Lax Kw'alaams Band
206 Shashaak Street,
Lax Kw'alaams BC V0V 1H0
Telephone:(250) 625-3293
Fax: (250) 625-3246

Lax Kw'alaams Band
100 1st Ave East
Prince Rupert BC V8J 1A6
Telephone: (250)627-5733
Fax: (250) 627-5933

March 3, 2023

Elenore Arend
Chief Executive Assessment Officer, and Associate Deputy Minister
British Columbia Environmental Assessment Office
2nd Floor, 836 Yates Street
Victoria, BC V8W 9V1

Re: Ksi Lisims LNG Project Readiness Decision

Dear Ms. Arend,

Lax Kw'alaams writes following our meeting of March 1, 2023 to discuss the proposed Ksi Lisims LNG Project. Lax Kw'alaams appreciates the opportunity for further dialogue regarding outstanding issues related to the Project at this stage. Further to our discussion, offer the following submissions leading into the Readiness Decision you, as CEAO, will undertake. Lax Kw'alaams trusts you, and your office, will give these submissions earnest consideration.

Within the DR process, as acknowledged by both parties, consensus has not been reached regarding the recommendation to proceed to an environmental assessment. Lax Kw'alaams does not consent to the Project moving forward to an environmental assessment for the reasons outlined in our submissions within the Dispute Resolution process. Lax Kw'alaams submissions are attached as Appendices "A" & "B" to this Letter. In Lax Kw'alaams view, the Project's application should be terminated as the Project would induce the breach of BC's legislated climate targets and would cause extraordinarily adverse effects to Lax Kw'alaams rights as proposed.

In the alternative to termination, Lax Kw'alaams would consider potential amendments to the Project's Detailed Project Description that would address Lax Kw'alaams concerns outlined in our DR submissions. Lax Kw'alaams would be open to considering the perspective of the Project proponent, or other third parties as appropriate, in reply to our submissions with a view to ensuring the Project, as proposed, would not induce the breach of BC's legislated climate goals or cause EAE on Lax Kw'alaams rights.

In addition to its submissions supporting termination, Lax Kw'alaams has some specific perspective in reply to certain documents within the record in the Readiness Phase as follows:

Readiness Report Draft

- Lax Kw'alaams maintains the project should be terminated. However, La Kw'alaams understands the EO is not currently recommending termination. Notwithstanding consensus has not been reached on this, Lax Kw'alaams would like to propose some minor edits to the language of the Readiness Report.
- **Para 4**: delete "are not unmitigable and therefore" The term unmitigable is subject to disagreement among the parties. It is more neutral to state that it is the EAO's view that Lax submissions do not constitute EAE. This deletion also acknowledges there are other factors that go into making this determination.
- **Para 6**: delete "will be greater than the effects of comparable projects in a prescribed category under the Reviewable Projects Regulation", and insert "will cause EAE". Given consensus was not reached on this issue, Lax Kw'alaams would prefer simply stating the conclusion reached by the EAO.

Letter to J. Nicholls of Feb 21, 2023

- **Para 2**: Lax Kw'alaams appreciates the acknowledgement of shared concerns regarding potential effects of the project on lax Kw'alaams rights and the province ability to meet its climate targets.
- **Para 3**: Lax Kw'alaams notes there is uncertainty, however, some conclusions of Lax Kw'alaams technical advisors are certain from the view of Lax Kw'alaams – such as the view that it will be impossible to mitigate the GHG related effects of the project in any circumstance (subject of submissions 1) and the resultant effects (submissions 2). Lax Kw'alaams maintains that it is appropriate to consider these matters in the readiness phase according to the provisions of the Act.
- **Para 4**: Lax Kw'alaams would be interested in more information about the comparison to projects in a prescribed category. This was the subject of procedural disagreement in DR – either the project is together with other LNG facilities and the GHG emissions are high, or it is compared to other large scale industrial projects (as was the focus for Lax Kw'alaams) and the emissions profile is still considered high in the view of Lax Kw'alaams.
- **Para 5**: Lax Kw'alaams appreciates this and, although maintains termination is appropriate, would welcome this approach in later stages of the EA process should those come to pass.
- **Confidentiality**: the EAO may share the Submissions of Lax Kw'alaams – and agrees with the benefits of doing so outlined.
- **Consensus Seeking**: Lax agrees in principle, acknowledging that the challenges existed with the facilitation process and Lax Kw'alaams maintains significant concerns with how the process was facilitated and how report was prepared.
    - Very little guidance to the parties setting out a clear process
    - Disregard for agreed timelines when those did finally surface.
    - Submitting Report without Lax comment or adequate consideration of submissions.
- **Concept of a 'Mini- assessment'**: Lax Kw'alaams is still unclear about this term. In Lax Kw'alaams view, its analysis is contemplated within the scope of the Act. Lax Kw'alaams,

would welcome input from the proponent, and other technical advisors, on its submissions.

- **Commitments:** Lax Kw'alaams welcomes these commitments. Acknowledging that an important decision has yet to be made about the Project.

Dispute Resolution Report:

- Lax Kw'alaams maintains significant concerns with the DR facilitation process, including failure to set out a clear process for consensus seeking on key issues.
- Lax Kw'alaams has concerns that the DRF has acted beyond their powers. The DRF has drawn conclusions that are outside the powers of the DRF. In summary, Lax Kw'alaams would like to seek agreement with the EAO to jointly strike certain sections from the report that constitute findings or conclusions that are outside the powers of the DRF.
- As discussed on March 1, 2023 Lax Kw'alaams legal counsel will follow up with a proposal for the parties to consider.

Letter of P. Kelly to CEAO on Feb 15, 2023 enclosing Report:

- In Lax Kw'alaams view, Mr. Kelly, as DRF, makes conclusions that are outside the scope of the DRF's powers.
- The DRF also erred in weighing Lax Kw'alaams submissions in the context of other phases of the EA process. Lax Kw'alaams focused its submissions on the readiness phase.
- **Para 2**: P. Kelly recommends CEAO proceed to readiness decision based on EAO recommendation for the Project to proceed to EA. This conclusion is outside the scope of engagement of the facilitator. At outset, Mr. Kelly stated it was not his role to draw conclusions. It is for the parties to seek consensus or not. Facilitator is there to assist with consensus seeking, not draw conclusions and weigh submissions. Improper for facilitator to recommend proceeding to EA.
- **Para 3:** DR occurs in the context of Readiness Decision Phase. Lax position focused on readiness decision phase. It is, by definition, outside the scope of the DR process and readiness decision phase to speculate or consider future phases of the EA process. Lax Kw'alaams also disagrees that it is too early to consider the 'technical merits of the position of Lax Kw'alaams'. It is Lax Kw'alaams view that its submission properly fall within the scope of the phase of the EA process and the purview of the applicable legislation. In any event, it is not the role of the facilitator to make such findings.
- **Para 4:** For Lax Kw'alaams, mere awareness on the part of the EAO is not sufficient. Lax Kw'alaams submits *action* is required at this stage to address inconsistency with law and policy, as well as prevent EAE on Lax Kw'alaams rights. The Act provides for termination of the application. Lax Kw'alaams also disagrees that 'substantial capacity' exists in future phases. Lax Kw'alaams highlighted capacity challenges and limited resources of Lax Kw'alaams to engage in comprehensive assessments as rationale for termination. The facilitators finding here is inappropriate and made absent submissions of the parties.
- **Para 5**: it is apparent that Mr. Kelly does not recognize the limits of his role.

Thank you for your consideration of Lax Kw'alaams perspective. Lax Kw'alaams has contributed a great deal of effort and consideration of its position in respect of the Project and has concluded the Project should be terminated at this stage.

Respectfully,

Mark Bowler

Mark Bowler
Lands and Stewardship Director

Appendix A:
Lax Kw’alaams DR Submissions 1

LAX KW'ALAAMS SUBMISSIONS FOR DISPUTE RESOLUTION #1

A. INTRODUCTION:

1. Lax Kw'alaams does not consent to the recommendation under Section 16(2) of the *Environmental Assessment Act* [SBC 2018, c.51] by the EAO to the Chief Executive Assessment Officer (CEAO) that Ksi Lisims LNG (the "Project") proceeds to an Environmental Assessment.

2. Lax Kw'alaams submits the chief executive assessment officer must recommend the Minister issue a termination order as:

   (a) According to section 16(2)(c)(i)(B), the Project will have extraordinary adverse effects on Lax Kw'alaams due to adverse impacts on the climate; and

   (b) According to 16(2)(c)(iii), is clearly incompatible with a government policy, mainly BC's climate related commitments.

3. In the alternative, Lax Kw'alaams submits the chief executive assessment officer must, at minimum, require the proponent to submit a revised detailed project description that addresses the concerns of Lax Kw'alaams.

B. CLIMATE & GHG-RELATED ISSUES

4. Lax Kw'alaams' ability to exercise our rights as Indigenous People depends on maintaining the longstanding relationship within the territory's climate-induced environment. Climate Change is a direct existential threat to the cultural continuity of Lax Kw'alaams as an Indigenous people. Therefore, certainty must be provided by proponents who wish to operate within our territory, that an unjust infringement upon the ability of the Lax Kw'alaams' rights will not ensue. The evidence is strong that proceeding with the Project will induce BC's failure to meet its climate targets as well as induce harmful climate related adverse impacts on Lax Kw'alaams people.

5. As described in Lax Kw'alaams Initiating document, Natural gas production and export is a significant driver of BC's emissions and, when combined with LNG emissions will prohibit BC from reaching its legislated targets under the *Climate Change Accountability Act*, specifically the Oil & Gas sectoral targets for 2030 and 2050.

6. The Project has identified that it is dependent upon obtaining power from the BC Hydro grid. A delay in this connection would ultimately deter the facility from achieving its "net-zero" requirement. The Project has based estimated carbon offsets for Project related GHG emissions solely on the premise of a successful BC Hydro grid connection, creating a significant misrepresentation of potential offsetting requirements for the Project. The Project's GHG emissions between the Base and Alternative Case vary considerably; creating significant concerns for BC to accomplish legislated emission targets under the *Climate Change Accountability Act*.

7. Additionally, as described below, the Project presents significant uncertainty around the timing and quantity of power available, necessary system enhancements and costs associated with delivering BC Hydro grid power to the Project. Without a guaranteed connection to the BC Hydro grid, both the Project and the province will lack the ability to meet legislated policy objectives for GHG emissions under the Climate Change Accountability Act for Oil and Gas Sector production and development.

8. Until such time that the Project can provide assurance around its ability to execute provincial climate objectives for GHG emissions through an appropriate plan for electrification, Lax Kw'alaams cannot consent to a decision by the CEAO that Ksi Lisims LNG proceeds to an Environmental Assessment.

9. Lax Kw'alaams submits the chief executive assessment officer must recommend the Minister issue a termination order as the Project will have extraordinary adverse effects on Lax Kw'alaams due to adverse impacts on the climate and by extension: Lax Kw'alaams; and is clearly incompatible with a government policy, mainly BC's climate related commitments.

10. Full particulars of Lax Kw'alaams climate related concerns are detailed in the sections that follow.

2. Ksi Lisims will make it even harder for BC to meet its 2030 Target and Oil & Gas sector target:

11. BC's current climate plan does not put it on track to meet its 2030 emissions target. Approval of the Ksi Lisims LNG Project will be inconsistent with BC's climate related policies including contributing to BC exceeding its GHG emissions targets.

12. The BC government has stated that all new LNG projects must fit within BC's climate targets. This requires Ksi Lisims to operate on electricity if it is going to proceed. The DPD claims that using renewable hydroelectricity from the BC Hydro grid to power the Project is important to the Nisga'a Nation, "one of the key features of the Project for its investors and customers" and that "in the event that there is no committed power connection to BC Hydro, then the project will not proceed".[1]

13. Despite the purported importance of a BC Hydro grid connection, a connection from the Project to the BC Hydro grid does not exist yet and is not certain. Substantial system enhancements to the power grid are required to deliver the required power to the Project and the proponent has a third party – WindRiver, working with BC Hydro to identify the necessary upgrades and the timeline for connection.[2] If connection does not occur by 2027, the DPD contemplates self-generating power by burning natural gas on floating "power barges", and estimates that this may be necessary for 1-5 years - from commencement of operations in 2027 to 2032.[3]

14. Provided the Project can establish a connection to the BC Hydro grid (the "base case"), which is not guaranteed, the base case will produce between 0.25-0.4 Mt CO_2e/yr.[4] This includes on-site emissions including combustion in acid gas incinerators, direct-fired process heaters, and vented, flared and fugitive sources and "acquired emissions" produced by BC Hydro

[1] Detailed Project Description, pp.6, 30 & 47.
[2] Detailed Project Description, pp.29-30, pdf p.649
[3] Detailed Project Description, pp. 29-30, 44,
[4] Operational emissions (Base case): 197,000 tCO_2e of annual direct energy GHGs + 50,000-200,000 tCO_2e of annual acquired energy GHGs (full electrical power acquired from BC Hydro grid) → 0.247-0.397 Mt (DPD, p.49). The acquired energy GHGs are based on BC's grid electricity GHG intensity factors for the "integrated grid" in 2020 and 2021 (DPD, p.48), which the BC government reports as 40.1 & 9.7 tCO_2e/GWh, respectively.

in generating electricity. When the power barges are in operation (the "alternative case"), the Project will produce 1.86-1.90 Mt CO_2e/yr.[5]

15. Neither of these emissions estimates include emissions from upstream production and transportation of natural gas or downstream shipment of the LNG, conversion to natural gas, and combustion of natural gas.

16. According to BC's latest 2022 Climate Change Accountability Report, BC's climate plans are currently projected to:

(a) Bring BC 97% of the way to its 2030 Target, leaving a gap of 0.8 Mt.[6] BC's 2030 Target is to reduce emissions at least 40% (below 2007 levels), which equates to provincial emissions of 39.3 Mt in 2030.

(b) Reduce BC's Oil & Gas emissions by 32% (below 2007 levels) by 2030. BC's Oil & Gas sector target is to reduce emissions 33-38% (below 2007 levels) by 2030, which equates to sector emissions of 8.25-8.91 Mt in 2030.

17. Of further concern is that BC appears to rely on policies that have not been developed to reach its required reductions, particularly in respect of the oil and gas sector target. Overall, this increases the uncertainty about meeting required targets and demands a cautionary approach to recommending new LNG facilities, such as the Project, for approval.

18. As shown in the table below, adding the emissions from the Project – both in the Base Case and Alternative Cases – will exacerbate the extent by which BC will miss both its overall and Oil and Gas Sector targets:

Ksi Lisims emissions and BC's emissions and targets

[5] Operational emissions (Alternative Cases): 1,860,000-1,900,000 tCO_2e of annual direct energy GHGs (DPD p.49)
[6] BC (Nov 2022) *2022 Climate Change Accountability Report*, accessed 14 Dec 2022 online, p.10-11.

BC's emissions and targets					Gap to Target[7]		
	2007	**2020**	**2030 Target**	**2030 Projected**	**Existing**	**With Ksi Lisims Base Case**	**With Ksi Lisims Alt. Case**
BC	65.5 Mt	64.6 Mt	40% reduction 39.3 Mt	38.8% reduction 40.1 Mt	3% 0.8 Mt	4-4.3% 1.05-1.12 Mt	10.2-10.3% 2.66 -2.7 Mt
Oil & Gas sector	13.3 Mt	12.4 Mt	-33-38% 8.25-8.91 Mt	-32% 9.04 Mt	3% 0.13 Mt	9-12% 0.38-0.53 Mt	45-46% 1.99-2.03 Mt

3. LNG is a driver of natural gas production and upstream emissions:

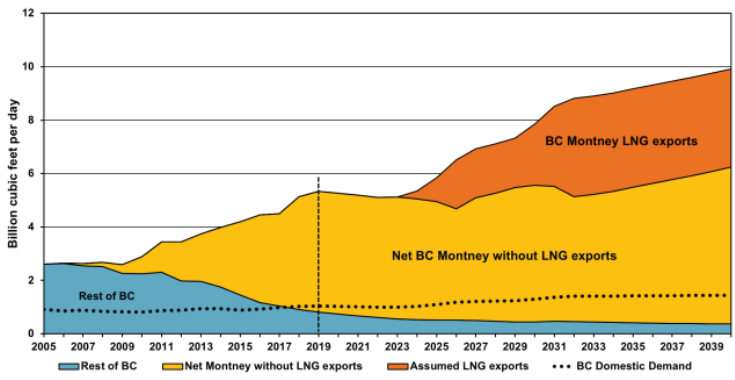
19. The DPD does not state the influence of the Project on natural gas production in BC. However, modelling for the BC government's CleanBC plan estimates that 60% of LNG production will be from an increase in supply and 40% will be from diversion of current production levels. Similarly, the Canadian Energy Regulator (CER) assumes that 75% of LNG feedstock will come from new production that only exists because LNG export capacity exists. The other 25% is diverted from production that would have occurred anyway. While these numbers differ, it is evident that LNG projects are expected to be significant drivers of new natural gas production.

20. The figure below, using data from a 2019 CER report, depicts the amount of natural gas production in BC's Montney formation that would be dedicated to LNG exports.[8] The orange shape shows the increase in gas production driven by LNG exports.

[7] The gap as expressed as a percentage is the amount of the required emissions reduction that is not expected to be achieved. Eg. BC needs to reduce 26.2 Mt of GHGs from 2007 levels to achieve the 2030 target; 0.8 Mt is 3% of that 26.2 Mt.

[8] *BC's Carbon Conundrum*, p.19.

Figure 4: BC gas production by formation, with Canada Energy Regulator forecast from 2019 to 2040 showing proportion that would be dedicated to LNG exports.



Source: Canada Energy Regulator, *Canada's Energy Future 2019*, December, 2019.
Note: Also shown is BC domestic gas consumption.

21. The DPD also does not state how many upstream emissions will be associated with the Project, although it suggests this will be calculated during the EA-IA process. Without experts, this is difficult to estimate, but a comparison with LNG Canada – whose upstream emissions have been calculated – can help.

22. A report by the David Hughes for the Canadian Centre for Policy Alternatives estimates that increasing production for LNG Canada (Phases 1 and 2) would add a total of 13 Mt of GHGs per year, including 3.96 Mt of GHGs from the terminal itself.[9] This estimate assumed a 15 % reduction in upstream emissions through reduced fugitive methane and electrification. LNG Canada will require 3.7 bcf/day and will produce 26 Mt LNG/year at full build out.

23. The Project will receive 1.7-2.2 bcf/day and will produce up to 12 Mt LNG/year.[10] This is 46-54% of LNG Canada's daily feedstock and 46% of LNG Canada's annual LNG output. Using these numbers as a guide suggests that production of natural gas to supply the Project will produce 46-54% of the emissions of LNG Canada, or between 4.1-4.9 Mt CO_2e/year. Adding these upstream emissions to the Project's operational emissions the Project will be responsible for the following emissions:

(a) Base Case: 4.35-5.3 Mt CO_2e/yr

(b) Alternative Cases: 6.0-6.8 Mt CO_2e/yr

[9] *BC's Carbon Conundrum*, p.9.
[10] Detailed Project Description, p.xiii.

24. These quantities of upstream emissions would make it virtually impossible for BC to achieve its 2030 targets, not to mention BC's 2040 and 2050 targets, which get progressively smaller. With upstream emissions and project emissions, even with electrification, this project would account for between 33-41% of all of BC's allowable emissions to meet its 2050 target.

4. BC is unlikely to have enough electricity to power the Project:

25. The DPD does not explicitly state how much electricity the Project will require to power its operations, which makes it difficult whether BC has the electricity available to power the Project. However, in stating the "annual acquired emissions…due to full electrical power acquired from the BC Hydro grid", the DPD provides some information that can be used to calculate the Project's electricity load.

26. The DPD states that the Project's annual acquired emissions are 50,000-200,000 tCO_2e/yr and that these are based on a "2020 and 2021 Integrated grid GHG emissions intensity factor, as published by the BC Government".[11] The relevant BC government publication states that the intensity factors were 40.1 tCO_2e/GWh in 2020 and 9.7 tCO_2e/GWh in 2021.[12]

27. It is logical to assume that two intensity factors (which are significantly different) produced the large range in the Project's annual acquired emissions. When solving for the annual electricity load for the Project, you would divide the annual acquired emissions by the intensity factor. Dividing the high end of the range by the high intensity factor and dividing the low end of the range by the low intensity factor should provide the same value, as below:

(a) $50{,}000\ tCO_2e/yr \div 9.7\ tCO_2e/GWh = 5{,}154\ GWh$

(b) $200{,}000\ tCO_2e/yr \div 40.1\ tCO_2e/GWh = 4{,}988\ GWh$

28. These values are sufficiently close to suggest our calculations are correct. This indicates that the annual electricity load that the Project requires to operate is approximately 5,000

[11] Detailed Project Description, p.48.
[12] BC Government (2022) *Electricity emission intensity factors for grid-connected entities*, accessed 14 Dec 2022 online.

Gwh/yr. The Site C dam will generate about 5,100 GWh/yr,[13] meaning that Ksi Lisims will require the equivalent of an additional Site C dam to itself.

5. Existing demands on BC Hydro grid:

29. BC will already struggle to generate or obtain enough electricity to power the province in a future where we achieve our legislated climate targets. The addition of already approved LNG projects will make this even more difficult.

30. A recent article by Clean Energy Canada noted that:

(a) BC Hydro has concluded that that, for B.C. to remain on track to meet its climate targets, it will need the electricity of one and a half more Site C dams by 2030 — or about 12% more electricity than currently planned.

(b) If LNG Canada's Phase 2 expansion proceeds (it has the necessary approvals) and uses electricity rather than natural gas for liquefaction (as it must to fit within the province's climate targets), the electricity equivalent of **three more Site Cs** will be needed by 2040 — most of which will be required in the early 2030s.

(c) Purchasing additional electricity will be difficult and costly as most western US states (from whom we buy electricity) also have climate plans requiring massive amounts of clean electricity. Already, none of the subregions in the western U.S. and Canada generate enough electricity to meet their own needs during periods of high demand. [14]

31. The article did not mention other LNG projects that expect to use electricity. The 2017 BC Hydro Load Forecast that was submitted for the Site C assessment indicates that the combined incremental demand for three LNG projects (LNG Canada Phase 1, Woodfibre, and

[13] BC Government (n.d) FACTSHEET: Site C Hydroelectric Project, accessed 14 Dec 2022 online.
[14] Zacharias, M. (Nov 2022) *Canada's LNG export dreams could leave B.C. powerless to pursue other opportunities*, Clean Energy Canada, accessed 14 Dec 2022 online.

Tilbury) in 2025 will be 2,662 GWh/yr.[15] This is approximately half of the Site C dam's annual generating capacity.

(a) Fortis BC Tilbury project will require 132 GWh/yr;

(b) LNG Canada Phase 1 will require 946 GWh/yr (a CBC article indicates that it will need approximately 2,000 GWh/yr[16]); and

(c) Woodfibre LNG will require 1,584 GWh/yr.

32. In summary, BC will struggle to find enough electricity to meet its climate targets and it may already be impossible to accommodate the addition of LNG Canada Phase 2 (which has already been approved by provincial and federal governments). In this context, powering Ksi Lisims on electricity seems out of the question.

6. New long-term LNG facilities like Ksi Lisims and projected LNG demand are not aligned with global net-zero emissions by 2050 and global temperature goals:

33. Despite the DPD continually repeating that the project is aligned with net zero and global temperature goals, recent analysis by the International Energy Agency makes clear that new LNG facilities that will not come online past 2025 are not aligned with net zero. Further, LNG supply and trade must decline continuously from 2021 on in order to achieve net-zero globally by 2050.

34. The DPD states that one of the four purposes of the project is to provide lower carbon intensive energy to meet growing global energy demands and support lower global GHG emissions.[17] Further it says that the project will be one of the only net zero LNG facilities in the world and that it will align with limiting global warming to 1.5-2°C.[18]

---

[15] Lee, M. (2019) A *critical look at BC's new tax breaks and subsidies for LNG*, Canadian Centre for Policy Alternatives, accessed 12 Dec 2022 online, p.4; BC Hydro (2017) *BC Hydro Filing to the BCUC – Inquiry respecting Site C Clean Energy Project*, accessed 12 Dec 2022 online, pp.6 & 23.
[16] Lindsay, B. (Oct 2018) *Does B.C. need Site C to power massive LNG project?* CBC News, accessed 14 Dec 2022 online.
[17] Detailed Project Description, pp 3, 6.
[18] Detailed Project Description, pp 44, 212.

35. The DPD claims both to have cost-effective LNG that will help meet increasing global demand for LNG by 2040 while claiming to have a goal of meeting net zero targets and working towards net zero LNG production.[19] The DPD suggests that even if GHG emissions may increase in BC and Canada, global emissions from the project will decrease.[20]

36. In 2021, the International Energy Agency released its groundbreaking Roadmap to Net Zero report, which concluded, among other things, that no new fossil fuel expansion projects were needed as of 2021. In 2022, its World Energy Outlook affirmed and strengthened those conclusions, even with the energy crisis caused by the invasion of Ukraine.[21] Regarding gas demand, the World Energy Outlook concluded the following:

(a) To reach net zero, natural gas demand must drop 20% between 2021 and 2030 by 2050, drops to only 15% of demand for gas. Rates of decline in the 2030s are by 7% per year on average.[22]

(b) Natural gas fired electricity generation peaks in 2025.[23]

(c) Gas production must contract in a scenario where net-zero by 2050 is achieved. It will only need to increase in a scenario where the world fails to meet is temperature goals and we have warming of more than 1C.[24]

(d) <u>In a scenario where net zero is achieved, there is no need for additional LNG export capacity beyond what exists or is already under construction.[25]</u>

(e) Further, greenfield projects like LNG Canada that require additional infrastructure to connect to gas fields as the "upper end of the scale" of breakeven costs for LNG – meaning they are unlikely to be cost-effective in a net zero scenario.

[19] Detailed Project Description, p 30.
[20] Detailed Project Description, p 168.
[21] International Energy Agency, *World Energy Outlook 2022*, online.
[22] World Energy Outlook, pp 133, 370, 377.
[23] World Energy Outlook, p 139.
[24] World Energy Outlook, p 378.
[25] World Energy Outlook, p 383.

(f) There is doubt whether natural gas as a transition fuel in Asia as "natural gas now faces existential questions about its long-term future".[26]

37. This analysis clearly shows that the Ksi Lisims project, which will not come online until 2027 at the earliest is not aligned with net zero globally. BC has committed to net zero by 2050. In order to meet this policy, BC cannot also undermine the world's ability to meet net zero by approving projects that are not in line with a net zero scenario globally.

38. Given that there is no need for additional LNG export capacity globally, as supply must decrease between 2021 and 2030, Ksi Lisims would undermine its purpose of helping to achieve global climate targets and allowing BC to align with net zero by 2050.[27]

39. The Project must be terminated because it does not align with government net-zero policy. However if the Project is not terminated, the DPD must be revised to acknowledge that LNG demand must decline significantly to align with net zero. The current DPD says that LNG demand is growing out to 2040 according to the IEA;[28] however, it omits that the IEA also projects LNG demand and supply must decline significantly as of 2021 to meet the net zero target. LNG demand only would rise past 2030 if the world failed to achieve its temperature goals. The proponent must revise their DPD to respond to the IEA net zero scenario, otherwise they are justifying their demand projections based on a scenario where the world fails to meet their climate targets while claiming that the project is aligned with net zero. It is misleading for the project to say it is aligned with net zero but use natural gas demand scenarios based on the world failing to meet that target.

C. NATURAL GAS TO SUPPLY THE PROJECT IS NOT "CLEAN" OR "LOW-CARBON"

40. The DPD attempts to justify the Project by claiming that that gas it will use to produce LNG is "clean" and "low-carbon". The DPD does not substantiate this claim and evidence demonstrates this claim is false.

[26] World Energy Outlook, p 403.
[27] World Energy Outlook, p 370.
[28] Detailed Project Description, p xiv.

41. The DPD states that the Project will use Canadian natural gas from the Western Canadian Sedimentary Basin of northeastern BC and northwest/central Alberta as feedstock to convert into LNG. On several occasions the DPD refers to the natural gas that it will use as being "clean" or "low-carbon".[29]

42. The DPD does not define "clean" or "low-carbon" but, when used in relation to an energy source, "clean" usually means that the source is non-polluting, not harmful to human health, and does not impact the climate. "Low-carbon" also usually means that the energy source has a minimal impact on the climate. The DPD also does not calculate the upstream emissions associated with the Project, noting only that they are expected to exceed 500,000 tCO_2e, a value that will be refined at later date.[30]

43. The natural gas that the Project intends to use is not "clean" or "low-carbon" because of the climate impacts of upstream fugitive methane and the pollution that natural gas production causes, as explained below.

1) Natural gas has a significant climate impact from upstream fugitive methane

44. When considering the emissions that are released over the entire lifecycle of natural gas – production, transportation, processing, and combustion – the climate impact of natural gas is comparable to other fossil fuels.[31] Fugitive emissions – methane that leaks from natural gas production sites, pipelines, and processing machinery - contribute a significant share of natural gas lifecycle emissions. Natural gas production sites are typically the largest source of fugitive emissions in the natural gas lifecycle.[32] Fugitive emissions make a meaningful contribution to Canada's overall emissions; in 2020, fugitive methane emissions from oil and natural gas systems amounted to 7.5% of Canada's total emissions.[33]

---

[29] Detailed Project description, pp. xiii, xiv, 3, and 212.
[30] Detailed Project Description, pp.49-50.
[31] Schneising, O. et al. (2020). *Remote sensing of methane leakage from natural gas and petroleum systems revisited,* Atmospheric Chemistry and Physics, 20(15), p.9169-9182.
[32] The Atmospheric Fund (May 2022). *Fugitive Methane: New guidelines determine need to curb natural gas emissions in Ontario*, accessed 4 Sept. 2022 online ("TAF: Fugitive Methane Guidelines"), p.5; Hughes, J.D. (2020) *BC's Carbon Conundrum*, accessed 13 Dec 2022 online, p.48.
[33] Environment and Climate Change Canada (2022). *National Inventory Report 1990-2020: Greenhouse Gas Sources and Sinks in Canada*, accessed 5 Sept. 2022 online (p. 50).

45. However, it is likely that the full scale of fugitive methane emissions is unknown, in part because the natural gas industry and governments in Canada and around the world are not accurately tracking them. Recent studies show that fugitive methane emissions may be much higher than reported:

(a) In B.C. oil and gas facilities, methane emissions are 1.6-2.2 times greater than federal inventory estimates;[34]

(b) In Ontario, fugitive methane emissions are at least 90% higher than federal inventory estimates;[35]

(c) In Alberta, the majority of oil and gas emissions are unreported under current reporting requirements;[36]

(d) Globally, methane emissions are 25-40% higher than reported,[37] though other studies have found that methane emissions could be as high as 70% higher than reported.[38]

46. The climate impact of natural gas increases further when considering the significant impact of methane over the short-term. Methane only lasts 12 years in the atmosphere, while carbon dioxide lasts 300-1000 years. The standard timeframe for measuring the impact of GHGs on the climate is 100 years, known as "global warming potential 100" (GWP 100). This is what the Proponent uses in the DPD. Using this timeframe, methane is 30 times more effective than carbon dioxide at trapping heat in the atmosphere. However, measuring the impact of GHGs over

[34] Tyner, D., Johnson, M. (12 July 2021). *Where the Methane Is – Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data*, Environmental Science & Technology, 55(14), 9773-9783, accessed Sept. 2022 online.
[35] The Atmospheric Fund (May 2022). *Fugitive Methane: New guidelines determine need to curb natural gas emissions in Ontario*, accessed 4 Sept. 2022 online, p.4.
[36] Zavala-Araiza, D. et al. (2018). *Methane emissions from oil and gas production sites in Alberta, Canada*. Elementa: Science of the Anthropocene, 6.
[37] Hmiel, B. et al. (2020) *Preindustrial 14CH4 indicates greater anthropogenic fossil CH4 emissions*, Nature, 578 (7795), pp. 409-412.
[38] IEA Global Methane Tracker (n.d.). *Overview*, accessed Sept. 2022 online.

a 20 year time period – known as "global warming potential 20" (GWP 20) – methane is **at least 80 times** more effective than carbon dioxide at trapping heat in the atmosphere.[39]

47. Using GWP 20 to assess the impacts of methane is more accurate because it aligns better with its lifespan. It also better reflects the timeframe within which the international community has agreed to tackle climate change; we must reduce emissions drastically by 2050 in order to achieve the 1.5°C goal.

48. The figure below, from a report by The Atmospheric Fund, compares the climate impact of natural gas and different fossil fuels over 100-year and 20-year timeframes. It demonstrates the significant role of fugitive emissions in the climate impact of natural gas. [40]

[39] United Nations Environmental Programme (2021). *Methane Emissions are driving climate change. Here's how to redeuce them*, accessed 9 Sept. 2022 online.
[40] TAF: Fugitive Methane Guidelines

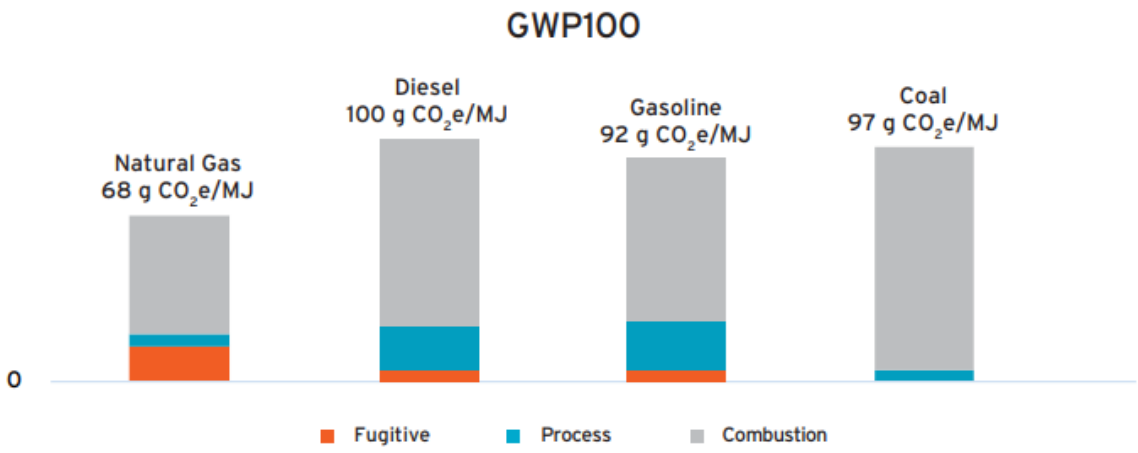


Figure 5: Comparison of the long-term impact of common fossil fuels, GWP100

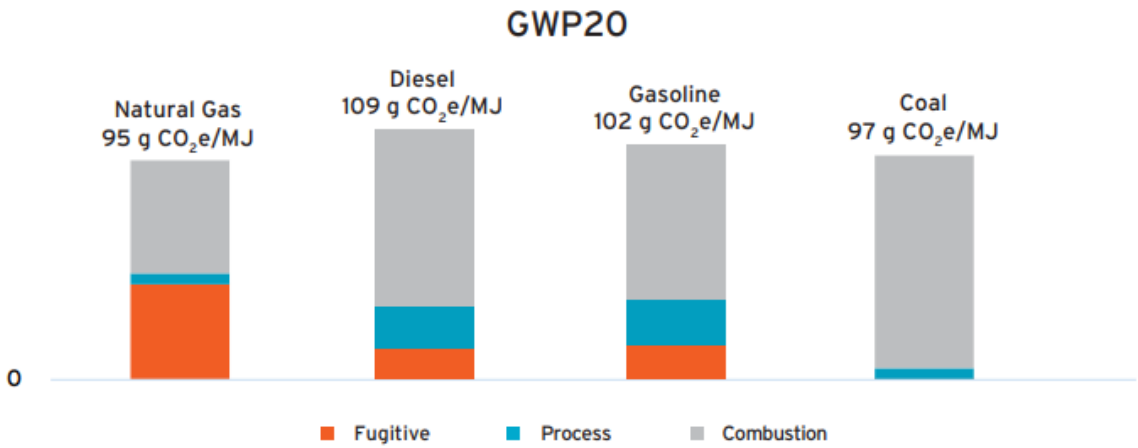


Figure 6: Comparison of the medium-term impact of common fossil fuels, GWP20

2. Natural gas production is highly polluting:

49. The production of natural gas causes negative environmental impacts – namely air and water pollution, which creates risks to human health. There are several sources of air pollution at a natural gas production site:

(a) diesel engines that emit nitrogen oxides (NO_X), fine particulate matter ($PM_{2.5}$), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs);

(b) flaring, the practice of burning of some natural gas at the production site, which generates CO_2, carbon monoxide, sulfur dioxide, NO_X, particulate matter (PM), and VOCs;

(c) general fugitive emissions that contain VOCs that come from the natural gas, and

(d) the volatilization of components of fluids that are used in fracking.[41]

50. In the United States, higher concentrations of hazardous air pollutants have been found around natural gas production sites, especially unconventional natural gas operations.[42] These pollutants include VOCs and NO_x (precursors of ground-level ozone), as well as radon, hydrocarbons, benzene, PAHs, and heavy metals. [43] Drilling wells can also lead to the release of naturally occurring radioactive materials into the air.[44]

51. The natural gas industry is a significant contributor to air pollution. In 2019, the Canadian oil and gas industry contributed 39% of total national emissions of volatile organic compounds; 37% of sulphur oxides; 30% of nitrogen oxides; and 11% of carbon monoxide.[45] The industry is also a source of fine particulate matter and ammonia. All of these have harmful effects on the environment – contributing to smog and acid rain, while also interfering with plant and crop growth, among other impacts.[46]

52. Natural gas production also pollutes local water sources. This can occur through the construction of natural gas well pads, pipelines, and access roads which cause the erosion of dirt, minerals, and other harmful pollutants into nearby waterways.[47] Gas production can contaminate groundwater with fracking fluids, methane, and VOCs.[48] This kind of water contamination, which occurs primarily through well leakages or improperly handled wastewater, can lead to negative impacts on regional drinking water quality.

---

[41] Macfarlane, R. & Perrotta, K. (2020). *Fractures in the Bridge: Unconventional (Fracked) Natural Gas, Climate Change and Human Health*, Canadian Associations of Physician for the Environment, accessed 9 Sept. 2022 online, ("Fractures in the Bridge"), p.18; US Energy Information Administration (2021). *Natural gas explained*, accessed 6 Sept. 2022 online.
[42] Macey, G.P. et al. (2014). Air concentrations of volatile compounds near oil and gas production: a community-based exploratory study. *Environmental Health*, *13*(1), pp.1-18.
[43] Fractures in the Bridge, p.3.
[44] Fractures in the Bridge, pp.14-15.
[45]Environment & Climate Change Canada (2022). *Air Pollutant Emissions,* accessed Sept. 2022 online:
[46] Environment & Climate Change Canada (n.d.). *Air pollution: drivers and impacts,* accessed Sept. 2022 online:
[47] Williams, H.F.L et al. (2008). *Field-based monitoring of sediment runoff from natural gas well sites in Denton County, Texas, USA*. Environmental Earth Sciences, 55(7), accessed 9 Sept 2022 online: DOI:10.1007/s00254-007-1096-9, pp.1463–1471.
[48] Union of Concerned Scientists (19 Jun 2014). *Environmental Impacts of Natural Gas,* accessed Sept. 2022 online.

53. Fracking poses a particular risk of water pollution due to the large volumes of water and numbers of toxic chemicals that it uses. Over 1,000 different chemicals have been used in fracking fluids, including some carcinogens, reproductive or developmental toxicants, or endocrine disruptors, though toxicity data is not available for many of these chemicals.[49] Fracking can contaminate surface water and groundwater through underground well leakages and spills, through leaks of chemical additives, diesel or other fluids from equipment on-site, and through wastewater from storage, treatment, and disposal facilities. [50]

54. Pollution from natural gas production poses serious risks to human health, including respiratory illnesses, cardiovascular disease, and impairments to infant and maternal health.[51] Fracking in Colorado, USA, has been linked to an increased risk of acute lymphocytic leukaemia (a form of cancer) among children whose mothers live in close proximity to oil and gas wells during pregnancy.[52] A study conducted in northeastern B.C. also found high levels of benzene metabolites in the urine of pregnant women who live in close proximity to fracking wells.[53] Benzene is a carcinogen and high levels of exposure in pregnancy is associated with low birth weight, an increased risk of childhood leukemia and a greater incidence of birth defects such as spina bifida.[54] Women, children, the elderly, Indigenous populations and racial and ethnic minority groups experience disproportionate health impacts from air, water and soil pollution associated with gas extraction and refining.[55]

3. Life Cycle Emission Reduction Claims are Poorly Supported and Require Fulsome Explanation:

[49] Fractures in the Bridge, p.14.
[50] Fractures in the Bridge, p.17.; Burton, G.A. et al. (2013). *Hydraulic fracturing in the state of Michigan: Environment/ecology technical report*. University of Michigan, accessed 9 Sept. 2022 online.
[51] Epstein, A.C. (2017). *The human health implications of oil and natural gas development*. In: Advances in chemical pollution, environmental management and protection (Vol. 1, p. 113-145). Elsevier.
[52] McKenzie, L. et al. (2017). *Childhood hematologic cancer and residential proximity to oil and gas development*, PLoS One 12(2), accessed 6 Sept. 2022 online.
[53] Caron-Beaudoin, É. et al. (2018). *Gestational exposure to volatile organic compounds (VOCs) in northeastern British Columbia, Canada: A pilot study*, Environment International 110 (2018): p.131-138, accessed 6 Sept. 2022 online.
[54] ScienceDirect (n.d.) *Benzene*, accessed 6 Sept. 2022 online.
[55] Hemmerling, S.A., DeMyers, C.A. and Parfait, J., 2021. Tracing the flow of oil and gas: a spatial and temporal analysis of environmental justice in coastal Louisiana from 1980 to 2010. Environmental Justice, 14(2), pp.134-145. Waldron, I.R., 2021. There's something in the water: Environmental racism in Indigenous & Black communities. Fernwood Publishing. p. 114

55. The DPD claims that the project will reduce emissions by over 45 Mt per year when you examine life cycle emissions of the project.[56] This is a bold claim founded on questionable assumptions. First, as described above, it is worth noting that even if the project would decrease emissions slightly in the near future, there is no support for the claim that it would be in line with the emission reductions necessary to achieve net-zero emissions globally by 2050. Expanding gas supply results in the construction of carbon intensive infrastructure that will continue to operate for decades – Ksi Lisims itself plans to operate past 2050. These long-term developments postpone the adoption of low-carbon energy and "lock-in" emissions for decades – at a time when we must be reaching net zero emissions globally by 2050. [57]

56. Further, the claim that the project will reduce emissions by over 45 Mt annually is based on the unrealistic assumption that all exported natural gas will displace coal. There is no way to guarantee that increased gas supply will be used to substitute coal.[58] Even if coal was switched for gas, fugitive emissions for gas must be below 3.2% to reduce emissions by switching to natural gas, despite current estimates in Canada being as high as 4.4%.[59]

57. The Project makes claims about reducing life cycle emissions without actually quantifying upstream or downstream emissions. The proponent has committed to assessing upstream and other "scope 3" emissions, but the DPD seems to suggest that it will not calculate downstream emissions (i.e., the emissions from the combustion of exported natural gas in Asia). In order to justify its life cycle emissions claim, the proponent at minimum must provide this information for upstream and all downstream emissions so that decision-makers and stakeholders can assess the assumptions behind this life cycle emission reduction claim.

D. CONCLUSION:

[56] Detailed Project Description, at 168.
[57] Horen-Greenford opinion, at p 9 (Council of Canadians Cedar LNG Submission).
[58] Horen-Greenford opinion, at p 20 (Council of Canadians Cedar LNG Submission).
[59] Horen-Greenford opinion, at p 21 (Council of Canadians Cedar LNG Submission); Alvarez, R. A., Pacala, S. W., Winebrake, J. J., Chameides, W. L., & Hamburg, S. P. (2012). Greater focus needed on methane leakage from natural gas infrastructure. *Proceedings of the National Academy of Sciences*, *109*(17), 6435–6440. https://doi.org/10.1073/pnas.1202407109; Johnson, M. R., Tyner, D. R., Conley, S., Schwietzke, S., & Zavala-Araiza, D. (2017). Comparisons of Airborne Measurements and Inventory Estimates of Methane Emissions in the Alberta Upstream Oil and Gas Sector. *Environmental Science & Technology*, *51*(21), 13008–13017. https://doi.org/10.1021/acs.est.7b03525.

58. Lax Kw’alaams does not consent to the recommendation under Section 16(2) of the 2018 Act by the EAO to the Chief Executive Assessment Officer (CEAO) that Ksi Lisims LNG proceeds to an Environmental Assessment.

59. Lax Kw’alaams submits the chief executive assessment officer must recommend the Minister issue a termination order as:

(a) According to section 16(2)(c)(i)(B), the Project will have extraordinary adverse effects on Lax Kw’alaams due to adverse impacts on the climate; and

(b) According to 16(2)(c)(iii), is clearly incompatible with a government policy, mainly BC’s climate related commitments.

60. In the alternative, Lax Kw’alaams submits the chief executive assessment officer must, at minimum, require the proponent to submit a revised detailed project description that addresses the concerns of Lax Kw’alaams as described above.

Appendix B:
Lax Kw’alaams DR Submissions 2 on EAE

LAX KW'ALAAMS SUBMISSION 2: EXTRAORDINARILY ADVERSE EFFECTS

February 14, 2023

2. PURPOSE

61. At a dispute resolution meeting of January 18, 2023, the parties agreed that Lax Kw'alaams would provide additional submissions regarding how the proposed Ksi Lisims LNG Project ("the Project") would have extraordinarily adverse effects ("EAE") on LKB's rights recognized and affirmed by section 35 of the *Constitution Act, 1982.*

62. These submissions provide the Environmental Assessment Office (EAO) and the Chief Executive Assessment Officer (CEAO) with the Lax Kw'alaams perspective regarding extraordinarily adverse effects the Project will have on LKB rights. Lax Kw'alaams supports a recommendation to the Minister that the environmental assessment (EA) for the Project be terminated pursuant to applicable provisions of the *Environmental Assessment Act*.

3. INTERPRETATION OF S. 16(2)(c)(i)(B) OF THE *ENVIRONMENTAL ASSESSMENT ACT, (SBC 2018)*

63. The Supreme Court of Canada requires the interpretation of legislation that relates to Indigenous rights be interpreted and applied in a broad manner, especially where the abrogation and/or preservation of rights is concerned.[60] Section 16(2)(c)(i)(B) of the *Environmental Assessment* Act, (SBC 2018) states that if the Chief Executive Assessment Officer ("the CEAO") considers that a

[60] *Nowegijick v. The Queen*, [1983] 1 S.C.R. 29 at page 36; and, *Mitchell v. Peguis Indian Band*, [1990] 2 S.C.R. 85 at 98.

project will have EAE on an Indigenous nation or right recognized and affirmed by section 35 of the *Constitution Act, 1982* the CEOA will recommend the Minister issue a project termination order.

64. For Lax Kw'alaams, evaluation under section 16(2)(c)(i) of the potential for the Project to cause extraordinarily adverse effects must address the following factors:

(a) The Project's contribution to climate change and global heating

(b) The Project's outsized contribution to cumulative effects within the region (considering other fossil fuel projects)

(c) The Project's adverse impact to multi-generational continuity of Lax Kw'alaams mode-of-life

65. Lax Kw'alaams also submits that the assessment of EAE be informed by the the EAO's obligation under section 2(2)(ii) to support reconciliation, and the obligation under section 2(2)(i) to promote sustainability by protecting the environment and fostering a sound economy.

66. The EAO has stated that the CEAO will, in the context of s. 16(2)(c)(i)(B), consider whether the Project will have unmitigable adverse effects such that there is no value in carrying out an environmental assessment. LKB cautions the EAO against reading-in statutory interpretation that would narrowly interpret s. 16(2)(c)(i)(B) insofar as LKB section 35 rights are concerned, as per direction of the Supreme Court of Canada. For reasons set out below, LKB submits that the effects and impacts of the Project emissions, resulting in atmospheric temperature increases, climate change, and cumulative effects will have EAE that cannot be

mitigated on LKB's rights recognized and affirmed by section 35 of the *Constitution Act, 1982*.

67. The Act provides no definition or guidance for the term "extraordinarily" when used in s. 16(2)(c)(i). For Lax Kw'alaams, this term must be read in its plain and ordinary meaning. Black's law dictionary defines the term as follows: "Beyond what is usual, customary, regular, or common". Mirriam Websters dictionary defines the term as follows: "going beyond what is usual, regular, or customary." Lax Kw'alaams imports no weight to the adverb form used in the statute.

68. The EAO has a significantly more stringent definition that relies on the threshold of 'unmitigable' adverse effects. Lax Kw'alaams submits this is not consistent with the statute. Unmitigable is a significantly higher standard then extraordinary. If the legislature intended this higher standard the statute would have been written differently or the term defined as such. The plain and ordinary meaning of this term is simply beyond what is usual, regular, or common.

69. For Lax Kw'alaams, the Projects effects on Lax Kw'alaams rights are certainly beyond what is usual, regular, or common.

70. Lax Kw'alaams submits that factors such as timing, duration, magnitude, geographic extent, frequency, reversibility, can be helpful.

71. In the context of the Project:

(a) Timing: the Project is proposed during a critical moment in human history when GHG levels are unprecedented. Extraordinary efforts are required to curb GHG emissions to ensure Lax Kw'alaams territory can sustain future generations in the context of potential,

and likely, catastrophic climate change. Timing of this project is poor.

(b) Duration: the Project will facilitate the emission of GHGs for decades. Decades of emissions is a poor duration in the context of reducing GHG emissions and protecting Lax Kw'alaams rights.

(c) Magnitude: the magnitude of emissions associated with this Project is immense. The magnitude of the projects effects far exceeds what is reasonable to protect and steward Lax Kw'alaams rights.

(d) Geographic Extent: The Project's adverse climate related effects touch every inch of Lax Kw'alaams territory. It is impossible to imagine a larger geographic extent of Project effects.

(e) Frequency: the GHG emissions from the project will be effectively constant and get worse over time.

(f) Reversibility: the reversibility of the Projects effects is not certain, and likely not possible in the span of a single century. All efforts made so far to curb GHG induced climate change have failed to reverse the gradual warming of Earth.

72. For Lax Kw'alaams it is patently obvious this Project will cause EAE as described.

73. Although Lax Kw'alaams does not accept the EAO's policy framework for EAE as outlined by the EAO. Lax Kw'alaams submits the Projects effects nevertheless meet all criteria outlined. The Project's effects will be unmitigable, will be extreme relative to other large industrial projects for a similar cost and

duration, and the existing cumulative effects of climate change on Lax Kw'alaams rights are already unacceptable to Lax Kw'alaams.

4. EXTRAORDINARILY ADVERSE IMPACTS TO LAX KW'ALAAMS S.35 RIGHTS

(a) GHG Emissions and Climate Impacts

74. Indigenous peoples are disproportionately affected by the impacts of climate change.[61] Climate change, driven by increasing concentrations of GHGs in the atmosphere, fundamentally alters many environmental parameters that dictate the abundances and distributions of species, the stability and productivity of ecosystems, and the ecosystems services and functions that Lax Kw'alaams relies on. These effects have profound implications for Lax Kw'alaams' rights and interests, including the maintenance of harvesting practices for food, social, cultural and economic purposes, as well as community infrastructure, safety, and resilience.

75. The residual effects from Project related GHG emissions will be global, long-term, continuous, and irreversible. Lax Kw'alaams first written submission provides ample evidence on GHG related issues with the Project.

76. The Province of British Columbia ("the Province") has implemented policy and enacted legislation to address climate change through emission reduction requirements and a firm transition to a low carbon economy.[62] Scientific consensus has confirmed that failure to take urgent steps will lead to catastrophic consequences.

---

[61] BC AFN Climate Strategy <https://www.bcafn.ca/sites/default/files/2022-04/BCFNCSAP%20Final%20Draft%20%2822April2022%29.pdf>.
[62] Clean BC - https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/energy-efficiency/cleanbc_roadmap_2030.pdf

77. The Province has legislated targets for reducing greenhouse gas emissions 40% below 2007 levels by 2030, 60% by 2040, and 80% by 2050. The Province also has an interim target to reduce emissions 16% by 2025, and the Province established 2030 emission reduction targets sectors, with 2007 as the baseline – the oil & gas industry is required to reduce by Oil and gas, 33-38%.[63]

78. The mere fact the Province has set legislation and aggressive policies to address climate is evidence the EAO must take the catastrophic and extraordinary effects and impacts of GHG emissions very serious, especially when it comes to the constitutionally recognized and affirmed rights of an Indigenous nation.

79. Terrestrial and marine harvesting activities were, and continue to be, central and integral to the people of Lax Kw'alaams economy and way of life. The traditional seasonal round of subsistence activities across a reliable and productive ecosystem have enabled the people of Lax Kw'alaams to access a consistent supply of resources, securing food, medicines, and materials (DMCS and Lax Kw'alaams Band 2019). Surplus production was used strategically for feasting and trade purposes (Anderson 2006). Feasting is an integral part of cultural practices and is a key component of the people of Lax Kw'alaams governance system, which requires substantial amounts of culturally important harvested resources (DMCS and Lax Kw'alaams Band 2019; Kwon and Roberts 2019).

80. The marine environment is critically important to Lax Kw'alaams harvesting practices, culture and economy. Key marine and intertidal species harvested include, but are not limited to salmon (chinook, chum, coho, pink, sockeye, spring), other fish species (abalone, char, cod, halibut, trout, eulachon,

[63] https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/legislation

lingcod, red snapper, herring), and shellfish (butter clam, Chinese slippers, cockles, crabs; DMCS and Lax Kw'alaams Band 2019). Other marine resources traditionally harvested by Lax Kw'alaams include marine mammals (seals, sea lions, sea otters), birds (black ducks, mallard, seagulls, swans, Canada geese), seagull and oystercatcher eggs, herring roe, multiple varieties of marine plants (red laver seaweed, bull kelp, giant kelp, seagrass, sea prunes), and a variety of other marine species such as octopus, eel, shrimp and prawn, crab, sea cucumber, barnacle, snail, sea urchin, and squid (DMCS and Lax Kw'alaams Band 2019, British Columbia Environmental Assessment Office 2015).

81. Terrestrial harvesting activities involve, but are not limited to hunting key species such as mountain goat, beaver, deer, elk, sheep, mountain lion; trapping lynx, hare, porcupine, mink, beaver, marmot, muskrat and fox; and gathering a wide variety of plant species for food, medicine, and tool and material manufacture. Key plant gathering species include trees such as alder, balsam, birch, cottonwood, fir, hemlock, pine, red cedar, Sitka spruce, spruce, western hemlock, willow, yellow cedar and yew, key shrubs such as fireweed, cow parsnip, crabapple, licorice fern, devil's club, deer fern, Hudson Bay tea, Indian Hellebore, mint, plums, rice root, stinging nettle, and berries including blueberries, cranberries, huckleberries, raspberries, salal berries, salmonberries and wackleberries (DMCS and Lax Kw'alaams Band 2019).

82. The people of Lax Kw'alaams' ability to practice marine and terrestrial harvesting activities have been impacted by colonial policies, industrial activities and major developments (Kwon and Roberts 2019). LKB continues to rely on marine and terrestrial harvesting activities for food, social and ceremonial purposes with a majority of members reporting actively participating in these harvesting activities (Kwon and Roberts 2019).

83. In a survey of LKB members, over 53% of respondents felt that the impacts of climate change to the community have been felt most through changes in ocean life. Forty eight percent (48%) reported changes in storm surges, 43% reported changes to wildlife, and 41% noted food security as impacts to the community associated with climate change (Lax Kw'alaams 2022). Other impacts reported by survey respondents included shoreline erosion (28%), flooding (21%), changes to vegetation (18%), and evacuation alerts (14%) (Lax Kw'alaams 2022).

E. FISHING

84. For generations, and until the present, LKB members have, throughout LKB traditional territory, fished numerous shellfish, fish and aquatic plant species that remain central and integral to LKB culture, sustenance and way of life. Vital fish species include salmon (sockeye, coho, spring), eulachon, cod, halibut, snapper, herring, trout, among other species.

85. Shifts in glacial, snowpack, and rainfall contributions to freshwater systems under changing climatic conditions can have profound effects on watersheds and the many species that depend upon these freshwater systems for the completion of their life cycle, including fish species harvested by LKB members. These impacts arise from a variety of effects associated with human-driven climate change, including but not limited to changes in stream flow, changes in stream temperature, and changes in the relative timing of biological events.

86. As climate change shifts the region towards drier summers and wetter falls and winters, the Skeena River mean annual discharge is expected to rapidly increase between 2011-2040 due to increasing ice melt. In the latter half of the century, discharge is predicted to decrease or stabilize, as ice melt contributions

decline and are offset by increasing rainfall contributions. These trends will result in an intensification of seasonality in Skeena river discharge, with two distinct peaks occurring during the primary spring freshet and a late summary secondary flow peak resulting from increasing precipitation (Wild et al. 2022). Rapid decreases in stored water (as snow) are predicted as climate warming progresses in the Skeena river watershed. The frequency of below-normal stored water conditions, and the frequency of hot and wet snow drought conditions, are projected to steadily increase as global mean temperatures rise (Shrestha et al. 2021).

87. Drier summertime conditions with reduced stream flow rates can elevate water temperatures, heighten the risk of disease in summer-migrating Pacific salmon, introduce thermal migration barriers and thermally stressful waters for salmon, decrease their likelihood of reproductive success, and alter phenological cues and migration timing (Mantua, Tohver, and Hamlet 2010; Carr-Harris et al. 2018). Extreme flooding events and heightened winter stream flows, on the other hand, can cause mass-mortality events in salmon and zooplankton populations, significantly alter community compositions post recovery, and potentially hinder egg-to-fry survival rates (Milner et al. 2013; Mantua, Tohver, and Hamlet 2010).

88. Sockeye salmon populations in the Skeena River watershed have a high degree of phenological diversity in smolt migration timing. Additionally, their zooplankton prey items have highly variable and seasonal abundances which affect their availability to migrating salmon (Carr-Harris et al. 2018). The timing and magnitude of critical nutrient subsidies are influenced by rainfall and glacial inputs which may be altered by shifts in the timing of peak outflow events under changing climatic conditions (Wipfli and Baxter 2010). The potential for further decoupling of phenological cues, critical nutrient subsidies, environmental

conditions, and the life-history strategies of Pacific salmon and key prey species threatens the resilience of local salmon populations.

89. Shifting streamflow, nutrient, and water temperature regimes under human-driven climate change scenarios pose a threat to the maintenance of critically important freshwater resources, including Pacific salmon species (Shanley et al. 2015). The historical abundance of Skeena River chum (Oncorhynchus keta) is estimated to have been 39-52 times larger than the estimated abundance from 2007-2010. Similarly, sockeye (Oncorhynchus nerka) populations in the Skeena River are estimated to have declined by 56% to 99%, with particularly notable declines in larger fish due to size-selective fishery practices (Price et al. 2019; Price, Gayeski, and Stanford 2013). It is critical to note that the impacts of climate change to Pacific salmon are not occurring in isolation, but rather are acting on populations that have been severely diminished by commercial fisheries and other cumulative effects, threatening their resilience and recovery (Pauly 1995). Decades of overfishing pressure coupled with intensifying human-driven climate change will exacerbate the impacts of environmental variability on salmon within the Skeena River. These upstream consequences resulting from climate change will further affect the ability of LKB members to utilize these resources in accordance with traditional norms, protocols, and rights-based needs.

90. Oceanic warming and marine heatwaves also affect offshore and subtidal marine resources. “The Blob,” a 2014 oceanographic anomaly that persisted along the coast of the Northeast Pacific, produced anomalously high sea surface temperatures that exceeded 4.5 standard deviations above mean anomaly values and whose thermal legacy persisted in the region into 2017. Nearby deep water glacial fjords have warmed by 0.8°C and have similar thermal legacies following marine heatwaves (Jackson et al. 2018; 2021). Average sea surface temperatures

are expected to increase by 0.5°C to 2.0°C along the BC continental shelf by 2065-2078, relative to sea surface temperatures in 1995-2008, and ocean bottom temperatures are expected to increase by up to 3.5°C along the North Coast by 2100 (Franco et al. 2022). As ocean temperatures rise, the seawater's capacity to store dissolved oxygen declines. Decreasing dissolved oxygen can have substantial metabolic impacts to marine species (Franco et al. 2022).

91. As climate change progresses, marine warming is expected to affect the abundances and distributions of marine species, with implications for coastal First Nations. Along the North Coast of BC, the relative catch potential of critical species such as eulachon, Pacific salmon, Pacific halibut, and Pacific herring are all expected to significantly decline under modelled climatic conditions (RCP2.6 and RCP8.5)[64] as species become less locally abundant and their ranges shift northward (Weatherdon et al. 2016). This declining catch potential can have damaging consequences to LKB members' harvest at traditionally-expected rates (Weatherdon et al. 2016). Impacts to traditional foods as a result of climate change have the potential to result in reductions to the nutritional and health benefits associated with these foods for LKB members (Bernhardt and O'Connor 2021).

92. Beyond the isolated effects of ocean acidification, increasing temperatures, and deoxygenation, the interactions among these stressors are also a critical consideration in the context of climate change impacts. Interactions among environmental stressors can result in synergistic effects – giving rise to impacts greater than the individual stressors' effects (i.e., impacts greater than the sum of its parts). Low oxygen concentrations, for example, can hinder a species'

[64] Representative Concentration Pathways – greenhouse gas concentration pathways as projected by the Intergovernmental Panel on Climate Change (IPCC) modelling under differing future greenhouse gas emissions.

ability to cope with a heatwave (Kroeker, Kordas, and Harley 2017; Crain, Kroeker, and Halpern 2008). Considered together, oceanic warming and deoxygenation are expected to significantly reduce the amount of viable Pacific halibut (*Hippoglossus stenolepis*) in the Northeast Pacific and force populations northward towards Alaska (Franco et al. 2022). The harvesting of marine resources, such as seaweeds, relies heavily on interactions between the life history strategies of target species and local environmental stressors (Turner and Clifton 2009). The combined effects of declining abundances, range shifts, phenological mismatches, and reduced fitness in traditionally harvested marine resources pose a direct and substantial threat to Lax Kw'alaams rights and interests.

F. HARVESTING AND GATHERING MARINE RESOURCES

93. For generations, and until the present, LKB members have, throughout LKB traditional territory, harvested an abundance of sea and marine resources that remain central and integral to LKB culture, sustenance and way of life. Vital sea marine species included clams, cockles, mussels, prawn, crab, octopus, sea cucumber, sea urchins, spawn on kelp, seaweed, and other species.

94. Increasing GHG concentrations from anthropogenic emissions, and the resulting climatic changes, pose a variety of threats to marine productivity and harvesting opportunities for shellfish and aquatic plants. These impacts include, but are not limited to: the effects associated with ocean acidification; ocean warming and marine and terrestrial heatwaves; deoxygenation; and phenological shifts (changes in the timing of biological events). Lax Kw'alaams Band members have identified changes to marine life as a key impact of climate change on the community (Sydneysmith, Telsuk, and Piggot 2021).

95. Ocean acidification, driven by the absorption of atmospheric carbon dioxide, reduces the availability of aragonite and calcite in the water, which are essential to shell formation. Effects to shell-forming species, such as clams, scallops, abalone, and geoduck, can range from physiological changes or reduced growth to mortality (Kroeker et al. 2013). Oceanic currents on the coast of the Northeast Pacific cause upwelling events that can drastically reduce pH at shallow depths (< 125 m). The timing of these upwelling events, which occur primarily in the spring and summer months, coincides with important periods for the growth and productivity of shell-forming larvae. Ocean acidification will exacerbate the drop in pH experienced by shellfish in the region during upwelling events, with implications for their growth, fitness, and ability to detect predators. Shellfish species affected by acidified waters may become less abundant, smaller and less nutritionally and calorically sufficient for subsistence needs (Kroeker et al. 2013).

96. For intertidal zone species such as shellfish and eelgrass, terrestrial climate warming and heatwaves also pose a substantial risk to the abundances of these species and their ability to perform key ecological functions. The physiology and fundamental biological rates of these species are heavily dictated by environmental temperatures (Somero 2005; Tomanek and Somero 1999; Kaldy 2014). The vertical distribution of species in intertidal zones can be restricted as warming temperatures makes previously inhabitable intertidal habitat uninhabitable as thermal and desiccation stress increase. These dynamics can fundamentally alter species interactions and produce community-level responses that affect the health and productivity of intertidal ecosystems (Harley 2011). The prevalence of eelgrass wasting disease, for example, is strongly linked to higher seawater temperatures, and warm summertime temperatures can drive harmful outbreaks (Groner et al. 2021). As many species in the intertidal zone are sessile, or limited in their mobility, they lack the ability to avoid these conditions or

relocate during stressful low tides. If aerial heatwaves coincide with daytime low tides, significant mortality events can occur, such as those observed in the Salish Sea during the 2021 heat dome experienced by much of the Northeast Pacific (Raymond et al. 2022). Climate change is expected to increase the frequency and intensity of heat dome events (Perkins-Kirkpatrick and Lewis 2020). If a similar heat dome event were to occur within Lax Kw'alaams traditional territory as human-driven climate change progresses, intertidal zone communities and culturally important species may be significantly damaged as a result.

97. Recently leading experts in marine and aquatic resources and science, including esteemed professor Dr. Chris Harley of Institute for the Oceans and Fisheries and the University of British Columbia's Department of Zoology, have determined that the effects of climate change, such as recent heat waves in the north coast of British Columbia, are having harmful and catastrophic effects on the ocean, rivers, and lakes.

98. A unprecedented *heat dome* event in 2021 led to the destruction of marine ecosystems, biological communities and shoreline species such as clams and mussels due water temperatures that ranged from18 degrees C up to as high as 56.7 degrees C in mussel beds near very hot marine rocks, with even the most tolerant of species not being able to survive in temperatures higher than approximately 46 degrees C.[65] Low tides and hot temperatures caused extraordinary and catastrophic among of animals such as crabs, snails, sea stars, mussels, fish, and many other marine plant species including seaweed or rockweed (which countless microorganism species essential to and relied upon by the larger marine ecosystem) to die or be destroyed.

[65] https://oceans.ubc.ca/2021/07/21/record-breaking-heatwaves-aquatic-biodiversity-and-human-communities-bc-and-beyond/.

99. Based on physical scientific evidence, experts concluded the recent heat weather event on the North Coast, including Lax Kw'alaams territory, was coast was a result of climate change, and that continued GHG emissions will increase frequency of these hot weather events in the coming years.[66]

G. HUNTING AND TRAPPING

100. For generations, and until the present, LKB members have, throughout LKB traditional territory, hunted an abundance of mammals and ungulates that remain central and integral to LKB culture, sustenance and way of life. Vital hunting and trapping species include moose, goat, sheep, deer, elk, duck, hare, porcupine, sea otter, lynx, otter, mink, marmot, muskrat, beaver, and fox.

101. Lax Kw'alaams Band members have identified changes to wildlife as a key impact of climate change (Lax Kw'alaams 2022). The abundance, health, and distribution of wildlife and birds have been affected by changing climatic conditions. Changes in the health and behaviour of bears and wolves, for example, have been attributed to unusual weather patterns (Turner and Clifton 2009). At a global scale, species distributions have shifted poleward with warming temperatures (Parmesan and Yohe 2003). Species that occur within Lax Kw'alaams territory at the southernmost extent of their range may be lost from this area if these trends continue.

102. Changes in the timing of key events, such as migrations, breeding activity, nesting, and springtime bud burst have generally shifted towards earlier in the season (Root et al. 2003). The breeding season of the common murre (Uria aalge), for example, has shifted in its onset by a dramatic 24-days per decade within the past 50 years (Root et al. 2003). Harvesting practices are often guided by

[66] Ibid.

environmental cues, which are used to gauge when to pick certain berries and when to fish or hunt for specific game (Turner and Clifton 2009). Changes in the timing of biological events have the potential to decouple resource availability from harvesting cues and protocols, including other harvesting and processing requirements.

H. HARVESTING FOREST RESOURCES AND GATHERING AND CULTIVATING PLANTS FOR FOOD AND MEDICINAL PURPOSES

103. Terrestrial plants and wildlife are an important part of the traditional seasonal round of Tsimshian subsistence activities. Key plant gathering species include trees such as alder, balsam, birch, cottonwood, fir, hemlock, pine, red cedar, Sitka spruce, spruce, western hemlock, willow, yellow cedar and yew, key shrubs such as fireweed, cow parsnip, crab apple, licorice fern, devil's club, deer fern, Hudson Bay tea, Indian Hellebore, mint, plums, rice root, stinging nettle, and berries including blueberries, cranberries, huckleberries, raspberries, salal berries, salmonberries and wackleberries (DMCS and Lax Kw'alaams Band 2019).

104. Lax Kw'alaams Band members rely on the environmental conditions required to maintain seasonal abundances of particular resources, such as berries, medicines, and game. Changes to vegetation are among the impacts identified by LKB members as a result of climate change (Lax Kw'alaams 2022).

105. Shifting weather patterns threaten the integrity of ecosystems and plant communities of high importance to the maintenance of Tsimshian practices. Yellow cedar (Callitropsis nootkatensis), for example, is highly valued for a wide range of traditional uses, from the construction of vessels and paddles, to tool handles and totem poles. Yellow cedar is well recognized for its ecological,

cultural, and commercial worth. This species, however, relies heavily on snow cover to protect its shallow roots from cold winter temperatures. With rising temperatures, less snowpack covering the ground, and shifting precipitation patterns, there has been widespread mortality of yellow cedar along the coast of BC and Alaska (Buma et al. 2017). By the end of this century, approximately 50% of the area that currently has a suitable climate for yellow cedar is expected to warm beyond that threshold (Buma et al. 2017).

106. Altered interactions among plants, insects, and wildlife pose a further threat to the integrity of these communities under shifting climatic conditions. Warmer summers and milder winters, for example, have contributed to severe outbreaks of pine beetle infestations east of Lax Kw'alaams territory (Raffa et al. 2008). Under shifting weather patterns and changing growing conditions, native plant species may struggle to adapt or cope with new environmental stressors, providing opportunities for introduced species to outcompete local flora. Increases in non-indigenous plants, and particularly 'noxious' weeds that are harmful or injurious to human health or physical well-being, can threaten the productivity and sustainability of subsistence activities.

I. CULTURAL SITES, INFRASTRUCTURE AND SAFETY

107. Climate change poses a threat to the integrity of cultural sites and the infrastructure of coastal communities, as well as the health and safety of community members. Increased storminess, sea level rise, and flooding are key concerns for communities on the north coast of BC.

108. Storm intensities in the North Pacific have increased from 1940 to 1998. As air and ocean temperatures increase and meteorological patterns of circulation are affect, it is anticipated that storms may become more frequent and intense

(Thomson, Bornhold, and Mazzottie 2008; Dolan and Walker 2004; Whitney et al. 2020). Remote and coastal communities face unique challenges and hazards when faced with coastal storms, given that support services and infrastructure, including rescue services, communications, are often much more logistically challenging (Wall and Marzall 2006; Dolan and Walker 2004). Increasing storm intensities in Lax Kw'alaams traditional territory pose unique and complex challenges for the community due to its geographic context.

109. Rising sea levels, as a result of melting ice sheets and glaciers combined with warming seawater temperatures, amplifies the impacts of storm activity. Sea levels in Prince Rupert have risen by approximately 13 centimetres between 1910 – 2014 and are projected to rise by an additional 25 centimetres by 2100 (Indicators of Climate Change for British Columbia, 2016 Update 2016). Higher water levels in the nearshore environment increase the height and energy of waves as they strike the coast. The combination of rising sea levels and storms therefore increases the risk of storm-surge flooding. This has the potential to be highly destructive to nearshore infrastructure and can result in substantial erosion and structural damage. Cultural sites have also experienced erosion associated with these events, leading to the loss of important areas and cultural artifacts. Over the long-term, sea level rise may result in an increased risk of coastal flooding, even in the absence of storm surges (Vadeboncoeur et al. 2016).

110. Under changing climatic conditions, flooding risks may increase not only because of coastal storms and sea level rise, but also due to changes in precipitation. Atmospheric rivers and extreme rainfall events are projected to become more frequent and intense within Lax Kw'alaams traditional territory as a result of human-driven changes in climatic conditions (Radić et al. 2015). Climatological modelling (under RCP4.5) predicts that autumn extreme atmospheric river events in BC will increase in frequency from 23 events between

1974-2004 to 91 events between 2070-2100. Additionally, extreme atmospheric rivers that make landfall in BC are projected to move further northward, bringing more extreme shifts in precipitation to Lax Kw'alaams traditional territory (Radić et al. 2015). The risk of flooding associated with these events is further exacerbated by increases in the extent and intensity of wildfires, which reduce the forest's ability to absorb rainfall and buffer high stream flows (Jakob and Hungr 2005; Jordan et al. 2006).

111. Flooding events can contribute to significant infrastructure damage through washouts and debris flowing downstream (Sepúlveda et al. 2022). In BC, at least one extreme flooding event per year has occurred since 2001, with some of the costliest natural disasters in Canadian history resulting from floods (Vadeboncoeur et al. 2016). The increased risk of flooding due to climate change poses a threat to the community's infrastructure, the safety of Lax Kw'alaams members, and the ability of members to exercise their rights to traditional practices and resource harvesting at culturally and ecologically appropriate times.

J. CUMULATIVE EFFECTS AND CLIMATE CHANGE

112. Cumulative pressures and development in LKB traditional territory have affected the quantity, quality, and access to harvesting certain resources. Post-contact, the Allied Tribes of Lax Kw'alaams engaged and prospered from ongoing economic trade and sale of natural resources, with commercial fishing driving the economies of most Nation members in the 1900s.

113. Since the 1940s, increasing industrialization in Lax Kw'alaams territory (Kwon and Roberts 2019), along with other pressures such as overfishing, increased competition, harvesting regulations pollution and climate change, combined to create increased cumulative pressures on harvesting resources, and

therefore on LKB self-sufficiency and economy (Kwon and Roberts Band 2019). Many LKB members continue to operate in the commercial fishing sector, members note concerns over declines in fish stocks and revenue, reduced access to harvesting areas, and potential impacts of the lack of access to commercial fishing equipment and continuity of knowledge associated with commercial fishing (Kwon and Roberts 2019). As a result, the people of Lax Kw'alaams have both struggled economically as well as shifted the attention and focus of economic self-sufficiency to other sectors of the modern economy.

114. Cumulative effects of these multiple sources of impacts over different time periods reduced access to harvesting sites, quality of the harvesting experience, as well as the quality and the quantity of resources. When compared to pre-contact baselines, present environmental conditions and limitations are already constituting serious infringement on the people of Lax Kw'alaams ability to use the land (Kwon and Roberts 2019).

115. Cumulative pressures have impacted LKB members' ability to practice terrestrial harvesting activities throughout the territory, reaching higher levels of significance in areas with dense development and areas where access restrictions apply. Although community members continue to practice seasonal pattern of harvesting activities such as hunting and trapping throughout the territory, community members have repeatedly identified trends depleting member's ability to harvest.

K. CONCLUSIONS

116. It is regrettable that it appears the EAO has so far not conducted a substantive evaluation of the Project to support the EAO's current position regarding EAE.

117. Lax Kw'alaams submits there is sufficient information to conclude the Project will cause EAE. The Project will contribute to unmitigable impacts on Lax Kw'alaams rights due to an outsized contribution to climate change and global heating. This Project will result in significant adverse cumulative impacts that are far greater in scope, intensity and duration than any comparable project. Lax Kw'alaams routinely supports and participates in large infrastructure projects that do not extraordinarily contribute to these adverse effects.

118. Lax Kw'alaams must ensure that Lax Kw'alaams rights are available to future generations of Lax Kw'alaams people. Lax Kw'alaams cannot ignore the, once amorphous, now immediate and real effects of climate change. It is patently obvious to Lax Kw'alaams that fossil fuel infrastructure contributes an outsized impact to climate change.

119. The Project does not promote sustainability as defined in section 2(2)(i) of the Act. As Lax Kw'alaams submissions outline, the Project cannot be approved in a manner consistent with protecting the environment. The Project will leave a multi-generational legacy of pollution.

120. The Project is inconsistent with the EAO's obligation to support reconciliation with Lax Kw'alaams pursuant to section 2(2)(ii). Lax Kw'alaams has consistently and clearly outlined its concerns and opposition to the Project. A recommendation to continue with an EA contrary to evidence and Lax Kw'alaams consent is colonialism manifest; contradicting *UNDRIP* and reconciliation.

121. Ocean warming and marine heatwaves, ocean acidification, deoxygenation, and the interactions among these GHG-induced stressors threaten the abundances and distributions of marine and terrestrial resources that are critically important to the ways of life and rights-based practices of LKB

members. Shifting patterns of precipitation, snow accumulation and melt, and stream flows can substantially alter biogeochemical processes and environmental conditions within rivers and streams in Lax Kw'alaams traditional territory. Such changes pose a substantial risk to vulnerable Pacific salmon populations, with implications for the freshwater and terrestrial communities that depend on them for an annual influx of rich marine nutrients transported by their migration to spawning streams. Shifting weather patterns and climatic changes also threaten the integrity of plant and wildlife communities – with implications for the distribution, abundance, health, and phenological patterns of species in Lax Kw'alaams traditional territory. Climate change has and will continue to increase the frequency and intensity of storms and atmospheric river events in Lax Kw'alaams traditional territory. Increases in the frequency of extreme weather events, coupled with sea level rise, put critical infrastructure and the safety of LKB members at risk.

Works Cited

Bernhardt, Joey R., and Mary I. O'Connor. 2021. "Aquatic Biodiversity Enhances Multiple Nutritional Benefits to Humans." *Proceedings of the National Academy of Sciences* 118 (15): e1917487118. https://doi.org/10.1073/pnas.1917487118.

Buma, Brian, Paul E. Hennon, Constance A. Harrington, Jamie R. Popkin, John Krapek, Melinda S. Lamb, Lauren E. Oakes, Sari Saunders, and Stefan Zeglen. 2017. “Emerging Climate-Driven Disturbance Processes: Widespread Mortality Associated with Snow-to-Rain Transitions across 10° of Latitude and Half the Range of a Climate-Threatened Conifer.” *Global Change Biology* 23 (7): 2903–14. https://doi.org/10.1111/gcb.13555.

Carr-Harris, Charmaine N., Jonathan W. Moore, Allen S. Gottesfeld, Jennifer A. Gordon, William M. Shepert, James D. J. Henry, Harvey J. Russell, Wade N. B. Helin, David J. Doolan, and Terry D. Beacham. 2018. “Phenological Diversity of Salmon Smolt Migration Timing within a Large Watershed.” *Transactions of the American Fisheries Society* 147 (5): 775–90. https://doi.org/10.1002/tafs.10068.

Crain, Caitlin Mullan, Kristy Kroeker, and Benjamin S. Halpern. 2008. “Interactive and Cumulative Effects of Multiple Human Stressors in Marine Systems.” *Ecology Letters* 11 (12): 1304–15. https://doi.org/10.1111/j.1461-0248.2008.01253.x.

Dolan, A H, and I J Walker. 2004. “Understanding Vulnerability of Coastal Communities to Climate Change Related Risks.” *Journal of Coastal Research*, no. 39.

Foreman, M.G.G., W. Callendar, D. Masson, J. Morrison, and I. Fine. 2014. “A Model Simulation of Future Oceanic Conditions along the British Columbia Continental Shelf. Part II: Results and Analyses.” *Atmosphere-Ocean* 52 (1): 20–38. https://doi.org/10.1080/07055900.2013.873014.

Franco, Ana C., Hongsik Kim, Hartmut Frenzel, Curtis Deutsch, Debby Ianson, U. Rashid Sumaila, and Philippe D. Tortell. 2022. “Impact of Warming and Deoxygenation on the Habitat Distribution of Pacific Halibut in the Northeast Pacific.” *Fisheries Oceanography* 31 (6): 601–14. https://doi.org/10.1111/fog.12610.

Gillett, Nathan P., Alex J. Cannon, Elizaveta Malinina, Markus Schnorbus, Faron Anslow, Qiaohong Sun, Megan Kirchmeier-Young, et al. 2022. “Human Influence on the 2021 British Columbia Floods.” *Weather and Climate Extremes* 36 (June): 100441. https://doi.org/10.1016/j.wace.2022.100441.

Groner, Ml, Me Eisenlord, Rm Yoshioka, Ea Fiorenza, Pd Dawkins, Oj Graham, M Winningham, et al. 2021. “Warming Sea Surface Temperatures Fuel Summer Epidemics of Eelgrass Wasting Disease.” *Marine Ecology Progress Series* 679 (November): 47–58. https://doi.org/10.3354/meps13902.

Harley, Christopher D. G. 2011. “Climate Change, Keystone Predation, and Biodiversity Loss.” *Science* 334 (6059): 1124–27. https://doi.org/10.1126/science.1210199.

Indicators of Climate Change for British Columbia, 2016 Update. 2016. Rev. June 2016. Victoria, B.C.: Ministry of Environment.

Jackson, Jennifer M., Laura Bianucci, Charles G. Hannah, Eddy C. Carmack, and Jessy Barrette. 2021. "Deep Waters in British Columbia Mainland Fjords Show Rapid Warming and Deoxygenation From 1951 to 2020." *Geophysical Research Letters* 48 (3). https://doi.org/10.1029/2020GL091094.

Jackson, Jennifer M., Gregory C. Johnson, Hayley V. Dosser, and Tetjana Ross. 2018. "Warming From Recent Marine Heatwave Lingers in Deep British Columbia Fjord." *Geophysical Research Letters* 45 (18): 9757–64. https://doi.org/10.1029/2018GL078971.

Jakob, Matthias, and O. Hungr. 2005. *Debris-Flow Hazards and Related Phenomena*. Berlin ; New York: Springer.

Jordan, P, K Turner, D Nicol, and D Boyer. 2006. "Developing a Risk Analysis Procedure for Post-Wildfire Mass Movement and Flooding in British Columbia."

Kaldy, James E. 2014. "Effect of Temperature and Nutrient Manipulations on Eelgrass Zostera Marina L. from the Pacific Northwest, USA." *Journal of Experimental Marine Biology and Ecology* 453 (April): 108–15. https://doi.org/10.1016/j.jembe.2013.12.020.

Kroeker, Kristy J., Rebecca L. Kordas, Ryan Crim, Iris E. Hendriks, Laura Ramajo, Gerald S. Singh, Carlos M. Duarte, and Jean-Pierre Gattuso. 2013. "Impacts of Ocean Acidification on Marine Organisms: Quantifying Sensitivities and Interaction with Warming." *Global Change Biology* 19 (6): 1884–96. https://doi.org/10.1111/gcb.12179.

Kroeker, Kristy J., Rebecca L. Kordas, and Christopher D. G. Harley. 2017. "Embracing Interactions in Ocean Acidification Research: Confronting Multiple Stressor Scenarios and Context Dependence." *Biology Letters* 13 (3): 20160802. https://doi.org/10.1098/rsbl.2016.0802.

Lax Kw'alaams. 2022. "Lax Kw'alaams Physical Development Plan: Membership Survey Results."

Mantua, Nathan, Ingrid Tohver, and Alan Hamlet. 2010. "Climate Change Impacts on Streamflow Extremes and Summertime Stream Temperature and Their Possible Consequences for Freshwater Salmon Habitat in Washington State." *Climatic Change* 102 (1–2): 187–223. https://doi.org/10.1007/s10584-010-9845-2.

Milner, Alexander M., Anne L. Robertson, Michael J. McDermott, Megan J. Klaar, and Lee E. Brown. 2013. "Major Flood Disturbance Alters River Ecosystem Evolution." *Nature Climate Change* 3 (2): 137–41. https://doi.org/10.1038/nclimate1665.

Parmesan, Camille, and Gary Yohe. 2003. “A Globally Coherent Fingerprint of Climate Change Impacts across Natural Systems.” *Nature* 421 (6918): 37–42. https://doi.org/10.1038/nature01286.

Patton, A. Katherine, Andrew Martindale, Trevor J. Orchard, Sage Vanier, and Gary Coupland. 2019. “Finding Eulachon: The Use and Cultural Importance of Thaleichthys Pacificus on the Northern Northwest Coast of North America.” *Journal of Archaeological Science: Reports* 23 (February): 687–99. https://doi.org/10.1016/j.jasrep.2018.11.033.

Pauly, Daniel. 1995. “Anecdotes and the Shifting Baseline Syndrome of Fisheries.” *Trends in Ecology & Evolution* 10 (10): 430. https://doi.org/10.1016/S0169-5347(00)89171-5.

Price, Michael H. H., Nick Gayeski, and Jack A. Stanford. 2013. “Abundance of Skeena River Chum Salmon during the Early Rise of Commercial Fishing.” *Transactions of the American Fisheries Society* 142 (4): 989–1004. https://doi.org/10.1080/00028487.2013.790842.

Price, Michael H.H., Brendan M. Connors, John R. Candy, Brenda McIntosh, Terry D. Beacham, Jonathan W. Moore, and John D. Reynolds. 2019. “Genetics of Century-old Fish Scales Reveal Population Patterns of Decline.” *Conservation Letters* 12 (6). https://doi.org/10.1111/conl.12669.

Radić, Valentina, Alex J. Cannon, Brian Menounos, and Nayeob Gi. 2015. “Future Changes in Autumn Atmospheric River Events in British Columbia, Canada, as Projected by CMIP5 Global Climate Models.” *Journal of Geophysical Research: Atmospheres* 120 (18): 9279–9302. https://doi.org/10.1002/2015JD023279.

Raffa, Kenneth F., Brian H. Aukema, Barbara J. Bentz, Allan L. Carroll, Jeffrey A. Hicke, Monica G. Turner, and William H. Romme. 2008. “Cross-Scale Drivers of Natural Disturbances Prone to Anthropogenic Amplification: The Dynamics of Bark Beetle Eruptions.” *BioScience* 58 (6): 501–17. https://doi.org/10.1641/B580607.

Raymond, Wendel W., Julie S. Barber, Megan N. Dethier, Hilary A. Hayford, Christopher D. G. Harley, Teri L. King, Blair Paul, et al. 2022. “Assessment of the Impacts of an Unprecedented Heatwave on Intertidal Shellfish of the Salish Sea.” *Ecology* 103 (10). https://doi.org/10.1002/ecy.3798.

Root, Terry L., Jeff T. Price, Kimberly R. Hall, Stephen H. Schneider, Cynthia Rosenzweig, and J. Alan Pounds. 2003. “Fingerprints of Global Warming on Wild Animals and Plants.” *Nature* 421 (6918): 57–60. https://doi.org/10.1038/nature01333.

Schindler, Daniel E., Mark D. Scheuerell, Jonathan W. Moore, Scott M. Gende, Tessa B. Francis, and Wendy J. Palen. 2003. “Pacific Salmon and the Ecology of Coastal Ecosystems.” *Frontiers in Ecology and the*

Environment 1 (1): 31–37. https://doi.org/10.1890/1540-9295(2003)001[0031:PSATEO]2.0.CO;2.

Sepúlveda, Sergio A, Brent Ward, Scott Cosman, and Rachel Jacobs. 2022. "PRELIMINARY INVESTIGATIONS OF GROUND FAILURES TRIGGERED DURING THE MID-NOVEMBER 2021 ATMOSPHERIC RIVER EVENT ALONG THE SOUTHWESTERN BRITISH COLUMBIA HIGHWAY CORRIDORS." *Canadian Geotechnical Journal*, October, cgj-2022-0093. https://doi.org/10.1139/cgj-2022-0093.

Shanley, Colin S., Sanjay Pyare, Michael I. Goldstein, Paul B. Alaback, David M. Albert, Colin M. Beier, Todd J. Brinkman, et al. 2015. "Climate Change Implications in the Northern Coastal Temperate Rainforest of North America." *Climatic Change* 130 (2): 155–70. https://doi.org/10.1007/s10584-015-1355-9.

Shrestha, Rajesh R., Barrie R. Bonsal, James M. Bonnyman, Alex J. Cannon, and Mohammad Reza Najafi. 2021. "Heterogeneous Snowpack Response and Snow Drought Occurrence across River Basins of Northwestern North America under 1.0°C to 4.0°C Global Warming." *Climatic Change* 164 (3–4): 40. https://doi.org/10.1007/s10584-021-02968-7.

Somero, George N. 2005. "Linking Biogeography to Physiology: Evolutionary and Acclimatory Adjustments of Thermal Limits." *Frontiers in Zoology* 2 (1): 1. https://doi.org/10.1186/1742-9994-2-1.

Sydneysmith, Robin, Jordan Telsuk, and Georgia Piggot. 2021. "Lax Kw'alaams Community Report: Climate Change Adaptation Planning for Northwest Skeena Communities." University of British Columbia.

Thomson, R.E., B.D. Bornhold, and S. Mazzottie. 2008. "An Examination of the Factors Affecting Relative and Absolute Sea Level in Coastal British Columbia." Fisheries and Oceans Canada.

Tomanek, Lars, and George N Somero. 1999. "Evolutionary and Acclimation-Induced Variation in the Heat-Shock Responses of Congeneric Marine Snails (Genus Tegula) from Different Thermal Habitats: Implications for Limits of Thermotolerance and Biogeography," October.

Turner, Nancy J., and Helen Clifton. 2009. "'It's so Different Today': Climate Change and Indigenous Lifeways in British Columbia, Canada." *Global Environmental Change* 19 (2): 180–90. https://doi.org/10.1016/j.gloenvcha.2009.01.005.

Vadeboncoeur, Nathan, Thomas A Okey, Marcus Schnorbus, Debbie Ianson, Deborah Carlson, Christopher Harley, Daniel Pauly, et al. 2016. "Perspectives on Canada's West Coast Region." In *Canada's Marine Coasts in a Changing Climate*.

Wall, Ellen, and Katia Marzall. 2006. “Adaptive Capacity for Climate Change in Canadian Rural Communities.” *Local Environment* 11 (4): 373–97. https://doi.org/10.1080/13549830600785506.

Weatherdon, Lauren V., Yoshitaka Ota, Miranda C. Jones, David A. Close, and William W. L. Cheung. 2016. “Projected Scenarios for Coastal First Nations’ Fisheries Catch Potential under Climate Change: Management Challenges and Opportunities.” Edited by Juan Carlos Molinero. *PLOS ONE* 11 (1): e0145285. https://doi.org/10.1371/journal.pone.0145285.

Whitney, Charlotte K., Tugce Conger, Natalie C. Ban, and Romney McPhie. 2020. “Synthesizing and Communicating Climate Change Impacts to Inform Coastal Adaptation Planning.” Edited by Steven J. Cooke. *FACETS* 5 (1): 704–37. https://doi.org/10.1139/facets-2019-0027.

Wild, Amanda Lily, Eva Kwoll, D. Gwyn Lintern, and Shannon Fargey. 2022. “Fluvial Response to Climate Change in the Pacific Northwest: Skeena River Discharge and Sediment Yield.” *Water* 15 (1): 167. https://doi.org/10.3390/w15010167.

Wipfli, Mark S., and Colden V. Baxter. 2010. “Linking Ecosystems, Food Webs, and Fish Production: Subsidies in Salmonid Watersheds.” *Fisheries* 35 (8): 373–87. https://doi.org/10.1577/1548-8446-35.8.373.