814 Broad St.
Weymouth, MA 02189

T 781.337.0016
TRCcompanies.com

October 25, 2021

VIA EMAIL: ernest.sandland@whrsd.org

Mr. Ernest Sandland
Facilities Department
Whitman Hanson Regional School District
600 Franklin Street
Whitman, MA 02382

TRC Project No. 455410

Subject: **Final Report**
Indoor Air Quality Evaluation
John H. Duval School
60 Regal Street
Whitman, Massachusetts

Dear Mr. Sandland:

TRC Environmental, Inc. (TRC) is pleased to present its final report entitled *"Indoor Air Quality Evaluation"* performed at the John H. Duval School located at 60 Regal Street in Whitman, MA.

TRC appreciates the opportunity to be of service. If you have any questions or concerns, please contact me at (781) 337-0016.

Very Truly Yours,
TRC ENVIRONMENTAL, INC.

Olivia Smaracko
BSI - Sr. Industrial Hygienist

Gregory Hatch
BSI - Office Practice Leader

814 Broad St.
Weymouth, MA 02189

T 781.337.0016
TRCcompanies.com

Indoor Air Quality
at

John H. Duval School
60 Regal Street
Whitman, Massachusetts

TRC Project No. 455410
October 25, 2021

Prepared for:

Whitman Hanson Regional School District
Facilities Department
600 Franklin Street
Whitman, MA 02382

Prepared by:

TRC Companies, Inc.
814 Broad Street
Weymouth, Massachusetts
781.337.0016

CONTENTS

1.0 INTRODUCTION

Mr. Ernest Sandland of the Whitman Hanson Regional School District (WHRSD) authorized TRC Environmental, Inc. (TRC) to perform an indoor air quality evaluation at the John H. Duval School at 60 Regal Street, Whitman, MA.

WHRSD requested this evaluation to be conducted in a proactive manner to address potential occupant concerns. TRC Industrial Hygienist, Gregory Hatch, visited the school to perform the evaluation on August 27, 2021. During the evaluation, building access and information was provided by Mr. Ernest Sandland of the WHRSD Facilities Department.

Appendix A presents the results of instantaneous direct-reading environmental measurements. Appendix B presents the monitoring calibration report.

2.0 OBSERVATIONS AND DISCUSSION

TRC's assessment included evaluating representative occupied spaces at the school building. TRC's observations and discussions were based on the following:

- Inspecting for possible microbiological reservoirs or amplifiers and sources of odor, chemical air contaminants, and combustion products within the survey areas and associated with the heating, ventilating and air conditioning (HVAC) system serving those areas.

- Collecting instantaneous, direct-reading measurements for dry bulb temperature, relative humidity, carbon dioxide and carbon monoxide concentrations indoors in the representative areas and outdoors for comparison.

2.1 OCCUPIED SPACE

The building is typical school building with office space, common areas such as hallways, Cafeteria, Auditorium, Library, Gymnasium and classroom space. The following was noted:

- School was not in session yet, but a few teachers were present preparing classrooms for opening day. Most of the unit ventilators and individual air conditioners in classrooms were not in operation.

- Summer camp for kids was in session on the day of the assessment. Most of these activities were on the playground outside but the Cafeteria was in use beginning, lunch time and end of day.

- No substantial water leaks or intrusion areas were observed.

2.2 DIRECT-READING ENVIRONMENTAL MEASUREMENTS

TRC performed direct-reading environmental measurements within select classrooms, offices, gymnasium, and cafeteria, and in the outdoor air, on August 27, 2021. TRC

measured for dry bulb temperature, relative humidity, carbon dioxide and carbon monoxide concentrations using a TSI Q-Trak Indoor Air Quality Monitor. This is a direct reading instrument.

Appendix A presents direct-reading environmental measurements and Appendix B provides the updated instrument calibration report.

2.2.1 Dry Bulb Temperature and Relative Humidity

On the day of the survey, TRC measured indoor dry bulb temperatures ranging from 76.7 to 82.6°F. The outdoor dry bulb temperature ranged from 91.7 to 93.1 °F. TRC measured indoor relative humidity in the occupied spaces ranging from 53.9 to 76.6%. The outdoor relative humidity ranged from 47.6 to 55.6%.

Occupant thermal comfort is based on a combination of temperature and relative humidity. The American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE) Standard 55-1992, *Thermal Environmental Conditions for Human Occupancy*, and Standard 55a-1995 Amendment, recommends a range and combination of temperature and relative humidity considered as acceptable for general occupant comfort.

The temperatures and relative humidity levels recommended in ASHRAE Standard 55-1992 and Standard 55a-1995 provide for conditions for which 90 percent of occupants will not express discomfort. The range of temperatures and relative humidity prescribed change from summer to winter and assume that occupants dress appropriately for the season. Ranges of temperature include adjustment factors based on occupant activity (metabolic rate) and clothing factor.

For occupants of office space with a metabolic range of 0.8 to 1.2, the recommended comfort ranges for temperature and relative humidity are:

- **Winter**

  Temperature - Dry Bulb: 67 to 76 ºF at 64 ºF Wet Bulb
  (85 to 54 Percent Relative Humidity)
  and
  69 to 76 ºF at 36 ºF Dew Point
  (30 to 23 Percent Relative Humidity)

- **Summer**

  Temperature - Dry Bulb: 73 to 79 ºF at 68 ºF Wet Bulb
  (78 to 58 Percent Relative Humidity)
  and
  74 to 87 ºF at 36 ºF Dew Point
  (28 to 20 Percent Relative Humidity)

If space utilization or clothing factors change, then the temperature range will also change in accordance with:

T active = T sedentary – 5.4 (1 + Clo) (Met - 1.2)
Regardless of the metabolic rate calculation from above;
the minimum temperature permitted is 59 ºF

ASHRAE Standard 62:2001, *Ventilation for Acceptable Indoor Air Quality*, recommends that, to avoid fungal amplification in building fabrics, relative humidity in occupied spaces should be maintained below 60 percent.

Several of the measured indoor temperatures were found to be slightly above the 79 ºF acceptable range. The relative humidity readings were below the recommended 78% maximum level. The temperatures readings measured outside of the recommended levels are due to the summer like conditions outside in conjunction with the some of the unit ventilators and air conditioners not operating yet as the school was not in session.

2.2.2 Carbon Dioxide

On the day of the survey, TRC measured outdoor carbon dioxide concentrations between 444 to 569 parts per million (ppm). Indoor carbon dioxide concentrations ranged between 406 to 936 ppm.

ASHRAE Standard 62:2001, *Ventilation for Acceptable Indoor Air Quality*, identifies indoor carbon dioxide concentrations as a surrogate determination of ventilation efficiency. For a building under normal occupancy load and operating in its normal conditioning, a comparison of indoor air and outdoor air carbon dioxide concentrations can be used to indicate relative ventilation efficiency for the occupied spaces. Provided the occupant density does not exceed the recommended levels in ASHRAE Standard 62:2001, when the peak indoor carbon dioxide concentration exceeds the outdoor concentration by more than 700 ppm, the ventilation rate for that space is inadequate for the occupant loading.

An indoor carbon dioxide concentration of 700 ppm above the outdoor concentration is not a significant risk to health; however, other bio-effluents from occupants and pollutants from building components may accumulate to irritant levels or result in discomfort for the occupants due to inadequate ventilation.

Of the indoor measurements collected on August 27, 2021, none of the readings exceeded the recommended maximum 1,144 ppm (700+444), the calculated ASHRAE recommended indoor carbon dioxide concentration at the start of the survey.

2.2.3 Carbon Monoxide

Carbon monoxide is an odorless, colorless toxic gas produced by the incomplete combustion of solid, liquid and gaseous fuels. Elevated indoor carbon monoxide concentrations may be a result of combustion sources indoors or the introduction of combustion products from outdoors into the indoor air. In the absence of indoor sources, indoor carbon monoxide concentrations are usually less than, or equal to outdoor concentrations. ASHRAE Standard 62-2001 recommends an upper limit for carbon monoxide of 9 ppm as a 24-hour average, and 35 ppm as a 1-hour average.

The indoor and outdoor carbon monoxide concentrations were less than 1ppm.

3.0 CONCLUSIONS AND RECOMMENDATIONS

TRC's conclusions and recommendations are based on its observations, including visual surveys, sample results and inspections presented in this report.

3.1 CONCLUSIONS

A. Temperature readings were slightly above normal ranges likely due to the summertime outdoor temperatures.

B. The CO_2, relative humidity and carbon monoxide levels were within the recommended limits. The direct read measurements are attached in Appendix A.

C. No visible suspect mold or water staining was observed.

3.2 RECOMMENDATIONS

TRC presents the following recommendations to assist the WHRSD in improving indoor air quality:

- Make sure the unit ventilators and supplemental air conditioners are in operation to maintain the temperature levels within the recommended ranges when school is in session.

Should you have any questions or if things change within the building please give us a call.

This report prepared by:

Gregory Hatch
BSI - Office Practice Leader

This report reviewed by:

Olivia Smaracko
BSI – Senior Industrial Hygienist

Date: October 25, 2021

APPENDIX A

DIRECT-READING ENVIRONMENTAL MEASUREMENTS

School Name: John H. Duval School Date: 8/27/21

60 Regal Street, Whitman, MA

LOCATION	Time	Temp (^{0}F)	CO (ppm)	CO_2 (ppm)	RH (%)	Comments/ [Number of Occupants]
ACCEPTABLE LIMIT	a.m./p.m.	73 – 79	9	1,144	<78	
Outdoor	10:50 am	91.7	0	444	47.6	Sunny hot summer day
	2:15 pm	93.1	0	569	55.6	Sunny hot summer day
Room 129	11:01 am	78.0	0	542	53.9	0 (occupants)/Window AC unit on/Univent (UV) on but vent partially covered
	1:44 pm	80.2	0	558	59.0	Window AC unit on/Univent (UV) on but vent partially covered
Room 125	11:03 am	78.4	0	443	68.0	0/Window AC unit off/UV on
	1:46 pm	80.2	0	444	63.2	0/Window AC unit off/UV on
Cafeteria	11:06 am	80.0	0	702	76.6	~75/Summer Camp/Fans on
	1:47 pm	81.2	0	936	72.3	~75/Summer Camp/Fans on
Teacher Dining	11:09 am	80.6	0	416	71.2	0/UV on
	1:49 pm	81.5	0	446	64.9	0/UV on
Room 117	11:10 am	80.2	0	432	69.1	0/UV on
	1:50 pm	79.2	0	473	54.4	0/UV on/ Window AC unit on
Room 124	11:12 am	81.4	0	406	77.2	0/UV on
	1:52 pm	81.8	0	398	72.2	0/UV on
Room 209	11:15 am	82.1	0	453	71.9	0/UV on
	1:54 pm	82.3	0	468	72.9	0/UV on
Room 214	11:17 am	81.4	0	480	56.6	0/UV on/ Mobile AC unit on
	1:55 pm	81.1	0	468	56.6	0/UV on/ Mobile AC unit on
Room 208	11:20 am	81.4	0	421	72.9	2/UV on/2 mobile AC units off
	1:57 pm	81.2	0	473	60.6	2/UV on/2 mobile AC units on

Room 203	11:22 am	82.5	0	431	63.3	2/UV on/2 mobile AC units on/windows open
	1:59 pm	82.6	0	418	65.1	2/UV on/2 mobile AC units off/windows open
Gym	11:26 am	81.9	0	462	72.1	0/HVAC on
	2:01 pm	82.6	0	438	70.1	0/HVAC on
Room 103 Art	11:30 am	81.0	0	452	73.1	0/UV on/2 mobile AC units off
	2:02 pm	82.0	0	448	68.1	0/UV on/2 mobile AC units off
Library	11:32 am	77.9	0	637	60.6	1/Central AC on
	2:04 pm	80.0	0	597	62.3	1/Central AC on
Corner Admin Office	11:35 am	76.7	0	556	64.9	1/Central AC on
	2:05 pm	77.4	0	547	63.4	1/Central AC on
Room 105	11:37 am	76.9	0	500	76.7	0/UV on but covered
	2:07 pm	77.9	0	465	74.2	0/UV on but covered
Room	11:40 am	77.5	0	493	76.5	0/UV on/Window AC unit off
	2:09 pm	78.3	0	461	73.9	0/UV on/Window AC unit off

APPENDIX B

IAQ MONITOR CALIBRATION REPORT

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.52 (22.0)	°F (°C)
RELATIVE HUMIDITY	50.7	%RH
BAROMETRIC PRESSURE	29.10 (985.4)	inHg (hPa)

MODEL	7575-X
SERIAL NUMBER	7575X1421005

☒ AS LEFT ☒ IN TOLERANCE
☐ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

THERMO COUPLE — **SYSTEM PRESSURE01-02** — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	70.9 (21.6)	70.9 (21.6)	68.9~72.9 (20.5~22.7)				

BAROMETRIC PRESSURE — **SYSTEM PRESSURE01-02** — *Unit: inHg (hPa)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	29.11 (985.8)	29.11 (985.8)	28.53~29.69 (966.1~1005.4)				

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E004626	02-14-20	02-28-21	Pressure	E005254	10-10-19	10-31-20
Pressure	E003982	07-21-20	01-31-21	DC Voltage	E003493	06-17-20	06-30-21

ChaoVang
CALIBRATED

July 31, 2020
DATE

Doc. ID: CERT_GEN_WCC

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.55 (22.0)	°F (°C)
RELATIVE HUMIDITY	50.5	%RH
BAROMETRIC PRESSURE	29.11 (985.8)	inHg (hPa)

MODEL	7575-X
SERIAL NUMBER	7575X1421005

☐ AS LEFT ☒ IN TOLERANCE
☒ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

THERMO COUPLE — **SYSTEM PRESSURE01-02** — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	70.8 (21.6)	70.6 (21.4)	68.8~72.8 (20.4~22.7)				

BAROMETRIC PRESSURE — **SYSTEM PRESSURE01-02** — *Unit: inHg (hPa)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	29.12 (986.1)	29.08 (984.8)	28.54~29.70 (966.5~1005.8)				

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E004626	02-14-20	02-28-21	Pressure	E005254	10-10-19	10-31-20
Pressure	E003982	07-21-20	01-31-21	DC Voltage	E003493	06-17-20	06-30-21

ChaoVang
VERIFIED

July 31, 2020
DATE

Doc. ID: CERT_GEN_WCC

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.50 (21.9)	°F (°C)
RELATIVE HUMIDITY	47.4	%RH
BAROMETRIC PRESSURE	29.24 (990.2)	inHg (hPa)

MODEL	982
SERIAL NUMBER	P14180028

☒ AS LEFT ☒ IN TOLERANCE
☐ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

TEMPERATURE VERIFICATION — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.2 (0.1)	31.1~33.1 (−0.5~0.6)	2	140.0 (60.0)	140.0 (60.0)	139.0~141.0 (59.5~60.6)

HUMIDITY VERIFICATION — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	8.9	7.8~12.2	4	70.0	69.7	67.8~72.2
2	30.0	29.1	27.8~32.2	5	90.0	89.2	87.8~92.2
3	50.0	49.7	47.8~52.2				

CO_2 GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3018	3030	2928~3109
2	501	502	451~551	5	5031	5035	4880~5182
3	1005	1019	955~1055				

CO GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	36	32~38	2	101	100	98~104

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E010657	02-14-20	02-28-21	Temperature	E010658	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21	Humidity	E003539	02-26-20	08-31-20
5000 CO2	14a044096	04-06-20	04-06-28	200 CO	149801	03-24-20	03-24-28
N2	13B110153	04-27-20	04-27-28	Air	A79204	05-20-20	05-20-28
Flow	E003341	09-03-19	09-30-20	Flow	E003980	04-22-20	04-30-21
Flow	E003525	01-06-20	01-31-21	Flow	E003342	09-03-19	09-30-20
2000 C4H8	EB0054467	08-13-19	08-12-22	100 C4H8	CC507339	03-24-20	03-24-28

Baoyang
CALIBRATED

August 3, 2020
DATE

Doc. ID: CERT_GEN_WCC

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	74.3 (23.5)	°F (°C)
RELATIVE HUMIDITY	48	%RH
BAROMETRIC PRESSURE	29.07 (984.4)	inHg (hPa)

MODEL	982
SERIAL NUMBER	P14180028

☐ AS LEFT ☐ IN TOLERANCE
☒ AS FOUND ☒ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

GAS CO_2 AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3021	2975	2930~3111
2	504	484	454~554	5	5031	4900	4880~5182
3	1007	1002	957~1057				

GAS CO AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	34	32~38	2	100.7	* 94.8	97.7~103.7

TEMPERATURE AS FOUND — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.2 (0.1)	31.1~33.1 (−0.5~0.6)	2	140.0 (60.0)	140.0 (60.0)	139.0~141.0 (59.5~60.6)

HUMIDITY AS FOUND — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	9.9	7.0~13.0	4	70.0	67.5	67.0~73.0
2	30.0	29.1	27.0~33.0	5	90.01	* 86.22	87.01~93.01
3	50.0	48.5	47.0~53.0				

**Indicates Out-of-Tolerance Condition*

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due
5000 CO_2	14a044096	04-06-20	04-06-28
N2	13B110153	04-27-20	04-27-28
Flow	E003341	09-03-19	09-30-20
Flow	E003525	01-06-20	01-31-21
2000 C4H8	EB0054467	08-13-19	08-12-22
Temperature	E010657	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21

Measurement Variable	System ID	Last Cal.	Cal. Due
200 CO	149801	03-24-20	03-24-28
Air	A79204	05-20-20	05-20-28
Flow	E003980	04-22-20	04-30-21
Flow	E003342	09-03-19	09-30-20
100 C4H8	CC507339	03-24-20	03-24-28
Temperature	E010658	02-14-20	02-28-21
Humidity	E003539	02-26-20	08-31-20

Chao Vang
VERIFIED

August 3, 2020
DATE

DOC. ID: CERT_GEN_WCC

TSI P/N 2300157