg Rm 207 SqFt: 744

H4

CR Reg Rm 208 SqFt: 896

209

209A-IT

H2

ELEV01

CR Reg Rm 210 SqFt: 748

210A

213A RR Girls

213B RR Boys

210B RR Fac Uni

CR Reg Rm 211 SqFt: 750

Stair 01

CR Reg Rm 212 SqFt: 742

CR Reg Rm 213 SqFt: 742

CR Reg Rm 214 SqFt: 742

CR Reg Rm 215 SqFt: 742

Stair 04

CR Reg Rm 216 SqFt: 753

Feet

0

100

N

Date: 9/17/2019

Document Path: M:\PROJECTS\Projects_2018-19\Map Requests\Facility Plans Map Book 2019\FloorPlanMapBook_2019_v2.aprx

**Space Use**

- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

**School Grounds**

- Campus Footprints
- Athletic Field
- Playground: Paved
- Playground: Unpaved
- Streets
- Doors

## Total Number Of Rooms By Classification

| | |
|---|---|
| Classrooms: 15 | Special Purpose: 0 |
| Office Spaces: 1 | Storage: 2 |