REPORT TO

CORPORATE SERVICES, STRATEGIC PLANNING AND PROPERTY COMMITTEE

STATUS UPDATE REGARDING THE COLLECTION OF INTERIOR AIR TEMPERATURES IN NON-AIR-CONDITIONED SCHOOLS (ALL WARDS)

"I can do all things through Him who strengthens me."
Philippians 4:13 (NRSVCE)

Created, Draft	First Tabling	Review
November 27, 2017	December 13, 2017	

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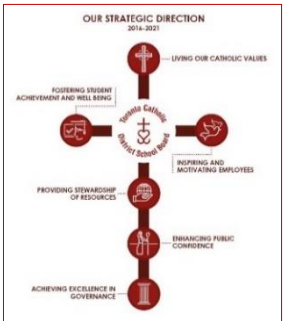
RECOMMENDATION REPORT

Vision:
At Toronto Catholic we transform the world through witness, faith, innovation and action.

Mission:
The Toronto Catholic District School Board is an inclusive learning community uniting home, parish and school and rooted in the love of Christ.
We educate students to grow in grace and knowledge to lead lives of faith, hope and charity.



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A. EXECUTIVE SUMMARY

As per the report approved at the May 2017, Student Achievement and Well Being Committee, this report provides a status update regarding the collection of daily interior air temperatures at twelve (12) sample schools that do not have air-conditioning nor displacement ventilation systems. The report provides indoor air temperature data for one additional school, St. Cyril Elementary School, in Ward 5 for a total of thirteen (13) sample schools.

Temperature collection was undertaken for the months of May, June and September 2017 at the thirteen schools, using electronic temperature and humidity data loggers. This data provides information that will be beneficial for the planning and prioritization of future passive cooling measures and potential funding request to the Ministry of Education. Appendix A provides a summary of the average hourly outdoor temperatures for May, June and September. Appendix B provides the indoor air temperatures collected from the hottest classroom in each of the thirteen schools, between the hours of six am to six pm, for May, June and September.

The cumulative staff time dedicated to developing this report was 250 hours.

B. PURPOSE

1. On March 9, 2017, at the Corporate Services, Strategic Planning and Property Committee, the Board approved the Staff proposal to collect indoor air temperatures at twelve (12) non-air conditioned schools, one per ward, for the months of May, June and September 2017.

2. The purpose of this report is to provide a summary of the resulting findings and to provide options to improve occupant comfort in the existing TCDSB facilities that do not have air conditioning.

C. BACKGROUND

1. There have are been several reports submitted to the Board since 2015 regarding indoor air quality, and specifically the issue of air conditioning in schools. On June 6, 2016, a report regarding *Passive Cooling for Schools without Air-conditioning* was presented at Corporate Services, Strategic

Planning and Property Committee. The Board direction to staff is noted below:

1. *That we consider the strategies outlined in the report and include the following items:*

   a) Increase insulation on all west and south facing walls in our buildings;
   b) Operable windows should have upper operable windows beyond the 100 mm (10 cm) openings);
   c) Install white roofs with solar panels initially to reduce Hydro usage or to run air conditioning;
   d) Investigate green roofs to include native plants or succulents that do not require frequent watering (desert types);

2. *That staff begin collection of day-to-day temperature data in order to prioritize the implementation of passive cooling measures in our schools. Priority for data collection and monitoring to be for those schools without air conditioning, air displacement ventilation.*

2. On May 13, 2017, the Student Achievement and Well Being Catholic Education and Human Resources Committee, approved revisions to the TCDSB Hot Weather Standard Operating Procedure for Schools. Please note, this report had been deferred from the March 2017 Corporate Services Committee. The Board also approved the methodology and selection of twelve (12) sample schools for the purpose of collecting indoor air-temperature data for the months of May, June and September.

3. Interior room temperature is influenced by various factors; exterior temperature and relative humidity, building age, room size and exposure, number of occupants in the space, window type/number and the type of mechanical and ventilation systems provided in the building. Individual occupant comfort is also impacted by an individual's metabolism, activity levels and appropriate clothing. The Board's Hot Weather Standard Operating Procedure, takes this into account and recommends for example, a reduction of physical activities on hot days, as well as other measures to reduce heat stress.

4. The thirteen (13) selected schools represent different building ages, construction types, and in some cases, have partial mechanical ventilation – primarily exhaust of washrooms and storage rooms, as noted in the Table below.

5. In order to facilitate the collection of the space temperature data, a dedicated staff person from the Energy Department visited each of the selected schools and installed a total of 53 temperature and humidity data loggers in all 13 schools. Staff consulted with the Principal, Head Caretaker and representatives of the Catholic Parent School Committee, if available, to select the warmest rooms in the building, The following table provides the list of schools and the number of data loggers.

List of Sample Schools Selected for Temperature Measurements

Ward	School	Bldg. Area (ft^2)	Built Year	Existing Mechanical Ventilation system (full or Partial*)	# of Floors	Number of Temperature Sensors	# of Temp. and Humidity sensors
1	St Benedict	56,069	1966	Partial	4	4	2
2	St Gregory	72,237	1999	Full	3	3	2
3	St Matthew	41,336	1950	Partial	3	3	2
4	St Charles Garnier	37,501	1975	Partial	3	2	1
5	St Charles	37,147	1959	Partial	3	2	2
6	St Clare	65,326	1964	Partial	4	4	2
7	St Kevin	20,335	1965	Partial	2	2	2
8	The Divine Infant	37,512	1986	Partial	1	2	1
9	Holy Rosary	35,725	1921	No	3	3	2
10	St Cecilia	69,965	1914	Partial	3	3	2
11	Notre Dame	68,512	1949	Partial	3	3	2
12	St Barbara	34,627	1965	Partial	2	2	2
5	St Cyril **	26,781	1960	Partial	3	0	2
Totals						33	24

*Note 1: Partial ventilation refers roof top exhaust in washrooms in most cases. Some schools may have interior rooms (no windows) that are mechanically ventilated or there is an addition built after 1990, which has mechanical ventilation but without air-conditioning.

**Note 2: St. Cyril Catholic Elementary School was added to the data collection initiative because the school recently received a new roof, this data will help track the impact of the additional roof insulation on indoor air temperatures.

6. The data loggers are portable battery-powered electronic instruments that are capable of autonomously recording air temperature and/or humidity at set time intervals over a period of time.

7. The Board deployed 33 data loggers of Onset HOBO MX100 and 24 units of Mx1101 capable of recording and transmitting data wirelessly to a nearby mobile phone installed with a HOBO application via Bluetooth technology for this research study. The loggers used have a ±0.5°C accuracy in -5°C to 50°C temperature range and are capable of recording 30,000 measurements in its memory.

8. Hourly temperature and humidity data stored in the memory of data loggers were downloaded to mobile phone on periodic separate data collection visits to the 13 locations. This data was used to prepare frequency charts as detailed in Appendix B to determine length of time the classrooms stayed at different temperature ranges. More descriptions are provided in Appendix B.

D. EVIDENCE/RESEARCH/ANALYSIS

1. The average daily temperature for the months of May, June and September for the past six years, as recorded by Environment Canada and Climate Change (ECCC), is noted below:

Average Temperature (°C)			
Year	**May**	**June**	**September**
2012	18.2	21.6	18.2
2013	13.3	17.5	16.5
2014	12.2	18.3	17.4
2015	13.9	17.0	19.9
2016	12.8	18.4	20.1
2017	14.2	19.2	18.8

2. Appendix A provides a bar graph showing the average **hourly** outside air temperatures for the months of May, June and September 2017.

3. Appendix B provides detailed summary charts regarding the Temperature Range versus Duration (Hourly) for the classroom with the highest indoor air temperature recordings, for each of the sample schools. The total amount of hours, where the classroom temperature was equivalent or higher than 27℃ during the school week, between the 6 am and 6 pm, May, June and September was 516 hours.

4. The Board currently communicates heat stress awareness information as well as City of Toronto Heat Alerts to all schools. Heat Alerts are issued by Toronto Public Health when the forecasted outside air temperatures are equal to or anticipated to exceed 31°C and/or the forecasted humidex is equal or exceeding a level of 40.

5. **Appendices C-1 and C-2** provide a summary list of the number of elementary and secondary schools that have full or partial air conditioning, including schools currently in construction. Approximately 84% of elementary schools do not have air-conditioning. There are 27 secondary schools that have full or partial air-conditioning or partial, which represents 80% of the secondary panel. Currently, 46% of the portable classrooms do not have air-conditioning.

6. Approximately 21% of Toronto District School Board (TDSB) elementary schools have full air-conditioning (equivalent to 125 schools). The TDSB is undertaking a five-year phased plan to install cooling centres in non-air conditioned schools, in gymnasiums. The majority of TDSB gymnasiums have mechanical ventilation systems and the plan is to replace these with new air-handling systems that include air conditioning. By contrast, many TCDSB elementary schools have small gymnasiums (2000 sq. ft.), and the majority do not have existing mechanical ventilation systems. In most cases, it would be costlier to add a new mechanical ventilation system to a larger volume gymnasium space rather than a library – however, this will need to be investigated on a school-by-school basis.

7. School classrooms have above-normal cooling loads requirements (about 600 BTU/occupant plus computers etc.) as compared to residential or office buildings, due to the higher occupant load factor and the larger room spaces. Floor-standing and window-mounted portable air conditioning units are

typically intended for residential use. These units do not have the capacity or power to sufficiently cool an occupied classroom.

8. Installing several portable A/C units per classroom would in most cases, overload the building's electrical service resulting in power outages. In addition, there is a security concern as these units need to be vented to the exterior, through a removable panel that fits within the window. These panels are not secure and may result in break-ins, as well as allowing wind-driven rain into the building. The on-going operational and maintenance requirements to support system-wide use of individual portable air-conditioning units would be significant.

E. METRICS AND ACCOUNTABILITY

1. Alternative strategies to improve indoor air quality in school buildings and portable classrooms are listed in the tables the below.

Strategy 1: Measures to reduce heat gain for Buildings and Sites, and improve indoor air quality		
Strategy	Benefits/Challenges	
Shade trees & shade islands	Deciduous trees provide shade preventing summer solar radiation into the building. Need to plant away from building foundation. Need a summer watering program for first 3 to 5 years.	⊗
Solar canopies or awnings	Properly designed canopy or awning can block high summer sun. Requires existing exterior wall to be in good condition.	
Solar window blinds	Exterior shading is more effective than interior shading, however window blinds are more effective than drapes to reduce solar glare/heat gain in rooms. May inhibit window operation	⊗
Replace windows	Double or triple glazing will help to reduce heat gain. May increase overheating if ventilation is inadequate	⊗
Minimize internal heat gain	Energy efficient lighting (LED) saves energy and reduces heat dissipated into indoor air	⊗
Reduce use of desk top computers in classrooms, and in computer labs	Laptops and tablets discharge less heat than desk-top CPU's. Turning off computers and photocopies when not in use also helps to reduce heat build-up in classrooms and other spaces.	⊗

Increase the insulation value of exterior walls and roofs	Current City of Toronto Green Standards for new construction has increased the R-value of exterior walls & roofs.	⊗
Cool Roofs	Using white or light grey covering materials for new roofs to reflect light and reduce heat gain. Require maintenance and periodic cleaning to preserve the lighter surface colour.	⊗
Green Roofs	City of Toronto Green Standards, for new construction requires percentage of roof to be green, as a means of dealing with storm water discharge and added insulation. The roof should be certified for its load bearing capacity for extra weight, require maintenance	⊗
Natural Ventilation (including night cooling)	Provide more operable window sections, to provide more ventilation in classrooms. Security/Noise concerns may limit willingness to open windows	⊗
Using fans in classrooms/other spaces	Circulating air through the use of fans can provide some relief to room occupants by dissipating hotter air. Ceiling mounted fans may also have benefits in the winter to circulate air, though there are restrictions based on ceiling height and availability of resources/cost to install. Schools may purchase floor-standing/portable fans for classroom use. Storage of fans during the winter months may be an issue.	⊗
Cost/Funding/Operational considerations		
Estimated costs to undertake any or all of the measures are project specific and depend on building and/or site conditions. Many of these measures can be funded through the School Renewal program for existing buildings, or through Capital Priorities funding, for new construction, subject to Ministry approval. Operations/Maintenance costs – depends on each measure, and the resources needed to maintain and operate the equipment on an annual basis.		

- ⊗ *Indicates measures currently being implemented.*

Strategy 2: Providing a designated cooling centre in each non-air conditioned elementary or secondary school	
Strategy	Benefits/challenges
Install an appropriately sized, energy-efficient rooftop unit with required ducts and controls, to create an air-conditioned cooling centre in the school. In most cases, the school library would be the preferred location as these rooms tend to be large enough to accommodate one or two classes at one time. **The estimated cost for a cooling centre is approximately $75,000/school**, including electrical service upgrades, roof work, designated substances removal and any interior room re-finishing.	Would also benefit Before and After programs and childcare tenants. The Board has committed to attaining Net Zero Energy status. Adding 155 additional air-conditioning centres would increase the Board's utility costs, and require other offsetting measures making it very difficult to meet Net Zero Energy targets. Cooling Centres should be maintained at 25℃ to 26℃ interior room temperature (occupied).
Total estimated costs: $11.625 M for installation of 155 cooling centres in the non-air conditioned elementary and secondary schools. Phased Implementation over four years would be $3 M a year, for approximately 40 schools per year, three to four per Ward. Additional staff resources would be required to oversee the installation program and to undertake yearly preventative maintenance of the new cooling centres equipment. Total estimated additional electrical costs at the end of the full implementation would be: $210,000/year based on a rate of $0.20/kw (current peak rate).	

Strategy 3: Add Air Conditioning to all Portable Classrooms	
Strategy	Benefits/challenges
The number of portable classrooms is anticipated to decrease by approximately 100 portables upon completion of the current capital projects. The strategy would be to remove and install any existing A/C units into those portables, where cost-effective, or add new air-conditioning units to the remaining portables that do not have	The annual March report regarding Pupil Accommodation and Portable Classroom Requirements would provide a more detailed summary of the number/location of portables that do not have air-conditioning. Under this initiative, the portable

A/C units. Prioritize schools that have a significant number of non-air-conditioned portable classrooms, and that are not likely to receive an addition or new school in the next five years.	classrooms would have AC even if the main school building does not.
Estimated Total Cost: Cost of retrofitting and/or replacing the *Tempspec* unit in each non-air conditioned portable, is estimated to be between $8,000 and $12,000 (new) per portable. **Given the anticipated decrease in portable classrooms**, the total estimated costs to add A/C units to the remaining portables, could be in the range of $624,000 to $1,000,000. This work should be phased over two years, subject to completion of the current planned capital projects.	

2. Given the amount of attention the issue of non-air conditioned schools received in the fall of September 2017, it is to the Board's advantage to initiate the roll-out of a phased four-year implementation plan. Approximately forty (40) schools a year would be completed, starting in 2018. Prioritization of the schools per phase (Years 1, 2,3 & 4) would depend on the following factors:
    a. Even distribution across all Ward areas per phase/year;
    b. Complexity of the project, in terms of requiring ancillary structural, electrical or other upgrades;
    c. Coordination with other critical renewal (or capital) work occurring in the building – either as a conflict or as a means of combining the work;
    d. Direction from the Long Term Accommodation Plan as to future replacement school or major addition.

3. The installation costs for adding cooling centres in approximately 155 schools may vary depending on the building typology/age, size and location of the library, available electrical service and other factors. The work can be funded from School Renewal – however, this would divert funds from other renewal work. The Board's current deferred maintenance backlog is $625 M, and despite annual renewal upgrade sin the range of $30 M, the backlog will continue to increase as buildings continue to age. The cooling centre projects individually uploaded into VFA, the Ministry's Facilities Assessment database upon completion. This will allow Board staff to develop cost benchmarks for the four-year implementation program.

4. The current Ministry of Education (EDU) capital cost benchmark for new schools does not accurately reflect the true cost of building in Toronto. As evidenced by the three most recent new elementary school projects, the funding benchmark is insufficient to include full air-conditioning throughout

the school as well as additional energy-saving or renewal energy measures. It is important to note that the Ministry's funding model only takes into account the capital costs and not whether there are any longer-term life cycle or operational cost benefits to enhancing energy-efficiency in the design, or adding renewal energy components such as photovoltaic panels to offset future electrical consumption costs.

5. All school boards are required to develop a five-year energy management plan and to provide public access to the energy consumption rates for each building in the portfolio. This data would be used to review the impact of the new cooling centres on the Board's electrical costs, and form part of the research regarding achieving Net Zero Energy status.

6. In order to manage energy use and utility costs, the cooling centres should be maintained between 25℃ to 26℃ for when the space is occupied. This is in keeping with the Board's 2008 Standard Operating Procedure for indoor air temperatures for schools with air-conditioning.

7. A report regarding the goals and measures required to become a Net Zero Energy School Board will be presented to the Board in early 2018. The report will also look at the impact of adding air-conditioning to existing and new schools, in terms of the Board's goal to achieve Net Zero Energy.

F. IMPLEMENTATION, STRATEGIC COMMUNICATIONS AND STAKEHOLDER ENGAGEMENT PLAN

1. That the Board-approved 2017 Hot Weather Standard Operating Procedures be distributed by email to all school principals and Catholic Parents School Council in the spring and at the start of the school year, also indicating that schools are permitted to purchase and install fans in classrooms.

2. Upon approval of this report and the recommended cooling centre strategy plan, a communication will be issued to all non-air conditioned schools regarding the phased installation of cooling centres.

3. A building specialist will be engaged to begin detailed engineering and building evaluation studies to plan and prioritize implementation for installation of the cooling centres. An update regarding phasing and implementation will be provided to Trustees by the June of 2018.

G. STAFF RECOMMENDATION

1. That the Board approve a four-year phased implementation plan to add cooling centres at non-air conditioned schools as detailed in the report, funded from School Renewal.
2. That the annual Pupil Accommodation and Portable Classroom Requirements report provide detailed information and recommendations for the installation of air-conditioning units to portable classrooms.
3. That the Chair of the Board send a letter to the Ministry of Education regarding the impact of hot weather on interior air temperatures in classrooms, as detailed in this report, with a request for additional funding to assist school boards to implement cooling centres.