



Stantec

Stantec Consulting Ltd.
Suite 102, 40 Highfield Park Drive
Dartmouth NS B3A 0A3
Tel: (902) 468-7777
Fax: (902) 468-9009

**FINAL REPORT:
Odour Investigation –
Highland Consolidated Middle School**

Report Prepared for:

Chignecto-Central Regional School Board
60 Lorne Street
Truro, NS B2N 3K3

Attention: Jackie Fahey
Coordinator, Health & Safety

faheyj@ccrsb.ca

File: 121411939

April 20, 2012

Executive Summary

At the request of Chignecto-Central Regional School Board, Stantec Consulting Ltd. conducted an odour investigation at Highland Consolidated Middle School between January 17 and March 16, 2012. Several staff members had reported health concerns that they correlated with various odours detected in the school.

As a result of our findings, Stantec makes the following conclusions:

- Based on employee feedback derived from interviews, questionnaires and staff diaries, the 5 most frequently reported symptoms include headache, sinus (dry, irritated, congested), throat (sore, dry, itchy), eyes (burning, watering, itchy, blurred) and mouth/lips/tongue (burn, tingle, swelling). The problems related to the mouth/lips/tongue are similar in nature to skin problems reported by some staff members. These symptoms, unlike the others which are more non-specific in nature, tend to point to a more specific causative agent in the environment. An agent has not been identified to date.
- The odours were variously reported as either “mouldy”, “chemical” or “sewer gas” in character.
- The onset of symptoms had been reported on 3 occasions; immediately following the partial roof replacement in March 2011, the start of school in the fall 2011 and following the Christmas break in early 2012.
- Indoor air quality testing on January 24, 2012 indicates that key indicators of indoor air quality were generally within accepted standards. Elevated levels of carbon dioxide are not unexpected in areas that are not mechanically ventilated with multiple occupants.
- Results of testing for total volatile organic compounds (TVOCs) during the roof replacement between March 12-16, 2012 indicate that levels were generally found to meet the comfort standard with exceptions attributable to the roofing activities taking place at the time. The highest concentrations of TVOCs were measured in the pipe chase near the Janitors Closet on the second floor, which was believed to be leaking sewer gas. TVOCs levels were found to drop off appreciably throughout the school as the roof construction was nearing completion.
- Water damaged and stained building materials, most commonly ceiling tiles and drywall around windows, were identified in some areas of the school during the visual assessment on February 8, 2012. Intrusive investigation indicated that mould was present in the exterior wall cavity in 3 areas; Classroom 204 (Chemistry Lab), Classroom 206 and Classroom 174 (Wood Shop).
- Radiators throughout the school were found to be dusty and containing debris.
- The recycling bin on the first floor was constructed of wood, which is not a suitable material to prevent mould growth.
- A damp cardboard box with obvious staining was observed in Room 142.

At this time, Stantec is unable to point to a single reason for the symptoms reported by staff members of HCMS. Our findings suggest there are multiple contributing factors to the odours that have been reported. CCRSB has been diligently working to resolve the problems identified in the school to date. It is expected that their attention to these various issues will contribute to an overall improvement in indoor air quality within HCMS.

Stantec recommends the following actions as a result of our study:

- Ensure that a minimum of 2 windows remain open in each occupied classroom to minimize the buildup of carbon dioxide.
- Install exhaust fan in Janitors Room where chemicals are stored and batteries recharged.
- Clean dust and debris from radiators throughout the school.
- Develop an action plan to manage drains in unused boys and girls locker rooms beneath the Gym.
- Ensure recycling container is made of water-repellent, non-porous material that can be easily cleaned.
- Exert caution in bringing materials into the school to be sure they do not introduce contaminants into the environment, such as mould or chemical residues.
- Ensure that sources of water intrusion in the building have been identified and corrected.
- Remove and replace identified water damaged building materials, including ceiling tiles.
- Remediate mould-impacted building materials on the exterior walls of Classroom 204 (Chemistry Lab), Classroom 206 and Classroom 174 (Wood Shop) in accordance with appropriate industry standards and guidelines (e.g., Canadian Construction Association). If remediation activities cannot be conducted in the short term, a mitigative plan should be developed and implemented to reduce building occupant exposures to any mould present in the building

Table of Contents

EXECUTIVE SUMMARY	E.1
1.0 INTRODUCTION	1
1.1 GENERAL.....	1
1.2 BACKGROUND.....	1
1.3 SCOPE OF WORK.....	1
2.0 INDOOR AIR QUALITY STANDARDS	2
2.1 CARBON DIOXIDE (CO ₂)	2
2.2 CARBON MONOXIDE (CO)	3
2.3 TEMPERATURE (TEMP) & RELATIVE HUMIDITY (RH)	3
2.4 TOTAL VOLATILE ORGANIC COMPOUNDS (TVOC _s)	3
2.5 TOTAL SUSPENDED PARTICULATES (TSP).....	3
2.6 MOULD	4
2.7 SUMMARY OF INDOOR AIR QUALITY STANDARDS	4
3.0 METHODS	5
3.1 INTERVIEWS & QUESTIONNAIRES	5
3.2 INDOOR AIR QUALITY	5
3.3 BUILDING ASSESSMENT	5
4.0 RESULTS	6
4.1 INTERVIEWS & QUESTIONNAIRES	6
4.2 INDOOR AIR QUALITY	8
4.3 BUILDING ASSESSMENT	12
4.3.1 Visual Assessment	12
4.3.2 Intrusive Assessment	15
5.0 DISCUSSION	16
5.1 INTERVIEWS & QUESTIONNAIRES	17
5.2 INDOOR AIR QUALITY ASSESSMENT	18
5.3 BUILDING ASSESSMENT	18
5.3.1 Visual Assessment.....	18
5.3.2 Intrusive Assessment	19
6.0 CONCLUSIONS	19
7.0 RECOMMENDATIONS	20
8.0 CLOSURE	21

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

LIST OF APPENDICIES

- APPENDIX A Questionnaire
- APPENDIX B Laboratory Report

LIST OF TABLES

Table 1	Indoor Air Quality Standards	4
Table 2	Air Sampling Instruments	5
Table 3	Symptom Responses - Interviews	6
Table 4	Symptom Responses - Questionnaires	7
Table 5	Symptom Responses – staff diaries	7
Table 6	Spot Measurements - Indoor Air Quality Testing, HMCS, January 24, 2012.....	8
Table 7	Spot Measurements – TVOCs during Roof Replacement, HMCS Mar 12-16, 2012.....	9
Table 8	Visual Assessment, HCMS, February 8, 2012.....	12
Table 9	Intrusive Assessment, HCMS, March 13, 2012	15

1.0 Introduction

1.1 GENERAL

At the request of Chignecto-Central Regional School Board (CCRSB), Stantec Consulting Ltd. (Stantec) conducted an odour investigation at Highland Consolidated Middle School (HCMS) between January 17, 2012 and March 16, 2012. It was reported that several staff members of the school had reported symptoms of ill health that they believed were related to odours detected in the building at various intervals since the partial roof repair at Spring Break in 2011.

1.2 BACKGROUND

CCRSB has undertaken an extensive investigation to address the odour concerns since they were first reported in March 2011. Many of their actions were outlined in a letter dated December 2, 2011 to the Occupational Health and Safety Committee. Since that letter, additional actions have been taken, which notably included removal and repair of plumbing pipework and fixtures at key areas identified by CCRSB. Attention to this matter has been ongoing.

1.3 SCOPE OF WORK

Stantec conducted the following scope of work for this study:

- Reviewed available information pertaining to indoor air quality at HCMS.
- Conducted on-site interviews with affected and interested staff of HCMS regarding odour concerns; invited staff members to complete a questionnaire following their interview;
- Collected spot measurements of key indicators of indoor air quality at selected locations in HCMS over the course of a representative work day;
- Conducted a visual assessment of readily accessible areas in HCMS to assess building envelope for sources of odour;
- Conducted an intrusive assessment of selected areas of concern to evaluate the presence of water impacts on hidden building materials and to attempt to identify sources of moisture intrusion;
- Collected bulk samples of various building materials from selected areas of the building for subsequent laboratory analysis to detect the possible presence of mould; and
- Provided this detailed written report documenting our findings.

2.0 Indoor Air Quality Standards

Under the Nova Scotia Occupational Health and Safety Act, the employer is responsible for maintaining a healthy work environment for its employees.

Most Canadian regulators have adopted as workplace air quality standards the chemical and physical agent exposure values published by the American Conference of Governmental Industrial Hygienists (ACGIH) in an annually updated booklet called *Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices*. The 2012 version was in effect at the time of this study.

ACGIH defines the maximum average concentration of airborne chemicals to which nearly all workers may be exposed for specific work intervals, typically an 8-hour workday in a 40-hour week over a working lifetime, without adverse effect. This time-weighted average concentration is referred to as the Threshold Limit Value Time-Weighted Average or TLV-TWA.

Although TLVs apply to all workplaces, there is an added measure of comfort expected of a non-industrial work environment. Health Canada provides guidelines for indoor air quality in their publication, *Indoor Air Quality in Office Buildings: A Technical Guide* (1995). This document references guidelines developed by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) for indoor air quality and ventilation, including:

- Standard 55-2010 Thermal Environmental Conditions for Human Occupancy, and
- Standard 62.1-2010 Ventilation for Acceptable Indoor Air Quality.

ASHRAE defines “acceptable indoor air quality” as that to which a substantial majority (80% or more) of the people exposed do not express dissatisfaction. However, all environmental standards, including the ASHRAE standards, have limitations in that they cannot provide an indoor environment that satisfies everyone, given the wide range of human susceptibilities.

A brief discussion of key indoor air quality parameters typically selected for study follows.

2.1 CARBON DIOXIDE (CO₂)

Carbon dioxide is a colourless, odourless gas, and is a normal constituent of outdoor air at concentrations between 350 to 400 parts per million (ppm). It is generated indoors primarily through human respiration. The concentration of carbon dioxide indoors varies according to factors such as occupant density and the time of day, with levels tending to rise during the day. Carbon dioxide levels are often used as a surrogate measure of the ventilation rate in a building. Typically, complaints about indoor air quality rise with the concentration of carbon dioxide. Although the current ASHRAE standard is 700 ppm above outdoors, research has shown that as levels rise above 800 ppm, increasingly more of occupants become dissatisfied with air quality.

2.2 CARBON MONOXIDE (CO)

Carbon monoxide is a colourless, odourless, toxic gas that is a product of incomplete combustion. Carbon monoxide levels rise when combustion gases are not properly exhausted or are being re-entrained into the building. In office and commercial buildings, important sources of combustion contaminants include garages and loading docks that are attached or have a pathway to working spaces. Air intakes located at ground level or adjacent to vehicles or other combustion sources can transport contaminants to areas served by the air handling system. Furnaces are also important sources of carbon monoxide in indoor environments.

2.3 TEMPERATURE (TEMP) & RELATIVE HUMIDITY (RH)

Levels of temperature together with relative humidity typically have the most impact on comfort in non-industrial environments. Temperatures are influenced by the number of occupants as well as computers and other operating equipment. As a rule, low levels of relative humidity (below 25%) are associated with the most complaints about the quality of indoor air, when occupants complain of dry eyes and irritated nose and throat, which may cause sore throats and nosebleeds. Dry air also creates static electricity which may hinder the operation of office equipment and shocks the individual when touched. High humidity levels (above 60%) cause the air to feel clammy and sweat does not easily evaporate from the skin, causing discomfort. Structural damage may also result from extended periods of high humidity.

2.4 TOTAL VOLATILE ORGANIC COMPOUNDS (TVOC_s)

Total volatile organic compounds (TVOCs) are generally considered to be organic compounds that have boiling points roughly in the range of 50 to 250°C. There are several thousand chemicals, synthetic and natural, that can be called TVOCs. Of these, over 900 have been identified in indoor air, with over 250 recorded at concentrations higher than 0.001 ppm. Identification and measurement of individual VOCs are expensive and time-consuming, and invariably the total is underestimated because the VOCs present at very low concentrations are difficult to identify and measure. The concept of *total* volatile organic compounds was therefore developed to deal with this situation.

2.5 TOTAL SUSPENDED PARTICULATES (TSP)

Total suspended particulates are solid or liquid particles in air. Common solid particulates include dust, fumes, smoke, and bioaerosols such as viruses, pollen grains, bacteria, and fungal spores. Sources of indoor particles are primarily from the infiltration of outdoor air. Secondary sources are from within the indoor environment, including work activities (i.e., paper handling, filing, etc.), housekeeping and retrofit activities. The mechanical ventilation system itself may be a source of particles (humidifier additives, scale, rust, biological growth, disinfectants, duct and pipe insulation).

2.6 MOULD

Moulds are found everywhere in the natural environment. Thousands of species of mould have been identified and they are adapted to a wide variety of environmental conditions. Like every living organism, they only require food and water to grow. While mould growth is encouraged by warm and humid conditions, many moulds may also grow in cold temperatures. Each one of us is exposed to several varieties and concentrations of mould spores daily in the air we breathe.

The health impacts associated with mould remain under study and there are no health-based standards of exposure available. The scientific community agrees that living or working in an environment where mould amplification is present results in increased risk of respiratory illness. Individuals considered susceptible to mould include infants and small children, the elderly and those who are immuno-suppressed.

As there is no practical way to eliminate the presence of mould spores in the environment, prevention of wet conditions in indoor environments and remediation of any water or mould-impacted materials / structures is the current emphasis. The growth of mould in indoor environments is typically due to a moisture problem relating to the building envelope or mechanical system deficiencies. The way to control mould is to control moisture.

Fungal (mould) investigations are generally based on recommendations provided in various guidance documents, including but not limited to:

- “Mould Guidelines for the Canadian Construction Industry”. Canadian Construction Association, 2004;
- “Recognition, Evaluation and Control of Indoor Mould”. American Industrial Hygiene Association, 2008;
- “Bioaerosols: Assessment and Control”. American Conference of Governmental Industrial Hygienists (ACGIH), 1999; and
- “Fungal Contamination in Public Buildings: A Guide to Recognition and Management”, Federal-Provincial Committee on Environmental and Occupational Health, 2004.

2.7 SUMMARY OF INDOOR AIR QUALITY STANDARDS

Table 1 Indoor Air Quality Standards

Parameter	Health Canada
Carbon dioxide (CO ₂)	1,100 ppm
Carbon monoxide (CO)	9 ppm (5.0 ppm Action ^A)
Temperature (Temp)	20.5-25.5°C (winter months)
Relative humidity (RH)	25-60%
Total Volatile Organic Compounds (TVOC)	0.4 ppm; 2.2 ppm Action ^A)
Particulates (TSP)	0.5 mg/m ³
Mould	Prevention of conditions suitable for mould growth and remediation of impacted areas

Notes:

^A Action refers to the trigger concentration meaning “take note” and “investigate”.

3.0 Methods

3.1 INTERVIEWS & QUESTIONNAIRES

The principal elements involved in information gathering were an interview and questionnaire process intended to invite comments and questions regarding health concerns related to odour issues from affected staff.

Stantec was on site on January 17 and January 24, 2012 to interview staff and administer the questionnaire. The process was strictly confidential and voluntary.

Interviews with interested employees were conducted in a private office over the 2-day site visit. The average time interval for each interview was approximately 20 minutes. A copy of the questionnaire is included in Appendix A.

3.2 INDOOR AIR QUALITY

Key indicators of indoor air quality in HCMS were assessed by Stantec on January 24, 2012. TVOCs as a measure of odour were also assessed on March 12-13 and March 16, 2012 during Spring Break when the roof replacement was taking place.

Selected chemical parameters were assessed using direct-reading instruments, as described in Table 2. Spot measurements of these chemical parameters (*i.e.*, point in time concentrations) were collected at various locations within HCMS at different times during the day. The instruments were calibrated in accordance with the manufacturer's specifications. Calibration records are retained on file at Stantec.

Table 2 Air Sampling Instruments

Chemical Parameter	Instrument	Serial Number
Carbon dioxide, carbon monoxide, temperature, relative humidity	QTrak (TSI)	P11300002
Total Volatile Organic Compounds	ppbRAE (RAE Systems)	250-100623
Total Suspended Particulate	DustTrak (TSI)s	85201428

3.3 BUILDING ASSESSMENT

Stantec conducted a visual assessment of readily accessible areas in HCMS on February 8, 2012. The objective was to check for issues related to the integrity of the building envelope, with attention to signs of water staining/damage, areas of possible water and moisture intrusion, and any areas of staining suggesting apparent mould growth.

Based on the findings of the visual assessment, intrusive assessments were recommended in selected locations. The intrusive assessment was conducted on March 13, 2012 during Spring Break, scheduled to take place when the school roof was being replaced. The intrusive assessment consisted of cutting exploratory holes in wall cavities (10 cm x 10 cm) to facilitate

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

visual assessment of concealed building materials to evaluate the presence of water intrusion or damage.

Bulk samples of building materials with visually apparent water damage or staining were collected during the intrusive investigation and submitted to Mycotaxon Consulting Ltd. in Halifax, Nova Scotia for analysis. Mycotaxon Consulting Ltd. is recognized for mold analysis by Public Works and Government Services Canada (PWGSC) and has an Environmental Microbiology Proficiency Analytical Testing (EMPAT) Reference Mycologist on staff.

Limitations: The information and observations contained within this report are based on visual assessments of the readily-accessible interior surfaces of the building (i.e., walls, ceilings, and floors) and in ceiling and wall cavities where intrusive assessments were conducted. The visual assessment of the wall and ceiling cavities is limited to the area made accessible through the installation of exploratory holes by removing building products, typically an area of 15 cm diameter. Information obtained during the investigation may not be extrapolated to areas of the building not assessed during the investigation.

4.0 Results

4.1 INTERVIEWS & QUESTIONNAIRES

A total of 20 staff members were interviewed for this study. Of these individuals, only 2 indicated that they had not experienced any symptoms of ill health. The incidence of reported symptoms and the onset of these symptoms are summarized in Table 3.

Table 3 Symptom Responses - Interviews

Symptom	Symptom Onset				Total
	March 2011	Fall 2011	Early 2012	Unspecified	
Headache	2	4	4	2	12
Sinus (dry, irritated, congested)	2	4	1	2	9
Throat (sore, dry, itchy)	2	3	3	1	9
Eyes (burning, watering, itchy, blurred)	2	1	4	1	8
Mouth/lips/tongue (burn, tingle, swelling)	1	1	5	1	8
Nose bleeds	--	1	5	--	6
Ears (discomfort, congested)	2	--	2	--	4
Skin (itchy, rash, swelling)	1	1	1	--	3
Nausea	--	--	1	--	1
Dizziness	1	--	--	--	1
Cough	1	--	--	--	1
Fatigue	--	--	1	--	1
Vocal changes	--	1	--	--	1
TOTAL	14	16	27	7	64

A total of 9 questionnaires were completed by staff members who had participated in the interviews. Their symptoms are reported below in Table 4.

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 4 Symptom Responses - Questionnaires

Symptom	Symptom Onset				Total
	March 2011	Fall 2011	Early 2012	Unspecified	
Headache	2	2	1	--	5
Sinus (dry, irritated, congested)	1	2	--	--	3
Throat (sore, dry, itchy)	2	3	2	--	7
Eyes (burning, watering, itchy, blurred)	2	--	2	1	5
Mouth/lips/tongue (burn, tingle, swelling)	1	1		--	2
Nose bleeds	1	1	1	--	3
Ears (discomfort, congested)	--	--	--	--	--
Skin (itchy, rash, swelling)	--	--	--	--	--
Nausea	--	--	--	--	--
Dizziness	1	--	--	--	1
Cough	1	--	--	--	1
Fatigue	1	--	--	--	1
Vocal changes	--	--	--	--	--
TOTAL	12	9	6	1	28

A total of 18 staff diaries chronicling dates when staff members experienced symptoms of ill health or discomfort were provided to Stantec for review. The symptoms are summarized in Table 5.

Table 5 Symptom Responses – staff diaries

Symptom	Symptom Onset				Total
	March 2011	Fall 2011	Early 2012	Unspecified	
Headache	5	4	4	Note: Dates specified within diaries	13
Sinus (dry, irritated, congested)	6	3	--		9
Throat (sore, dry, itchy)	7	3	4		14
Eyes (burning, watering, itchy, blurred)	2	4	6		12
Mouth/lips/tongue (burn, tingle, swelling)	3	2	6		11
Nose bleeds	1	1	1		3
Ears (discomfort, congested)	2	1	1		4
Skin (itchy, rash, swelling)	3	3	1		7
Nausea	2	--	--		2
Dizziness	2	--	--		2
Cough	4	--	--		4
Fatigue	--	--	--		--
Vocal changes	1	--	--		1
Shortness of breath	1	--	--		--
Irritability	1	--	--		--
TOTAL	40	21	23		82

The offensive odours described by the staff members in the interviews, questionnaires and staff diaries can be described as either resembling “mould”, “chemicals” or “sewer gas” based on the following descriptors which are grouped based on their similar character:

- Mouldy, damp mop, old basement, musty, stale – typically noticed in the stairwell next to the Gym and at the top of the stairs, emanating into the second floor hallway and adjacent classrooms

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

- Chemical, solvent, paint – found in and around the Staff Room and some classrooms (notably Room 216) and hallways
- Sewer, sulfur, soil, rotten, rotting oranges – found in the OPP area, washrooms and some classrooms

Each of these odours has been reported periodically in the school since March 2011. Since recent plumbing repair work, the sewer gas odour has reportedly diminished, particularly in the OPP area.

4.2 INDOOR AIR QUALITY

The spot measurement results in HCMS collected on January 24, 2012 are summarized in Table 6. Since the school does not have a mechanical ventilation system, open windows serve as the primary source of fresh air.

Table 6 Spot Measurements - Indoor Air Quality Testing, HCMS, January 24, 2012

Location	CO ₂ [ppm]		CO [ppm]		Temp [°C]		RH [%]		TVOCs [ppm]		TSP [mg/m ³]		Window Open
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	#
10:20 AM													
Rm 146	361	--	0.5	--	19.4	--	20.4	--	0.000		0.003	--	--
Rm 220	678	--	0.2	--	19.8	--	37.1	--	0.000	Re-zero at 11AM	0.013	--	1
Rm 263	580	--	0.0	--	20.7	--	34.0	--	0.000		0.007	--	--
Rm Lab	575	--	0.1	--	20.8	--	34.5	--	0.000		0.008	--	--
Rm 101 Café	430	--	0.6	--	20.3	--	46.6	--	0.000		0.007	--	--
Lunch break													
Rm 211	787	--	0.0	--	21.0	--	41.1	--	0.044	--	0.006	--	--
Rm 218	860	--	0.3	--	21.3	--	38.5	--	0.127	--	0.035	--	--
Rm 216	587	--	0.2	--	20.8	--	40.4	--	0.010	--	0.006	--	2
Rm 213	625	--	0.3	--	20.4	--	40.1	--	0.024	--	0.016	--	--
Office	854	--	0.3	--	21.7	--	36.3	--	0.161	--	0.011	--	--
Rm 130 Gym office	550	--	0.7	--	20.8	--	34.3	--	0.044	--	0.024	--	--
After school													
OPP Class	--	1090	--	0.3	--	21.5	--	42.9	--	0.003	--	0.018	--
Rm 220	--	1598	--	0.3	--	21.2	--	50.2	--	0.073	--	0.083	1
Rm 217	--	1166	--	0.2	--	20.5	--	49.9	--	0.099	--	0.028	4
Rm 215	--	1191	--	0.1	--	21.2	--	47.8	--	0.071	--	0.023	1
Rm 216	--	974	--	0.3	--	21.3	--	49.1	--	0.037	--	0.015	2
Rm 214	--	1115	--	0.3	--	21.8	--	46.2	--	0.050	--	0.017	1
Rm 208 Staff	--	1006	--	0.3	--	21.8	--	24.4	--	0.050	--	0.017	--
Rm 209 Girls	--	885	--	0.1	--	21.8	--	46.8	--	0.026	--	0.021	--
Rm 206 Boys	--	856	--	0.3	--	21.7	--	47.0	--	0.021	--	0.013	--
Rm 203	--	882	--	0.1	--	21.9	--	46.5	--	0.017	--	0.033	1
Rm 200	--	759	--	0.3	--	21.9	--	45.1	--	0.007	--	0.022	1
Rm 201	--	837	--	0.3	--	21.9	--	46.2	--	0.011	--	0.009	1

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 6 Spot Measurements - Indoor Air Quality Testing, HMCS, January 24, 2012

Location	CO ₂ [ppm]		CO [ppm]		Temp [°C]		RH [%]		TVOCs [ppm]		TSP [mg/m ³]		Window Open #
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
Principal wash	--	663	--	0.0	--	21.0	--	38.5	--	0.013	--	0.003	--
Principal office	--	670	--	0.2	--	21.1	--	37.9	--	0.025	--	0.007	--
Rm 100	--	847	--	0.6	--	21.1	--	45.7	--	0.093	--	0.012	0
Rm 102	--	825	--	0.3	--	21.7	--	42.7	--	0.016	--	0.011	0
Rm 105 Boys	--	729	--	0.3	--	21.2	--	43.0	--	0.010	--	0.009	1
Rm 109 Girls	--	670	--	0.4	--	21.1	--	43.5	--	0.017	--	0.010	1
Rm 111 Gym	--	462	--	0.3	--	20.9	--	40.8	--	0.005	--	0.005	--
Rm 116	--	911	--	0.2	--	21.0	--	41.9	--	0.014	--	0.009	0
Rm 118	--	583	--	0.2	--	20.9	--	40.9	--	0.001	--	0.019	0
Rm 120 Lab	--	789	--	0.4	--	21.2	--	38.1	--	0.016	--	0.014	0
Rm 121 Fitness	--	1490	--	0.6	--	21.0	--	55.2	--	0.045	--	0.026	0
Outdoors	--	345	--	1.2	--	--	--	--	--	--	--	--	--
<i>Average</i>	<i>626</i>	<i>913</i>	<i>0.3</i>	<i>0.3</i>	<i>20.6</i>	<i>21.3</i>	<i>36.7</i>	<i>43.9</i>	<i>0.037</i>	<i>0.031</i>	<i>0.012</i>	<i>0.018</i>	<i>--</i>
Standard	1100		9.0 (5.0)		20.5-25.5		25-60		0.4 (2.2)		0.05		2

Stantec was on site on March 12-13 and March 16 to collect spot measurements of TVOCs concentrations while the roof replacement was underway. The results are summarized in Table 7.

Table 7 Spot Measurements – TVOCs during Roof Replacement, HMCS Mar 12-16, 2012

Time	Location	Concentration [ppm]	Conditions
March 12, 2012			
10:05AM	Roof top	0.000	• Upwind and downwind of new roof
		1.263-1.760	• Inside bucket of Tremco Burmastic Adhesive
		0.080-0.090	• 6 inches above Tremco bucket
		0.000	• 24 inches from Tremco bucket
10:35AM		5.426	• Chain saw operating; back to 0 ppm when activity stopped
	Outside Rm 204	0.197	• Ongoing cleaning by janitors in this area
	Rm 201	0.148	
	Rm 200	0.385-0.410	• Area near where roof replacement is taking place • Painting ongoing in Rooms 200-203
	Rm 203	0.000	• No roof work; some wall painting ongoing
	Rm 200	0.114-0.133	• Open windows
	Above t-bar ceiling in hall	0.233	
	Rm 217, 218, 220	0.000	
	Rm 212	0.086-0.099	• Photocopy area
11:48AM	Rm 200	0.085-0.110	• Open windows
12:00PM	Rm 200	0.060-0.140	• Close window
12:10PM	Roof top	1.601	• Next to adhesive on roof, approx. 4 inches from adhesive
		1.000-1.240	• Adhesive applied last Thursday
		0-0.240	• Around work area
		0.240-2.607	• 3 inches from wet edge of work area

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Time	Location	Concentration [ppm]	Conditions
		0.000-0.145	• 8 inches from wet edge of work area
1:06PM	Rm 200	0.000	• Window open for over an hour
	Hall outside Rm 204	0.093	
	Rm 203	0.080-0.089	• Open windows
	Rm 201	0.184-0.200	• No windows open
	Rm 204 Lab	0.000	• No door or windows open today
	Rear parking lot, outdoors	0.000	• Can detect odour of roofing material
1:25PM	Roof top	1.103	• 3 inches from wet edge of work area
		0.946-1.466	• 8 inches from wet edge of work area
		0-0.015	• 15 inches from wet edge of work area
		3.282	• Around new roof, second layer, 4 feet from surface
2:09PM		1.346-4.286	• Wind picking up, on new roof
3:10PM	Rm 200	0.394-0.419	• Windows closed
	Rm 201	0.225	• Windows closed
	Rm 203	0.140	• Windows closed
March 13, 2012			
6:45AM	2 nd FI Hall below new roof, Rooms 200, 201, 204	0.000	
	Hall outside Rm 206-207	0.702	• Girls and boys washrooms
	Rm 206	0.720	
	Rm 207	1.112	
6:55AM	Rm 200	0.057-0.092	• Door and windows closed overnight
	Rm 201	0.752	• Door and windows closed overnight • Can detect odour of roofing material
	Rm 203	2.657	• Door and windows closed overnight • Can detect odour of roofing material
	Lab	0.000	• Door and windows closed overnight
	Rm 206	0.017	• Door and windows closed overnight
	Janitors Closet Pipe Chase	1.000-12.000	• Highest level recorded where vent pipe goes through roof
11:00AM	Rm 200	0.000	• Door and windows closed
	Rm 201	0.381	• Door and windows closed • Roof work above classroom, tar leaking from new roof
	2 nd FI Hall	0.000	
	Rm 203	1.207	• Roof work above classroom
	Rm 204	0.224	• Door and windows closed
	Hall outside Janitor's Closet, Rm 207	0.238	
	Boys Washroom	0.270	
	Janitors Room 207 next to open pipe chase area	0.530	
	Girls Washroom	0.263	
	Washroom 206	0.233	
	Rm 211, 213, 214, 215, 216, 217, 218, 200 & Hall	0.000	
	Rm 100	0.106-0.472	
12:45PM	1 st Floor	0.000	• Hallway, Gym, Main Office, Workout Room and some classrooms
2:15PM	Rm 200, 201, 203	0.000	• In Rm 203, can smell roof odour next to open window
	Boys washroom	0.007	
	Rm 207 Janitor Closet	0.480-0.618	
	Inside Pipe Chase	1.200	

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Time	Location	Concentration [ppm]	Conditions
	Girls washroom	0.006	
	2 nd FI Hall	0-0.165	
	Rm 204, 206	0.000	
March 16, 2012			
8:00AM	1 st FI Hall	0.000	
	Rm 140	0.000	• Kitchen breakfast program
	Rm 142	0.000	
	Rm 147, Wood Shop	0.000	
	Rm 119, 121	0.000	• Odour from rubber mats
	Rm 113, Janitors Rm	0.000	
	Rm 118	0.000	
	2 nd FI Hall	0.000	
	Hall outside Rm 207, Janitors Closet	0-0.089	
	Inside Janitors Closet Rm 207	0.066	• Odour of wax remover and acetone; somewhat musty
	Inside pipe chase	0.245	
	Rm 200	0.000	
	Rm 201	0.129	• Same odour as area in Rm 207, Janitors Closet
	Rm 203	0.199	• Same odour as area in Rm 207, Janitors Closet
	Rm 204	0.000	
	Rm 211, 213, 215, 217	0.000	
	Rm 214, 216, 218, 220	0.000	
9:10AM	Rm 203	0.078	
	Rm 201	0.008	
	Staff/Copy room	0.000	
	Rm 200	0.000	
	Boys/Girls Washrooms	0.000	
	Roof top, fan discharge point	1.563	• Plumbers in Boys Washroom on 1 st Floor, using ABS Cement
	Plumbing vent stack	0.000	
	Gym roof exhaust fan discharge	0.000	
	1 st FI Boys Washroom	4.691	• ABS Cement applied by plumbers
11:35AM	2 nd FI, Hall outside Rm 217	0.000	
	2 nd FI Girls Washroom	0.001-0.025	
	2 nd FI Boys Washroom	0.000	
	Rm 203	0.052	
	Rm 201	0.020	
	Rm 200	0.011	
1:39PM	Hall outside Rm 207	0.000	
	Rm 200, 201, 202, 203	0.000	
	Rm 207 Janitors Closet	0.173	
	Standard	0.4 (2.2)	--

4.3 BUILDING ASSESSMENT

4.3.1 Visual Assessment

The subject building is a detached structure with two (2) storeys and no basement. The roof is flat. The walls are constructed of concrete brick under metal siding. The building was reportedly constructed in 1966.

The interior wall surfaces of the building are only partially finished with drywall. The exterior walls on the front side of the building are finished with drywall and the exterior walls on the back side of the building are not.

Other interior finishes include vinyl tiled flooring and metal Q-deck ceilings, only some of which are finished with drywall.

The subject building has a history of water intrusion, including leaking roof, sewer pipes and windows over several years. Reported renovations on the building include new siding in 2002; new windows in late 1990's; partial roof replacement in March 2011; and the planned completion of roof replacement by March 31, 2012.

The results of the visual assessment of the school conducted by Stantec on February 8, 2012 are detailed below in Table 8.

Table 8 Visual Assessment, HCMS, February 8, 2012

Room	Construction	Issues	Actions
Rm 204 Chemistry Lab	Interior walls - concrete block Exterior wall -drywall Ceiling -drywall Floor - 9x9 vinyl tiles	<ul style="list-style-type: none"> Water damage to window sill 4'x12"; paint peeling/blistering; staining on ceiling above window sill 8"x4" Moisture meter (MM) <7% on window sill, wall and below damaged sill Water damage – dark staining on wall and where wall and ceiling meet; 40 ft2 of damage (exterior wall); MM <7% RH – 21%; Temp – 21.6C 	Intrusive
Rm 211	Walls – concrete block Ceiling – metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> Previous reports of musty odour Water leaks repeated from windows and roof; leaks now repaired Exterior wall has cracks in mortar around concrete blocks, no water staining noted Paint peeling in several different areas on ceiling (metal); new roof area 	Intrusive
Rm 213	Walls – concrete block Ceiling – metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> Where new and old roof meet the classroom, there had been water issues but not currently Crack in wall corner; no staining noted 	
Rm 216	Exterior walls – drywall Interior walls – concrete block Ceiling metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> Water damage on window sill RH – 22.2%; Temp – 21.7C 	Intrusive
Rm 218	Exterior walls – drywall	<ul style="list-style-type: none"> Window sill – paint peeling, bubbling, some dark staining 	Intrusive

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 8 Visual Assessment, HCMS, February 8, 2012

Room	Construction	Issues	Actions
	Interior walls – concrete block Ceiling metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • MM <7% • Where ceiling and wall meet, can see roofing material; rusty beam apparent; to be fixed and painted (ongoing work) 	
Rm 220	Exterior walls – drywall Interior walls – concrete block Ceiling metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • Roof leaking in one spot; some black staining on drywall above windows • RH – 21.5%; Temp – 21.5C 	Intrusive
Rm 217	Walls – concrete block Ceiling – metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • Water damage to window sill; small amount of black staining on window sill 	Intrusive
	Ceiling space in main hallway	<ul style="list-style-type: none"> • Nothing noted 	
South stairwell, second floor		<ul style="list-style-type: none"> • Possible to see outdoors from inside of hallway; potential for water intrusion through this route • Ceiling tiles have been replaced in the last year; exterior wall painted; water damage repaired 	
Rm 214	Exterior walls – drywall Interior walls – concrete block Ceiling metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • Paint peeling from metal ceiling; small amount paint peeling on window sill 	
Staff Room		<ul style="list-style-type: none"> • Nothing noted 	
North hall, 1 st Floor		<ul style="list-style-type: none"> • Nothing noted 	
Rm 206	Exterior walls – drywall Interior walls – concrete block Ceiling metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • Water damaged window sill; some paint peeling from ceiling; 2 samples of impacted drywall from below sill taken last June, negative results 	Intrusive
Boys		<ul style="list-style-type: none"> • Rust on window; paint peeling on concrete block above window • Roof repair 2011 fixed water leaks 	
Rm 203	Walls – concrete block Ceiling – metal decking Floor – vinyl tiles	<ul style="list-style-type: none"> • Roof repair 2011 fixed water leaks • Nothing noted • RH – 18.4%; Temp – 21.5C 	
Rm 201		<ul style="list-style-type: none"> • Sink in lab not used much; run water once weekly to ensure trap full • Paint peeling on metal ceiling • Some concrete mortar joints cracked on exterior wall; no staining noted 	
Rm 200	Exterior walls – drywall Interior walls – concrete block Floor – vinyl tiles	<ul style="list-style-type: none"> • Science storage room of Rm 202 • Nothing noted 	
	North end stairwell second floor	<ul style="list-style-type: none"> • Six (6) water staining ceiling tiles • No reported leaks lately 	
Rm 100	Exterior walls – drywall Interior walls – concrete block Ceiling - drywall Floor – vinyl tiles	<ul style="list-style-type: none"> • Bad odours previously; leaking pipe from second floor repaired • Nothing noted • RH – 17.3%; Temp – 20.7C 	Intrusive

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 8 Visual Assessment, HCMS, February 8, 2012

Room	Construction	Issues	Actions
Café		<ul style="list-style-type: none"> Nothing noted 	
North end hallway, 1 st Floor		<ul style="list-style-type: none"> Recycled garbage station; made of wood and needs to be made of material that can be more easily cleaned Above T-bar ceiling, nothing noted 	
Rm 102 Library	Exterior walls – drywall Interior walls – concrete block Floor – vinyl tiles	<ul style="list-style-type: none"> Paint peeling on window sill No reported problems 	
Boys		<ul style="list-style-type: none"> Nothing noted Antifreeze added to floor drains; evaporates at a slower rate than water 	
Rm 103 Kitchen		<ul style="list-style-type: none"> Nothing noted 	
Rm 104		<ul style="list-style-type: none"> Previous odour resolved when lab plumbing removed Nothing noted 	
Principal Office		<ul style="list-style-type: none"> Nothing noted 	
Main office 108		<ul style="list-style-type: none"> Nothing noted RH – 17.5%; Temp 21.6C 	Intrusive
VP office		<ul style="list-style-type: none"> One (1) stained ceiling tile 	
Gym	Walls – concrete block Ceiling – metal Floors – vinyl tiles	<ul style="list-style-type: none"> Reported odours in gym; now that ceiling fan is now on “low” setting, no more odour Several stained ceiling tiles 	Intrusive
Old Boys Locker Rm		<ul style="list-style-type: none"> No longer used; should be removed Toilet has dirty, smelly water inside Many drains that could dry up unless maintained 	
New Boys Locker Rm		<ul style="list-style-type: none"> Several water stained ceiling tiles 	
Rm 116		<ul style="list-style-type: none"> Nothing noted 	
Rm 118	Exterior walls – drywall Interior walls – concrete block Ceiling – drywall/stucco	<ul style="list-style-type: none"> Nothing noted 	
Rm 113		<ul style="list-style-type: none"> Old kitchen, now Janitor’s Rm Chemical storage; no exhaust fan Location where battery operated cleaning unit recharged 	Ventilation required
Rm 120		<ul style="list-style-type: none"> Nothing noted 	
Rm 122 Music Rm		<ul style="list-style-type: none"> Nothing noted 	
Rm 121		<ul style="list-style-type: none"> Workout room Strong odour from floor mats 	
Rm 119		<ul style="list-style-type: none"> Nothing noted 	
Rm 115		<ul style="list-style-type: none"> Nothing noted 	
Rm 117		<ul style="list-style-type: none"> Old washroom Nothing noted 	
Rm 140 OPP Rm	Walls – drywall Ceiling – drywall/stucco Floor – tiles	<ul style="list-style-type: none"> Plumbing issue repaired; no more reported odours RH 14.2%; Temp 20.7C 	
Rm 141		<ul style="list-style-type: none"> Nothing noted 	
Rm 142		<ul style="list-style-type: none"> Large cardboard box with dark staining 	Ensure materials brought into school are

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 8 Visual Assessment, HCMS, February 8, 2012

Room	Construction	Issues	Actions
			not damp or mould impacted
Rm 144-5		<ul style="list-style-type: none"> Exhaust fan on Stained ceiling tiles 	
Rm 146		<ul style="list-style-type: none"> Nothing noted 	
Rm 174 Wood shop		<ul style="list-style-type: none"> Exhaust fans turned out; ductwork not cleaned; possibility of wood dust in system Some black staining on wall below work bench next to drill press, exterior wall 	Intrusive test

4.3.2 Intrusive Assessment

Stantec was on site on March 13, 2012 to conduct an intrusive assessment of areas of concern previously identified in the visual assessment performed on February 8, 2012. The results are detailed in Table 9.

Table 9 Intrusive Assessment, HCMS, March 13, 2012

Room	Issues	Lab Results*	Actions
Rm 204, Lab	<ul style="list-style-type: none"> Intrusive Hole (IH) #1 – Exterior wall, hole cut next to west set of windows 16'5" from west interior wall, 40" from floor. Black staining noted on back of drywall paper; more black staining noted on drywall paper inside intrusive hole. Bulk sample material (BSM) #1 – Piece of drywall paper on the back of piece cut out from IH#1, black staining apparent mould. 	<u>BSM#1</u> Active growth <i>Stachybrotrys</i> sp. colonies	<ul style="list-style-type: none"> Remove and replace exterior wall above window sill to ceiling, checking for water damage or staining in ceiling above when cavity fully exposed.
Rm 206, Classroom	<ul style="list-style-type: none"> IH#2 – Exterior wall, cut hole in window ledge with water damaged drywall. Hole approx. 8'11" from Rm 204, black staining on back of drywall paper. BSM#2 – Piece of drywall paper with black staining taken from IH#2. 	<u>BSM#2</u> Active growth <i>Stachybrotrys</i> sp. Colonies <i>Acremonium</i> sp. Colonies	<ul style="list-style-type: none"> Remove and repair exterior wall from at least 2 ft. around water damaged area in vicinity of window sills.
Rm 218, Classroom	<ul style="list-style-type: none"> IH#3 – Exterior wall, between windows, 15'8" from Rm 216, nothing noted. 		
Rm 220, Classroom	<ul style="list-style-type: none"> IH#4 – Exterior wall, hole through drywall, nothing noted. Noted roof leaking close to interior wall concrete block wall, metal ceiling. 		
Rm 217, Classroom	<ul style="list-style-type: none"> Roof observed to be leaking BSM#3 – Paint from below window exterior wall, area where paint peeling/lifting. 	<u>BSM#3</u> Growth inapparent	<ul style="list-style-type: none"> Ensure roof is no longer leaking in this area.
Rm 100	<ul style="list-style-type: none"> IH#5 – Hole cut in water damaged window sill, approx. 15' from back exterior wall; nothing noted. 		
Gym area next to Rm 134/132	<ul style="list-style-type: none"> BSM#4 – Piece of wood taken from the front 2"x4" framing; water damaged/stained. BSM#5 – Pipe insulation covering water stained material. 4-5 water stained ceiling tiles noted in this area. Ceiling pipe chase. 	<u>BSM#4</u> Growth inapparent <u>BWM#5</u> Growth inapparent	<ul style="list-style-type: none"> Replace stained ceiling tiles.

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

Table 9 Intrusive Assessment, HCMS, March 13, 2012

Room	Issues	Lab Results*	Actions
Rm 147, Wood Shop	<ul style="list-style-type: none"> • IH#6 – Interior wall corner with exterior wall main shop, NE corner; some water damage to 2" bottom plate. • IH#7 – Exterior wall next to IH#6, water damage to exterior of drywall, black staining noted; inside hole, black staining and water damaged wood and drywall. • BSM#6 – Piece of drywall paper next to IH#7, black staining. 	<u>BSM#6</u> Active growth <i>Stachybotrys</i> sp. Colonies	<ul style="list-style-type: none"> • Remove and repair exterior wall from at least 2 ft. around water damaged area in vicinity of window sills.
Janitor's Closet	<ul style="list-style-type: none"> • Access hatch to pipe chase for washrooms. When opened, elevated TVOCs readings (1000-12,000 ppm), with highest readings where the vent pipe goes through the roof. Daylight above could be seen. Ivan noted that changes have been made to the area where the vent pipe travels through the roof; roof edge has been raised. 		

* Note: Consult Appendix B for a copy of the laboratory report.

5.0 Discussion

Indoor air quality has become an important occupational health and safety issue in the non-industrial workplace. Individuals often report symptoms of ill health that develop over the course of the day, however, it is difficult to link many of these symptoms to a specific source or chemical contaminant.

Occupational exposure limits for individual chemical compounds are established to protect the health of workers in *all types* of work environments and such limits are referenced in occupational health and safety legislation. An additional element of comfort is expected by workers in non-industrial environments, for which indoor air quality guideline values have been developed. These guidelines for comfort are significantly more stringent than health-based standards.

Unusual or unexplained odours often trigger alarm in non-industrial settings. The sense of smell can be an important indicator of something different or wrong in any given situation. Until the source of odour is found, occupants will continue to wonder and worry about what it is and its effects on their health. However, it is very difficult to assess odour using existing technology. There is no instrument that is as *sensitive* or *specific* as the human nose. The odour threshold of a given chemical substance or chemical mixture may be well below the detection capability of an instrument. And just because a chemical can be detected does not mean it is present at hazardous levels. For example, the rotten eggs odour associated with hydrogen sulfide can be detected at levels of 0.0005 ppm and the current occupational exposure limit (TLV-TWA) for hydrogen sulfide is 1 ppm. On the other hand, the odour threshold for formaldehyde is very nearly the same value as the regulated limit of 1 ppm.

5.1 INTERVIEWS & QUESTIONNAIRES

Of the 20 interviews conducted with interested staff, 9 completed a questionnaire. A total of 18 staff diaries were also completed and submitted for review. Given that there were reportedly up to 25 individuals in HCMS eligible to offer comments at the time of the survey, this response rate that ranges between 36%-80% is optimal. A 30% response rate is considered acceptable for voluntary enrolment in epidemiological studies.

Symptoms of illness and discomfort reported in a non-industrial environment may be related to a host of factors other than air contamination as such. Elevated carbon dioxide levels may produce headaches, drowsiness and the feeling the air is “stuffy” or “dead”. Carbon monoxide may cause headaches and dizziness. Dry air may cause irritated eyes, sore throats and nosebleeds. Volatile organic compounds are often linked to odours. Airborne particulate may contribute to allergies. Ergonomics (office design), noise and lighting levels may be also implicated in symptoms of illness. Adding to the complicated mix is the fact that not all people are affected with the same symptoms or to the same extent. Individual sensitivities play a key role in the development of symptoms of ill health.

In each of the 3 reports of symptoms experienced by staff, the top 5 symptoms include the following:

- Headache
- Sinus (dry, irritated, congested)
- Throat (sore, dry, itchy)
- Eyes (burning, watering, itchy, blurred)
- Mouth/lips/tongue (burning, tingling, swelling)

The first 4 symptoms can be regarded as non-specific, where they may be caused by any one of a number of sources. The symptoms associated with the mouth, lips and tongue are unusual, however. These symptoms are also similar to skin problems experienced by some individuals. These symptoms described as burning, tingling, itchiness and swelling point to a more specific causative agent in the environment.

Many of the symptoms of ill health have been reported as occurring in each one of the three time intervals since March 2011. Based on the interview results, the onset of most of the symptoms occurred in early 2012. The results of the questionnaire and staff diaries point to the March 2011 as the time when symptoms were first noticed, however.

5.2 INDOOR AIR QUALITY ASSESSMENT

The results of indoor air quality testing in HCMS are generally acceptable and in accordance with expectation for a school that is not mechanically ventilated. Levels of carbon dioxide outside the range of comfort are expected when windows are the primary source of fresh air in a work space with several occupants at any one time.

Levels of total volatile organic compounds (TVOCs) measured during the roof replacement in March 2012 were generally found to meet the comfort standard of 0.4 ppm with exceptions attributable to the roofing activities taking place at the time. There were only 5 instances where concentrations of TVOCs exceeded the action level of 2.2 ppm, most notably 12 ppm measured in the pipe chase within the Janitors Closet on the second floor of HCMS. The aging cast iron piping with lead joints was believed to be leaking sewer gas. Property Services staff accompanying Stantec at the time of testing made a note to ensure the necessary repairs are made. Most important is the fact that TVOCs had diminished to near negligible levels at the end of week, as roofing activities were nearing completion.

5.3 BUILDING ASSESSMENT

5.3.1 Visual Assessment

In the visual assessment conducted at HCMS on February 8, 2012, the following items were noted by Stantec:

- The school has a history of water intrusion, where the roof, sewer pipes and windows have reportedly leaked over several years. Water damage and staining in some areas of the building were observed, including ceiling tiles and window sills. Water stained or damaged building materials should be replaced to better enable the detection of any new leaks or water sources as part of the ongoing building maintenance program. Some areas where water intrusion was observed were earmarked for further investigation during the intrusive assessment.
- The school reportedly had new siding in approximately 2002, new windows in the late 1990s and a partial roof replacement in March 2011.
- Exhaust fans were recently installed at the copy machines on the first and second floors and the washrooms. An exhaust fan in the Janitors Room where chemicals are stored and batteries are discharged is recommended.
- Sewer lines on the second floor had been replaced in late 2011; the bad odour at one end of the school had since diminished.
- Drains in the unused boys and girls locker rooms below the Gym were considered foul and needing a plan of action to manage them going forward.
- The radiators throughout the school contained apparent dust and debris, which need to be removed.

- The recycling container on the first floor was constructed of wood, where conditions suitable for mould growth were present. A water repelling, non-porous material more conducive to cleaning is a better choice for such a container.
- A damp cardboard box with obvious staining was noted in Room 142. It is important to ensure that materials brought into the school do not introduce contaminants into the environment, such as mould or chemical residues.

5.3.2 Intrusive Assessment

Water intrusion into the building envelope is often the main cause of indoor mould growth. Mould growth may occur in as little as 24 to 48 hours after water damage has occurred.

During the intrusive assessment conducted on March 13, 2012, a total of 7 intrusive holes were cut to access building cavities in areas where water damage or staining had been observed during the earlier visual assessment. Of the 6 bulk samples collected, 3 were positive for mould growth in Classroom 204 (Chemistry Lab), Classroom 206 and Classroom 174 (Wood Shop).

These results indicate that the affected building materials need to be remediated in accordance with appropriate industry standards and guidelines. It is essential to verify that the source(s) of water that contributed to the mould growth has been identified and rectified to prevent a recurrence.

6.0 Conclusions

Based on the findings of the odour investigation at HCMS between January 17 and March 16, 2012, Stantec makes the following conclusions:

- Based on employee feedback derived from interviews, questionnaires and staff diaries, the 5 most frequently reported symptoms include headache, sinus (dry, irritated, congested), throat (sore, dry, itchy), eyes (burning, watering, itchy, blurred) and mouth/lips/tongue (burn, tingle, swelling). The problems related to the mouth/lips/tongue are similar in nature to skin problems reported by some staff members. These symptoms, unlike the others which are more non-specific in nature, tend to point to a more specific causative agent in the environment. An agent has not been identified to date.
- The odours were variously reported as either “mouldy”, “chemical” or “sewer gas” in character.
- The onset of symptoms had been reported on 3 occasions; immediately following the partial roof replacement in March 2011, the start of school in the fall 2011 and following the Christmas break in early 2012.
- Indoor air quality testing on January 24, 2012 indicates that key indicators of indoor air quality were generally within accepted standards. Elevated levels of carbon dioxide are not unexpected in areas that are not mechanically ventilated with multiple occupants.

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

- Results of testing for total volatile organic compounds (TVOCs) during the roof replacement between March 12-16, 2012 indicate that levels were generally found to meet the comfort standard with exceptions attributable to the roofing activities taking place at the time. The highest concentrations of TVOCs were measured in the pipe chase near the Janitors Closet on the second floor, which was believed to be leaking sewer gas. TVOCs levels were found to drop off appreciably throughout the school as the roof construction was nearing completion.
- Water damaged and stained building materials, most commonly ceiling tiles and drywall around windows, were identified in some areas of the school during the visual assessment on February 8, 2012. Intrusive investigation indicated that mould was present in the exterior wall cavity in 3 areas; Classroom 204 (Chemistry Lab), Classroom 206 and Classroom 174 (Wood Shop).
- Radiators throughout the school were found to be dusty and containing debris.
- The recycling bin on the first floor was constructed of wood, which is not a suitable material to prevent mould growth.
- A damp cardboard box with obvious staining was observed in Room 142.

At this time, Stantec is unable to point to a single reason for the symptoms reported by staff members of HCMS. Our findings suggest there are multiple contributing factors to the odours that have been reported. CCRSB has been diligently working to resolve the problems identified in the school to date. It is expected that their attention to these various issues will contribute to an overall improvement in indoor air quality within HCMS.

7.0 Recommendations

Stantec offers the following recommendations as a result of our study:

- Ensure that a minimum of 2 windows remain open in each occupied classroom to minimize the buildup of carbon dioxide.
- Ensure necessary repairs are made to the pipe chase accessible through the Janitors Closet on the second floor.
- Install exhaust fan in Janitors Room where chemicals are stored and batteries recharged.
- Clean dust and debris from radiators throughout the school.
- Develop an action plan to manage drains in unused boys and girls locker rooms beneath the Gym.
- Ensure recycling container is made of water-repellent, non-porous material that can be easily cleaned.
- Exert caution in bringing materials into the school to be sure they do not introduce contaminants into the environment, such as mould or chemical residues.
- Ensure that sources of water intrusion in the building have been identified and corrected.

- Remove and replace identified water damaged building materials, including ceiling tiles.
- Remediate mould-impacted building materials on the exterior walls of Classroom 204 (Chemistry Lab), Classroom 206 and Classroom 174 (Wood Shop) in accordance with appropriate industry standards and guidelines (e.g., Canadian Construction Association). If remediation activities cannot be conducted in the short term, a mitigative plan should be developed and implemented to reduce building occupant exposures to any mould present in the building.

8.0 Closure

This report was prepared for the sole benefit of Chignecto-Central Regional School Board (CCRSB). This report cannot be used by any other person or entity without the express written consent of Stantec Consulting Ltd. and CCRSB.

Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal or medical advice.

The conclusions presented in this report represent the best technical judgment of Stantec Consulting Ltd. based on the data obtained from the work. The conclusions are based on the site conditions encountered by Stantec Consulting Ltd. at the time the work was performed at the specific inspection and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. Due to the nature of the investigation and the limited data available, Stantec Consulting Ltd. cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

Stantec
FINAL REPORT – ODOUR INVESTIGATION
HIGHLAND CONSOLIDATED MIDDLE SCHOOL

We trust that the above is satisfactory for your purposes at this time. Should you have any questions or concerns, or require additional information, please do not hesitate to contact the undersigned at your *convenience*.

Yours sincerely,

STANTEC CONSULTING LTD.

A handwritten signature in blue ink, appearing to read 'Pamela Sears', with a large, stylized flourish at the end.

Pamela Sears, MHSc, BFA, CIH
Industrial Hygienist

V:\1214\active\1214xxxx\121411939 Chignecto School Board IAQ\Report\HCMS Final Report 20April_2012.doc

APPENDIX A
Questionnaire

Date: _____

Indoor Air Quality Questionnaire	
Background Information	
Work Location/Building Area:	Department/Position:
How long have you worked in this area?	
Describe air quality problem(s) in your area:	
Symptoms and Patterns	
<input type="checkbox"/> Headache	<input type="checkbox"/> Shortness of breath
<input type="checkbox"/> Nausea	<input type="checkbox"/> Coughing
<input type="checkbox"/> Dizziness	<input type="checkbox"/> Sneezing
<input type="checkbox"/> Tiredness/fatigue	<input type="checkbox"/> Wheezing
<input type="checkbox"/> Watering eyes	<input type="checkbox"/> Blurred vision
<input type="checkbox"/> Sore throat	<input type="checkbox"/> Sinus congestion
<input type="checkbox"/> Nose bleeds	<input type="checkbox"/> Difficulty concentrating
<input type="checkbox"/> Congestion	<input type="checkbox"/> Shoulder or back pain
<input type="checkbox"/> Vomiting	<input type="checkbox"/> Other (describe):
<input type="checkbox"/> Diarrhea	
Have your co-workers reported similar symptoms? If so, estimate how many.	
Is there any noticeable odour before these symptoms occur? If so, describe:	
When did these problems first occur?	
When do these problems usually occur?	
<input type="checkbox"/> Morning	<input type="checkbox"/> All day?
<input type="checkbox"/> Afternoon?	<input type="checkbox"/> Every day?
<input type="checkbox"/> Specific days of the week _____	<input type="checkbox"/> Specific time of year _____
<input type="checkbox"/> No trend	
Do these symptoms clear up after work?	If so, how long does it take?
Have your symptoms caused you to miss work? (explain)	
Have you sought medical attention for your symptoms? (explain)	
Do you have any allergies or chronic respiratory problem (e.g. asthma, bronchitis)? If so, list:	
Any sensitivities? (e.g. tobacco smoke, perfume) If so, list:	



Indoor Air Quality Questionnaire**Additional information**

Are you satisfied with the air quality in your office on a day to day basis? (comments)

Is your temperature/humidity/air movement comfortable in your work area? (comments)

Can you control temperature/humidity/drafts in your work area? (comments)

Do you have an idea as to what is the cause of symptoms in your workplace?

Can you offer any comments or observations that may be helpful in determining the environmental condition of your workplace.

Thank you for completing this questionnaire. We will use this information to better investigate the problem in your workplace.

If you have any additional comments or questions, please contact:
Pamela Sears, MHSc, BFA, CIH – Stantec Consulting Ltd.
Tel: (902) 468-0415 or (902) 222-2202
Email: psears@stantec.com



APPENDIX B
Laboratory Report

MYCOTAXON CONSULTING LTD.
3 Rockwood Avenue
Halifax, Nova Scotia
Canada B3N 1X4
Phone: 902-475-1456
Fax: 902-475-1982

Ms. Pamela Sears
Stantec Consulting Ltd.
Suite 102
40 Highfield Park Dr.
Dartmouth, N.S.
B3A 0A5

March 20, 2012

Dear Ms. Sears:

Herewith are the results of the microscopic examination of the bulk samples from your project 121411939, which were received by this laboratory on March 15, 2012.

SAMPLE	GENERA
BMS #1 drywall paper	active growth <u>Stachybotrys</u> sp. colonies
BMS #2 drywall paper	active growth <u>Stachybotrys</u> sp. colonies <u>Acremonium</u> sp. colonies
BMS #3 dried paint	growth inapparent
BMS #4 wood chips	growth inapparent
BMS #5 cloth	growth inapparent
BMS #6 gyproc paper	active growth <u>Stachybotrys</u> sp. colonies

I hope this is helpful. If you have any questions concerning this report, please do not hesitate to contact me.

Sincerely yours,
Mycotaxon Consulting Ltd.

Per: Thomas G. Rand, Ph.D. Mycology