LEGISLATIVE RETURN

SUBMITTED BY: Hon. Mr. Clarke, Minister of Highways and Public Works

1. On [date], [MLA]

☐ asked the following question during the Oral Question Period at page(s) [page numbers] of *Hansard*

☐ submitted the following written question – WQ No. #

☐ gave notice of the following motion for the production of papers – MPP No. #

RE: [subject]

OR

2. This legislative return relates to a matter outstanding from discussion with Emily Tredger, Member for Whitehorse Centre on April 26, 2022 related to:

Bill No. #204 ☐ Second Reading ☐ Third Reading

☒ Committee of the Whole: Vote 55 Highways and Public Works

Motion No. # RE: Climate Risk Assessments

at page(s) 2048 of *Hansard.*

The response is as follows:

Question:

I am wondering if the minister can table for the House the climate risk assessment that was done for Whistle Bend School. I assume that a climate change risk assessment was done. I am wondering if there was any assessment done of the greenhouse gas emissions produced by the building and operation of this facility and if that could be shared with us.

Response:

The Whistle Bend School is being designed to meet aggressive energy efficiency and greenhouse gas reduction targets. This is consistent with our work to meet the 2030 goals laid out in Our Clean Future.

We worked with the engineering team to design a good energy model for the building:

- The building design will achieve an energy performance target of 53 per cent better than the National Energy Code for Buildings. This exceeds our target in OCF by almost 20 per cent.
- The building design will achieve a greenhouse gas reduction target of 57 per cent better than the reference building. This exceeds our target in OCF by almost 25 per cent.
- These measures are a result of our work on making the building envelope energy efficient as well as maximizing heat recovery.
- The building will have a tie-in point for a future renewable heating system to further reduce greenhouse gas emissions from the building.

A Climate Change – Risks and Hazards Report (attached) was done as part of the Whistle Bend Elementary School Functional Program and Business Case. The planning of the Whistle Bend Elementary School predated the commitment for doing climate risk assessments on major infrastructure projects. Thus, while a number of climate

2022-10-03
Date

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LEGISLATIVE RETURN

vulnerabilities were acknowledged, this report may not follow the guidelines for climate risk assessments that other reports include.

2022-10-03

Date

Signature

GOVERNMENT OF YUKON
WHISTLE BEND ELEMENTARY SCHOOL

FUNCTIONAL PROGRAM & BUSINESS CASE

PREPARED BY:
Colliers Project Leaders
Date: April 28, 2020
Doc.# 821073-0032(6.0)

PREPARED FOR:
Government of Yukon,
Department of Highways and Public Works,
Property Management Division

In Partnership with

kobayashi+zedda

APPENDIX I

CLIMATE CHANGE – RISKS AND HAZARDS

CLIMATE CHANGE: RISKS AND HAZARDS

Temperature

The Intergovernmental Panel on Climate Change's (IPCC) *Climate Change 2014: Synthesis Report* states that the globally averaged combined land and ocean surface temperature data shows a warming trend of 0.85°C during the interval of 1880 to 2012.[1] Research conducted by Environment Canada suggests that Canada's average temperature warmed 1°C between 1950 and 2000. The Arctic Climate Impact Assessment (2004) indicates that during the same period, winter temperatures in the Yukon (and throughout Alaska and western Canada) increased as much as 3-4°C and are expected to continue increasing.[2] These predictions are supported by the knowledge and observations of Indigenous Elders and Traditional Knowledge holders throughout the North who have reported changes in seasonal weather patterns.[3]

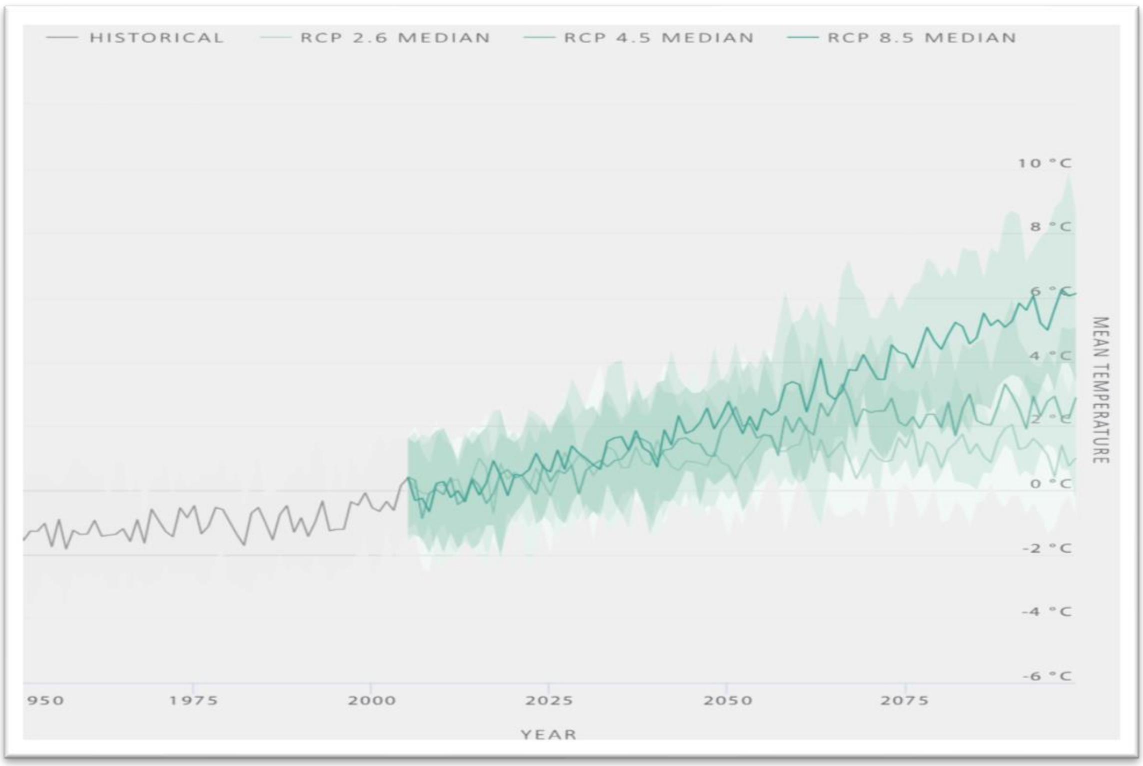

Figure 1. Whitehorse Mean Temperature Warming Trends. *Data from ClimateData.ca.*

Freeze-Thaw

Throughout Canada, the occurrence of freeze-thaw cycling is predicted to increase as seasonal temperature patterns change.[4] According to the Yukon Government Climate Change Action Plan, Yukon's infrastructure is vulnerable to changes in climate including

[1] Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2014), 40.
[2] Arctic Climate Impact Assessment, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (Cambridge: Cambridge University Press, 2004), 22, http://www.acia.uaf.edu.
[3] Ibid., 93.
[4] Jeff Casello and Will Towns, "Urban," In *Climate Risks and Adaptation Practices for the Canadian Transportation Sector 2016,* eds. K. Palko and D.S. Lemmen (Ottawa, ON: Government of Canada, 2017), 282.

freeze-thaw cycles.[5] Consideration should be given to the impact of freeze-thaw cycling when designing future buildings and site infrastructure.

In the Whitehorse area, winter daytime melting combined with overnight freezing have substantially increased icy conditions at building pedestrian and vehicular entrances. Freeze-thaw can also lead to permanent damage of any building components that are susceptible to hydraulic forces when moisture is trapped and frozen.

Architects should consider snow protection at all major pedestrian pathways adjacent to building entrances as well as building details that can weep and wick moisture away from building assemblies and components.

Permafrost and Northern Infrastructure

Permafrost is defined as ground that remains below 0°C for two or more successive years. In permafrost zones, the layer of ground found above permafrost that fluctuates seasonally by thawing in summer and refreezing in winter is named the active layer.[6] This freeze-thaw cycling presents a challenge for building designers. This dynamic movement may cause damaging frost heaves and can exert an uplift force on deep foundations that may jack them out of the ground.[7]

Permafrost thaw represents one of the greatest threats to northern infrastructure. The formation and persistence of permafrost is most generally associated with climate factors. As air and ground warming trends continue in the Yukon, permafrost conditions are also expected to warm.[8] Buildings and their foundations are susceptible to altered soil strength due to seasonal warming and cooling and annual freeze-thaw cycles.

Permafrost conditions in Whitehorse (though not prevalent) are susceptible to degradation; they are relatively warmer and shallower than the permafrost conditions found in the Arctic. The City of Whitehorse is in an area that is generally categorized as the sporadic discontinuous permafrost zone. By definition, 10-50% of the land area in this zone is underlain by permafrost occurring in isolated patches.[9] While permafrost conditions vary according to site-specific conditions, the sporadic discontinuous permafrost underlying Whitehorse is often characterized as "warm permafrost", as its temperature approaches 0°C.[10] Typically, permafrost in Whitehorse is found on northern aspects and at higher elevations. It is generally quite shallow, ranging between two and three meters in depth.[11]

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[5] Yukon Government, *Yukon Government Climate Change Action Plan* (Whitehorse: Environment Yukon, 2009), 17, https://yukon.ca/sites/yukon.ca/files/env/env-yukon-government-climate-change-action-plan.pdf.

[6] Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost: A Guideline for Climate Change Adaptation* (Mississauga, ON: Canadian Standards Association, 2010), 5.

[7] Ibid., 76.

[8] Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost*, 34.

[9] Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost*, 88.
See also National Atlas of Canada, *Canada Permafrost*, MCR 4177, (ed. 5), 1995, National Research Canada, https://doi.org/10.4095/205314.

[10] "Permafrost," Government of Yukon, accessed October 22 2019, https://yukon.ca/en/yukon-geohazards#permafrost. See also Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost*, 21.

[11] Ryan Hennessey and John Streicker, *Whitehorse Climate Change Adaptation Plan* (Whitehorse: Northern Climate ExChange, Yukon Research Centre, Yukon College, 2011), 17, https://www.yukoncollege.yk.ca/sites/default/files/inline-files/Whitehorse_CAP_Plan_FINAL_0.pdf.

While it is helpful to understand general subsurface conditions, site-specific information can be gathered by engaging a geotechnical engineer to perform a desk report and site investigation. As local permafrost conditions in Whitehorse are susceptible to warming trends, care should be taken when designing infrastructure and buildings on this site. Full consideration should be given to the potential for climate change, and particularly air warming trends, to incur permafrost warming and/or thawing in the future. Changes in climate and local permafrost conditions can greatly alter future foundation conditions, causing a greater challenge to building designers.[12]

Particular attention should be paid during site preparation and development as related activities (clearing, grading, etc.) can impact and raise ground temperatures, weakening frozen soils as they warm and/or thaw.[13] Other local climate factors can impact permafrost. Conditions above grade including forest fires or heavy snowfall can degrade permafrost below.[14]

Precipitation

According to the *Whitehorse Climate Change Adaptation Plan* (2011), projected annual mean precipitation levels for Whitehorse are predicted to increase from 268 mm to as much as 327 mm by 2050. The greatest seasonal relative increase is expected to occur in winter, where precipitation is project to increase by as much as 37%.[15] Increasing precipitation and relative humidity levels can present new challenges with regard to building design and building science.

Higher humidity levels in winter are absorbed by dry, powdery snow increasing its overall density. This action carries a significant impact on the snow load bearing capacity of roofs and infrastructure.

Forest Fires

Whitehorse is located within the northern boreal system; which research suggests is susceptible to an increase in the intensity and frequency of forest fires due to climate change. An increase in average temperatures and precipitation could increase the risk of forest fires in the city’s relatively arid climate.[16]

[12] Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost*, 6.
[13] Canadian Standards Association, *Technical Guide: Infrastructure in Permafrost*, 6.
[14] Hennessey and Streicker, *Whitehorse Climate Change Adaptation Plan,* 47.
[15] Ibid., 20.
[16] Ibid., 46.

7. CLIMATE CHANGE RELATED RISKS - Climate trends taken from Yukon Climate Change Indicators and Key Findings 2015, by Yukon Research Centre)										
7.1	Ground conditions change over time	Ground conditions changing will be predicated on groundwater and permafrost. Current site not in Permafrost and hence change will be due to groundwater behaviour - see 7.7								
7.2	Precipitation characteristics change over time	The frequency and intensity of precipitation events is increasing. Precipitation is projected to increase 10 to 20% over the next 50 years. In winter months this is resulting in more snowfall that is also denser due to a higher humidity level. In summer the precipitation will result in more storm water management on site.	Scope: Consider a detailed study of likely increase in precipitation: rain and rain as snow. Make allowance for higher snow loads in design and consider snow accumulation in building form and higher standing water levels on roof. Consider stormwater management strategies to account for the increase in extreme events. Even more important to keep rain water away from the building. An increase in the level of the water table is an issue as it reduces the bearing capacity. Time: The time required is not much and can be done in parallel to current project activities if completed as soon as possible. Cost: Additional investigation and incorporation into design. Increase capital cost to account for increased loading. $xxxx Operations: No impact, except snow clearing management plan needed early on.	Design	3	2	6	10 - 50 yrs	Mitigate	- Owners team to provide a site specific climate analysis to give greater certainty to impacts. Site specific considerations for design basis to be established for the proponent. The City of Whitehorse Servicing Standards Manual does not address climate change within their document. Address as site specific.
7.3	Humidity levels change over time	As precipitation and temperature increase humidity levels are likely to increase also. This will impact the weight of snowfall and human occupancy comfort.	**Scope:** Consider a detailed study of likely increase in precipitation and effect on humidity. Consider sensitivity of HVAC selection to higher humidity. **Time:** The time required is not much and can be done in parallel to current project activities if completed as soon as possible. **Cost:** Additional investigation and incorporation into design if necessary. Since the envelope and HVAC systems would not change to respond to higher average humidity unless there is cooling. This would increase the cooling load. $xxxx **Operations:** No impact.	Design	2	1	2	10 - 50 yrs	Accept	- Humidity impact as an a individual risk is not a notable impact. It can be mitigated when considered with item 7.1 and 7.3
7.4	Temperature conditions change over time	Annual warming is projected to be an additional 2 to 2.5°C in the Yukon over the next 50 years. There will also be a significant increase in the maximum daily temperature and the number of consecutive days with temperatures exceeding 30 degrees.	**Scope:** Consider a detailed study of likely increase in temperature. Consider sensitivity of HVAC selection to higher peak temperatures and longer duration. An increase in temperatures will lead to a reduced active zone. This is not a problem for buildings. **Time:** The time required is not much and can be done in parallel to current project activities if completed as soon as possible. **Cost:** Additional investigation and incorporation into design. The level of cooling may be increased to address potential comfort issues in the space. This could manifest as improved shading or mechanical cooling, which will have impact on the building design and cost. . $xxxx **Operations:** No impact.	Design	3	2	6	10 - 50 yrs	Transfer	- Owners team to provide a site specific climate analysis to give greater certainty to impacts. Site specific considerations for design basis to be established for the proponent. May be able to transfer the risk to the future. One strategy would be to allow for the addition of a cooling section to the equipment to facilitate future upgrades for cooling.

7.5	Air quality change over time.	Wildfire risk is increasing due to Climate Change and this will be the highest contributor to poor air quality in the Yukon. The trend suggests that this is fairly low increase in probability	**Scope:** Consider sensitivity of HVAC selection to air quality events. **Time:** The time required is not much and can be done in parallel to current project activities if completed as soon as possible. **Cost:** Additional investigation and incorporation into design. Increase capital cost to account for mitigation strategy. Higher filtration can be incorporated into the design. $xxxx **Operations:** No impact.	Design / Operation	2	1	2	10 - 50 yrs	Transfer	- Owners team to provide a site specific climate analysis to give greater certainty to impacts. Site specific considerations for design basis to be established for the proponent. May be able to transfer the risk to the future. One strategy would be to allow for the filter rack and fan power to include the required filters.
7.6	Increase in extreme weather events	The variability of the climate is expected to increase. This will mean an increase in extreme weather events which impact the delivery of utility and services. Black outs and loss of utilities and service will be a risk (Energy/water/telecom)	**Scope:** Consider redundancy of power/fuel systems in design requirements. Consider potential uses of space (place of refuge) in an extreme event. IF temperatures increase, any planting near the building might be at risk by soil desiccation and shrinkage. **Time:** The time required is not much and can be done in parallel to current project activities if completed as soon as possible. **Cost:** Additional investigation and incorporation into design. Increase capital cost to account for systems to provide improved robustness and redundancy. $xxxx **Operations:** No impact.	Design / Operation	3	3	9	10 - 50 yrs	Mitigate	- Owners team to provide a site specific climate analysis to give greater certainty to impacts. Site specific considerations for design basis to be established for the proponent. Do not plant tress or high water usage plants anywhere near the foundations.
7.7	Groundwater conditions change over time	The identified high groundwater would suggest it may be influenced by storm events. Climate change in the Yukon is leading to changes in precipitation, streamflow and groundwater flow patterns and flood risk. Rain and storm events are projected to increase. This could affect the maximum ground water level for design and long-term storm water management. If the ground water level drops there could be a settlement issue as the ground compacts under its own increased self weight.	**Scope:** Consider a detailed study of groundwater and stormwater management with respect to climate change to be accounted for in design. This may lead to increased sizing of stormwater management and drainage systems to account for future conditions. **Time:** No impact to schedule if study is completed in parallel to concept design activities. **Cost:** Small additional cost to complete the study. If design elements are oversized for future conditions, the capital cost now will be higher than if future conditions are not considered. **Operations:** No impact expected.	Phase 2	1	2	2	10 - 50 yrs	Mitigate	- Owners Advisor team to provide a site specific climate analysis to give greater certainty to impacts. Site specific considerations for design basis to be established for the proponent. - Manage the ground water and soils under the building to minimize settlement risks.