November 25, 2015

Lake Oswego School District
Brent Paul, Director of Facility Operations
PO Box 70
Lake Oswego, Oregon 97034

Re: Follow-Up IAQ Testing
River Grove Elementary School
5850 McEwan Road, Lake Oswego, Oregon 97035
PBS Project No. 21600.013 Phase 0004

Dear Mr. Paul:

On October 30, 2015, PBS Engineering and Environmental Inc. (PBS) performed formaldehyde air monitoring in Classroom D4 and carbon dioxide monitoring in Classroom D1. This testing was performed at the request of the District to provide follow-up data for testing originally performed on September 11, 2015. Below is a summary of our findings.

FINDINGS

Formaldehyde
PBS performed follow-up formaldehyde air monitoring in Classroom D4. A second sample was collected outdoors to gather outdoor background information. Samples were collected during school hours (approximately 10:00 am) with the building’s HVAC system running under normal operating conditions. Samples were collected and analyzed in accordance with National Institute for Occupational Safety and Health (NIOSH) Method 2016. See Table 1 below for a summary of the sample results.

Table 1: NIOSH 2016 Formaldehyde Results

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Sample Location</th>
<th>Result (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>009</td>
<td>D Pod; Classroom D4</td>
<td>0.017</td>
</tr>
<tr>
<td>010</td>
<td>Outdoors; D Pod Area</td>
<td>0.0014</td>
</tr>
</tbody>
</table>

The below information was included in the original report and provided here again for reference purposes.

Currently, there are no generally agreed-upon standards for indoor formaldehyde concentrations. Various governmental agencies have established indoor limits or recommended thresholds. For your reference, Table 2 below summarizes the exposure limit thresholds by OSHA, the regulatory agency. Table 3 provides recommended limits by nonregulatory agencies.

Table 2: Formaldehyde Limits – Enforced

<table>
<thead>
<tr>
<th>Agency</th>
<th>Exposure Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational Safety and Health Administration (OSHA)</td>
<td>Permissible Exposure Limit = 0.75 ppm</td>
</tr>
<tr>
<td></td>
<td>Short-Term Exposure Limit = 2.0 ppm</td>
</tr>
</tbody>
</table>
Table 3: Formaldehyde Limits – Nonregulatory

<table>
<thead>
<tr>
<th>Agency</th>
<th>Exposure Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Conference of Governmental Industrial Hygienists (ACGIH)</td>
<td>Threshold Limit Value = 0.30 ppm</td>
</tr>
<tr>
<td>National Institute of Occupational Safety and Health (NIOSH)</td>
<td>Recommended Exposure Limit (REL) = 0.016 ppm</td>
</tr>
<tr>
<td>US Department of Housing and Urban Development (HUD)</td>
<td>Maximum Allowable Concentration = 0.30 ppm</td>
</tr>
<tr>
<td>World Health Organization (WHO)</td>
<td>Non-Occupational = 0.10 ppm for 30 minutes</td>
</tr>
<tr>
<td>State of California Office of Health Hazard Assessment (OHHEA)</td>
<td>Recommended Limit = 0.023 ppm (as low as reasonably achievable)</td>
</tr>
</tbody>
</table>

Ambient Background Levels

- Agency for Toxic Substances and Disease Registry (ATSDR) considers the ranges of background formaldehyde levels in outdoor air to be 0.0015–0.047 ppm in urban areas and 0.0002–0.006 ppm in rural and suburban areas.¹
- Consumer Product Safety Commission (CPSC) states background levels are typically “less than 0.03 ppm in both outdoor and indoor air.”

Classroom D4’s result fell below the OSHA’s permissible exposure limit, ACGIH’s threshold limit value, HUD’s maximum allowable indoor concentration, WHO’s indoor standard and State of California OHHEA recommended limit. The result barely exceeded the NIOSH REL by 0.001 ppm. Outdoor background levels fell within expected ranges as referenced above.

Ventilation Efficiency Monitoring

PBS utilized a Fluke Airmeter 975 to perform data log screening for carbon dioxide (CO₂), carbon monoxide (CO), relative humidity (RH), and temperature (°F) in Classroom D1. Testing was performed for a period of four days while school was in session. See Table 4 below for results. Also see attached time-plotted graphs for additional information.

Table 4: Ventilation Efficiency Monitoring Data Summary

<table>
<thead>
<tr>
<th></th>
<th>Temperature (°F)</th>
<th>RH (%)</th>
<th>CO (ppm)</th>
<th>CO₂ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>62.6</td>
<td>34.10</td>
<td>0</td>
<td>400</td>
</tr>
<tr>
<td>Maximum</td>
<td>73.4</td>
<td>53.90</td>
<td>0</td>
<td>1297</td>
</tr>
<tr>
<td>Average</td>
<td>68.9</td>
<td>42.49</td>
<td>0</td>
<td>491</td>
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</tbody>
</table>

Carbon Dioxide (CO₂) – CO₂ levels did exceed the American Society of Heating, Refrigeration, and Air Conditioning Engineer (ASHRAE) recommended threshold of 1,095 ppm (700 ppm over outdoor level of 395 ppm) for a period of approximately 35 minutes early Tuesday morning (11/03/15) with a peak level of 1,297 ppm. CO₂ levels remained below the threshold for the remainder of the monitoring period. Please refer to the attached time-plotted graph for further details.

**Carbon Monoxide (CO)** – The carbon monoxide levels were not a concern during this monitoring event as they were not detected during this monitoring event.

**Relative Humidity (RH)** – RH levels fell within ASHRAE’s recommended range of 30 to 60 percent.

**Temperature** – The average temperature over this monitoring period fell within ASHRAE’s recommended range of 68°F to 82°F. Generally speaking, temperature readings during school hours fell within the recommended range with the exception of a few periods where readings dipped below the lower limit of 68°F.

**CONCLUSIONS**

- Classroom D4 – Follow-up formaldehyde testing in classroom D4 had a result of 0.017 ppm. This result appears to be consistent with the results from other D Pod classrooms. This sample result is below the above-referenced regulatory agency (OSHA) threshold limit. This result was also below all of the other nonregulatory limits with the exception of the NIOSH REL where it exceeded it by 0.001 ppm. Outdoor background levels came in at 0.0014 ppm. As stated in the original report, formaldehyde levels are expected to decrease over time. To demonstrate this trend, PBS recommends the District perform periodic monitoring in representative classrooms to assure levels remain at or below the current levels.

- Classroom D1 – On November 3, carbon dioxide levels did exceed ASHRAE’s upper threshold for a period of 35 minutes (07:44 am–08:19 am). PBS does not have any information on whether or not the HVAC system was running at the time of this event. Given the location of the device (on the teacher’s desk), the spike may be attributed to an individual working at the desk during this period. It may also be attributed to an increase in room occupancy. PBS recommends the District look into the classroom occupancy during this elevated period. If it is determined that the cause was an increase in occupancy, the district should review the system settings to make sure it is providing enough fresh air during periods of high occupancy.

  The average temperature over the entire monitoring period fell within the ASHRAE recommended range. However, there were periods where it fell slightly below the lower limit of 68°F. Temperature levels did not appear to be of a concern during this monitoring event. That said, PBS recommends having the thermostat settings checked in all D Pod classrooms to make sure they are set properly.

  Carbon monoxide and relative humidity readings both fell within their acceptable ranges.

**LIMITATION OF SCOPE**

This study is limited to the tests and locations indicated in the above scope of work. The site as a whole may have other concerns that will not be characterized by this study. Further study may be recommended. The findings and conclusions of this work are not scientific certainties but, rather, are probabilities based on professional judgment concerning the significance of the data gathered during the course of this investigation. PBS is not able to represent conditions on the site beyond those conditions detected or observed by PBS.

Feel free to contact me if you have any questions regarding these results. My direct line is 503.417.7607.

Sincerely,

PBS Engineering and Environmental Inc.

Bob Kleckner  
Sr. Project Manager

Attachments:  
ALS Global Analytical Report  
Fluke Meter Ventilation Monitoring Graphs

BK:DM:ln
River Grove Elementary
D Pod Classroom D1

Relative Humidity

Percent (%)

11/2/15 - 11/6/15
River Grove Elementary
D Pod Classroom D1

![Graph showing parts per million (ppm) of carbon dioxide over time between 11/2/15 and 11/6/15. The graph displays fluctuations in carbon dioxide levels throughout the day, with peaks and troughs across different time periods.]
# ANALYTICAL REPORT

Report Date: November 06, 2015

Bob Kleckner  
PBS Environmental  
4412 SW Corbett Ave.  
Portland, OR 97239  

Phone: (503) 248-1939  
Fax: (503) 248-0223  
E-mail: bob@pbsenv.com  

Workorder: [34-1530724]  
Client Project ID: River Grove Elementary  
Purchase Order: 21600.013 Phase 0004  
Project Manager: Stella Hanis  

---

## Analytical Results

<table>
<thead>
<tr>
<th>Sample ID: 009</th>
<th>Lab ID: 1530724001</th>
<th>Sampling Location: River Grove Elementary</th>
<th>Collected: 10/30/2015</th>
<th>Received: 11/03/2015</th>
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</thead>
<tbody>
<tr>
<td><strong>Method:</strong> NIOSH 2016</td>
<td><strong>Media:</strong> SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine)</td>
<td><strong>Sampling Parameter:</strong> Air Volume 30 L</td>
<td><strong>Analyzed:</strong> 11/05/2015</td>
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<tr>
<td><strong>Analyte</strong></td>
<td>Result (ug/sample)</td>
<td>Result (mg/m³)</td>
<td>Result (ppm)</td>
<td>RL (ug/sample)</td>
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<tr>
<td>Formaldehyde</td>
<td>0.61</td>
<td>0.020</td>
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<table>
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<th>Lab ID: 1530724002</th>
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<tbody>
<tr>
<td><strong>Method:</strong> NIOSH 2016</td>
<td><strong>Media:</strong> SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine)</td>
<td><strong>Sampling Parameter:</strong> Air Volume 30 L</td>
<td><strong>Analyzed:</strong> 11/05/2015</td>
<td></td>
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<tr>
<td><strong>Analyte</strong></td>
<td>Result (ug/sample)</td>
<td>Result (mg/m³)</td>
<td>Result (ppm)</td>
<td>RL (ug/sample)</td>
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<tr>
<td>Formaldehyde</td>
<td>0.050</td>
<td>0.0017</td>
<td>0.0014</td>
<td>0.050</td>
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## Report Authorization  (/S/ is an electronic signature that complies with 21 CFR Part 11)

<table>
<thead>
<tr>
<th>Method</th>
<th>Analyst</th>
<th>Peer Review</th>
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<tr>
<td>NIOSH 2016</td>
<td>/S/ Lyle Edwards</td>
<td>/S/ Christopher Winter</td>
</tr>
<tr>
<td>11/06/2015 12:08</td>
<td>11/06/2015 12:48</td>
<td></td>
</tr>
</tbody>
</table>

## Laboratory Contact Information

ALS Environmental  
960 W LeVoy Drive  
Salt Lake City, Utah 84123  

Phone: (801) 266-7700  
Email: alslt.lab@ALSGlobal.com  
Web: www.alsslc.com  

---

ADDRESS 960 West LeVoy Drive, Salt Lake City, Utah, 84123 USA  
PHONE +1 801 266 7700  
FAX +1 801 268 9992  
ALS GROUP USA, CORP.  
An ALS Limited Company
General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

<table>
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<th>Testing Sector</th>
<th>Accreditation Body (Standard)</th>
<th>Certificate Number</th>
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<tr>
<td>Environmental</td>
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<td>ADE-1420</td>
<td><a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a></td>
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<td>Florida (TNI)</td>
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<td><a href="http://www.dep.state.fl.us/labs/bars/sas/qa/">http://www.dep.state.fl.us/labs/bars/sas/qa/</a></td>
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<td>Texas (TNI)</td>
<td>T104704456-11-1</td>
<td><a href="http://www.tceq.texas.gov/field/qa/lab_accred_certif.html">http://www.tceq.texas.gov/field/qa/lab_accred_certif.html</a></td>
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<td>Industrial Hygiene</td>
<td>AIHA (ISO 17025 &amp; AIHA IHLAP/ELLAP)</td>
<td>101574</td>
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<td>Lead Testing:</td>
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<td>CPSC</td>
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<td><a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a></td>
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<tr>
<td>Soil, Dust, Paint ,Air</td>
<td>AIHA (ISO 17025, AIHA ELLAP and NLLAP)</td>
<td>101574</td>
<td><a href="http://www.aihaaccreditedlabs.org">http://www.aihaaccreditedlabs.org</a></td>
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<td>Dietary Supplements</td>
<td>ACLASS (ISO 17025)</td>
<td>ADE-1420</td>
<td><a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a></td>
</tr>
</tbody>
</table>

Definitions

LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< This testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.
Sample Receipt Notification

Workorder Information

Workorder: 34-1530724
Client: PBS Environmental

Reporting Level 1
Manager: Stella Hanis
Stella.Hanis@ALSGlobal.com

Due: 11/10/15
Received: 11/03/15
TAT: 5 work days from receipt

Project: River Grove Elementary
Profile: B Kleckner
Format: Report < LOQ
Program: NA

Sample Condition at Receipt

<table>
<thead>
<tr>
<th>Temperature(s)</th>
<th>Expired at Receipt</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NO</td>
<td>Sample(s) received in good condition unless otherwise noted.</td>
</tr>
</tbody>
</table>

Report Delivery Information

-- Analytical Report Address --
Bob Kleckner
PBS Environmental
4412 SW Corbett Ave.
Portland, OR 97239

Email Delivery: bob@pbsenv.com
Stella.Hanis@ALSGlobal.com

EDD Requested: EDD001-<[Standard][NOQC]>

Invoice Delivery Information

-- Invoice Address --
Accounts Payable
PBS Environmental
4412 SW Corbett Ave.
Portland, OR 97239

Email Delivery: accountspayable@PBSenv.com
bob@pbsenv.com
Stella.Hanis@ALSGlobal.com

Laboratory Contact Information

-- Laboratory Address --
ALS Environmental
960 W. LeVoy Drive
Salt Lake City, UT 84123

Phone: (801) 266-7700
Email: alsit.lab@alsglobal.com
Web: www.alsslc.com
### Sample Information

<table>
<thead>
<tr>
<th>Client Sample ID</th>
<th>Lab Samp. ID</th>
<th>QC</th>
<th>Matrix</th>
<th>Sampling Site</th>
<th>Collected</th>
<th>Received</th>
<th>Tests</th>
<th>#</th>
<th>Parameter</th>
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</thead>
<tbody>
<tr>
<td>009</td>
<td>1530724001</td>
<td>N</td>
<td>Air</td>
<td>River Grove Elementa</td>
<td>10/30/15</td>
<td>11/03/15</td>
<td>1</td>
<td>1</td>
<td>30 L</td>
</tr>
<tr>
<td>010</td>
<td>1530724002</td>
<td>N</td>
<td>Air</td>
<td>River Grove Elementa</td>
<td>10/30/15</td>
<td>11/03/15</td>
<td>1</td>
<td>1</td>
<td>30 L</td>
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### Sample Preservation

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<th>Preservative</th>
<th>Temperature</th>
<th>pH</th>
<th>Tests</th>
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</thead>
<tbody>
<tr>
<td>226-119</td>
<td>COOL</td>
<td>NA</td>
<td>NA</td>
<td>NIOSH 2016</td>
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</table>
### Analysis Information

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<th>Lab Samp. ID</th>
<th>QC</th>
<th>Matrix</th>
<th>Requested Analysis</th>
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<tbody>
<tr>
<td>009</td>
<td>1530724001</td>
<td>Air</td>
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<tr>
<td>010</td>
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<td>Air</td>
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### Test(s)

<table>
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<tr>
<th>Method</th>
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<th>Container</th>
<th>Primary</th>
<th>Det. Lim.</th>
<th>Additional</th>
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<tbody>
<tr>
<td>NIOSH 2016</td>
<td>2</td>
<td>Air</td>
<td>226-119</td>
<td>ug/sample</td>
<td>ug/sample</td>
<td>mg/m³</td>
<td>ppm</td>
</tr>
</tbody>
</table>

Analyte(s): Formaldehyde
2. Date 11/2/15  Purchase Order No. 21600.013 Phase 0004
3. Company Name  PBS Engineering and Environmental
   Address  4412 SW Corbett Avenue
             Portland, Oregon 97239
Person to Contact  Bob Kleckner
Telephone (503) 248-1939
Fax Telephone ( )
E-mail Address  bob@pbsenv.com
Billing Address (if different from above)  Same

4. Quote No.  
5. Sample Collection
   Sampling Site  River Grove Elementary
   Industrial Process  Classroom D4
   Date of Collection  10/30/15
   Time Collected  10:00 am
   Date of Shipment  11/2/15
   Chain of Custody No.  21600.013 Phase 0004

6. REQUEST FOR ANALYSES

<table>
<thead>
<tr>
<th>Laboratory Use Only</th>
<th>Client Sample Number</th>
<th>Matrix*</th>
<th>Sample Volume</th>
<th>ANALYSES REQUESTED - Use method number if known</th>
<th>Units**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>009</td>
<td>226-119</td>
<td>30 L</td>
<td>NIOSH 2016 Mod</td>
<td>ppm</td>
</tr>
<tr>
<td></td>
<td>010</td>
<td>226-119</td>
<td>30 L</td>
<td>NIOSH 2016 Mod</td>
<td>ppm</td>
</tr>
</tbody>
</table>

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other
** 1. mg/sample  2. mg/m³  3. ppm  4. %  5. (other) Please indicate one or more units in the column entitled Units**

Comments  

Possible Contamination and/or Chemical Hazards  

Relinquished by  Bob Kleckner  Date/Time  11/2/15  14:00
Received by  Date/Time  11/3/15  10:25
Relinquished by  Date/Time
Received by  Date/Time
Relinquished by  Date/Time
Received by  Date/Time

960 West LeVoy Drive, Salt Lake City, UT 84123  800-280-8071 or 800-356-9135 / FAX: 775-213-8852
ALS Environmental
**LABORATORY TRANSMITTAL AND CHAIN OF CUSTODY**

**Project No.:** 21600.013  
**Phase No.:** 0004  
**Task No.:**

**Project Site/Location:** RIVER GROVE ELEMENTARY

Individuals signing this form warrant that the information provided is correct and complete. The Sender should keep a copy and send the original. The Receiver should complete the form, keep a copy and return the original to the Sender. Receiver shall report damage of package immediately to Sender.

**SENDER**

**Date Sent:** 11/2/15

PBS Engineering + Environmental
4412 SW Corbett Avenue
Portland, Oregon 97239
503.248.1939 Fax: 503.248.0223

**Bob Kieckhefer**

Name  
Authorized Signature  
Date  

**RECEIVER (lab use only)**

**Date Received:**

Company: 
Address: 
Phone: 

**Receiver Name**

Authorized Signature  
Date

Email Results To:  
Verbal Results To:  
Phone:

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Sample Type &amp; Description (asb. /lead, bulk/air, vol. /area, etc.)</th>
<th>Analysis Requested</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 009</td>
<td>FORMALDEHYDE AIR; CLASSROOM D4</td>
<td>NIOSH 2010 MOD</td>
</tr>
<tr>
<td>- 010</td>
<td>FORMALDEHYDE AIR; OUTSIDE CLASSROOM D4</td>
<td>NIOSH 2010 MOD</td>
</tr>
<tr>
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</tbody>
</table>

**TURNAROUND DESIRED:** NORMAL

**SPECIAL INSTRUCTIONS:**

Please email the results to the above Sender. Please archive any remaining sample components for a minimum of thirty days after analysis date.