# Denville Township Public Schools

# Indoor Air Quality Report

# New Wave Environmental

# September 2, 2020

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# INDOOR AIR QUALITY SURVEY

# DENVILLE TOWNSHIP SCHOOL DISTRICT

# LAKEVIEW ELEMENTARY SCHOOL
## 44 Cooper Road
## Denville, New Jersey 07834

**PREPARED FOR:**
**Denville Township School District**
**31 St Mary's Place**
**Denville, New Jersey 07834**

**PREPARED BY:**
**New Wave Engineering, LLC**
**PO Box 4124**
**Wayne, New Jersey 07470**

August 2020

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## 1.0 INTRODUCTION

New Wave Environmental (NWE), an environmental LLC, has been retained by the Denville Township School District (District) to conduct an indoor air quality (IAQ) survey within various classrooms located in the *Denville Elementary and Middle Schools*. As a consequence of the recent Corona Virus pandemic, the district requested an *Indoor Air Quality* (IAQ) investigation performed in various classrooms throughout the school buildings which represent different types of heating, ventilation and air conditioning systems within the schools to determine if current cleaning and disinfecting protocols, in conjunction with proper ventilation, are producing a *clean* environment for staff and students alike. This IAQ survey was conducted on August 28, 2020. New Wave staff was accompanied by District Business Administrator Mrs. Damaris Gurowsky.

The *COVID-19 pandemic*, also known as the *Coronavirus Pandemic*, is a recent ongoing global pandemic of the coronavirus disease: 2019 *(COVID-19)*, caused by the acute respiratory syndrome: *Coronavirus 2* (*SARS-CoV-2*). This outbreak was first identified in Wuhan, China, in December 2019. The World Health Organization had declared the outbreak a *Public Health Emergency of International Concern* on January 30, 2020 and a *Pandemic* on March 11, 2020. The virus is primarily spread between people during close contact, most often via small droplets produced by: coughing, sneezing and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through the air over long distances. However, transmission may also occur via smaller droplets which may be able to stay suspended in the air for a longer period of time. Also, and less common, people may become infected by touching a contaminated surface and then touching their face.

This IAQ survey includes New Wave's investigation of various classrooms and offices within the buildings via visual inspections for cleanliness and any current water intrusion stains. Our testing protocol includes real-time measurements of: temperature, humidity, carbon dioxide, and carbon monoxide, all industry standards for *Indoor Air Quality* surveys.

### 1.1 PROJECT OBJECTIVE

The objective of this survey is to ascertain the overall Indoor Air Quality in the various classrooms within the *Denville Elementary and Middle School* buildings and suggest/recommend proposals based upon overall survey findings and personal observations.

## 2.0 PROJECT METHODOLOGY

### 2.1 EQUIPMENT

A Q-Trak™ Plus Indoor Air Quality (IAQ) monitor, Model 7575-X, Serial Number 7575X1933002, was utilized to measure several IAQ parameters, including: carbon monoxide (CO), carbon dioxide ($CO_2$), relative humidity RH), and temperature (*F). Equipment was calibrated by the equipment provider.

### 2.2 SIMPLE RANDOM SAMPLING OF ROOMS

Simple random sampling is a basic type of sampling, since it can be a component of other more complex sampling methods. The principle of simple random sampling is that every classroom/area has the same probability of being chosen. This process and technique sampling is an unbiased surveying technique. Sampling was performed to include the different types of HVAC/ventilation systems utilized in the Denville Public School District.

## 3.0 INDOOR AIR QUALITY STANDARDS

Recommended levels established for office/school settings differ from regulatory levels set for industrial or manufacturing environments. Recommended IAQ contaminant levels for office/school areas are generally lower because they are based upon the individual susceptibility of building occupants and comfort, in addition to health. Some guidelines cited in this document refer to standards promulgated by the *American Society of Heating, Refrigerating and Air-conditioning Engineers Inc.* (*ASHRAE*). *New Wave* is a member of *ASHRAE*. These standards are found in the ASHRAE documents: *Ventilation for Acceptable Indoor Air Quality* (ASHRAE 62-2001) and *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55-2001).

## 3.1 INDOOR AIR QUALITY STANDARDS -

**New Jersey Department of Labor (NJDOL)**

The NJDOL has established IAQ regulations through the Public Employees Occupational Safety and Health (PEOSH) Act to protect public employees across the state and improve workplace environments.

**American Industrial Hygiene Association (AIHA)**

The AIHA has published "The IAQ Investigator's Guide" which references guidelines for volatile organic compounds (VOCs), relative humidity, formaldehyde, and various other materials that may contribute to indoor air quality concerns.

**United States Environmental Protection Agency (USEPA)**

The USEPA has published the *"Mold Remediation in Schools and Commercial Buildings"* document that provides guidelines for the remediation and cleanup of mold and moisture IAQ problems.

**American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)**

ASHRAE Standards 62.1 and 62.2 are the recognized standards for ventilation systems' design and acceptable *indoor air quality* (IAQ). Expanded and revised for 2019, both standards specify minimum ventilation rates and other measures in order to minimize adverse health effects for occupants. Standard 90.1 has been a benchmark for commercial building energy codes in the United States and a key basis for codes and standards around the world for more than 35 years. This standard provides the minimum requirements for energy-efficient design of most buildings. It offers, in detail, the minimum energy efficiency requirements for design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings, as well as criteria for determining compliance with these requirements. It is an indispensable reference for engineers and other professionals involved in the design of buildings and the buildings' systems.

## 3.2 PEOSH INDOOR AIR QUALITY STANDARDS

**Temperature**

The PEOSH IAQ and ASHRAE Standards requires a temperature range of 68ºF to 79ºF for office/school environments. The employer must verify that the heating, ventilation, and air-conditioning (HVAC) system is in proper operating order should temperatures fall outside this range. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the *Standard.*

**Relative Humidity**

The PEOSH IAQ Standard does not establish an acceptable range for indoor relative humidity; however, it does refer to the AIHA recommended relative humidity range of 30% to 60%.
*ASHRAE Standard 6.2-2001 states that high humidity can support the growth of pathogenic or allergenic organisms. Examples include: certain fungi, associated mycotoxins, and dust mites. Relative humidity in habitable spaces should preferably be maintained between 30 percent and 60 percent relative humidity to minimize growth of allergenic and pathogenic organisms.* **In 2016**, ASHRAE released an update to their standards. The update states the following:
***ASHRAE Standard 62.1-2016 recommends that "relative humidity in occupied spaces be controlled to less than 65% to reduce the likelihood of conditions that can lead to microbial growth."***

The industry standard concurs with the *ASHRAE* guideline that indoor temperatures in the winter be maintained between 68 degrees and 74 degrees, with a relative humidity level between 30 percent and 60/65 percent. Temperatures in the summer should be maintained between 73 degrees and 79 degrees, with a relative humidity level between 30 percent and 60/65 percent. These ranges should be acceptable for sedentary or slightly active persons.

## Carbon Dioxide

Carbon dioxide ($CO_2$) monitoring is a useful screening technique for determining if outside air supply is sufficient for maintaining acceptable indoor air quality. $CO_2$ is a naturally occurring constituent of the atmosphere and is also a product of human respiration. During periods of occupancy, $CO_2$ levels in a building will rise above the normal background level.

The *PEOSH IAQ* and *ASHRAE* Standards allow a maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. The employer must verify that the HVAC system is in proper operating order should $CO_2$ concentrations exceed this threshold. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the standard. Properly ventilated buildings should have carbon dioxide levels between 600ppm and 1,000 ppm, with a floor or building average of 800 ppm or less. If average carbon dioxide levels within a building are maintained at less than 800 ppm, with appropriate temperature and humidity levels, complaints about indoor air quality should be minimized. If carbon dioxide levels are greater than 1,000 ppm, complaints may occur. Therefore, 1,000 ppm should be used as a guideline for improving ventilation. If a building exceeds this guideline, it should **NOT** be interpreted as a hazardous or life-threatening situation. An elevated carbon dioxide level is only an indication of an inadequate amount of outside air/oxygen being brought into a building. The levels cited in this document should only be used as a guideline to determine the amount of fresh outside air entering the building.

In building areas where there are potential sources of carbon dioxide other than exhaled breath, the guidelines above cannot be used. Other sources of *CO2* can include exhaust gas from kilns, internal combustion engines, dry ice, etc. Under these conditions, the Occupational Safety and Health Administration (OSHA) standard for carbon dioxide should be used. The OSHA standard is an eight-hour time-weighted average (TWA) of 5,000 ppm with a short-term 15-minute average limit of 30,000 ppm

## CO Levels and Guidelines {carbon monoxide}

| PPM | Symptoms and applicable standard |
|---|---|
| 0-1 | Normal Background levels |
| 9 | Maximum indoor air quality level: Maximum allowable concentration per ASHRAE Residential Standards 62-1989 for living area. |
| 25 | Maximum limit 8 hours of continuous exposure per California OSHA workplace standards |
| 35 | Maximum 8 hours average exposure level per US OSHA workplace standards |
| 50 | Maximum concentration for continuous exposure in any 8-hour average level per OSHA standards |
| 100 | Remove employees from enclosed space if the CO concentration exceeds 100ppm per OSHA exposure limit. |
| 200 | Mild headache, fatigue, nausea and dizziness within 2-3 hours |
| 400 | Frontal headache, life threatening after 3 hours. Maximum concentration in fuel gas per the US EPA and AGA standards |
| 800 | Dizziness, nausea, convulsions, death within 2-3 hours |
| 1600 | Nausea within 20 minutes. Death within 2-3 hours. |

**Carbon Monoxide**

Carbon monoxide (CO) usually originates from outside the building from such sources as automotive traffic and loading docks. Internal sources could include cigarette smoke, petroleum-fired boilers, and petroleum-fired furnaces. Assuming internal sources are limited, monitoring for CO is a useful measure for determining if outside air intakes are being impacted by external sources/controls. The *PEOSH IAQ* and *ASHRAE Standards* states that when general ventilation cannot control indoor air contaminants below the Permissible Exposure Limit (PEL), the employer must implement other control measures. The United States Occupational Safety and Health Administration (OSHA) sets enforceable PELs to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. The current PEL for CO is 50 PPM for an eight-hour time weighted average (TWA).

## Mold/Fungi

Mold/fungal growth is most likely found in areas that have sufficient moisture along with: temperature, and nutritive sources to promote proliferation. Nutritive sources within buildings include: drywall paper backing, cellulose ceiling tiles, wallpaper, wood wall framing and trim, pipe insulation/wrappings and similar materials.

## VENTATIONAL SYSTEMS

The main purposes of a Heating, Ventilation and Air-Conditioning (*HVAC*) system is to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort. HVAC systems are among the largest energy consumers in schools. The choice and design of the HVAC system can also affect many other high-performance goals, including water consumption (water-cooled air-conditioning equipment) and acoustics. The Denville Township School District utilizes two (2) different HVAC systems: Uninvent (in conjunction with window air conditioner units) and exterior roof top or side units HVAC Systems.

### *A. Unit Ventilator (Univent)*

Many schools use unit ventilator (uninvent) systems. A uninvent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building. Return air is drawn through an air intake located at the base of each unit where fresh and return air are mixed, filtered, heated (and sometimes cooled) and provided to classrooms through an air diffuser located on the top of the unit. For univents to provide fresh air as designed, they must remain free of obstructions such as furniture placed in front of them or items placed on top. Importantly, these units must remain on and be allowed to operate while rooms are occupied.

### *B. Air Handling Systems*

Fresh air for most offices, common areas in schools, and other locations is provided by air handling units (AHUs). These may be located in mechanical rooms, on the roof, on the side of a building or in the basement. Outside air is drawn into AHUs from vents open to the exterior, filtered, heated/cooled and ducted to supply diffusers, typically wall or ceiling-mounted, but occasionally installed in floors.
Return air is typically drawn back into ceiling/wall/floor vents and is returned to the AHU via a plenum system or ductwork.

### *C. Filters*

Univents and air handling unit (AHUs) systems are equipped with filters to remove particulate matter from both outside and the classroom's recirculated air. Filters should be changed regularly, typically 2 to 4 times a year, and should fit properly into the units without any gaps. All filters should be of an appropriate *dust spot* efficiency. The dust spot efficiency is the ability of a filter to remove particulate matter of a certain diameter from the air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent are sufficient to reduce many airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). In univents, a disposable filter in a cardboard backing/frame is recommended rather than cut-to-fit filter material which is more time consuming to install and often does not fit properly. In AHUs, pleated filters with a Minimum Efficiency Reporting Value (MERV) dust-spot efficiency of 9 is normally to be recommended as this type of filter will remove common air particles such as pollen. In some situations: such as an area with high outdoor diesel pollution, installation of a filter with a MERV rating of 11 or higher in fresh air intakes of the HVAC system may be necessary. ASHRAE currently recommends using a minimum MERV 13 filter, which is at least 85% efficient at capturing particles in the 1 µm to 3 µm size range. A MERV 14 filter is approximately 90% efficient at capturing those same particles. Filters with MERV ratings higher than 14 would capture an even higher percentage of the particles of concern. High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious aerosols. By definition, a HEPA filter must be at least 99.97% efficient at capturing particles 0.3 µm in size. This 0.3 µm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger AND smaller than the MPPS. Thus, *HEPA filters are more that 99.97% efficient at capturing airborne viral particles associated with SARS-CoV-2*. Increasing filtration, however, can reduce airflow (called pressure drop), which can subsequently reduce the efficiency of the unit due to increased resistance. Prior to any increase of filtration, each unit should be evaluated by the district's *ventilation engineer* to ascertain whether the unit(s) can maintain adequate function with higher MERV efficient filters.

# 4.0 INDOOR AIR QUALITY SURVEY RESULTS

Direct reading measurements were taken at the identified locations within with Denville Lakeview Elementary School building included in the table below.

| Location | Temp. (°F) | Rel. Humidity (%) | $CO_2$ (ppm) | CO (ppm) | HVAC TYPE |
|---|---|---|---|---|---|
| Lakeview School | | | | | |
| Main Office | 78.0° | 55% | 660 | 0 | Roof top/central air |
| GYM | 79.5.° | 51% | 560 | 0 | Rooftop/ central air |
| A02 | 77.0° | 55% | 545 | 0 | Uninvent/ window unit |
| A07 | 76,0° | 55% | 574 | 0 | Uninvent/window unit |
| Hallway | 78.5° | 57% | 575 | 0 | No unit |
| C05 | 75,8° | 54% | 600 | 0 | Uninvent/window unit |
| C08 | 76.5° | 53% | 625 | 0 | Uninvent/window unit |
| B03 | 75.0° | 52% | 630 | 0 | Uninvent/window unit |
| B07 | 78.0° | 55% | 610 | 0 | Uninvent/window unit |
| A12 | 77.2° | 57% | 580 | 0 | Uninvent/window Unit |
| A09 | 75.5 | 49% | 612 | 0 | Uninvent/window unit |
| OUTSIDE | 84.0° | 60% | 505 | 0 | N/A |

## 4.1 VISUAL OBSERVATIONS

All classrooms were non-occupied during our inspection. The classrooms did have their ventilation systems in operation. The classrooms were cleaned and disinfected by school staff prior to the inspection. No mold growth was observed at the time of the survey. The temperature readings, relative humidity, carbon dioxide and carbon monoxide in the various classrooms were within the ASHRAE standards.

## 4.2 SAMPLING RESULTS

Sampling results indicate acceptable indoor air quality conditions. Locations within the school facilities *were within* the ASHRAE IAQ recommended guidelines for *temperature (68° to 79°)*, and the Relative Humidity (RH) *was within* the recommendation of 30- 60% RH. The Carbon Dioxide levels in the various classrooms *were below* the *PEOSH IAQ* and *ASHRAE* Standards' allowable maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. The Carbon Monoxide levels were consistently within normal and acceptable levels.
We believe that the rooms tested throughout the Lakeview Elementary School were and are consistently within well-established and acceptable IAQ standards at this time.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSION

Visual observation of the Lakeview School in areas that were the subject of the IAQ survey did not indicate the presence of fungal growth on environmental surfaces. Direct reading air measurements for $CO_2$ fall within NJ PEOSH acceptable limits. No detectable concentrations of CO were detected in the school facility during the time of the survey. Indoor temperatures were within the recommended comfort ranges. Relative humidity was within the recommendation's guidelines. The ventilation system was in operation and functioning properly. A secondary sampling of the indoor air quality should be performed when the ventilation system and heating system is turned on after October 15, 2020.

## 5.2 RECOMMENDATIONS

New Wave Engineering recommends the following to ensure proper indoor air quality.

- Continue replacing and upgrading HVAC filters according to the manufacturer's and ASHRAE's recommendations and the District's IAQ plan.
- All vents and registers should be routinely inspected and cleaned/disinfected to prevent dust and dirt accumulation.
- Continual cleaning and disinfecting of surface areas should continue on a daily basis.
- Continual inspection of the ventilation system to ensure the air quality and the air flow are adequate and avoid obstructing the flow of air.
- Clean all water stains with a biocide solution and when dry seal with a mold retardant primer and paint.

The results presented represent the conditions and concentrations present at the time of the survey.

# 6.0 LIMITATIONS

New Wave Engineering provided these services consistent with the level and skill ordinarily exercised by members of our profession currently practicing under similar conditions. Rooms tested were randomly selected by District personnel. This statement is in lieu of other statements either expressed or implied. This report is intended for the sole use of the Denville Township School District. Additionally, the passage of time may result in a change of the environmental characteristics at the Lakeview Elementary School. This report does not warrant against future operations or conditions that could affect the current recommendations made. The results, findings, conclusions, and recommendations expressed in this report are based upon conditions that were observed during New Wave's survey.

# INDOOR AIR QUALITY SURVEY

# DENVILLE TOWNSHIP SCHOOL DISTRICT

# RIVERVIEW ELEMENTARY SCHOOL
## 33 St. Mary's Place
## Denville, New Jersey 07834

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Return air is typically drawn back into ceiling/wall/floor vents and is returned to the AHU via a plenum system or ductwork.

### *C. Filters*

Univents and air handling unit (AHUs) systems are equipped with filters to remove particulate matter from both outside and the classroom's recirculated air. Filters should be changed regularly, typically 2 to 4 times a year, and should fit properly into the units without any gaps. All filters should be of an appropriate *dust spot* efficiency. The dust spot efficiency is the ability of a filter to remove particulate matter of a certain diameter from the air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent are sufficient to reduce many airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). In uninvents, a disposable filter in a cardboard backing/frame is recommended rather than cut-to-fit filter material which is more time consuming to install and often does not fit properly. In AHUs, pleated filters with a Minimum Efficiency Reporting Value (MERV) dust-spot efficiency of 9 is normally to be recommended as this type of filter will remove common air particles such as pollen. In some situations: such as an area with high outdoor diesel pollution, installation of a filter with a MERV rating of 11 or higher in fresh air intakes of the HVAC system may be necessary. ASHRAE currently recommends using a minimum MERV 13 filter, which is at least 85% efficient at capturing particles in the 1 µm to 3 µm size range. A MERV 14 filter is approximately 90% efficient at capturing those same particles. Filters with MERV ratings higher than 14 would capture an even higher percentage of the particles of concern. High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious aerosols. By definition, a HEPA filter must be at least 99.97% efficient at capturing particles 0.3 µm in size. This 0.3 µm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger AND smaller than the MPPS. Thus, *HEPA filters are more that 99.97% efficient at capturing airborne viral particles associated with SARS-CoV-2*. Increasing filtration, however, can reduce airflow (called pressure drop), which can subsequently reduce the efficiency of the unit due to increased resistance. Prior to any increase of filtration, each unit should be evaluated by the district's *ventilation engineer* to ascertain whether the unit(s) can maintain adequate function with higher MERV efficient filters.

# 4.0 INDOOR AIR QUALITY SURVEY RESULTS

Direct reading measurements were taken at the identified locations within with Denville Riverview Elementary School building included in the table below.

| Location | Temp. (°F) | Rel. Humidity (%) | $CO_2$ (ppm) | CO (ppm) | HVAC TYPE |
|---|---|---|---|---|---|
| Riverview School | | | | | |
| Main Office | 76.5° | 59% | 645 | 0 | Roof top/central air |
| Nurse's Office | 76.8° | 57% | 625 | 0 | Univent/window unit |
| Café/GYM | 78.0° | 60% | 545 | 0 | Roof Top/Central Air |
| Room 7 | 77,0° | 57% | 610 | 0 | Univent/window unit |
| Hallway | 78.5° | 57% | 590 | 0 | No unit |
| Room 5 | 77,7° | 52% | 629 | 0 | Univent/window unit |
| Room 10 | 78.9° | 55% | 590 | 0 | Univent/window unit |
| Room 11 | 76.3° | 52% | 600 | 0 | Univent/window unit |
| Library | 74.9° | 55% | 570 | 0 | Roof Unit/ Central Air |
| Room 31 | 77.9° | 57% | 580 | 0 | Univent/window Unit |
| OUTSIDE | 82.5° | 58% | 499 | 0 | N/A |

## 4.1 VISUAL OBSERVATIONS

All classrooms were non-occupied during our inspection. The classrooms did have their ventilation systems in operation. The classrooms were cleaned and disinfected by school staff prior to the inspection. No mold growth was observed at the time of the survey. The temperature readings, relative humidity, carbon dioxide and carbon monoxide in the various classrooms were within the ASHRAE standards.

## 4.2 SAMPLING RESULTS

Sampling results indicate acceptable indoor air quality conditions. Locations within the school facilities *were within* the ASHRAE IAQ recommended guidelines for *temperature (68° to 79°)*, while the Relative Humidity (RH) *was within* the recommendation of 30-60% RH. The Carbon Dioxide levels in the various classrooms *were below* the *PEOSH IAQ* and *ASHRAE* Standards' allowable maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. While the Carbon Monoxide levels were consistently within normal and acceptable levels.

We believe that the rooms tested throughout the Riverview Elementary School were consistently within well-established and acceptable IAQ standards at this time.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSION

Visual observation of the Riverview School in areas that were the subject of the IAQ survey did not indicate the presence of fungal growth on environmental surfaces.
Direct reading air measurements for $CO_2$ fall within NJ PEOSH acceptable limits. No detectable concentrations of CO were detected in the school facility during the time of the survey. Indoor temperatures were within the recommended comfort ranges. Relative humidity was within the recommendation's guidelines. The ventilation system was in operation and functioning properly. A secondary sampling of the indoor air quality should be performed when the ventilation system and heating system is turned on after October 15, 2020.

## 5.2 RECOMMENDATIONS

New Wave Engineering recommends the following to ensure proper indoor air quality.

- Continue replacing and upgrading HVAC filters according to the manufacturer's and ASHRAE's recommendations and the District's IAQ plan.
- All vents and registers should be routinely inspected and cleaned/disinfected to prevent dust and dirt accumulation.
- Continual cleaning and disinfecting of surface areas should continue on a daily basis.
- Continual inspection of the ventilation system to ensure the air quality and the air flow are adequate and avoid obstructing the flow of air.
- Clean all water stains with a biocide solution and when dry seal with a mold retardant primer and paint.

The results presented represent the conditions and concentrations present at the time of the survey.

## 6.0 LIMITATIONS

New Wave Engineering provided these services consistent with the level and skill ordinarily exercised by members of our profession currently practicing under similar conditions. Rooms tested were randomly selected by District personnel. This statement is in lieu of other statements either expressed or implied. This report is intended for the sole use of the Denville Township School District. Additionally, the passage of time may result in a change of the environmental characteristics at the *Riverview Elementary School*. This report does not warrant against future operations or conditions that could affect the current recommendations made. The results, findings, conclusions, and recommendations expressed in this report are based upon conditions that were observed during New Wave's survey.

# INDOOR AIR QUALITY SURVEY

# DENVILLE TOWNSHIP SCHOOL DISTRICT

# RIVERVIEW ANNEX ELEMENTARY SCHOOL
# 100 Route 46
# Denville, New Jersey 07834

**PREPARED FOR:**
**Denville Township School District**
**31 St Mary's Place**
**Denville, New Jersey 07834**

**PREPARED BY:**
**New Wave Engineering, LLC**
**PO Box 4124**
**Wayne, New Jersey 07470**

August 2020


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## 1.0 INTRODUCTION

New Wave Environmental (NWE), an environmental LLC, has been retained by the Denville Township School District (District) to conduct an indoor air quality (IAQ) survey within various classrooms located in the *Denville Elementary and Middle Schools*. As a consequence of the recent Corona Virus pandemic, the district requested an *Indoor Air Quality* (IAQ) investigation performed in various classrooms throughout the school buildings which represent different types of heating, ventilation and air conditioning systems within the schools to determine if current cleaning and disinfecting protocols, in conjunction with proper ventilation, are producing a *clean* environment for staff and students alike. This IAQ survey was conducted on August 28, 2020. New Wave staff was accompanied by District Business Administrator Mrs. Damaris Gurowsky.

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The *COVID-19 pandemic*, also known as the *Coronavirus Pandemic*, is a recent ongoing global pandemic of the coronavirus disease: 2019 *(COVID-19)*, caused by the acute respiratory syndrome: *Coronavirus 2* (*SARS-CoV-2*). This outbreak was first identified in Wuhan, China, in December 2019. The World Health Organization had declared the outbreak a *Public Health Emergency of International Concern* on January 30, 2020 and a *Pandemic* on March 11, 2020. The virus is primarily spread between people during close contact, most often via small droplets produced by: coughing, sneezing and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through the air over long distances. However, transmission may also occur via smaller droplets which may be able to stay suspended in the air for a longer period of time. Also, and less common, people may become infected by touching a contaminated surface and then touching their face.

This IAQ survey includes New Wave's investigation of various classrooms and offices within the buildings via visual inspections for cleanliness and any current water intrusion stains. Our testing protocol includes real-time measurements of: temperature, humidity, carbon dioxide, and carbon monoxide, all industry standards for *Indoor Air Quality* surveys.

### 1.1 PROJECT OBJECTIVE

The objective of this survey is to ascertain the overall Indoor Air Quality in the various classrooms within the *Denville Elementary and Middle School* buildings and suggest/recommend proposals based upon overall survey findings and personal observations.

## 2.0 PROJECT METHODOLOGY

### 2.1 EQUIPMENT

A Q-Trak™ Plus Indoor Air Quality (IAQ) monitor, Model 7575-X, Serial Number 7575X1933002, was utilized to measure several IAQ parameters, including: carbon monoxide (CO), carbon dioxide ($CO_2$), relative humidity (RH), and temperature (*F). Equipment was calibrated by the equipment provider.

### 2.2 SIMPLE RANDOM SAMPLING OF ROOMS

Simple random sampling is a basic type of sampling, since it can be a component of other more complex sampling methods. The principle of simple random sampling is that every classroom/area has the same probability of being chosen. This process and technique sampling is an unbiased surveying technique. Sampling was performed to include the different types of HVAC/ventilation systems utilized in the Denville Public School District.

## 3.0 INDOOR AIR QUALITY STANDARDS

Recommended levels established for office/school settings differ from regulatory levels set for industrial or manufacturing environments. Recommended IAQ contaminant levels for office/school areas are generally lower because they are based upon the individual susceptibility of building occupants and comfort, in addition to health. Some guidelines cited in this document refer to standards promulgated by the *American Society of Heating, Refrigerating and Air-conditioning Engineers Inc.* (*ASHRAE*). *New Wave* is a member of *ASHRAE*. These standards are found in the ASHRAE documents: *Ventilation for Acceptable Indoor Air Quality* (ASHRAE 62-2001) and *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55-2004).

## 3.1 INDOOR AIR QUALITY STANDARDS -

**New Jersey Department of Labor (NJDOL)**

The NJDOL has established IAQ regulations through the Public Employees Occupational Safety and Health (PEOSH) Act to protect public employees across the state and improve workplace environments.

**American Industrial Hygiene Association (AIHA)**

The AIHA has published "The IAQ Investigator's Guide" which references guidelines for volatile organic compounds (VOCs), relative humidity, formaldehyde, and various other materials that may contribute to indoor air quality concerns.

**United States Environmental Protection Agency (USEPA)**

The USEPA has published the *"Mold Remediation in Schools and Commercial Buildings"* document that provides guidelines for the remediation and cleanup of mold and moisture IAQ problems.

**American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)**

ASHRAE Standards 62.1 and 62.2 are the recognized standards for ventilation systems' design and acceptable *indoor air quality* (IAQ). Expanded and revised for 2019, both standards specify minimum ventilation rates and other measures in order to minimize adverse health effects for occupants. Standard 90.1 has been a benchmark for commercial building energy codes in the United States and a key basis for codes and standards around the world for more than 35 years. This standard provides the minimum requirements for energy-efficient design of most buildings. It offers, in detail, the minimum energy efficiency requirements for design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings, as well as criteria for determining compliance with these requirements. It is an indispensable reference for engineers and other professionals involved in the design of buildings and the buildings' systems.

## 3.2 PEOSH INDOOR AIR QUALITY STANDARDS

**Temperature**

The PEOSH IAQ and ASHRAE Standards requires a temperature range of 68ºF to 79ºF for office/school environments. The employer must verify that the heating, ventilation, and air-conditioning (HVAC) system is in proper operating order should temperatures fall outside this range. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the *Standard.*

**Relative Humidity**

The PEOSH IAQ Standard does not establish an acceptable range for indoor relative humidity; however, it does refer to the AIHA recommended relative humidity range of 30% to 60%.
*ASHRAE Standard 6.2-2001 states that high humidity can support the growth of pathogenic or allergenic organisms. Examples include: certain fungi, associated mycotoxins, and dust mites. Relative humidity in habitable spaces should preferably be maintained between 30 percent and 60 percent relative humidity to minimize growth of allergenic and pathogenic organisms.* **In 2016**, ASHRAE released an update to their standards. The update states the following:
***ASHRAE Standard 62.1-2016 recommends that "relative humidity in occupied spaces be controlled to less than 65% to reduce the likelihood of conditions that can lead to microbial growth."***

The industry standard concurs with the *ASHRAE* guideline that indoor temperatures in the winter be maintained between 68 degrees and 74 degrees, with a relative humidity level between 30 percent and 60/65 percent. Temperatures in the summer should be maintained between 73 degrees and 79 degrees, with a relative humidity level between 30 percent and 60/65 percent. These ranges should be acceptable for sedentary or slightly active persons.

## Carbon Dioxide

Carbon dioxide ($CO_2$) monitoring is a useful screening technique for determining if outside air supply is sufficient for maintaining acceptable indoor air quality. $CO_2$ is a naturally occurring constituent of the atmosphere and is also a product of human respiration. During periods of occupancy, $CO_2$ levels in a building will rise above the normal background level.

The *PEOSH IAQ* and *ASHRAE* Standards allow a maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. The employer must verify that the HVAC system is in proper operating order should $CO_2$ concentrations exceed this threshold. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the standard. Properly ventilated buildings should have carbon dioxide levels between 600ppm and 1,000 ppm, with a floor or building average of 800 ppm or less. If average carbon dioxide levels within a building are maintained at less than 800 ppm, with appropriate temperature and humidity levels, complaints about indoor air quality should be minimized. If carbon dioxide levels are greater than 1,000 ppm, complaints may occur. Therefore, 1,000 ppm should be used as a guideline for improving ventilation. If a building exceeds this guideline, it should **NOT** be interpreted as a hazardous or life-threatening situation. An elevated carbon dioxide level is only an indication of an inadequate amount of outside air/oxygen being brought into a building. The levels cited in this document should only be used as a guideline to determine the amount of fresh outside air entering the building.

In building areas where there are potential sources of carbon dioxide other than exhaled breath, the guidelines above cannot be used. Other sources of *CO2* can include exhaust gas from kilns, internal combustion engines, dry ice, etc. Under these conditions, the Occupational Safety and Health Administration (OSHA) standard for carbon dioxide should be used. The OSHA standard is an eight-hour time-weighted average (TWA) of 5,000 ppm with a short-term 15-minute average limit of 30,000 ppm

## CO Levels and Guidelines {carbon monoxide}

| PPM | Symptoms and applicable standard |
|---|---|
| 0-1 | Normal Background levels |
| 9 | Maximum indoor air quality level: Maximum allowable concentration per ASHRAE Residential Standards 62-1989 for living area. |
| 25 | Maximum limit 8 hours of continuous exposure per California OSHA workplace standards |
| 35 | Maximum 8 hours average exposure level per US OSHA workplace standards |
| 50 | Maximum concentration for continuous exposure in any 8-hour average level per OSHA standards |
| 100 | Remove employees from enclosed space if the CO concentration exceeds 100ppm per OSHA exposure limit. |
| 200 | Mild headache, fatigue, nausea and dizziness within 2-3 hours |
| 400 | Frontal headache, life threatening after 3 hours. Maximum concentration in fuel gas per the US EPA and AGA standards |
| 800 | Dizziness, nausea, convulsions, death within 2-3 hours |
| 1600 | Nausea within 20 minutes. Death within 2-3 hours. |

**Carbon Monoxide**

Carbon monoxide (CO) usually originates from outside the building from such sources as automotive traffic and loading docks. Internal sources could include cigarette smoke, petroleum-fired boilers, and petroleum-fired furnaces. Assuming internal sources are limited, monitoring for CO is a useful measure for determining if outside air intakes are being impacted by external sources/controls. The *PEOSH IAQ* and *ASHRAE Standards* states that when general ventilation cannot control indoor air contaminants below the Permissible Exposure Limit (PEL), the employer must implement other control measures. The United States Occupational Safety and Health Administration (OSHA) sets enforceable PELs to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. The current PEL for CO is 50 PPM for an eight-hour time weighted average (TWA).

## Mold/Fungi

Mold/fungal growth is most likely found in areas that have sufficient moisture along with: temperature, and nutritive sources to promote proliferation. Nutritive sources within buildings include: drywall paper backing, cellulose ceiling tiles, wallpaper, wood wall framing and trim, pipe insulation/wrappings and similar materials.

## VENTATIONAL SYSTEMS

The main purposes of a Heating, Ventilation and Air-Conditioning (*HVAC*) system is to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort. HVAC systems are among the largest energy consumers in schools. The choice and design of the HVAC system can also affect many other high-performance goals, including water consumption (water-cooled air-conditioning equipment) and acoustics. The Denville Township School District utilizes two (2) different HVAC systems: Uninvent (in conjunction with window air conditioner units) and exterior roof top or side units HVAC Systems. At the *Riverview Annex School*, a separate heating system is in place. Ventilation consists of roof top units for the office/nurse's areas. Classrooms are serviced by windows and ceiling fans with the exception of two rooms which have wall/window air conditioning units.

### *A. Unit Ventilator (Univent)*

Many schools use unit ventilator (uninvent) systems. A uninvent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building. Return air is drawn through an air intake located at the base of each unit where fresh and return air are mixed, filtered, heated (and sometimes cooled) and provided to classrooms through an air diffuser located on the top of the unit. For univents to provide fresh air as designed, they must remain free of obstructions such as furniture placed in front of them or items placed on top. Importantly, these units must remain on and be allowed to operate while rooms are occupied.

### *B. Air Handling Systems*

Fresh air for most offices, common areas in schools, and other locations is provided by air handling units (AHUs). These may be located in mechanical rooms, on the roof, on the side of a building or in the basement. Outside air is drawn into AHUs from vents open to the exterior, filtered, heated/cooled and ducted to supply diffusers, typically wall or ceiling-mounted, but occasionally installed in floors.
Return air is typically drawn back into ceiling/wall/floor vents and is returned to the AHU via a plenum system or ductwork.

### *C. Filters*

Univents and air handling unit (AHUs) systems are equipped with filters to remove particulate matter from both outside and classroom recirculated air. Filters should be changed regularly, typically 2 to 4 times a year, and should fit properly into the units without any gaps. All filters should be of an appropriate *dust spot* efficiency. The dust spot efficiency is the ability of a filter to remove particulate matter of a certain diameter from the air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent are sufficient to reduce many airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). In univents, a disposable filter in a cardboard backing/frame is recommended rather than cut-to-fit filter material which is more time consuming to install and often does not fit properly. In AHUs, pleated filters with a Minimum Efficiency Reporting Value (MERV) dust-spot efficiency of 9 is normally to be recommended as this type of filter will remove common air particles such as pollen. In some situations: such as an area with high outdoor diesel pollution, installation of a filter with a MERV rating of 11 or higher in fresh air intakes of the HVAC system may be necessary. ASHRAE currently recommends using a minimum MERV 13 filter, which is at least 85% efficient at capturing particles in the 1 µm to 3 µm size range. A MERV 14 filter is approximately 90% efficient at capturing those same particles. Filters with MERV ratings higher than 14 would capture an even higher percentage of the particles of concern. High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious aerosols. By definition, a HEPA filter must be at least 99.97% efficient at capturing particles 0.3 µm in size. This 0.3 µm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger AND smaller than the MPPS. Thus, *HEPA filters are more that 99.97% efficient at capturing airborne viral particles associated with SARS-CoV-2*. Increasing filtration, however, can reduce airflow (called pressure drop), which can subsequently reduce the efficiency of the unit due to increased resistance. Prior to any increase of filtration, each unit should be evaluated by the district's *ventilation engineer* to ascertain whether the unit(s) can maintain adequate function with higher MERV efficient filters.

# 4.0 INDOOR AIR QUALITY SURVEY RESULTS

Direct reading measurements were taken at the identified locations within with Denville Riverview Annex Elementary School building included in the table below.

| Location | Temp. (°F) | Rel. Humidity (%) | $CO_2$ (ppm) | CO (ppm) | HVAC TYPE |
|---|---|---|---|---|---|
| Riverview Annex School | | | | | |
| Nurse's Office | 77.0° | 60% | 600 | 0 | Roof top/central air/window open |
| Room 14 | 75.5.° | 70% | 628 | 0 | Windows open |
| Room 13 | 76.0° | 65% | 610 | 0 | Windows Closed/ceiling fans on |
| Room 12 | 77,0° | 59% | 618 | 0 | Windows Closed/ceiling fans on |
| Room 11 | 77.5° | 62% | 590 | 0 | Windows open/ceiling fans on |
| Room 10 | 78.0° | 57% | 620 | 0 | Windows Closed/ceiling fans on |
| Room 09 | 76.9° | 43% | 605 | 0 | Window air conditioner on/ceiling fans on |
| Room 08 | 77.0° | 52% | 645 | 0 | Windows Closed/ceiling fans on |
| Room 07 | 77.6° | 51% | 649 | 0 | Window Closed/ceiling Fans on |
| Room 06 | 73.2° | 44% | 600 | 0 | Mitsubishi Wall Unit on |
| Room 05 | 76.5° | 54% | 630 | 0 | Windows closed/ceiling fans on |
| Room 04 | 77.4° | 52% | 650 | 0 | Windows Closed/ceiling fans on |
| Room 03 | 77.3° | 51% | 647 | 0 | Windows closed/ceiling fans on |
| Room 02 | 76.1° | 56% | 625 | 0 | Windows Closed/ceiling fans on |
| OUTSIDE | 74.0° | 82% | 489 | 0 | N/A |

## 4.1 VISUAL OBSERVATIONS

Classrooms were non-occupied during our inspection. The classrooms did have their ventilation systems in operation. The classrooms were cleaned and disinfected by school staff prior to the inspection. No mold growth was observed at the time of the survey. The temperature readings, relative humidity, carbon dioxide and carbon monoxide in the various classrooms were within the ASHRAE standards.

## 4.2 SAMPLING RESULTS

Sampling results indicate acceptable indoor air quality conditions. Locations within the school facilities *were within* the ASHRAE IAQ recommended guidelines for *temperature (68° to 79°)*, and the Relative Humidity (RH) *was basically within* the recommendation of 30- 60% RH. Some areas exceeded the 60% due to the outdoor inclement weather. The Carbon Dioxide levels in the various classrooms *were below* the *PEOSH IAQ* and *ASHRAE* Standards' allowable maximum $CO_2$ threshold of 1,000 parts per million(PPM)

for office/school environments. The Carbon Monoxide levels were consistently within normal and acceptable levels.

We believe that the rooms tested throughout the Riverview Annex Elementary School were and are consistently within well-established and acceptable IAQ standards at this time.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSION

Visual observation of the Riverview Annex School in areas that were the subject of the IAQ survey did not indicate the presence of fungal growth on environmental surfaces. Direct reading air measurements for $CO_2$ fall within NJ PEOSH acceptable limits. No detectable concentrations of CO were detected in the school facility during the time of the survey. Indoor temperatures were within the recommended comfort ranges. Relative humidity was primarily within the recommendation's guidelines. The windows and ceiling fans were operable. A secondary sampling of the indoor air quality should be performed when the heating system is turned on after October 15, 2020.

## 5.2 RECOMMENDATIONS

New Wave Engineering recommends the following to ensure proper indoor air quality.

- Continue replacing and upgrading HVAC filters according to the manufacturer's and ASHRAE's recommendations and the District's IAQ plan in areas where roof top units and air conditioners are present.
- All vents and registers should be routinely inspected and cleaned/disinfected to prevent dust and dirt accumulation.
- Continual cleaning and disinfecting of surface areas should continue on a daily basis. This should include the blades of the ceiling fans.
- Continual inspection of the windows to ensure they are functioning properly.
- Should water stains become present, clean with a biocide solution and when dry seal with a mold retardant primer and paint. An investigation should occur to determine the source of the water intrusion.

The results presented represent the conditions and concentrations present at the time of the survey.

# 6.0 LIMITATIONS

New Wave Engineering provided these services consistent with the level and skill ordinarily exercised by members of our profession currently practicing under similar conditions. Rooms tested were randomly selected by District personnel and New Wave. This statement is in lieu of other statements either expressed or implied. This report is intended for the sole use of the Denville Township School District. Additionally, the passage of time may result in a change of the environmental characteristics at the Riverview Annex Elementary School. This report does not warrant against future operations or conditions that could affect the current recommendations made. The results, findings, conclusions, and recommendations expressed in this report are based upon conditions that were observed during New Wave's survey.

# INDOOR AIR QUALITY SURVEY

# DENVILLE TOWNSHIP SCHOOL DISTRICT

# VALLEYVIEW MIDDLE SCHOOL
## 320 Diamond Spring Road
## Denville, New Jersey 07834

**PREPARED FOR:**
**Denville Township School District**
**31 St Mary's Place**
**Denville, New Jersey 07834**

**PREPARED BY:**
**New Wave Engineering, LLC**
**PO Box 4124**
**Wayne, New Jersey 07470**

August 2020


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New Wave Environmental (NWE), an environmental LLC, has been retained by the Denville Township School District (District) to conduct an indoor air quality (IAQ) survey within various classrooms located in the *Denville Elementary and Middle Schools*. As a consequence of the recent Corona Virus pandemic, the district requested an *Indoor Air Quality* (IAQ) investigation performed in various classrooms throughout the school buildings which represent the different types of heating, ventilation and air conditioning systems within the schools, to determine if current cleaning and disinfecting protocols, in conjunction with proper ventilation, are producing a clean environment for staff and students alike. This IAQ survey was conducted on August 28, 2020. New Wave staff was accompanied by Business Administrator Mrs. Damaris Gurowsky.

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This IAQ survey includes New Wave's investigation of various classrooms and offices within the buildings via visual inspections for cleanliness and any current water intrusion stains. Our testing protocol includes real-time measurements of: temperature, humidity, carbon dioxide, and carbon monoxide, all industry standards for *Indoor Air Quality* surveys.

## 1.1 PROJECT OBJECTIVE

The objective of this survey is to ascertain the overall Indoor Air Quality in the various classrooms within the *Denville Elementary and Middle School* buildings and suggest/recommend proposals based upon overall survey findings and personal observations.

## 2.0 PROJECT METHODOLOGY

### 2.1 EQUIPMENT

A Q-Trak™ Plus Indoor Air Quality (IAQ) monitor, Model 7575-X, Serial Number 7575X1933002, was utilized to measure several IAQ parameters, including: carbon monoxide (CO), carbon dioxide ($CO_2$), relative humidity (RH), and temperature (°F). Equipment was calibrated by the equipment provider.

### 2.2 SIMPLE RANDOM SAMPLING OF ROOMS

Simple random sampling is a basic type of sampling, since it can be a component of other more complex sampling methods. The principle of simple random sampling is that every classroom/area has the same probability of being chosen. This process and technique sampling is an unbiased surveying technique. Sampling was performed to include the different types of HVAC/ventilation systems utilized in the Denville Public School District.

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## 3.2 PEOSH INDOOR AIR QUALITY STANDARDS

**Temperature**

The PEOSH IAQ and ASHRAE Standards requires a temperature range of 68ºF to 79ºF for office/school environments. The employer must verify that the heating, ventilation, and air-conditioning (HVAC) system is in proper operating order should temperatures fall outside this range. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the Standard.

**Relative Humidity**

The PEOSH IAQ Standard does not establish an acceptable range for indoor relative humidity; however, it does refer to the AIHA recommended relative humidity range of 30% to 60%.
*ASHRAE Standard 6.2-2001 states that high humidity can support the growth of pathogenic or allergenic organisms. Examples include: certain fungi, associated mycotoxins, and dust mites. Relative humidity in habitable spaces should preferably be maintained between 30 percent and 60 percent relative humidity to minimize growth of allergenic and pathogenic organisms.* **In 2016**, ASHRAE released an update to their standards. The update states the following:
***ASHRAE Standard 62.1-2016 recommends that "relative humidity in occupied spaces be controlled to less than 65% to reduce the likelihood of conditions that can lead to microbial growth."***

The industry standard concurs with the *ASHRAE* guideline that indoor temperatures in the winter be maintained between 68 degrees and 74 degrees, with a relative humidity level between 30 percent and 60/65 percent. Temperatures in the summer should be maintained between 73 degrees and 79 degrees, with a relative humidity level between 30 percent and 60/65 percent. These ranges should be acceptable for sedentary or slightly active persons.

## Carbon Dioxide

Carbon dioxide ($CO_2$) monitoring is a useful screening technique for determining if outside air supply is sufficient for maintaining acceptable indoor air quality. $CO_2$ is a naturally occurring constituent of the atmosphere and is also a product of human respiration. During periods of occupancy, $CO_2$ levels in a building will rise above the normal background level.

The *PEOSH IAQ* and *ASHRAE* Standards allow a maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. The employer must verify that the HVAC system is in proper operating order should $CO_2$ concentrations exceed this threshold. If the system is not found to be in proper operating order, the employer must take the necessary steps to remedy the situation as described by the standard. Properly ventilated buildings should have carbon dioxide levels between 600ppm and 1,000 ppm, with a floor or building average of 800 ppm or less. If average carbon dioxide levels within a building are maintained at less than 800 ppm, with appropriate temperature and humidity levels, complaints about indoor air quality should be minimized. If carbon dioxide levels are greater than 1,000 ppm, complaints may occur. Therefore, 1,000 ppm should be used as a guideline for improving ventilation. If a building exceeds this guideline, it should **NOT** be interpreted as a hazardous or life-threatening situation. An elevated carbon dioxide level is only an indication of an inadequate amount of outside air/oxygen being brought into a building. The levels cited in this document should only be used as a guideline to determine the amount of fresh outside air entering the building.

In building areas where there are potential sources of carbon dioxide other than exhaled breath, the guidelines above cannot be used. Other sources of *CO2* can include exhaust gas from kilns, internal combustion engines, dry ice, etc. Under these conditions, the Occupational Safety and Health Administration (OSHA) standard for carbon dioxide should be used. The OSHA standard is an eight-hour time-weighted average (TWA) of 5,000 ppm with a short-term 15-minute average limit of 30,000 ppm

## CO Levels and Guidelines {carbon monoxide}

| PPM | Symptoms and applicable standard |
|---|---|
| 0-1 | Normal Background levels |
| 9 | Maximum indoor air quality level: Maximum allowable concentration per ASHRAE Residential Standards 62-1989 for living area. |
| 25 | Maximum limit 8 hours of continuous exposure per California OSHA workplace standards |
| 35 | Maximum 8 hours average exposure level per US OSHA workplace standards |
| 50 | Maximum concentration for continuous exposure in any 8-hour average level per OSHA standards |
| 100 | Remove employees from enclosed space if the CO concentration exceeds 100ppm per OSHA exposure limit. |
| 200 | Mild headache, fatigue, nausea and dizziness within 2-3 hours |
| 400 | Frontal headache, life threatening after 3 hours. Maximum concentration in fuel gas per the US EPA and AGA standards |
| 800 | Dizziness, nausea, convulsions, death within 2-3 hours |
| 1600 | Nausea within 20 minutes. Death within 2-3 hours. |

**Carbon Monoxide**

Carbon monoxide (CO) usually originates from outside the building from such sources as automotive traffic and loading docks. Internal sources could include cigarette smoke, petroleum-fired boilers, and petroleum-fired furnaces. Assuming internal sources are limited, monitoring for CO is a useful measure for determining if outside air intakes are being impacted by external sources/controls. The *PEOSH IAQ* and *ASHRAE Standards* states that when general ventilation cannot control indoor air contaminants below the Permissible Exposure Limit (PEL), the employer must implement other control measures. The United States Occupational Safety and Health Administration (OSHA) sets enforceable PELs to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. The current PEL for CO is 50 PPM for an eight-hour time weighted average (TWA).

## Mold/Fungi

Mold/fungal growth is most likely found in areas that have sufficient moisture along with: temperature, and nutritive sources to promote proliferation. Nutritive sources within buildings include: drywall paper backing, cellulose ceiling tiles, wallpaper, wood wall framing and trim, pipe insulation/wrappings and similar materials.

## VENTILATIONAL SYSTEMS

The main purposes of Heating, Ventilation and Air-Conditioning (HVAC) systems are to help maintain good indoor air quality through adequate ventilation with filtration and to provide thermal comfort. HVAC systems are among the largest energy consumers in schools. The choice and design of the HVAC system can also affect many other high-performance goals, including water consumption (water-cooled air-conditioning equipment) and acoustics. The Denville Township School District utilizes two (2) different HVAC systems, Univents (in conjunction with window air conditioner units) and exterior roof top central air HVAC Systems.

### *A. Unit Ventilator (Univent)*

Many schools use unit ventilator (univent) systems. A univent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building. Return air is drawn through an air intake located at the base of each unit where fresh and return air are mixed, filtered, heated (and sometimes cooled) and provided to classrooms through an air diffuser located on the top of the unit. For univents to provide fresh air as designed, they must remain free of obstructions such as furniture placed in front of them or items placed on top. Importantly, these units must remain on and be allowed to operate while rooms are occupied.

### *B. Air Handling Systems*

Fresh air for most offices, common areas in schools, and other locations is provided by air handling units (AHUs). These may be located in mechanical rooms, on the roof, on the side of a building or in the basement. Outside air is drawn into AHUs from vents open to the exterior, filtered, heated/cooled and ducted to supply diffusers, typically wall or ceiling-mounted, but occasionally installed in floors.
Return air is typically drawn back into ceiling/wall/floor vents and is returned to the AHU via a plenum system or ductwork.

### *C. Filters*

Univents and air handling unit (AHU) systems are equipped with filters to remove particulate matter from both the outside and the classroom's recirculated air. Filters should be changed regularly, typically 2 to 4 times a year, and should fit properly into the units without any gaps. All filters should be of an appropriate *dust spot* efficiency. The dust spot efficiency is the ability of a filter to remove particulate matter of a certain diameter from the air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent are sufficient to reduce many airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). In univents, a disposable filter in a cardboard backing/frame is recommended rather than cut-to-fit filter material which is more time consuming to install and often does not fit properly. In AHUs, pleated filters with a Minimum Efficiency Reporting Value (MERV) dust-spot efficiency of 9 is normally to be recommended as this type of filter will remove common air particles such as pollen. In some situations: such as an area with high outdoor diesel pollution, installation of a filter with a MERV rating of 11 or higher in fresh air intakes of the HVAC system may be necessary. ASHRAE currently recommends using a minimum MERV 13 filter, which is at least 85% efficient at capturing particles in the 1 µm to 3 µm size range. A MERV 14 filter is approximately 90% efficient at capturing those same particles. Filters with MERV ratings higher than 14 would capture an even higher percentage of the particles of concern. High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious aerosols. By definition, a HEPA filter must be at least 99.97% efficient at capturing particles 0.3 µm in size. This 0.3 µm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger AND smaller than the MPPS. Thus, *HEPA filters are more that 99.97% efficient at capturing airborne viral particles associated with SARS-CoV-2*. Increasing filtration, however, can reduce airflow (called pressure drop), which can subsequently reduce the efficiency of the unit due to increased resistance. Prior to any increase of filtration, each unit should be evaluated by the district's *ventilation engineer* to ascertain whether the unit(s) can maintain adequate function with higher MERV efficient filters.

# 4.0 INDOOR AIR QUALITY SURVEY RESULTS

Direct reading measurements were taken at the identified locations within with Denville Valleyview Middle School building included in the table below.

| Location | Temp. (°F) | Rel. Humidity (%) | $CO_2$ (ppm) | CO (ppm) | HVAC TYPE |
|---|---|---|---|---|---|
| Valleyview School | | | | | |
| Main Office | 75.5° | 59% | 645 | 0 | Roof top/central air |
| GYM | 74.8° | 57% | 625 | 0 | Univent/window unit |
| STEM Room | 72.0° | 60% | 545 | 0 | Roof Top/Central Air |
| Band Room | 73,0° | 57% | 610 | 0 | Univent/window unit |
| B23 | 74.5° | 57% | 590 | 0 | No unit |
| B28 | 73.5° | 52% | 629 | 0 | Univent/window unit |
| B12 | 74.8° | 55% | 590 | 0 | Univent/window unit |
| B17 | 77.4° | 52% | 600 | 0 | Univent/window unit |
| B 14 | 76.4° | 55% | 570 | 0 | Roof Unit/ Central Air |
| C 3 | 75.9° | 57% | 580 | 0 | Univent/window Unit |
| C-8 | 74.5° | 59% | 600 | 0 | Univent/ window Unit |
| C-10 | 72.3° | 58% | 570 | 0 | Roof top/central air |
| C-13 | 72.5° | 58% | 575 | 0 | Roof top/central air |
| OUTSIDE | 84.0° | 58% | 485 | 0 | N/A |

## 4.1 VISUAL OBSERVATIONS

All classrooms were non-occupied during our inspection. The classrooms did have their ventilation systems in operation. The classrooms were cleaned and disinfected by school staff prior to the inspection. No mold growth was observed at the time of the survey. The temperature readings, relative humidity, carbon dioxide and carbon monoxide in the various classrooms were within the ASHRAE standards.

## 4.2 SAMPLING RESULTS

Sampling results indicate acceptable indoor air quality conditions. Locations within the school facilities *were within* the ASHRAE IAQ recommended guidelines for *temperature (68° to 79°)*, while the Relative Humidity (RH) *was within* the recommendation of 30-60% RH. The Carbon Dioxide levels in the various classrooms *were below* the *PEOSH IAQ* and *ASHRAE* Standards' allowable maximum $CO_2$ threshold of 1,000 parts per million (PPM) for office/school environments. While the Carbon Monoxide levels were consistently within normal and acceptable levels.
We believe that the rooms tested throughout the Valleyview Middle School were consistently within well-established and acceptable IAQ standards at this time.

# 5.0 CONCLUSIONS and RECOMMENDATIONS

## 5.1 CONCLUSION

Visual observation of the Valleyview School in areas that were the subject of the IAQ survey did not indicate the presence of fungal growth on environmental surfaces. Direct reading air measurements for $CO_2$ fall within NJ PEOSH acceptable limits. No detectable concentrations of CO were detected in the school facility during the time of the survey. Indoor temperatures were within the recommended comfort ranges. Relative humidity was within the recommendation's guidelines. The ventilation system was in operation and functioning properly. A secondary sampling of the indoor air quality should be performed when the ventilation system and heating system is turned on after October 15, 2020.

## 5.2 RECOMMENDATIONS

New Wave Engineering recommends the following to ensure proper indoor air quality.

- Continue replacing and upgrading HVAC filters according to the manufacturer's and ASHRAE's recommendations and the District's IAQ plan.
- All vents and registers should be routinely inspected and cleaned/disinfected to prevent dust and dirt accumulation.
- Continual cleaning and disinfecting of surface areas should continue on a daily basis.

- Continual inspections of the ventilation system to ensure the air quality and the air flow are adequate and avoid obstructing the flow of air.
- Clean all water stains with a biocide solution and when dry, seal the area with a mold retardant primer and paint.

The results presented represent the conditions and concentrations present at the time of the survey.

## 6.0 LIMITATIONS

New Wave Engineering provided these services consistent with the level and skill ordinarily exercised by members of our profession currently practicing under similar conditions. Rooms tested were randomly selected by District personnel. This statement is in lieu of other statements either expressed or implied. This report is intended for the sole use of the Denville Township School District. Additionally, the passage of time may result in a change of the environmental characteristics at the Valleyview Middle School. This report does not warrant against future operations or conditions that could affect the current recommendations made. The results, findings, conclusions, and recommendations expressed in this report are based upon conditions that were observed during New Wave's survey.

# 7.0 APPENDIX - CERTIFICATIONS

# Nadine B. Bello

New Wave Engineering- Wayne, New Jersey | 973-616-4601 | nadine@newwaveenvironmental.com

## BUSINESS

**OWNER OF NEW WAVE CONSULTANTS/ENGIEERING- 2000 TO PRESENT**

New Wave Environmental is a full service environmental compliance company specializing in the fields of Asbestos, Indoor Air Quality (mold/voc's), Haz-com communications, Blood Borne Pathogens training and testing.

## Education

**MASTER OF SCIENCE | MAY 1990 | MONTCLAIR STATE UNIVERSITY**

- Major: Masters of Science in Environmental Management/Education
- Related coursework: Concentration on Indoor Air Quality

**BACHLORS OF SCIENCE | MAY 1984 | SETON HALL UNIVERSITY**

- Major: Education
- Major: Political Science
- Minor: Religion
- Related coursework: Certified to teach: Early Childhood Education, Elementary Education, History and Science (Biology)

## Skills & Abilities

**CERTIFICATIONS**

- ACAC- NATIONALLY CERTIFIED INDOOR ENVIRONMENTAL CONSULTANT (CIEC)
- IAQA -INDOOR ENVIRONMENTALIST May 2015
- SCHOOL HEALTH and INDOOR ENVIRONMENTS LEADERSHIP DEVELOPMENT (SHIELD)- INDOOR AIR QUALITY MASTER CLASS – 2015
- STATE of FLORIDA - Mold Assessor 2015-Present
- NJ-DEPT.OF HEALTH/SENIOR SERVICE PE-OSH PROGRAM- INDOOR AIR QUALITY DESIGNATED PERSONS TRAINING -2007
- NAETI-INDOOR AIR QUALITY INVESTIGATION 2004
- NAETI-INSPECTION/TESTING/ASSESSMENT of MICROBIAL CONTAMINATED BUILDINGS- 2004
- NJ-DEP- INTEGRATED PEST MANAGEMENT COORDINATOR- 2006
- NFMT-BUILDING OPERATING MANAGEMENT'S -2015
- NAETI- ASBESTOS MANAGEMENT PLANNER- CURRENT
- NAETI- ASBESTOS BUILDING INSPECTOR- CURRENT
- NAETI- ASBESTOS PROJECT DESIGNER
- STATE OF NJ- ASBESTOS AIR SAEFTY TECHNICIAN (AST) STATE CERTIFIED

# Montclair State College

Upon the recommendation of the faculty and by virtue of the authority vested in the Board of Trustees hereby confers upon

## Nadine Bitner Mariconda

the degree of

## Master of Arts

with all the rights, privileges and immunities thereunto appertaining.

In Witness Whereof we have hereto affixed our signatures this twenty-fifth day of May, 1990.

Chairman, Board of Trustees

MONTCLAIR STATE COLLEGE
CARPE DIEM
1908

President

**MASTER OF ARTS IN ENVIRONMENTAL MANAGEMENT/SCIENCE/EDUCATION**

# Certificate of Completion

**This is to certify that**

## Nadine Bello

**has successfully completed a 2.0 hour webinar on**

## Introduction to Bacteriology

**We will ensure that IAQ industry professionals succeed on their quest for knowledge.**

**Date: Wednesday, July 8, 2020**

David F. Gallup
General Manager, Eurofins EMLab P&K

Dr. Harriet Burge
Director of Aerobiology, EMLab P&K

eurofins

Built Environment
EMLab P&K

ASHRAE®
Learning Institute

AIA: 2020Readiness

# CERTIFICATE OF ATTENDANCE

This is to certify that Nadine Bello has attended

Re-Opening Our Schools: Activities and Recommendations
1 PDHs/LUs/HSW

Presented By:
Raj Setty, P.E., Keith Hammelman, P.E. and Corey Metzger, P.E.
Tuesday, June 16, 2020
2020 ASHRAE Online Course

Darryl K. Boyce
ASHRAE President

Jeff Littleton
ASHRAE Executive Vice President

# American Council for Accredited Certification

hereby certifies that

## Nadine Bello

has met all the specific standards and qualifications of the re-certification process, including continued professional development, and is hereby re-certified as a

## CIEC

## Council-certified Indoor Environmental Consultant

This certificate expires on June 30, 2021.

Charles F. Wiles, Executive Director

1506022

Certificate Number

# Readiness and Emergency Management for Schools (REMS) Technical Assistance (TA) Center

Awards this Certificate of Completion to

## Nadine Bello

for participating in the

REMS TA Center

**School EOPs In-Depth: Planning for Infectious Diseases**

Online Course

on

**Monday, July 20, 2020**

READINESS AND EMERGENCY MANAGEMENT FOR SCHOOLS REMS

**THIS CERTIFICATE DOES NOT CONFER CONTINUING EDUCATION UNIT (CEU) CREDIT.**

# Certificate of Completion

This is to certify that

## Nadine Bello

has successfully completed a 2-hour webinar on

## Fungal Data Interpretation

We will ensure that IAQ industry professionals succeed on their quest for knowledge.

Date: Wednesday, December 5, 2018

David F. Gallup
Co-Founder, EMLab P&K

Dr. Harriet Burge
Director of Aerobiology, EMLab P&K

NJ Health
New Jersey Department of Health

Public Employees Occupational Safety and Health Program

# Certificate of Completion

This is to certify that

NADINE BELLO

HAS SUCCESSFULLY COMPLETED
The PEOSH
Indoor Air Quality Designated Persons Training Course
N.J.A.C.12:100-13

DATE: 2-9-18

LOCATION BERGEN

ASHRAE

Dear Mrs Nadine B Bello: February 12, 2020

Thank you for renewing your ASHRAE membership in the 125th year of our great Society!

We look forward to continuing to provide you with access to the latest technology and the best and brightest minds in the industry. If there is anything we can do to improve on your benefits or to assist you, please be sure to contact us. You can always find the most up-to-date ASHRAE information at ashrae.org.

Again, thank you for your participation in ASHRAE. Your commitment helps strengthen our Society, allowing you and your fellow members to shape tomorrow's built environment today.

Lastly, consider making it your goal to participate in something new this year as a part of your ASHRAE membership. Participate on a technical committee, attend an upcoming ASHRAE Conference or sign up as a volunteer. Learn more at ashrae.org/volunteer. And don't forget to tell others that you are an ASHRAE member! Add your ASHRAE member designation—Member ASHRAE, Associate Member ASHRAE, Affiliate Member ASHRAE or Student Member ASHRAE—to your email signature.

If you have questions about your membership, please call an ASHRAE member contact specialist today at 800-527-4723 (US/Canada) or 404-636-8400 (International), or contact us via email at membership@ashrae.org.

MBR# 8065236

Sincerely,

Jeff Littleton
ASHRAE Executive Vice President

ASHRAE

Name Mrs Nadine B Bello
Member since 7/1/2005
Membership grade Member
Paid thru 6/30/2021

84

State of New Jersey
DEPARTMENT OF COMMUNITY AFFAIRS
101 SOUTH BROAD STREET
PO BOX 821
TRENTON, NJ 08625-0821

PHILIP D. MURPHY
*Governor*

LT. GOVERNOR SHEILA Y. OLIVER
*Commissioner*

January 22, 2019

**AST #: 01315**

Nadine Bello
85 Redwood Avenue
Wayne, NJ 07470

Dear Nadine Bello:

You have been recertified as an Asbestos Safety Technician (AST) pursuant to the provisions in N.J.A.C. 5:23-8.

Enclosed herewith is your AST card. If your AST card is lost, damaged, or stolen, it is imperative that you immediately report in writing to this Department. You are further advised that it is your responsibility to notify this Department of any changes in your name, address or employer.

Please be duly advised that if you allow this recertification to lapse for longer than *30 days*, you will not be eligible for subsequent recertification. You will therefore be required to apply for initial certification.

If you have any questions or require any additional information, please contact this office at (609) 633-6224. Our address is P.O. Box 821, Trenton, NJ, 08625-0821. Thank you.

Sincerely,

O. Tex Falajiki
Supervisor,
Asbestos Safety Unit

NJ Department of Community Affairs
Division of Codes and Standards

This is to certify that

**Nadine Bello**

has been certified as:
*Asbestos Safety Technician*

Certification # **01315**
Effective Date **02/01/19**
Expiration Date **01/31/2021**

# EMSL ANALYTICAL, INC.

Certifies that

## Nadine Bello

Has completed 7 hours of training covering

## Fire, Smoke, Dust Characterization & Combustible Dust

**EMSL Certificate No.** **79000882**

**Course Date:** **08/23/2017**
**Granted:** **08/23/2017**

---

Sponsored by:
EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
Phone: (800) 220-3675
Fax: (856) 786-5973
www.emsl.com

**Michael Menz, CIH**
**Environmental, Health, & Safety Manager**

**Environmental, Mold, Bacteria, IAQ, Asbestos, Lead, Forensic and Materials Testing Since 1981**

# STATE OF FLORIDA
# DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

MOLD-RELATED SERVICES LICENSING PROGRAM
2601 BLAIR STONE ROAD
TALLAHASSEE FL 32399-0783

(850) 487-1395

Congratulations! With this license you become one of the nearly one million Floridians licensed by the Department of Business and Professional Regulation. Our professionals and businesses range from architects to yacht brokers, from boxers to barbeque restaurants, and they keep Florida's economy strong.

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Our mission at the Department is: License Efficiently, Regulate Fairly. We constantly strive to serve you better so that you can serve your customers. Thank you for doing business in Florida, and congratulations on your new license!

dbpr STATE OF FLORIDA DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

MRSA2347
MOLD ASSESSOR
BELLO, NADINE

ISSUED: 04/30/2020

Signature

LICENSED UNDER CHAPTER 468, FLORIDA STATUTES
EXPIRATION DATE: JULY 31, 2022

---

Ron DeSantis, Governor

Halsey Beshears, Secretary

## STATE OF FLORIDA
## DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION
## MOLD-RELATED SERVICES LICENSING PROGRAM

**LICENSE NUMBER: MRSA2347**

**EXPIRATION DATE: JULY 31, 2022**

THE MOLD ASSESSOR HEREIN IS CERTIFIED UNDER THE PROVISIONS OF CHAPTER 468, FLORIDA STATUTES

BELLO, NADINE
6119 GROSVENOR SHORE DRIVE
WINDERMERE FL 34786

ISSUED: 04/30/2020

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57405

True Copy
BM

# NAETI Inc.

## CERTIFICATE OF COMPLETION

**AHERA/EPA Accredited Per 40 CFR Part 763**
**Asbestos Accreditation under TSCA Title II**

*This is to certify that*

## *Nadine Bello*

*Successfully completed the course entitled*

**1/2-Day EPA/AHERA Asbestos Building Inspector Annual Refresher on July 6th, 2020**

*Expiration Date on July 6th, 2021*

Lee Wasserman
*President, NAETI Inc.*

Per 10 NYCRR Part 73.2 (L) (1), DOH 2832 Certificate of Completion of Asbestos Safety Training is the only official record of training for N.Y.S. students.

Language: English

ABIH 1/2 CM POINT

**3321 Doris Avenue, Building B, Ocean, NJ 07712** **Phone (732) 531-5571** **Fax (732) 531-5956** **www.naeti.com**

True Copy
BM

57384

# NAETI Inc.

## CERTIFICATE OF COMPLETION

**AHERA/EPA Accredited Per 40 CFR Part 763**
**Asbestos Accreditation under TSCA Title II**

*This is to certify that*

# *Nadine Bello*

*Successfully completed the course entitled*

**1/2-Day EPA/AHERA Asbestos Management Planner Annual Refresher on July 6th, 2020**

*Expiration Date on July 6th, 2021*

Lee Wasserman
*President, NAETI Inc.*

Per 10 NYCRR Part 73.2 (L) (1). DOH 2832 Certificate of Completion of Asbestos Safety Training is the only official record of training for N.Y.S. students.

Language: English

ABIH 1/2 CM POINT

3323 Doris Avenue, Building B, Ocean, NJ 07712 Phone (732) 531-5571 Fax (732) 531-5986 www.naeti.com

57901

# NAETI Inc.

## CERTIFICATE OF COMPLETION

True Copy BM

**AHERA/EPA Accredited Per 40 CFR Part 763**
**Asbestos Accreditation under TSCA Title II**

*This is to certify that*

## *Nadine Bello*

*Successfully completed the course entitled*

**1-Day EPA/AHERA Asbestos Project Designer Annual Refresher**
**on March 4, 2020**

~~*Expiration Date on March 4, 2021*~~

Lee Wasserman
*President, NAETI Inc.*

Per 10 NYCRR Part 73.2 (L) (1). DOH 2832 Certificate of Completion of Asbestos Safety Training is the only official record of training for N.Y.S. students.

Language: English

ABIH 1 CM POINT

**3321 Doris Avenue, Building B, Ocean, NJ 07712** **Phone (732) 531-5571** **Fax (732) 531-5956** **www.naeti.com**

# EMSL ANALYTICAL, INC.

Certifies that

# Nadine Bello

has completed 8 hours of training covering IAQ and Industrial Hygiene

## IAQ and Industrial Hygiene Workshop

EMSL Certificate No. NJ-2006-1019

**APPROVED FOR:**

ABIH - 1.0 Continuing Education Unit (CEU) – Approval # 02-3378
BOMI - 8 Continuing Professional Development (CPD) points
IICRC - 1.0 Credit in the Cleaning/Restoration Category or Mold Remediation Category
ASHI - 2.0 Membership Renewal Credits (MRCs)
NAHI – 8.0 Continuing Education Units (CEUs)

Course Date: 2/13/2007
Granted: 2/13/2007

**COURSE INSTRUCTORS:**

Diane Miskowski, B.Sc., MPH., EMSL Analytical, Inc., Ph: 800-220-3675
Jason K Dobranic, Ph.D., EMSL Analytical, Inc., Ph: 800-220-3675
Vince Daliessio, CIH., EMSL Analytical, Inc., Ph: 800-220-3675
Scott VanEtten, EMSL Analytical, Inc., Ph: 800-220-3675

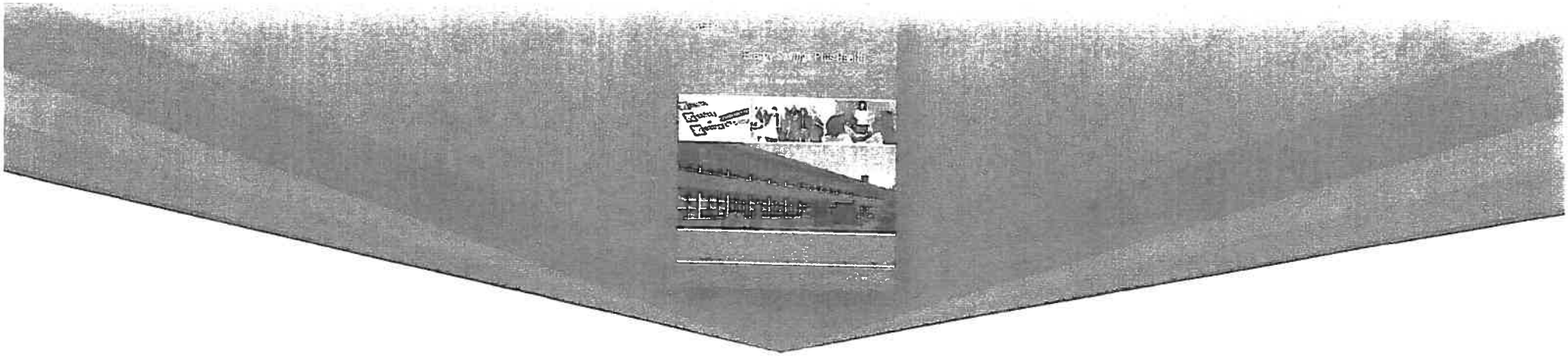
**Sponsored by:**

EMSL Analytical, Inc.
107 Haddon Avenue
Westmont, NJ 08108
Phone: (800) 220-3675
Fax: (856) 858-9551
www.emsl.com

EMSL

Jason Dobranic, Ph.D.
National Director of Microbiology

Environmental, Mold, Bacteria, IAQ, Asbestos, Lead, Forensic and Materials Testing Since 1981



# Certificate of Completion

## *Nadine Bello*

has completed

### Making the Connection: Linking IAQ, Energy Efficiency and Preventive Maintenance Together for Healthy Schools

This 1-hour training on indoor air quality (IAQ) in schools taught participants how to—

- Explain the critical connection between IAQ, energy efficiency and preventive maintenance, and the importance of properly integrating them for optimal occupant health and building performance during a renovation project.
- Use resources to help with energy efficiency and preventive maintenance efforts, including the Energy Savings Plus Health guide and the accompanying Interactive Air Quality Planner for Schools that helps users create a custom verification checklist for both building upgrades and concurrent IAQ assessment protocols for each step of the upgrade process.
- Use a case study from a school district on getting started using these resources to create healthy indoor learning environments.
- Start or improve a preventive maintenance program to include IAQ and energy efficiency components as part of a comprehensive building management approach.

Presented by the U.S. Environmental Protection Agency Indoor Environments Division

**February 22, 2018**

EPA United States Environmental Protection Agency

# INDOOR AIR QUALITY ASSOCIATION

# MEMBERSHIP CERTIFICATE

THIS DOCUMENT IS TO CERTIFY THAT

*Mr. Nadine Bello*

**Membership ID #:18377**

IS A MEMBER IN GOOD STANDING AND ENTITLED TO ALL RIGHTS & PRIVILEGES OF ASSOCIATION MEMBERSHIP

EXPIRES 05/31/2017

Indoor Air Quality ASSOCIATION INC.

Kent J. Rawhouser, President