AtkinsRéalis

Webequie Supply Road

Webequie First Nation

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APPENDIX P: HUMAN HEALTH RISK ASSESSMENT

Signature Page

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Webequie First Nation is completing an Environmental Assessment (EA) under Ontario's Environmental Assessment Act (EAA) and Impact Assessment (IA) under Canada's Impact Assessment Act (IAA) for the proposed Webequie Supply Road ("the Project", WSR). The proposed Project is a new all-season road approximately 107 kilometres (km) in length, connecting Webequie First Nation and its airport to existing mineral exploration activities and proposed future mining development in the McFaulds Lake area. As part of both the provincial and federal assessments, the proponent (Webequie First Nation) must outline and discuss how the Project will impact human health during each phase of the Project.

This human health risk assessment (HHRA) was prepared pursuant to the Human Health Study Plan prepared by AtkinsRéalis Canada Inc.[1] (AtkinsRéalis) in 2021 and will support the Health Impact Assessment (HIA), which will be summarized in the Environmental Assessment Report/Impact Statement (EAR/IS) for the Project.

Human health was identified as a valued component (VC) to be included in the EAR/IS; if significant Project-related changes in contaminant concentrations in any media type, including water, soil, sediment, or air, are predicted to result from Project construction and operation, the HHRA evaluates potential exposure of humans to these contaminants. Noise is also a potential Project-related non-chemical stressors that can affect human health; this stressor is evaluated in the HHRA.

Based on a review of the findings presented for indicator VCs including air quality; geology, terrain and soils; surface water resources; groundwater resources; and vegetation, fish and wildlife, no significant Project related increases in contaminant concentrations were predicted for any VC, except for air. Additionally, a review of the noise results indicated that net adverse effects of noise during the construction and operation phases of the Project are predicted to be not significant.

The results of the Air Quality Impact Assessment (AQIA) were reviewed to identify contaminants of potential concern (COPCs) for quantitative evaluation of human receptor exposure and risk in the HHRA. Contaminants with the potential to increase in concentration during the Project's construction or operation phases to concentrations exceeding the applicable air quality guidelines at points of impingement of interest were retained as COPCs, as follows:

- Construction phase: 24-hour concentrations of TSP, PM_{10}, $PM_{2.5}$, NO_2 (1-hour); and
- Operations phase: 24-hour concentrations of PM_{10}.

As the AQIA did not assess concentrations of metals, and as they are naturally occurring in soils that will be disturbed during the Project construction and operations, baseline soil data from the region and TSP concentrations predicted by the AQIA were used to predict concentrations of metals in TSP. The predicted metals concentrations were compared to the Ontario Ambient Air Quality Guidelines (AAQC) for metals; this comparison indicated that there is the potential for hexavalent chromium and iron to exceed the AAQC in TSP generated by the Project. On this basis, hexavalent chromium and iron were also retained as COPCs for evaluation in the HHRA.

Members of the Webequie First Nation community were identified as the critical receptor group for assessment in the HHRA, with exposures and risks estimated for residents considered protective of summer residents, community members hunting, fishing, trapping and foraging in the local study area (LSA), as well as other people who may live in or visit the LSA. As COPCs were only identified in air, the

[1] Formerly known as SNC-Lavalin Inc.

primary exposure pathway by which Webequie First Nation community members and other populations in the LSA have the potential to be exposed to Project related COPCs is via inhalation.

The HHRA assessed exposures and associated risks to Webequie First Nation community members exposed to the air COPCs identified during the construction and operation phases of the Project. The results of the HHRA indicated the potential for health risks exceeding regulatory negligible risk levels include the following:

- Acute exposures to TSP, PM_{10}, $PM_{2.5}$, NO_2 during the construction phase at sensitive receptors located proximate to the proposed WSR road centreline; and
- Chronic exposures to hexavalent chromium in TSP during the construction and operation phases of the Project at two sensitive receptors located within 60 m of the proposed WSR road centreline.

As the results of the AQIA are conservative and have likely overpredicted Project related emissions, the HHRA has also likely overpredicted associated exposures and health risks. Further, the predicted exceedances are localized spatially to areas proximate to the road centreline and are not predicted at existing residences and institutional buildings in the Webequie area, where people are present most frequently. An Air Quality and Dust Control Management Plan that will be developed and implemented for the Project will integrate a monitoring procedure for dustfall effects and measures to control or limit particulate emissions. Additional mitigation measures beyond those accounted for in the AQIA will be implemented, as warranted.

Due to the lack of baseline soil data for speciated chromium, conservative assumptions were used to estimate the percentage of total chromium in soil that is hexavalent chromium. This has resulted in high uncertainty in the risk estimates for hexavalent chromium. It is recommended that soil samples be collected from the WSR and submitted for chromium speciation, with the results used to revisit the results of the HHRA for hexavalent chromium.

Overall, the HHRA has likely overpredicted exposures and associated health risks associated with the Project. When the conservatism and uncertainty in the estimates are considered, it is unlikely that unacceptable health risks will result from the Project.

****The air quality results used in this HHRA are based on the draft air monitoring data available at the time the assessment was conducted. These data have since been updated. The revised results will be reviewed and incorporated into an addendum to this HHRA. ****

1. Introduction

Webequie First Nation is completing an Environmental Assessment (EA) under Ontario's *Environmental Assessment Act* (EA Act) and Impact Assessment (IA) under Canada's *Impact Assessment Act* (IA Act) for the proposed Webequie Supply Road ("the Project", WSR). The proposed Project is a new all-season road approximately 107 kilometres (km) in length, connecting Webequie First Nation and its airport to existing mineral exploration activities and proposed future mining development in the McFaulds Lake area. As part of both the provincial and federal assessments, the proponent (Webequie First Nation) must outline and discuss how the Project will impact human health during each phase of the Project.

The proposed WSR is a new two-lane all-season road within a cleared right-of-way (ROW) approximately 35 metres (m) in width and approximately 107 km in length. The preliminary recommended preferred route for the road consists of a northwest-southeast segment running 51 km from the Webequie First Nation Reserve to a 56 km segment running east-west before terminating near McFaulds Lake, within the Ring of Fire region. A total of 17 km of the WSR is within the Webequie First Nation Reserve lands, with the remainder of the road located on un-surveyed Ontario Crown lands.

This report was prepared pursuant to the Human Health Study Plan prepared by AtkinsRéalis Canada Inc.[2] (AtkinsRéalis) in 2021 and submitted to the Impact Assessment Agency of Canada (IAAC) and the Ontario Ministry of the Environment, Conservation and Parks (MECP) for review and validation that it meets the federal requirements in the Tailored Impact Statement Guidelines (TISG) and approved Terms of Reference (ToR) for the provincial EA. The results of this human health risk assessment (HHRA) will support the Health Impact Assessment (HIA), which will be summarized in the Environmental Assessment Report/Impact Statement (EAR/IS) for the Project and are intended to meet the requirements of both the federal TISG and the provincially approved ToR.

Human health was identified as a valued component (VC) to be included in the EAR/IS; if significant Project-related changes in chemical concentrations in any media type, including water, soil, sediment, or air, are predicted to result from Project construction or operation, the HHRA evaluates potential exposure of humans to these chemicals. Noise is also a potential Project-related non-chemical stressors that can affect human health, which was also included in the scope of the HHRA.

This HHRA is technical in nature, as it has been completed in accordance with specific and prescriptive risk assessment methodology and terminology as outlined in relevant federal (i.e., Health Canada) and provincial (i.e., MECP) guidance documents. Results of this HHRA have been summarized and interpreted in Section 17 (Human Health) of the EAR/IS.

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[2] Formerly known as SNC-Lavalin Inc.

2. HHRA Approach

2.1 Regulatory Framework and Guidance

Based on the scale and complexity of the Project, and the potential for significant environmental effects, a Comprehensive Environmental Assessment must be completed for approval under the Environmental Assessment (EA) Act. On May 3, 2018, the Ontario Minister of Environment, Conservation and Parks (then Minister of Environment and Climate Change) signed a voluntary agreement with Webequie First Nation to make the WSR Project subject to Ontario's Environmental Assessment Act. The purpose of this HHRA is to fulfil the assessment scope outlined in the provincial ToR and in the TISG published by the Impact Assessment Agency of Canada (IAAC) (February 2020).

The HHRA is completed as a deterministic detailed quantitative risk assessment (DQRA) principally following federal guidance available from Health Canada. Applicable federal and provincial risk assessment guidance used to complete the HHRA includes the following:

Health Canada / Federal Risk Assessment Guidance:

- Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 4.0 (HC, 2024; for guidance not specifically available in HC, 2010a).
- Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals ($HHRA_{Chem}$) (HC, 2010a).
- Toxicological Reference Values (TRVs), Version 3.0 (HC, 2021).
- Supplemental Guidance on Human Health Risk Assessment for Country Foods (HHRA Foods) (HC, 2010b).
- Supplemental Guidance on Human Health Risk Assessment of Air Quality, Version 2.0 (HC, 2017a).
- Guidance for Evaluating Human Health Impacts in Environmental Assessments: Human Health Risk Assessment. 2019.
- Guidance for Evaluating Human Health Impacts in Environmental Assessments: Air Quality. Health Canada. 2023a.
- Guidance for Evaluating Human Health Impacts in Environmental Assessments: Country Foods. Health Canada. 2023b.
- Evaluating Human Health Impacts in Environmental Assessments: Noise. Health Canada. 2017.
- Guidance for Evaluating Human Health Impacts in Environmental Assessments: Drinking and Recreational Water Quality. Health Canada. 2023c.

Ontario / Provincial Risk Assessment Guidance:

- Rationale for the Development of Generic Soil and Groundwater Standards for Use at Contaminated Sites in Ontario. 2011.
- Ontario's Ambient Air Quality Criteria. 2019.
- Standards and Guidelines to Support Ontario Regulation 419/05 – Air Pollution – Local Air Quality. 2019.
- Ontario – Air Contaminants Benchmarks List: Standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants.

2.2 HHRA Components and Approach

The HHRA was largely completed according to the above Health Canada guidance and is consistent with methods commonly used by regulatory agencies across Canada and the United States (US), including the Ontario MECP and the US Environmental Protection Agency (US EPA). The HHRA consists of five main components, including the following:

- *Problem Formulation:* The Problem Formulation presents the location and description of the Project, the identification of chemicals of potential concern (COPCs) for the Project, the populations (also referred to as receptors of concern) that have the potential to be exposed to COPCs, and the relevant exposure pathways for the receptors of concern.
- *Exposure Assessment:* The Exposure Assessment involves the estimation of the dose of each COPC that the receptors of concern have the potential to be exposed to.
- *Toxicity Assessment:* The Toxicity Assessment is the compilation of toxicity data on the potential adverse health effects for each of the COPCs, as well as TRVs for each of the COPCs. For non-carcinogenic chemicals, TRVs represent an exposure dose or air concentration below which no adverse effects are expected to occur. For carcinogenic chemicals, the TRV is presented as an upper bound of the increased cancer risk from a lifetime exposure to the chemical.
- *Risk Characterization:* In the Risk Characterization the doses estimated in the Exposure Assessment are compared to/combined with the TRVs identified in the Toxicity Assessment to estimate potential health risks associated with receptor exposure to the COPCs under the assumptions of the HHRA.
- *Uncertainty Analysis:* The Uncertainty Analysis is conducted to evaluate the sources of uncertainty inherent in the HHRA, as well as how the uncertainty affects the results of the HHRA.

This assessment has been conducted using a series of worst-case assumptions to ensure that human health risks associated with the Project are not under-predicted. This type of approach limits the likelihood of under-predicting health risks and is likely to result in a considerable over-prediction of risks. This is further discussed in the Uncertainty Analysis.

3. Problem Formulation

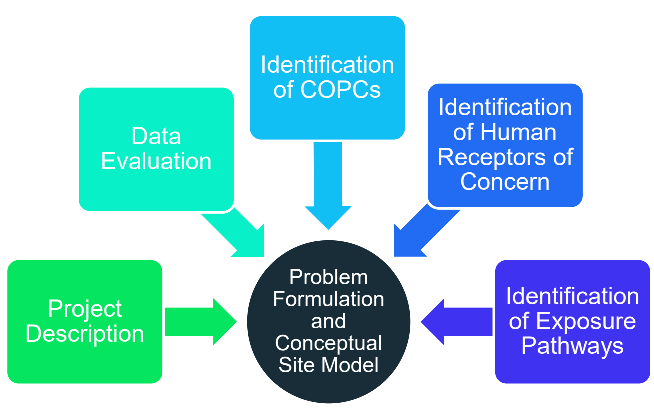
The first stage of the HHRA is the problem formulation and involves "screening" of the main aspects of human health risk comprising of contaminant concentrations in various exposure media that human receptors may be exposed to, the identification of the human receptors who may be exposed to contaminants identified in the study area, and the potentially operable exposure pathways by which humans have the potential to be exposed to the contaminants.

The Problem Formulation herein also includes a description of the Project and human use in the relevant study areas. Furthermore, a review of anticipated Project-related effects to linked VCs is also included, to allow for qualitative evaluation of relevant environmental media and to determine the scope of the quantitative HHRA. Where Project-related effects to contaminant concentrations in environmental media were not identified, or were not concluded to be significant, the potential exposures and effects to human health were also concluded to be not significant in the associated VC assessment, further evaluation of human exposure to these media and potential risk was not conducted. If potential Project-related effects to contaminant concentrations were identified, predicted concentrations were carried forward for further evaluation in the HHRA.

The main elements of Problem Formulation include the following:

1. **Project Description:** Details on the Project and surrounding lands are described to provide context for the HHRA and to provide a basis for the identification of receptors of concern and potential operable exposure pathways. The study area will also be defined, which will include both the Local Study Area (LSA) and Regional Study Area (RSA), as defined in **Section 3.5**.
2. **COPC Screening:** The data representative of the Project emissions and potential effects is reviewed, and the results of the data evaluation are used to screen data and identify COPCs.
3. **Human Receptors of Concern:** Using the information from the Project description and for the surrounding area, the locations with highest Project emissions and regulatory guidance are used to identify potential human receptors of concern.
4. **Identification of Exposure Pathways:** Using the findings of the previous sections (including the human receptor identification and COPC screening), potentially operable exposure pathways are identified.
5. **Conceptual Site Model:** The conceptual model provides a summary of the receptors of concern and the potentially operable exposure pathways carried forward for quantitative evaluation in the HHRA.

Figure 3-1: Main Elements of the Problem Formulation



Once relevant media have been identified, COPC screening conducted and relevant receptors defined, the outcome of the problem formulation is a conceptual site model (CSM), which is the foundation of the HHRA. The CSM outlines the receptor/COPC/exposure pathway combinations of highest potential risk and focuses the HHRA on those combinations. For a potentially unacceptable risk to be present, all three of: a) route of exposure to a COPC must be present, b) that COPC must be present in a high enough concentration to result in a health risk and c) a receptor must be present. If any one of these three components is not present, then an unacceptable risk will also not be present.

3.1 Project Description

The proposed WSR is located in north-western Ontario on un-surveyed Ontario Crown lands and Webequie First Nation Reserve lands approximately 525 km northeast of the City of Thunder Bay, as shown in **Figure 3-2** The WSR is intended to facilitate the movement of materials, supplies and people from Webequie First Nation Reserve to the mineral exploration areas near McFaulds Lake area and will connect the community to the provincial road network to the south should the other two road projects (Northern Road Link – NRL; and Marten Falls Community Access Road – MFCAR) be constructed. It is expected to accommodate an annual average daily traffic of less than 500 vehicles consisting of light to medium personal vehicles, commercial vehicles and heavier trucks hauling industrial supplies and equipment.

The proposed WSR will accommodate a two-lane all-season road with waterbody crossings. The cleared right-of-way (ROW) will be approximately 35 m in width and approximately 107 km in length, crossing through an area of extensive wetlands, organic soils and several watercourses, will include bridge construction over major waterbodies such as Winisk Lake, Winiskisis Channel, and the Muketei River. Minor waterbody crossings will be accomplished using a variety of culvert types and sizes.

The Project will also include aggregate pits/quarries located as close as possible to the WSR ROW, and associated access roads to connect these gravel sources to the ROW. Some of these will be retained to supply aggregates for road maintenance during the operations phase; those deemed unnecessary for this purpose with be decommissioned and restored. Currently, the proposed ROW for the road is undeveloped, except for approximately 5 km of existing roadway from Webequie First Nation to the south. Other project components will include rest and maintenance areas along the WSR, and a permanent Maintenance and Storage Facility (MSF) for operation and maintenance of the WSR once operational.

The terrain and topography along the preliminary recommended preferred route for the WSR are relatively flat with two distinct sections, namely the north-south trending section and the east-west trending section (refer to **Figure 3-3**). In general, the north-south section of the road passes typically through an area of high relief and better ground conditions, while the east-west section passes typically through an area of low relief and poor ground conditions (wetland, peat and bog). Typical elevations in the north-south section are >200 m, while in the east-west section they are <200 m.

The north-south trending segment of the road (51 km) resting mostly over mineral soil will be cleared of all vegetation within the 35 m wide ROW to accommodate the two-lane all-season road. Shoulders, ditches, and berms of stripped organic materials on the outside will also be shaped along this segment.

The east-west trending segment of the WSR is located within the Hudson Bay Lowlands Ecozone that includes James Bay ecoregion and is composed mostly of peatland (muskeg) having a depth of 2 m - 4 m of waterlogged organic soil, which represents poor to very poor conditions for building a road. A floating road design is therefore considered by adding an underlying layer of aggregates (along with geotextile fabrics or geogrids) that will compress the peat resulting in settlement and consolidation. A surface layer of crushed stone will be added to complete the road that is expected to lay 1.2 m above the surrounding lowland areas.

Construction of the all-season road will include, but not limited to, the following activities:

- Physical surveying of road right-way width and alignment, as well as supportive temporary infrastructure (e.g., access road, aggregate source areas and camps);
- Vegetation clearing, earth grading and road construction granular placement) within an approximately 35 m ROW width over a distance of 107 km;
- Construction of multi-span watercourse crossing structures ranging in length from 20 m to 250 m;
- Construction of single-span watercourse crossing structures ranging in length from 5 m to 20 m;
- Construction of watercourse crossing culverts and culverts for localized road drainage;
- Vegetation clearing, earth grading and construction of temporary and permanent supportive infrastructure (i.e., access roads, camps, storage/laydown yards, aggregate pits);
- Aggregate extraction and production (e.g., crushing/screening) at source areas;
- Earth and aggregate hauling operations;
- Operation, maintenance and storage of machinery and equipment;
- Construction camps (average workforce accommodation – 100);
- Management and stockpiling of topsoil and unsuitable earth material along the right-of-way;
- Post-construction clean-up and restoration;
- Equipment and crew mobilization/de-mobilization; and
- Construction monitoring to ensure avoidance of direct impacts on traditional activities of First Nations.

During the operation phase of the Project, activities such as the assessment of the condition and operating performance of the road surface, drainage system and structures at waterbody crossings will be conducted regularly along the road ROW.

Figure 3-2: Project Location

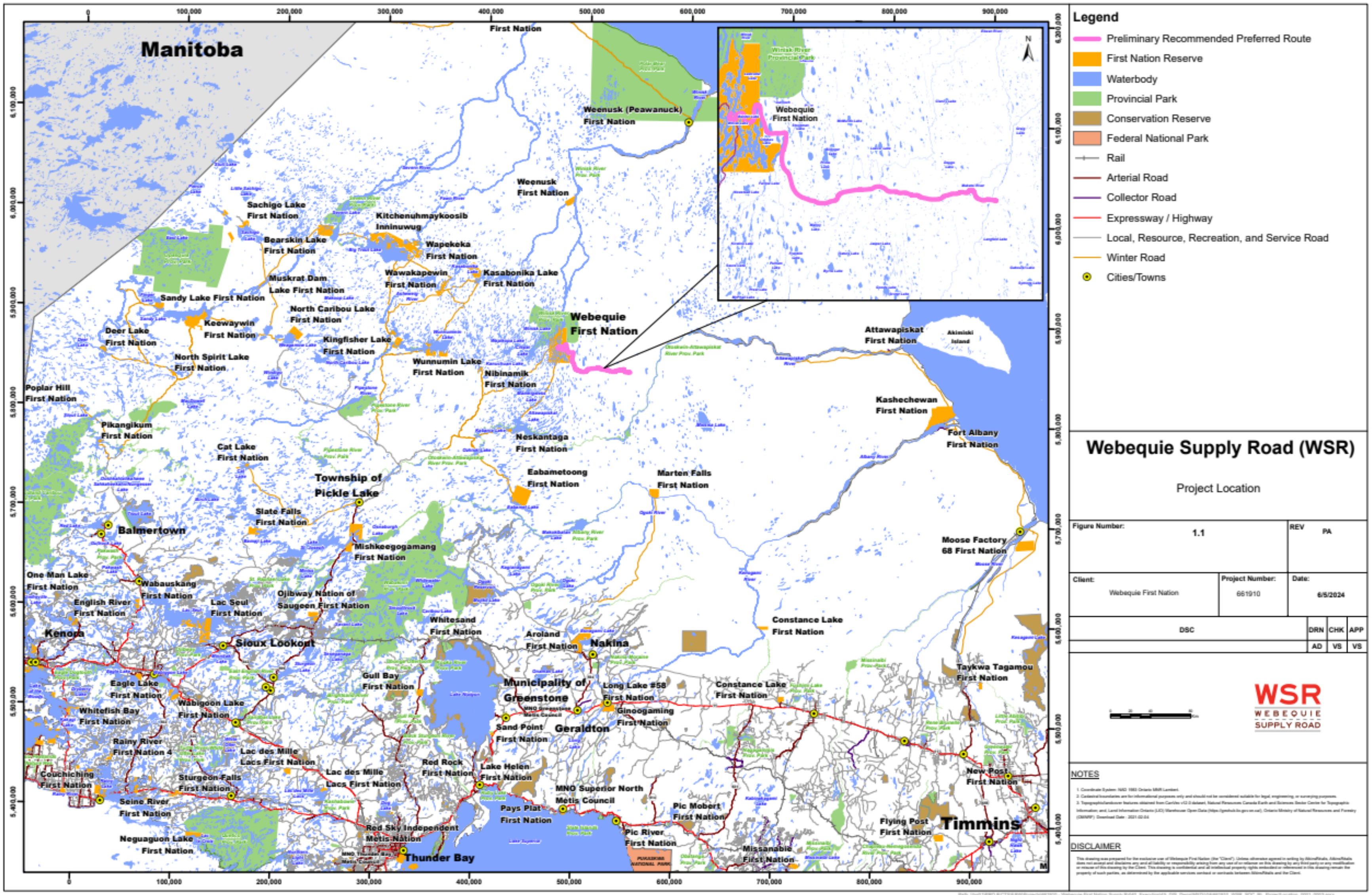
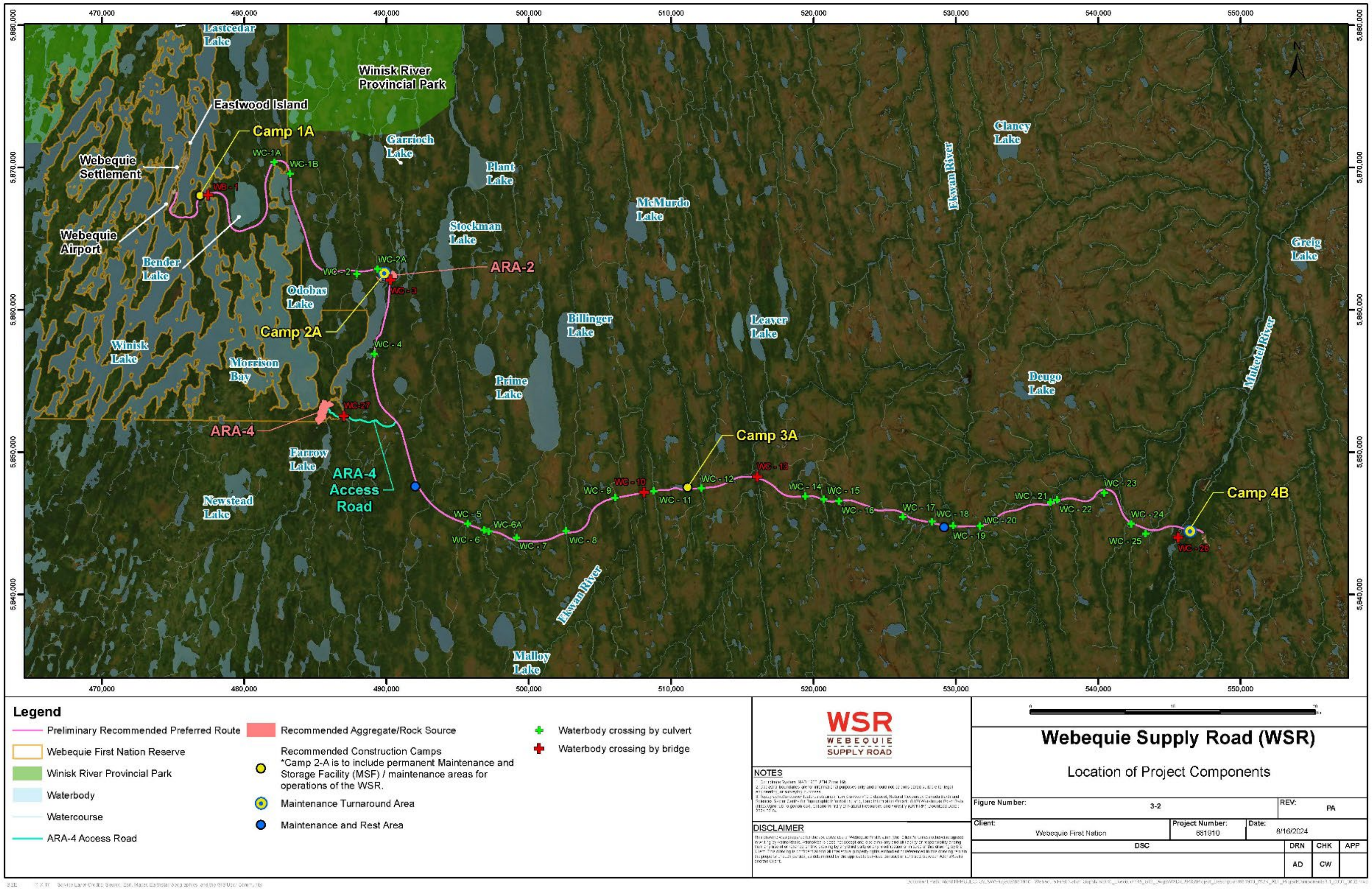


Figure 3-3: Location of Project Components



3.2 Human Use of the Study Area

The Project is located on largely undeveloped Crown lands, including the traditional lands of both Webequie First Nation and Marten Falls First Nation. Traditional activities of Indigenous community members include hunting, fishing and gathering, as well as cultural and spiritual activities, described further below. Other uses of the lands consist of recreational activities, typically fly-in camps and tourist lodges. Otoskwin/Attawapiskat River Provincial Park and the Winisk River Provincial Park also provide opportunities for recreational use. The Study Area as it pertains to the HHRA is further defined in **Section 3.5**.

In accordance with the Study Plan, the HIA and the current HHRA will focus on the potential for health impacts to the Webequie First Nation. Although other Indigenous communities are located within the broader area of the WSR, due to the proximity of their community to the Project, most Project-impacts will be experienced by the Webequie First Nation, and the evaluation of Project-related impacts to the health of Webequie First Nation community members is considered protective of members of other communities and individuals who may be exposed to Project-related impacts to a lesser extent. As such, information on human use of the Project LSA and RSA is focussed on Webequie First Nation. The subsequent information on Webequie First Nation use of the project study areas was obtained from the HIA.

The Webequie First Nation community is located on the northern peninsula of Eastwood Island on Winisk Lake. It is a remote community accessible only by air and winter road; it is currently serviced by a Visual Flight Rules (VFR) Webequie Airport, and a winter road, which branches off the Northern Ontario Resource Trail (NORT), 250 km northeast of the Township of Pickle Lake, providing road access for only a brief period in the winter months. First Nation fly-in communities have observed that winter road seasons are getting shorter, and this is a major concern for shipping in supplies (CBC, 2023b). Due to the isolation and difficulty in obtaining fresh produce, Webequie First Nation households are increasing their reliance on traditional country foods. The HIA indicates that over 75% of Webequie First Nation households include country foods in their meals at least two days per week.

Webequie First Nation has culturally significant and sensitive sites throughout their traditional land. Many culturally significant sites have been identified within the LSA and the RSA; however, no culturally significant sites are present within the WSR ROW. Water is seen as the most precious element of their livelihood; as a result, areas with waterbodies are seen as highly spiritual and there is a responsibility to protect them. Additionally, the area that extends 40-50 km in radius around the Webequie community is for traditional and recreational activities such has trapping, fishing, ceremonial activities, gathering/harvesting and hunting of local wildlife species. Wildlife species (e.g., moose, caribou, waterfowl) are a critical part of the diet of the community and hunting is a significant cultural activity that associates Webequie people to the land. As discussed in **Section 3.3.5**, in acknowledgement of the importance of traditional country foods to the Webequie First Nation, a Country Foods Assessment was conducted and is provided in Appendix 13 of the EAR/IS.

3.3 Review of Anticipated Project-Effects on Contaminant Levels

The HHRA supports the requirements of the evaluation of human health provided in the HIA, which is based on the information requirements outlined in the approved TISG and ToR for the Project. The scope of the HIA was determined in consultation with multiple stakeholders, including regulatory agencies, Indigenous communities and members of the public, as described in Section 17 (Human Health) of the EAR/IS.

The HHRA includes site setting information, as well as the methods and results for the assessment. The potential for risks to human health were only assessed where measurable changes in concentrations in relevant media, including soil, sediment, water, air, vegetation, wildlife and/or fish, were identified to be significant as a result of Project construction or operations phases. The HHRA relies on the findings presented in the EAR/IS for indicator VCs, including:

- Section 6 - Geology, Terrain and Soils (**Section 3.3.1**);
- Section 7 - Surface Water Resources (**Section 3.3.2**);
- Section 8 - Groundwater Resources (**Section 3.3.3**); and
- Section 9 – Atmospheric Environment (Air Quality; **Section 3.3.4**).

Consideration of Country Foods was included in the Study Plan for the HHRA/HIA. The potential for Project-related increases of concentrations of contaminants in country foods is linked to the potential for changes in contaminant concentrations in environmental media that country foods biota could be exposed to (including soil, water and air) and thus are linked to the VC assessments listed above. Additionally, assessments of vegetation, fish and wildlife are linked to the HHRA as exposures of these biotas to contaminants are addressed in each of these linked VC assessments. As a result, the review of anticipated Project-effects to country foods, presented in **Section 3.3.5**, below, discusses results of all linked VC assessments to determine the path forward for assessment of country foods in the HHRA.

Finally, as noise is included in the scope of the HHRA, the results of the noise assessment provided in the EAR/IS Section 9 Atmospheric Environment assessment are evaluated in **Section 3.3.6**.

Results of each of these indicator VCs with respect to their relevance to the HHRA are summarized and discussed in the following sub-sections. Following these discussions and qualitative evaluations, the final scoping for the HHRA is presented in **Section 3.4**.

3.3.1 Geology, Terrain and Soils

The assessment of potential effects to Geology, Terrain and Soils presented in Section 6 of the EAR/IS includes a subcomponent on soil quality, which supports the quality of resources and land available for use by human receptors.

Changes to soil quality resulting from Project-related activities in the construction and operation phases, are anticipated due to:

- Surveying, vegetation clearing, and grubbing;
- Construction grading, backfilling, excavation and blasting activities;
- Use of supportive infrastructure, the constructed road, and structure at waterbodies;
- Decommissioning and closure of temporary aggregate extraction and processing areas;
- Construction camps, access roads, and laydown/storage area emissions, discharges and wastes;

- Maintenance and repair of the road; and
- Operation of pits, quarries and maintenance yard/facility.

The effect is considered negative as changes to soil quality can have an impact on the environment and ecosystem function. The magnitude of the effect is considered moderate as activities that can result in the changes to soil quality beyond what could naturally occur on the landscape. The effect is limited to the disturbed areas within the Project footprint. The impact on soil resources is anticipated to be moderate due to the abundance of soil resources on the landscape. Effect timing is negligible as disruption will occur during non-sensitive and sensitive periods. The duration of most effects from changes to soil quality is considered short-term as they are anticipated to only be impacted during the construction phase of the Project, with only a few effects that would extend into the operations phase being characterized as medium-term. The effect frequency is expected to be continuous during construction and infrequently during operations. The effect is reversible, changes to soil quality are expected to be recovered or restored after site reclamation. The effect is certain to occur as activities resulting in changes to soil quantity, distribution, and quality are integral to the construction of project-related infrastructure.

The net effect of anticipated changes to soil quality is considered not significant, and the assessment indicates that soil quality changes will be limited to the immediate Project Footprint (i.e., the WSR ROW), when human receptors are not expected to spend much time. While dust generation and deposition are expected to occur during both the construction and operations phases, they are not expected to change soil quality within the LSA or RSA, as the disrupted soils would have the same quality as the soils in adjacent locations. As a result, quantitative evaluation of potential exposures and risks for human receptors exposed to soils impacted as a result of the Project construction and operations is not warranted.

3.3.2 Surface Water Resources

The assessment of potential effects to Surface Water Resources, presented in Section 7 of the EAR/IS, included surface water quality. Surface water quality, evaluated through consideration of indicators such as the concentration of suspended solids and concentration of chemical constituents, is an important consideration for human use, including drinking water consumption and recreational or cultural use. The assessment of Surface Water Resources identified the potential for effects to surface water quality during the construction and operations phases of the Project.

Changes in surface water quality are anticipated, due to:

- Short-term discharges of construction water, wastewater, or wash water that have different quantities of chemical constituents or suspended solids from the receiving waterbody;
- Blasting activities releasing chemical constituents into nearby waterbodies; and
- Road maintenance activities leading to the deposition of sediment into waterbodies.

However, changes to surface water quality in the Surface Water Resources assessment were not predicted to be significant. Local water quality within the surface water LSA may experience increases of potential contaminants above applicable screening criteria; however, these changes are expected to be of low magnitude and contained within the boundaries of the LSA. With mitigation and environmental protection measures applied, the net effects on the surface water quality are of low magnitude and predicted to be not significant.

Effects on water quality are predicted to be of low magnitude resulting from short-term discharges, blasting activities, and erosion and sedimentation. Water quality sample data were collected from major crossings and will be used in conjunction with an environmental monitoring plan to compare water quality conditions post-construction and during operations. The moderate confidence level is attributed to the complexity inherent in predicting the magnitude of effects, considering the dynamic nature of surface runoff patterns and potential influences on water quality. The Project does not include the release or diversion of any substantial water sources and mitigation measures are planned for accidental release of chemicals.

As significant effects to water quality were not predicted for the construction or operations phases of the Project, quantitative evaluation of potential exposures and risks of humans to contaminants in surface water is not warranted as exposures and risks would also not be expected to be significant. Surface water quality will continue to be monitored throughout the construction and operation phases of the Project.

3.3.3 Groundwater Resources

The assessment of potential effects to Groundwater Resources includes a subcomponent on groundwater quality, which supports the access and use cleaning drinking water by human receptors. The potential for blasting of rocks to introduce deleterious substance and reduce groundwater quality was identified as a potential cause to change groundwater quality during the construction stage of the Project.

The effect of blasting of rocks on alteration of groundwater quality is considered to be negative as the introduction of substances with the use of explosives may result in reduction of groundwater quality in the vicinity of the blasting locations. The magnitude of the effect is low to moderate as the change in groundwater quality is anticipated to be less than or within the range of seasonal variations.

The effect's geographic extent will be limited to the quarry areas within the Project footprint, where rocks will be blasted for the extraction of road construction materials. The effect occurs during blasting activities in construction and operations phases. This could happen either in dry or non-dry seasons. The effect is medium-term in duration. The effect is predicted to be intermittent in frequency as it only happens when rock blasting occurs.

For ecological context, the effect is categorized as sensitive as measurable changes in groundwater levels in shallow aquifers are expected. The effect is reversible. The groundwater quality can be restored to pre-development conditions by natural attenuation. The effect may occur (possible) when rock blasting occurs.

Overall, the alteration of groundwater quality due to the blasting of rocks is considered to be not significant to groundwater contaminant concentrations, and by extension to human receptor exposures and potential health risks. As a result, quantitative evaluation of potential exposures and risks of humans to contaminants in groundwater is not warranted.

3.3.4 Air Quality

The Air Quality Impact Assessment (AQIA) (AtkinsRéalis, 2024a) is provided as an Appendix of the EAR/IS, in support of the Section 9 Atmospheric Environment assessment. The AQIA evaluated the potential for the Project to impact the ambient air quality around the road and near supportive infrastructure. Potential air contaminants included the criteria air contaminants (CACs) (NO_2, CO, SO_2,), particulates (TSP, PM_{10}, $PM_{2.5}$), ten (10) toxic contaminants from the VOC category (including carbonylic and aromatic compounds), benzo[a]pyrene as a surrogate to PAHs, diesel particulate matter (DPM) and dustfall.

Atmospheric dispersion modelling was carried out using expected but conservative emission scenarios during road construction and the operation phase. The emission sources were from the combustion of diesel fuel or gasoline from land mobile equipment, heavy-duty trucks and light-duty vehicles during the construction and operation phase of the WSR. The modelling exercise also considered fugitive dust emissions mostly from vehicular traffic on the road and the handling of aggregates and other earth materials during construction.

Ambient concentrations of emitted contaminants were calculated at points of impingement of interest including existing residences or group of residences within the community of Webequie, institutional buildings, culturally sensitive areas, and locations for future residences along the road. The results of the AQIA were compared to Ontario Ambient Air Quality Criteria (AAQC) and the Canadian Ambient Air Quality Standards (CAAQS) (collectively referred to as the air quality guidelines)

Changes in air quality, estimated based on Project emissions compared with baseline concentrations, and for cumulative (baseline + Project emissions) greater than the air quality guidelines, were predicted for both the construction and operation phases of the Project, both with and without planned mitigative measures in place. For this HHRA, only the AQIA results predicted assuming that mitigation has been implemented have been further considered. The predicted changes in air quality include the following:

- During the construction phase, 24-hour concentrations of TSP, PM_{10}, $PM_{2.5}$, NO_2 (1-hour and 24-hour), acrolein and benzene exceeded the air quality guidelines at one or more location. In addition, the annual average B(a)P exceeded the AAQC (but was attributed to baseline) and dustfall at a maximum distance of 50 m from the road centre line exceeded the 30-day AAQC.
  - Of these exceedances, only 24-hour concentrations of TSP, PM_{10}, $PM_{2.5}$, NO_2 (1-hour and 24-hour) were predicted to at points of impingement of interest, and specifically at culturally sensitive areas identified by the Webequie First Nation.
- During the operation phase, 24-hour concentrations of TSP, PM_{10} and dustfall exceed air quality guidelines at one or more location. Concentrations of all other potential air contaminants evaluated, included gaseous CACs and the toxic contaminants, were less than the air quality guidelines at all modelled locations, including at maximum locations within the WSR ROW:
  - Of these exceedances, only 24-hour concentrations of PM_{10} were predicted at points of impingement of interest, and specifically at a culturally sensitive area identified by the Webequie First Nation, and at a location of a proposed future residence.

The AQIA was conducted using a conservative approach and assumptions, and thus, has likely overpredicted the potential for effects on air quality. Despite this, based on the potential for changes to air quality, quantitative evaluation of potential exposures and risks of humans to contaminants in air will be conducted in the HHRA.

3.3.5 Country Foods

As the WSR and Webequie First Nation area is used by the community for hunting, fishing and harvesting activities, a baseline country foods (or “traditional foods”, as per HC, 2023) study was conducted to assess baseline concentrations of potential contaminants in berries, game birds, small and large mammals and fish. A Country Foods Consumption and Use Survey was conducted from December 2022 and January 2023 in the Webequie community, the results of which are supplemented with information available from the First Nations Food, Nutrition and Environment Study (FNFNES) community data, as detailed in the Country Foods Assessment report (Chan et al., 2019). Additionally, AtkinsRéalis collected vegetation samples (where available) and fish samples in 2020, while the Webequie First Nation provided mammal and bird samples to AtkinsRéalis in 2020 and 2021. Results of the above-listed studies were provided in the Country Foods Assessment report (AtkinsRéalis, 2024b; Appendix 13 of the EAR/IS).

The potential for Project-related increases of concentrations of contaminants in country foods is linked to the potential for changes in contaminant concentrations in environmental media country foods biota are exposed to, including soil, water and air. To evaluate the potential for the Project to adversely affect the concentrations of contaminants in country foods, linked assessments for the environmental media, as well as groups of biota that would include country foods, were reviewed for indicator VCs in the following EAR/IS sections:

- Section 6 - Geology, Terrain and Soils;

- Section 7 - Surface Water Resources;
- Section 8 - Groundwater Resources;
- Section 9 - Air Quality;
- Section 10 - Fish and Fish Habitat;
- Section 11 - Vegetation and Wetlands; and
- Section 12 - Terrestrial Habitat and Wildlife.

Consideration of potential contaminant-related effects to groups of country food items, including plants, fish and wildlife, are discussed below. Note that other effects to country foods (e.g., habitat availability, access for harvest, migration, etc.) are not included in the current discussion, as the HHRA is focused on contaminant levels in biota tissues, and the subsequent human exposures to contaminants following consumption of country food items.

Changes to concentrations of contaminants in environmental media are not anticipated to be significant for surface water, groundwater or soil (see **Sections 3.3.1** to **3.3.3**). As a result, consistent with the results of linked VC assessments (i.e., for Vegetation and Wetlands, Fish and Fish Habitat, and Terrestrial Habitat and Wildlife), exposures of plants, fish or wildlife to changes (if any) in concentrations of contaminants in surface water, groundwater or soil are also not expected to be significant.

As described in **Section 3.3.4**, increased levels of contaminants and dust in air during construction and operation phases of the Project was identified as a predicted Project-related effect with and without mitigation. The potential for air exposures to affect exposures and contaminant concentrations in each group of country food items is discussed in further detail in **Sections 3.3.5.1** to **3.3.5.3**, below.

3.3.5.1 Plants

Contaminant uptake by plants is not anticipated to increase as a result of Project-related activities, as no significant effects to surface water, groundwater or soil quality are anticipated. However, results of the AQIA indicate that dust will be generated through construction and operation phases of the Project; this dust could deposit on edible vegetation, which could then be consumed by human receptors.

During construction, the results of the air quality modelling indicate a maximum dust deposition value of 12 g/m^2 over 30-days at 50 m distance from the road center line without dust control (water trucks) and 10 g/m^2 over 30-days with controls. These values represent 166% and 143% respectively of the provincial ambient air quality criteria (AAQC). That said, given the depletion effect, dust surficial concentration on ground decreases systematically beyond 50 m from the centerline reaching at maximum 5.4 g/m^2 (including background) at 150 m distance which is lower than the 7.0 g/m^2 AAQC limit value. These values dramatically decrease further during operations to 4.3 g/m^2 (61% of the AAQC) over 30-days at 50 m of the road centerline decreasing systematically outside 50 m reaching at maximum, 3.7 g/m^2 at 150 m distance.

The Vegetation and Wetland assessment indicated that effects to plants from air quality / dust deposition decreases with distance from the roadway, with significant and moderate effects to community / species diversity and composition occurring within 20 m and 60 m of the roadway. Within these distances from the roadway, it is unlikely that significant foraging for edible vegetation would occur, and no culturally sensitive areas have been identified within these boundaries. While the deposition model considers local topography, it does not consider the presence of vegetation and trees that can act as physical barriers, especially against the dispersion of particulate down-wind. Even with the conservatism of the model, no dustfall exceedances of the AAQC were predicted at culturally sensitive areas, which includes areas that are traditionally used for foraging edible vegetation. Deposition would also be limited temporally during construction given the short period of dust emissions in an area, and thus any dust deposited on vegetation would most likely be washed away by precipitation and other natural phenomena (e.g., wind).

As a result, based on the lines of evidence summarized above and discussed in further detail in the AQIA and the Vegetation and Wetland assessment, while dust may accumulate on vegetation near the roadway, no significant foraging in these areas is anticipated. Given that dustfall levels are below the AAQC at all culturally sensitive areas and sensitive receptors, the deposition of dust on edible vegetation that may be foraged is not anticipated to be significant, and thus would not be expected result in appreciable increases in human receptor exposure to contaminants through the ingestion pathway. It is further noted that, during the operation phase, dust generated by the Project is from soil disturbances (i.e., soil dust), and thus is not anticipated to differ in composition from baseline dust.

3.3.5.2 Fish

Contaminant uptake by fish is not anticipated to increase as a result of Project-related activities, as no significant effects to surface water, groundwater or sediment quality are anticipated. The AQIA indicates that dust will be generated through construction and operations phases of the Project; while dust could deposit in nearby aquatic receiving environments, the Fish and Fish Habitat assessment did not identify the potential for significant increases of contaminants in these aquatic habitats to result in increased exposures or effects to fish species. As a result, deposition of dust in aquatic receiving environments is not expected to result in appreciable changes to concentrations of contaminants in fish tissue.

3.3.5.3 Wildlife

Wildlife includes a variety of species, including mammals and birds. Contaminant uptake by wildlife is not anticipated to increase as a result of Project-related activities, as no significant effects to surface water, groundwater, soil or sediment quality are anticipated. While dust may deposit on vegetation consumed by wildlife, the Terrestrial Habitat and Wildlife Assessment indicated that effects to wildlife resulting from dust deposition were of low significance. Mammals typically have large home ranges, which means they are less likely to be affected by localized changes in contaminant levels, particularly as the primary impact anticipated is dust generation in the vicinity of the roadway. However, it is likely that mammals will be deterred from being present when construction and vehicle traffic is active. Birds also tend to have large flight ranges and can avoid areas with active construction and vehicle traffic. These factors combined indicate that the project activities will not significantly impact the contaminant concentrations in wildlife.

3.3.5.4 Country Foods Assessment Summary

Country foods baseline tissue data is available and has been summarized in the Country Foods Assessment report (AtkinsRéalis, 2024b; Appendix 13 of the EAR/IS). As described in the preceding sections and based on the results of the linked VC assessments, Project-related contaminant in increases in country foods items are not expected to be appreciable; therefore, increases in exposures and resulting risks for human receptors consuming country foods items from the Project area are not anticipated. As a result, a quantitative evaluation of human exposures and risks to contaminants in country food items for the baseline and Project scenarios has not been included herein.

The various linked VC assessments indicate that monitoring programs will continue through Project construction and operation phases, to monitor the concentrations of contaminants in environmental media over time. It is recommended that, if appreciable changes in concentrations of parameters, particularly those that are bioaccumulative, are identified in surface water, groundwater, soil or sediment during the Project construction or operation phases, that additional sampling of relevant country food biota (i.e., biota with the potential to be exposed to noted contaminant increases in the environment) be conducted. Measured concentrations in country food items could then be compared to recorded baseline concentrations summarized in the Country Foods Assessment Report (AtkinsRéalis, 2024b; Appendix 13 of the EAR/IS). If warranted, quantitative evaluations of exposure and risk to human receptors could also be conducted at that time.

3.3.6 Noise

An assessment of noise has been conducted and described in a Noise and Vibration Technical Report (SLR, 2024) and the Assessment of Effects on Atmospheric Environment in the Section 9 of the EAR/IS. Noise levels have the potential to increase in both the construction and operation phases of the Project, through activities that include blasting, and use of vehicles, machinery and equipment. The predicted net effects for changes in noise levels are provided as follows:

Change in Noise Levels due to Aggregate Extraction Operations During Construction Phase

- The Noise Impact Modelling conducted for aggregate extraction activities indicated that predicted sound levels are expected to minorly exceed NPC-300 guideline limits at Construction Camp 2A located near ARA-2. Given workers will be in the field during the daytime, the exceedances are minor (by a maximum of 4 dBA). Therefore, the magnitude of the effect is considered to be low.
- The effect's geographic extent will be limited to the noise LSA. The effect is short-term in duration and predicted to be infrequent in the aggregate resource areas. For ecological and social context, the effect is categorized as moderate resilience as the noise LSA is considered a rural area. The effect is likely to occur but is reversible as the acoustic environment is expected to return to the background noise levels when noise generating activities cease.

Change in Noise Levels due to General Construction Activities During Construction Phase

- The Noise Impact Modelling conducted for the construction of the proposed roadway and bridges indicated that the highest predicted noise levels at the culturally sensitive areas CHL-5, CHL-7, CHL-17, CHL-25, and Construction Camp 1A site C05 are between 48 and 57 dBA, exceeding the MNL threshold of 47 dBA (L_{DN}). Therefore, the magnitude of the effect is considered to be low to moderate.
- The effect's geographic extent will be limited to the noise LSA. The most affected NSAs are found within 150 m of the roadway, or 300 m of a waterbody crossing (involving pile driving/bridge construction). There are no exceedances predicted for the existing permanent residences within the Webequie community. The effect is short-term in duration and predicted to be infrequent. Noise impacts from roadway construction are only expected to affect NSAs for approximately one week based on an approximate 100 m/day rate of construction.
- For ecological and social context, the effect is categorized as moderate resilience as the noise LSA is considered a rural area. The effect is likely to occur but is reversible as the acoustic environment is expected to return to the background noise levels when noise generating activities cease.

Change in Noise Levels due to Vehicle Use of the Proposed Road During Operation Phase

- The noise modelling conducted to predict noise generated from the operations of the WSR indicated that changes in sound levels resulting from the proposed Project are expected to be negligible for the existing residences within the Webequie community and less than the 5 dB change threshold outlined in the Joint Protocol and MTO Noise Guide. Overall "Build" sound levels are predicted to be less than or equal to 45 dBA which is considered appropriate for a quiet rural environment. For the culturally sensitive areas, the maximum sound level is predicted to be 46 dBA. The maximum change is predicted to be 14 dB which is above the MTO Joint Protocol/Noise Guide threshold. Overall "Build" sound levels are highly dependent on the exact location of the NSAs. Sound levels are predicted to be less than 46 dBA which is considered appropriate for a quiet rural area. With respect to Health Canada Guidelines, changes in sound levels resulting from the proposed Project are expected to be negligible for all NSAs and less than the 6.5% threshold. Therefore, the magnitude of the effect is considered to be low.

- The effect's geographic extent will be limited to the noise LSA. The effect is medium-term in duration and predicted to be frequent as it is expected that there will be intermittent presence of vehicles on the road during the operation phase.
- For ecological and social context, the effect is categorized as moderate resilience as the noise LSA is considered a rural area. The effect is likely to occur but is reversible as the acoustic environment is expected to return to the background noise levels as noise from vehicle use of the road will attenuate following a vehicle pass-by.

Summary of Project-related Noise Effects

With the implementation of mitigation measures, the Project will result in construction and operation noise effects that are not expected to exceed guidance levels that require noise mitigation beyond best management practices outlined in the Atmospheric Environment assessment (Section 9 of the EAR/IS).

The predicted overall sound levels during construction are not excessive and meet the guidelines limits for a suburban or semi-rural area. Additionally, the predicted sound pressure levels during operations are expected to well below the Health Canada threshold for annoyance. As a result, further assessment of noise in the HHRA is not warranted.

As indicated in the Section 9 Atmospheric Environment assessment, implementation of a noise monitoring program throughout construction and operations phases has not been recommended for the Project. However, if noise complaints arise, they will be investigated and addressed.

3.4 HHRA Scope Definition

Through the evaluation of information provided in associated VC sections of the EAR/IS for indicator VCs, the potential for significant Project-related exceedances of relevant guidelines were identified and/or predicted for air only, associated with emissions released during Project construction and operation. As a result, direct exposures (e.g., through inhalation of outdoor air) of humans to contaminants of potential concern (COPCs) in emissions will the subject of the next stage of the quantitative HHRA. As no other Project-related increases in contaminant concentrations in other media (i.e., soil, sediment, groundwater, surface water or country foods) have been identified in other VC assessments, human exposures to these other media types have not been quantitatively evaluated in the HHRA.

The HHRA comprises an assessment of the possible human health effects associated with emissions from the Project released into outdoor air. As a result, the HHRA is comprised of the following:

- An acute and chronic air quality HHRA for the construction and operations phase of the Project. The HHRA assesses Project incremental exposure to airborne COPCs, including particulate matter.

3.5 Study Area

The proposed WSR is located in northwestern Ontario, near Webequie First Nation, which is located approximately 525 km northeast of Thunder Bay as shown in **Figure 3-2**. Main components of the Project are shown on **Figure 3.4**. As noted, the preliminary recommended preferred route for the WSR consists of a northwest-southeast segment running 51 km from Webequie First Nation to a 56 km segment running east before terminating near McFaulds Lake. A total of 17 km of the proposed WSR is within Webequie First Nation Reserve lands.

The WSR will be constructed and operated as a facility that only provides a connection between Webequie First Nation and the McFaulds Lake area to serve mineral exploration and future mining development activities, with no connection to the provincial highway system, although it is anticipated that the WSR will ultimately be an all-season road connection between the McFaulds Lake area and the provincial highway system to ensure/maximize the viability of mine developments. The study area for the HHRA represents the WSR between the Webequie First Nation to the McFaulds Lake area.

The HHRA relies on the results of the Air Quality Impact Assessment (AQIA) (AtkinsRéalis, 2024a) to characterize air quality. As presented in **Section 3.2**, no significant Project related effects have been predicted for other media, including soil, sediment, groundwater, surface water, fish and wildlife and vegetation. The study areas included in AQIA considered the following (refer to Figure 3.4):

- **The Local Study Area (LSA)**, or the area where largely direct, and indirect effects of the Project are likely to occur. The LSA extends 1 km from each side of the centreline of the WSR, and 500 m from temporary and permanent supportive infrastructure (construction camps, aggregate/rock source areas, access roads, MSF). This includes the road ROW or Project Footprint of the supportive infrastructure where the majority of sources that will impact air quality are likely to occur.
- **The Regional Study Area (RSA)** is the area where potential, largely indirect and cumulative effects of the Project in the broader, regional context may occur. The RSA extends 5 km from boundaries of the LSA.

In selecting the LSA and RSA boundaries, consideration was given to potential effects and effect pathways because of the Project. For air quality, the effects of the Project activities are considered to be constrained to the LSA spatial boundaries. Sensitive receptors and future land use were considered in the AQIA. The modelling approach for the assessment focused on the western portion of the WSR from the community of Webequie to the point where the road intersects with the proposed permanent access road to the ARA-4 aggregate source area (41.5 km). The approach to focus on the impacts to sensitive receptors located in and near the community of Webequie was adopted because the construction and operation of the road is expected to be similar along the full length (i.e., the impacts assessed for the western part will be of similar nature for the eastern part). It was determined that modelling the full road (>100 km) would be computationally time consuming and would not provide different results. The spatial assessment boundaries for the air dispersion modelling for the Project are presented in **Figure 3-4, Figure 3-5** and **Figure 3-6.**.

The LSA and RSA for each environmental discipline may vary from the above-described general study areas based on the potential for the Project to directly or indirectly affect each environmental discipline (valued component); therefore, in some cases discipline-specific LSAs and RSAs have been defined for the Project. The LSA and RSA associated with the AQIA were the primary study areas for the HHRA.

The following temporal boundaries were used:

- **Construction Phase**: All activities associated with the initial development and construction of the road and supportive infrastructure from the start of the construction to the start of the operation and maintenance of the Project and is anticipated to be approximately 5 to 6 years in duration.
- **Operation Phase**: All activities associated with operation and maintenance of the road and permanent supportive infrastructure (e.g., operation and maintenance yard, aggregate extraction and processing areas) that will start after the construction activities are complete, including site restoration and decommissioning of temporary infrastructure (e.g., access roads, construction camps, etc.). The Operations Phase of the Project is anticipated to be 75 years based on the expected timeline when major refurbishment of road components (e.g., bridges) is deemed necessary.

The proposed WSR is expected to operate for an indeterminate period; therefore, future suspension, decommissioning and eventual abandonment is not evaluated in AQIA or this HHRA.

Figure 3-4: Air Quality and Climate Change Study Areas

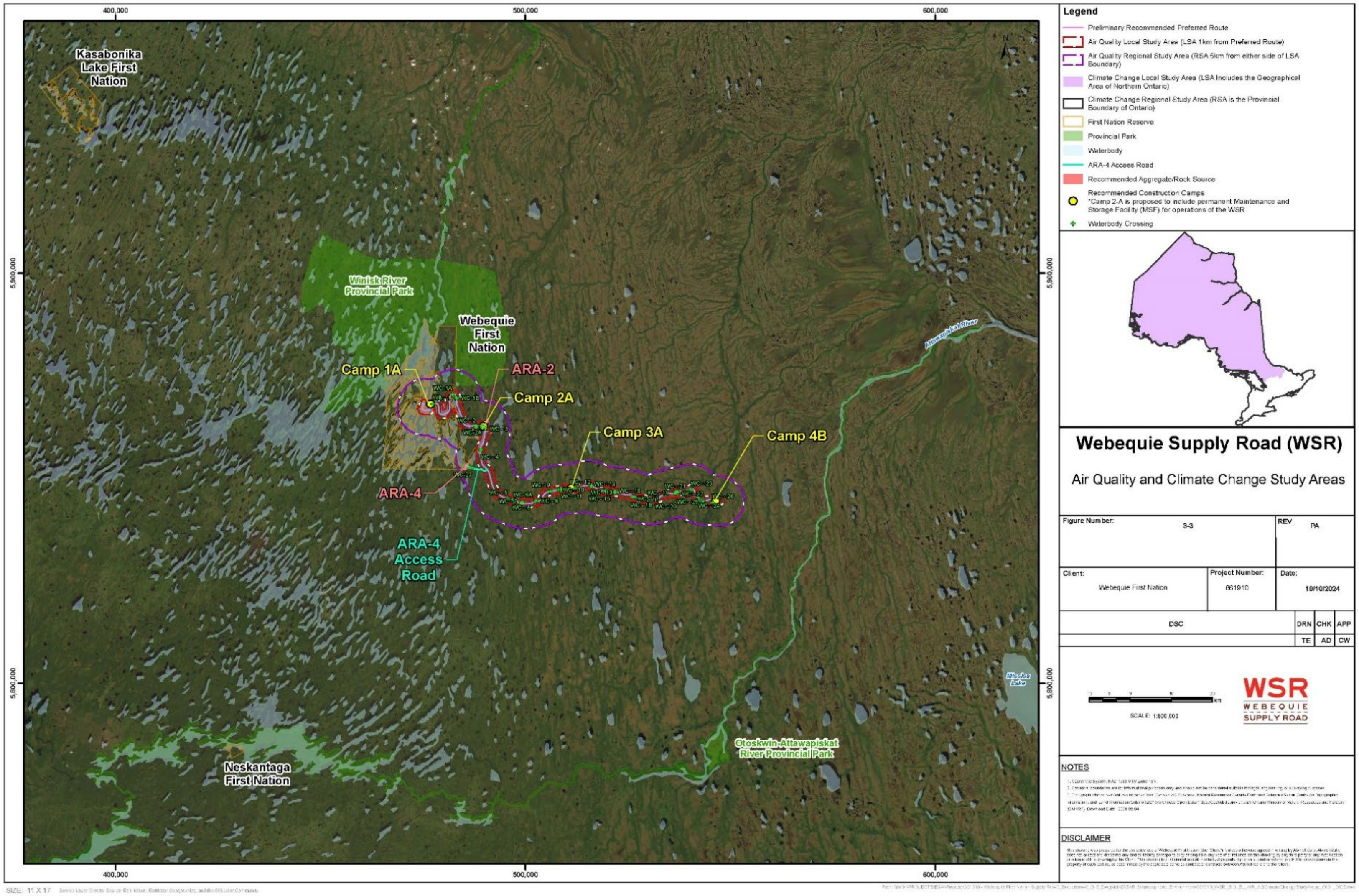


Figure 3-5: Air Dispersion Modelling Domain

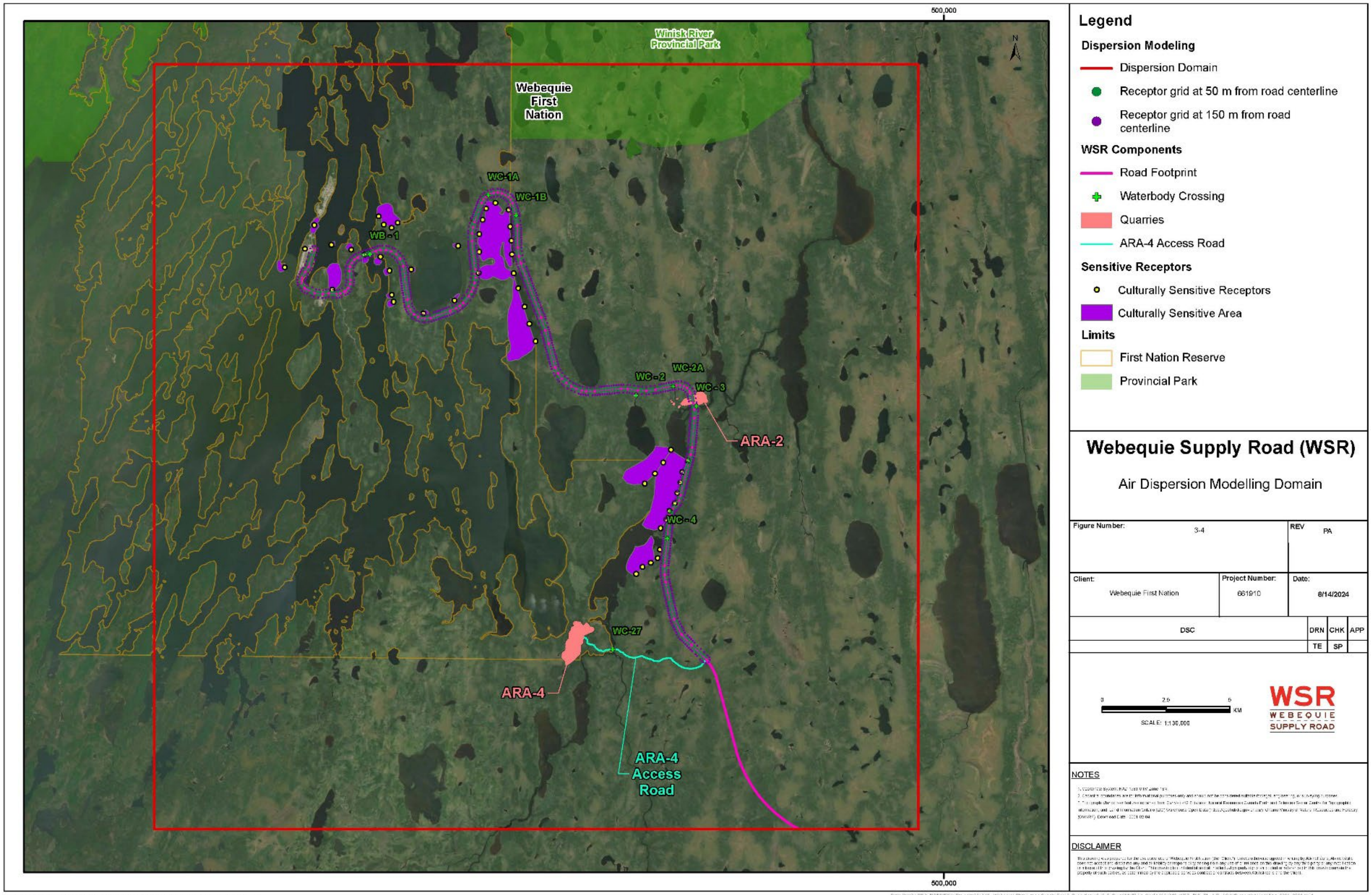
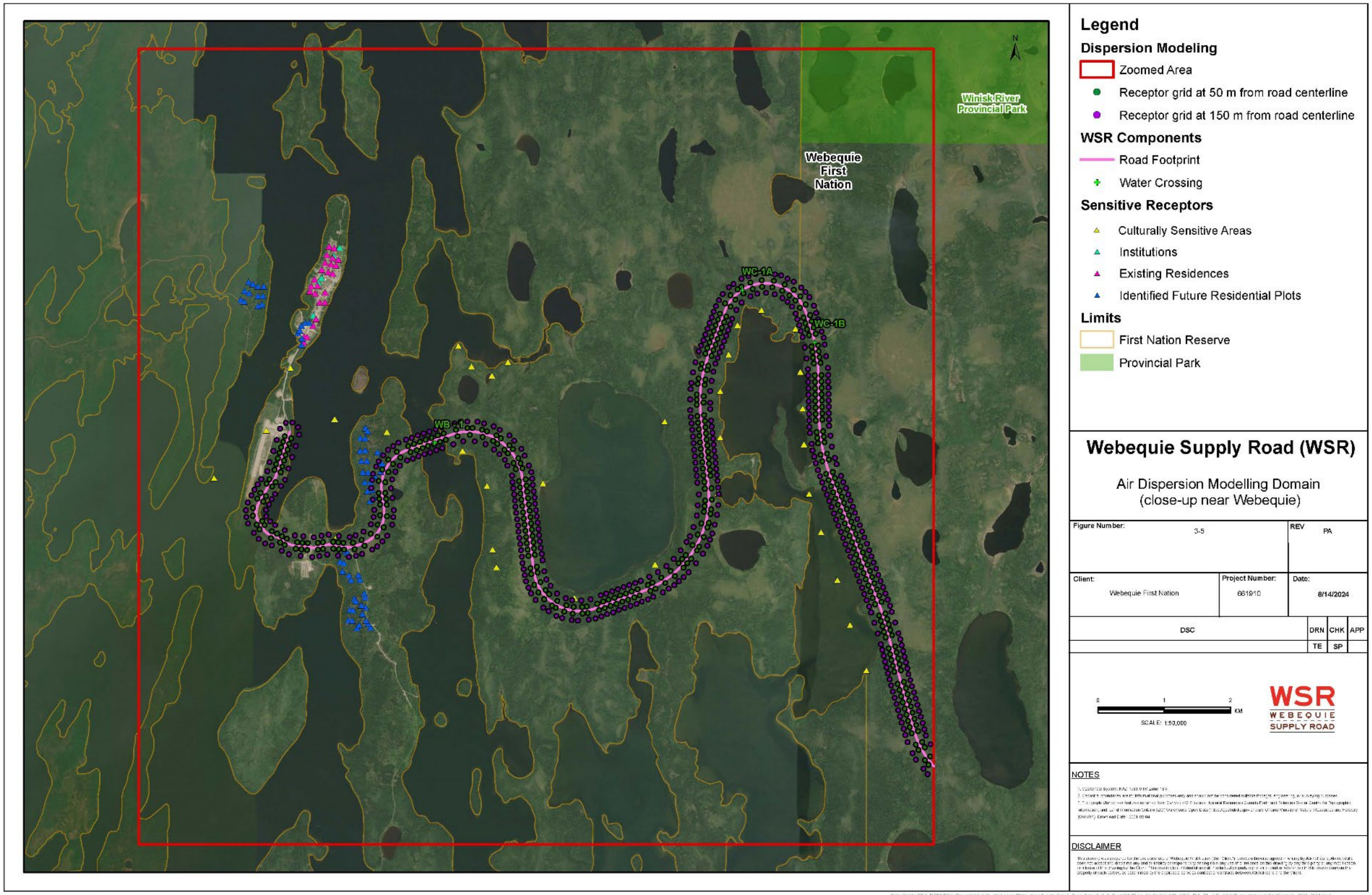


Figure 3-6: Air Dispersion Modelling Domain (close-up near Webequie)



3.6 Assessment Scenarios

The objective of the HHRA was to evaluate the potential human health risks for the following scenarios:

- Baseline Scenario – includes potential health risks associated with the existing environmental conditions; and
- Project Scenario – includes potential health risks associated with the Project, including the baseline condition, to assess both incremental and cumulative health risks associated with the Project.

The above-described scenarios are assessed in the HHRA and are discussed throughout the report.

3.7 COPC Screening

Project activities were evaluated (in each of the related VC sections) for their potential to introduce or significantly redistribute contaminants into the local environment; where identified, contaminants were then evaluated for their potential to adversely affect the health of populations with the potential to be exposed to the chemicals. As described in **Section 3.3**, no significant effects, including increasing concentrations of Project-related contaminants, were predicted for soil, groundwater, surface water, sediment, terrestrial wildlife, fish and/or vegetation.

Air quality is the only VC with links to human health where contaminant concentrations were predicted to have the potential to increase during construction and operations of the Project and exceed the applicable guidelines. All air contaminants with the potential to exceed the applicable guidelines have been retained as preliminary contaminants of potential concern (COPCs) in the HHRA.

Further evaluation of these preliminary COPCs is described in further detail in **Section 3.7.1**, below.

The AQIA (AtkinsRéalis, 2024a) used the indicators presented in **Table 3-1** to assess potential effects to air quality.

Table 3-1: Air Quality VC – Indicators

Indicators
Quantitative changes to ambient air contaminants in the study area, including: ▪ **Particulates** (total suspended matter (TSP), fine inhalable fraction of particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$)). ▪ **Criteria air contaminants** (sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO)). ▪ **Relevant volatile organic compounds** (VOC) (1,3-butadiene, Acetaldehyde, Acrolein, Benzene, Ethylbenzene, Formaldehyde, Hexanes, Propionaldehyde, Toluene, Xylenes). ▪ **Benzo(a)pyrene** as a surrogate to Polycyclic Aromatic Hydrocarbons. ▪ **Diesel particulate matter (DPM)**. ▪ **Dustfall**.

In addition to the above indicators, as metals are naturally occurring in soil, and soils will be disturbed during the construction of the WSR, as well as by vehicle traffic during the operation phase, metals have also been retained for evaluation in the HHRA. As air quality data was not available for metals, baseline soil data and the TSP concentrations predicted for the construction and operation phases of the Project were used to predict soil dust concentrations of metals for consideration in the HHRA.

3.7.1 Air COPCs

****The air quality results used in this HHRA are based on the draft air monitoring data available at the time the assessment was conducted. These data have since been updated. The revised results will be reviewed and incorporated into an addendum to this HHRA. ****

To assess the Project, atmospheric dispersion modelling was carried out using expected but conservative emission scenarios during road construction and the operation phase. The HHRA has relied on the results of the AQIA with mitigations in place as an Air Quality and Dust Control Management Plan will be employed during the construction phase of the Project. As the WSR will not be fully surfaced with asphalt or chip seal from the start, the maintenance crew will operate a truck that will spray water over the gravel-surface road from May to November, or when needed, during the operation phase until the asphalt or chip seal is in place.

The emission sources considered in the air dispersion modelling in the AQIA included the combustion of diesel fuel or gasoline from land mobile equipment, heavy-duty trucks and light-duty vehicles during the construction and operation phase of the WSR. The modelling also considered fugitive dust emissions mostly from vehicular traffic on the road and the handling of aggregates and other earth materials during construction.

The modelling considered receptors, or points of impingement, for potential contaminant concentrations in ambient air, at 50 m and 150 m distance from the road centreline (RCL) and at every 100 m on either side along the road. Discrete receptors were also placed at the air sensitive locations in the area including:

- **Twenty-four (24) existing residences** or group of residences including mostly homes within the community of Webequie.
- **Six (6) institutional buildings** including two schools, a nursing station, a church, a community building, and business center.
- **Twenty-one locations in culturally sensitive areas** including spiritual or sacred spaces for members of the Webequie First Nation and other Indigenous communities and/or stakeholders and locations important for harvesting country foods or hunting.
- **Sixty-six (66) locations for future** residences **(RPF)** per the Webequie First Nation On-Reserve Land Use Plan of 2019 distributed amongst four areas (Site A; Site West; Site C and Site D).

The AQIA presented the maximum concentrations expected at these locations for contaminants emitted during each phase with and without mitigation measures in place (AtkinsRéalis, 2024a); however, as noted, only the results with mitigation measures have been further evaluated in the HHRA.

The results of the AQIA for both the construction and operation phases of the Project are presented in the following sections, with the results used to identify final COPCs to carry forward for evaluation in the HHRA.

3.7.1.1 Construction Phase

The results of the AQIA for the construction phase, which includes project related emissions during the construction phase considered cumulatively with baseline conditions, with mitigation measures assumed to be in place, are presented in **Table 3-2**.

Table 3-2: Air Dispersion Modelling Results for the Construction Phase

Contaminant	Averaging Period	Maximum Total Concentration Including Background			Limit Value	Selected Background
		Location from RCL [1]	With Mitigation			
			µg/m³	% limit	µg/m³	µg/m³
Total Suspended Matter (TSP)	24-hour	Max at 50 m	1,573	**1,311**	120 (AAQC)	45
		Max at 150 m	291	**242**		
		CHL25 at 60 m	489	**407**		
		CHL17 at 130 m	230	**192**		
		CHL05 at 150 m	250	**208**		
		CHL14 at 200 m	210	**175**		
		CHL08 at 280 m	173	**144**		
Fine Inhalable Fraction (PM_{10})	24-hour	Max at 50 m	770	**1,541**	50 (AAQC)	20
		Max at 150 m	178	**356**		
		CHL25 at 60 m	270	**539**		
		CHL17 at 130 m	138	**275**		
		CHL05 at 150 m	146	**293**		
		CHL14 at 200 m	126	**253**		
		CHL08 at 280 m	105	**211**		
Fine Particulate Matter ($PM_{2.5}$)	24-hour	Max at 50 m	144	**534**	27 (AAQC & CAAQS)	12.6
		Max at 150 m	34	**127**		
		CHL25 at 60 m	52	**194**		
		CHL17 at 130 m	29	**109**		
		CHL05 at 150 m	31	**117**		
		CHL14 at 200 m	28	**105**		
		CHL08 at 280 m	24	91		
Nitrogen Dioxide (NO_2)	1-hour	Max at 50 m	144	36	400 (AAQC)	51
		Max at 50 m	116	**147**	79 (CAAQS)	28
		Max at 150 m	90	**114**		
		CHL25 at 60 m	93	**118**		
		CHL17 at 130 m	82	**104**		
		CHL05 at 150 m	86	**109**		
		CHL14 at 200 m	77	98		
		CHL08 at 280 m	68	86		
	24-hour	Max at 50 m	256	**128**	200 (AAQC)	23
		Max at 150 m	88	44		
		CHL25 at 60 m	101	50		

Table 3-2 (Cont'd): Air Dispersion Modelling Results for the Construction Phase

Contaminant	Averaging Period	Maximum Total Concentration Including Background			Limit Value	Selected Background
		Location from RCL (1)	With Mitigation			
			µg/m³	% limit	µg/m³	µg/m³
Acrolein	1-hour	Max at 50 m	0.67	15	4.5 (AAQC)	0.040
	24-hour	Max at 50 m	0.41	**101**	0.4 (AAQC)	0.040
		CHL25 at 60 m	0.16	40		
Benzene	24-hour	Max at 50 m	2.0	85	2.3 (AAQC)	0.90
Propionaldehyde	10-minute	Max at 50 m	2.8	28	10 (AAQC)	1.6
Benzo(a)pyrene (B[a]P)	Annual	Max at 50 m	1.1×10^{-5}	**107**	1.0×10^{-5} (AAQC)	1.0×10^{-5}
Dustfall	30-day	Max at 50 m	10	**143**	7 g/m² (AAQC)	0.4 g/m²
		Max at 150 m	5.4	77		
		CHL25 at 60 m	3.4	49		

Notes:
Concentrations that are greater than the corresponding AAQC or CAAQS are denoted in **bold**.
(1) Closest location from the road centerline (RCL) for culturally sensitive areas (CHL).

As shown in **Table 3-2**, exceedances of Ontario AAQC for TSP, PM_{10}, and $PM_{2.5}$ and CAAQS for NO_2 remain a possibility at some culturally sensitive areas, even with the application of mitigation measures. Further, while benzo(a)pyrene is predicted to exceed the AAQC of 1.0×10^{-5} µg/m³ with a predicted maximum annual concentration of 1.1×10^{-5} µg/m³, the contribution from the Project is minimal with the cumulative concentration essentially equivalent to the baseline of 1.0×10^{-5} µg/m³. Given this and the conservatism in the model, benzo(a)pyrene is not retained as a project related COPC.

In addition, the following factors should be considered when assessing the impact of the construction phase on air quality:

- The potential exceedances only concern short-term AAQC (24-hours and less) and could only occur over a short period (i.e., 1-2 days) at each receptor given that the emission sources will be moving as road construction progresses.
- There will be no long-term health impacts based on AAQCs. Dust deposition on the ground and on vegetation above the threshold would be limited to the road ROW and slightly beyond. No exceedance of the AAQC for dustfall was calculated at culturally sensitive areas. Deposition would also be limited temporally given the short period of dust emissions in an area, and thus any dust deposited on vegetation would most likely be washed away by precipitation and other natural phenomenon (e.g., wind).
- While the deposition model considers local topography, it does not consider the presence of vegetation and trees that can act as physical barriers, especially against the dispersion of particulate down-wind. Even with the conservatism of the model, no dustfall exceedances of the AAQC were predicted at culturally sensitive areas.

- As it is not possible to define the exact combination and distribution of equipment, or the activities that will occur at individual sections of the road during construction, all potential emissions (dozers, excavators, loaders, etc.) were combined as a single source and assumed to be operating concurrently as a simplified but conservative approach. For example, all three dozers and graders available on site were assumed to be in operation at the same time and in close proximity to one another, which results in higher localized concentrations that is unlikely to reflect reality (at a minimum, there would be some distance between the pieces of machinery).
- The Air Quality and Dust Control Management Plan will not be limited to the mitigation measures assumed in the AQIA, with many other options available to mitigate dust uplifting and exhaust emissions. Most of these options like idling minimization, limitation of unnecessary vehicle and heavy equipment movement, and the wetting of soil and aggregate during dry days cannot however be properly translated into the dispersion model and so their potential impact was not calculated. Moreover, mitigation measures for dozers and graders, which are the main source of particulates, could include watering but it would not be practical. The management plan could therefore integrate a monitoring procedure with the intent of mitigating the impact of these emissions by controlling (limiting) their usage during unfavorable weather conditions for example.
- Finally, it is important to note that no AAQC exceedances were calculated at existing residences and institutional buildings in the Webequie area (where people present most frequently) with and without mitigation measures in place.

Based on the above rationale, and as the AQIA only predicted exposures of short-term (i.e., 24-hour or 1-hour) guidelines, only the potential for acute exposures (i.e., < 24 hours) will be considered for the construction phase of the Project. As the HHRA does not consider short-term occupational exposures, only the exceedances predicted at sensitive receptors will be carried forward for quantitative evaluation in the HHRA. Based on this rationale, **Table 3-3** presents the COPCs carried forward in air for the construction phase of the Project.

Table 3-3: COPCs in Air – Construction Phase

Contaminant	Averaging Period	Maximum Total Concentration Including Background			Limit Value	Selected Background
		Location from RCL (1)	With Mitigation			
			µg/m³	% limit	µg/m³	µg/m³
Total Suspended Matter (TSP)	24-hour	CHL25 at 60 m	489	**407**	120 (AAQC)	45
		CHL17 at 130 m	230	**192**		
		CHL05 at 150 m	250	**208**		
		CHL14 at 200 m	210	**175**		
		CHL08 at 280 m	173	**144**		
Fine Inhalable Fraction (PM_{10})	24-hour	CHL25 at 60 m	270	**539**	50 (AAQC)	20
		CHL17 at 130 m	138	**275**		
		CHL05 at 150 m	146	**293**		
		CHL14 at 200 m	126	**253**		
		CHL08 at 280 m	105	**211**		

Table 3-3 (Cont'd): COPCs in Air – Construction Phase

Contaminant	Averaging Period	Maximum Total Concentration Including Background			Limit Value	Selected Background
		Location from RCL (1)	With Mitigation			
			µg/m³	% limit	µg/m³	µg/m³
Fine Particulate Matter ($PM_{2.5}$)	24-hour	CHL25 at 60 m	52	**194**	27 (AAQC & CAAQS)	12.6
		CHL17 at 130 m	29	**109**		
		CHL05 at 150 m	31	**117**		
		CHL14 at 200 m	28	**105**		
Nitrogen Dioxide (NO_2)	1-hour	CHL25 at 60 m	93	**118**	79 (CAAQS)	28
		CHL17 at 130 m	82	**104**		
		CHL05 at 150 m	86	**109**		

Notes:
Concentrations that are greater than the corresponding AAQC or CAAQS are denoted in **bold**.
(1) Closest location from the road centerline (RCL) for culturally sensitive areas (CHL).

In addition, to estimate Project scenario concentrations of metals in dust (i.e., TSP) generated from soils in the study area, soil data collected as part of the Eagle's Nest Multi-metal Mine Environmental Assessment, located in the Ring of Fire, has been used. It is noted that baseline soil data from the project study areas was collected as part of the country foods baseline assessment; however, the data collected is representative of peat, which based on moisture content is less likely to generate dust when disturbed. A review of the Eagle's Nest soil data indicates that concentrations of all metals were higher in the Eagle's Nest soils than in the peat samples collected during the country foods assessment. As such, use of the Eagle's Nest data is considered conservative and health protective.

A total of eight soil samples (+ one duplicate) were collected to characterize baseline soil conditions as part of the Eagle's Nest EA. As dusts would be generated from soils from various areas across the LSA and based on the assumption that the soil data is representative of the LSA, dust concentrations from soil were estimated using 95% upper confidence limit of the mean (UCLM) concentrations of the metals in soil. The 95% UCLMs were calculated using US EPA ProUCL Version 5.2, which explicitly considers non-detect observations.

Health Canada (2024) recommends a default dust (PM_{10}) concentration for unpaved roads of 250 µg/m^3. However, as the Ontario AAQC for metals are based on metals in TSP, the maximum predicted TSP concentration at a sensitive receptor (i.e., 489 µg/m^3 at CHL25 at 60 m from the road centreline) has been used along with the above discussed baseline soil data to predict metals concentrations in TSP). As presented in **Table 3-3**, only short-term (24-hour) exceedances of TSP were predicted. On this basis, and as exceedances at each location will only be on a short-term basis given that the emission sources will be moving as road construction progresses, metals concentrations in TSP were only predicted for this scenario (i.e., 24-hours).

Table 3-4 presents the estimated construction phase concentrations of metals in soil particulate. It is noted that baseline concentrations of metals in soil particulate have been estimated using the baseline Eagle's Nest soil data and the baseline TSP concentration of 45 µg/m^3. The predicted 24-hour TSP metals concentrations have been compared to the Ontario AAQC for metals.

Table 3-4: Metals COPCs in Air (24-hour TSP) – Construction Phase

Metal	95% UCLM Soil Concentration (µg/g)	Construction Phase Soil Particulate Concentration (µg/m³)**	Baseline Soil Particulate Concentration (µg/m³)	Baseline + Construction Phase Soil Particulate Concentration (µg/m³)	Ontario's Ambient Air Quality Criteria* (µg/m³)
Antimony (Sb)	1.0	0.0005	0.00005	0.0005	25 (24-hour)
Arsenic (As)	5.0	0.002	0.0002	0.003	0.3 (24-hour)
Barium (Ba)	106.9	0.05	0.005	0.06	10 (24-hour) total water soluble
Beryllium (Be)	0.9	0.0004	0.00004	0.0005	0.01 (24-hour)
Boron (B)	15.1	0.007	0.0007	0.008	120 (24-hour)
Cadmium (Cd)	0.5	0.0003	0.00002	0.0003	0.025 (24-hour)
Chromium (Cr)***	60.1	0.03 (total) 0.004 (VI) 0.025 (III)	0.003 (total) 0.0004 (VI) 0.0025 (III)	0.03 (total) 0.004 (VI) 0.025 (III)	0.5 (24-hour) (III) **0.0007 (24-hour) (VI)**
Cobalt (Co)	13.7	0.007	0.0006	0.007	0.1 (24-hour)
Copper (Cu)	21.0	0.01	0.001	0.01	50 (24-hour)
Iron (Fe)	33717	16.5	1.5	18.0	**4 (24-hour)**
Lead (Pb)	16.6	0.008	0.0008	0.01	0.5 (24-hour)
Lithium (Li)	35.0	0.02	0.002	0.02	20 (24-hour)
Mercury (Hg)	0.1	0.00005	0.000005	0.00006	2 (24-hour)
Molybdenum (Mo)	1.0	0.0005	0.00005	0.0006	120 (24-hour)
Nickel (Ni)	37.8	0.02	0.002	0.02	0.2 (24-hour)
Selenium (Se)	1.3	0.0006	0.00006	0.0007	10 (24-hour)
Uranium (U)	2.5	0.001	0.0001	0.001	0.3 (24-hour)
Vanadium (V)	61.8	0.03	0.003	0.03	2 (24-hour)
Zinc (Zn)	73.1	0.04	0.003	0.04	120 (24-hour)

Notes:

95% UCLM 95% upper confidence limit of the mean soil concentration.

* Ontario's Ambient Air Quality Criteria, Standards Development Branch, Ontario Ministry of the Environment April 2012.

** Estimated as the 95%UCLM soil concentration multiplied by the maximum predicted TSP concentration at a sensitive receptor of 489 µg/m³ (or 4.9E-04 g/m³).

*** No speciation data was available, conservatively assumed that 1/7 of total chromium is present as chromium (VI), with the remaining 6/7 present as chromium (III).

BOLD Exceeds AAQC.

When compared, despite the conservative approach used to estimate the metals concentrations in TSP, only hexavalent chromium and iron were identified as having the potential to exceed the AAQC. On this basis, in addition to TSP, PM_{10}, $PM_{2.5}$ and NO_2, hexavalent chromium and iron have been retained as COPCs in air for the construction phase of the Project. As noted, the exceedances predicted by the AQIA for the CACs were only for the short-term (24-hour, 1-hour) guidelines, and thus, only acute exposures will be evaluated in the HHRA.

3.7.1.2 Operation Phase

The results of the AQIA for the operation phase, which includes project related emissions during the operation phase considered cumulatively with baseline conditions, with mitigation measures assumed to be in place, are presented in **Table 3-5**.

Despite the conservative approach used for the air dispersion modelling included in the AQIA (AtkinsRéalis, 2024a), except for PM_{10}, concentrations of all other potential contaminants associated with the project (i.e. gaseous CACs, VOCs) were low and below all applicable AAQC and CAAQS even without mitigation, and thus, the data for those parameters for the operation phase have not been re-presented here. **Table 3-5** presents the operation phase air dispersion modelling results for PM_{10} predicted to exceed the applicable air quality guidelines, with mitigations in place. As discussed for the construction phase, only the exceedances at points of impingement of interest were carried forward for evaluation in the HHRA. As presented in **Table 3-5**, only PM_{10} has been retained as final COPC in air for the operation phase of the Project.

Table 3-5: COPCs in Air – Operations Phase

Parameter	Averaging Period	Maximum Total Concentration including Background			Limit Value	Selected Background
		Location from RCL (1)	With Mitigation			
			µg/m³	% limit	µg/m³	µg/m³
Fine Inhalable Fraction (PM_{10})	24-hour	Max at 50 m	70	**140**	50 (AAQC)	20
		Max at 150 m	39	78		
		CHL25 at 60 m	54	**<u>108</u>**		
		RP01 at 1,350 m	23	45		
		RFP42 at 55 m	56	**<u>112</u>**		

Notes:
Concentrations that are greater than the corresponding AAQC or CAAQS are denoted in **bold**. Concentrations exceeding the guidelines at sensitive receptors are **<u>underlined</u>**.
(1) Closest receptors from the road centerline (RCL25) for culturally sensitive areas (CHL), existing residences and institutions (RP01), and future residential plots (FRP42).

Except for PM_{10} at one culturally sensitive area and one future residential plot which are both located proximate to the WSR, no AAQC and CAAQS exceedances were calculated at all other points of impingement when integrating the mitigation measures. Although the road will eventually be fully surfaced with asphalt or chipseal, a gravel surface was assumed for the modelling to account for the initial unpaved conditions. Once the gravel or chipseal is in place, this will result in much lower particulate (TSP, PM_{10}) concentrations in air and dustfall on the ground in the immediate area of the road. The impact of a pavement on particulate emissions is expected to result in at least a 50% decrease in maximum PM_{10} concentrations, which would be enough to eliminate the exceedance of PM_{10} concentrations at both sensitive receptors noted above.

To be conservative and health protective, the predicted exceedances of PM_{10} at culturally sensitive area CHL25 at 60 m and future residential plot RFP42 at 55 m were carried forward for evaluation in the HHRA.

As with the construction phase, the Eagle's Nest EA soil data was used to predict concentrations of metals in soil particulate during the operations phase of the Project. As noted, the road will eventually be fully surfaced with asphalt or chipseal, however; as it won't be initially, the AQIA assumed the surfacing was not in place. Further, the AQIA indicates that during the operations phase, the predicted TSP and PM_{10} concentrations are primarily associated with road dust. On this basis, the maximum predicted TSP concentration for the operations phase at a sensitive receptor of 97 µg/m^3, has conservatively been used to predict the concentrations of metals in soil particulate during the operations phase. It is noted that the maximum TSP concentration was predicted at a future residence located proximate to the WSR (RPF42 (site D)).

As with the construction phase, only exceedances of short-term guidelines were predicted for the operations phase, and while no TSP exceedances were predicted, an exceedance of the 24-hour PM_{10} guideline was predicted (see **Table 3-5**). As particulate in air (including TSP and PM_{10}) is predicted to be below the air quality guidelines except for 24-hour PM_{10}, the maximum 24-hour TSP concentration at a sensitive receptor was conservatively used to predict the 24-hour concentrations of metals in TSP. The conservatism in the approach is emphasized, as once the asphalt or chip-seal is in place, as noted, the particulate air concentrations are predicted to decrease by approximately 50%.

As with the construction phase, the predicted TSP metals concentrations have been compared to the Ontario AAQCs for metals. While only 24-hour exceedances of PM_{10} were predicted, and the maximum 24-hour TSP concentrations were used to predict the metals concentrations, the results have conservatively been compared to both the 24-hour and annual AAQC, where available.

Table 3-6 presents the estimated construction phase concentrations of metals in TSP.

Table 3-6: Metals COPCs in Air (TSP) – Operations Phase

Metal	95% UCLM Soil Concentration (µg/g)	Operations Phase Soil Particulate Concentration (µg/m^3)**	Baseline Soil Particulate Concentration (µg/m^3)	Operations Phase + Baseline Soil Particulate Concentration (µg/m^3)	Ontario's Ambient Air Quality Criteria* (µg/m^3)
Antimony (Sb)	1.0	0.0001	0.00005	0.0002	25 (24-hour)
Arsenic (As)	5.0	0.0005	0.0002	0.0007	0.3 (24-hour)
Barium (Ba)	106.9	0.01	0.005	0.02	10 (24-hour) total water soluble
Beryllium (Be)	0.9	0.00009	0.00004	0.0001	0.01 (24-hour)
Boron (B)	15.1	0.002	0.0007	0.003	120 (24-hour)
Cadmium (Cd)	0.5	0.00005	0.00002	0.00007	0.025 (24-hour) 0.005 (annual)

Table 3-36 (Cont'd): Metals COPCs in Air (TSP) – Operations Phase

Metal	95% UCLM Soil Concentration (µg/g)	Operations Phase Soil Particulate Concentration (µg/m^3)**	Baseline Soil Particulate Concentration (µg/m^3)	Operations Phase + Baseline Soil Particulate Concentration (µg/m^3)	Ontario's Ambient Air Quality Criteria* (µg/m^3)
Chromium (Cr)***	60.1	0.006 total 0.005 (III) 0.00086 (VI)	0.003 (total) 0.0026 (III) 0.0004 (VI)	0.009 (total) 0.0077 (III) 0.0013 (VI)	0.5 (24-hour) (III) **0.00014 (annual) (VI)** **0.0007 (24-hour) (VI)**
Cobalt (Co)	13.7	0.001	0.0006	0.002	0.1 (24-hour)
Copper (Cu)	21.0	0.002	0.001	0.003	50 (24-hour)
Iron (Fe)	33717	3.3	1.5	4.8	**4 (24-hour)**
Lead (Pb)	16.6	0.002	0.0008	0.002	0.5 (24-hour) 0.2+ (30 day)
Lithium (Li)	35.0	0.003	0.002	0.005	20 (24-hour)
Mercury (Hg)	0.1	0.00001	0.000005	0.00002	2 (24-hour)
Molybdenum (Mo)	1.0	0.0001	0.00005	0.0002	120 (24 hour)
Nickel (Ni)	37.8	0.004	0.002	0.006	0.2 (24-hour) 0.04 (annual)
Selenium (Se)	1.3	0.0001	0.00006	0.0002	10 (24-hour)

Table 3-7: Metals COPCs in Air (TSP) – Operations Phase

Metal	95% UCLM Soil Concentration (µg/g)	Operations Phase Soil Particulate Concentration (µg/m^3)**	Baseline Soil Particulate Concentration (µg/m^3)	Operations Phase + Baseline Soil Particulate Concentration (µg/m^3)	Ontario's Ambient Air Quality Criteria* (µg/m^3)
Uranium (U)	2.5	0.0002	0.0001	0.0003	0.3 (24-hour) 0.06 (annual)
Vanadium (V)	61.8	0.006	0.003	0.009	2 (24-hour)
Zinc (Zn)	73.1	0.007	0.003	0.0103802	120 (24-hour)

Notes:

95% UCLM — 95% upper confidence limit of the mean soil concentration.

* — Ontario's Ambient Air Quality Criteria, Standards Development Branch, Ontario Ministry of the Environment April 2012.

** — Estimated as the 95%UCLM soil concentration multiplied by the maximum predicted TSP concentration at a sensitive receptor of 489 µg/m^3 (or 4.9E-04 g/m^3).

*** — No speciation data was available, conservatively assumed that 1/7 of total chromium is present as chromium (VI), with the remaining 6/7 present as chromium (III).

BOLD — Exceeds AAQC.

As with the construction phase results, the concentrations of hexavalent chromium and iron in TSP were predicted to have the potential to exceed the AAQC. On this basis, in addition to PM_{10}, hexavalent chromium and iron have been retained as COPCs for further evaluation in the HHRA.

3.8 Receptor and Exposure Pathway Identification

The LSA for the WSR includes the following communities:

- Webequie First Nation;
- Attawapiskat First Nation;
- Eabametoong First Nation;
- Kasabonika Lake First Nation;
- Marten Falls First Nation; and
- Neskantaga First Nation.

As described in **Section 3.4**, the HIA and this HHRA will specifically focus on the potential health impacts to the Webequie First Nation. In accordance with the Study Plan, due to the community's proximity to the Project, the Webequie First Nation community members have the potential to experience exposure to Project related COPCs more than other members of Indigenous communities in the LSA, as well as the general public. The Webequie First Nation community has therefore been selected as the critical receptor group for evaluation in the HHRA. The assessment of exposures and risks to members of the Webequie First Nation is considered protective of other potential receptor groups that live in or have the potential to visit the LSA.

Webequie First Nation community members reside in the LSA on a full-time basis. In addition, there are cabins present along the WSR ROW near Webequie First Nation that are likely used on a seasonal basis and as the Project may open us access to new areas east of Webequie First Nation, additional cabins may be established in the future. As such, Webequie First Nation community members may also reside at locations within the LSA on a seasonal basis.

Members of the Webequie First Nation have reported that they hunt, fish, forage and trap in the LSA. During these activities, community members may spend extended periods of time in areas near or along the WSR ROW or may travel back to their community daily.

As described in **Section 3.2** and **3.3**, air quality is the only VC with links to human health where contaminant concentrations were predicted to have the potential to increase during the Project. On this basis, COPCs in air were identified and have been carried forward in the HHRA. Subsequent sections of the HHRA will assess exposures and risks of identified receptors of concern to the COPCs identified in air. To estimate exposures, receptors will be assumed to be exposed to the maximum concentrations of the air COPCs predicted by the AQIA (and in **Section 3.3** for metals), regardless of location. On this basis, the duration of exposure will be the key determinant of risks, with the receptor group exposed for the longest duration receiving the highest potential exposures and associated risks.

Based on the above, Webequie First Nation community members residing in the community on a full-time basis have been identified as the critical receptor group for assessment in the HHRA. In accordance with Health Canada (2024) residents are assumed to be present and exposed to the identified COPCs for 24 hours a day, seven days a week, 52 weeks a year for 80 years. The subsequent sections of the HHRA will therefore focus on this receptor group, with exposures and risks estimated for residents protective of summer residents, community members hunting, fishing, trapping and foraging in the LSA, as well as other people that may live in or visit the LSA.

As COPCs were only identified in air, the primary exposure pathway by which Webequie First Nation community members and other populations in the LSA have the potential to be exposed to Project related COPCs is via inhalation. As discussed in **Section 3.2**, the emissions and dust generated by the Project are not predicted to have a significant adverse effect on other human health related VCs, including increasing concentrations of Project-related contaminants in other media, including in country foods. Thus, no COPCs were identified in these other media, and no other significant, operable exposure pathways were identified for Webequie First Nation community members or other populations spending time in the LSA.

3.9 Conceptual Site Model

The final stage of the Problem Formulation is the development of a Conceptual Site Model (CSM); a CSM presents a summary of the Problem Formulation for the HHRA, including identified receptors of concern, the age group(s) to be evaluated in the HHRA, and the identified operable exposure pathways. A CSM has been developed for the Project emissions and is presented below in tabular form.

Table 3-8: Conceptual Site Model, Human Health

Land Use	Receptor of Concern	Age Groups Considered	Operable Exposure Pathways
Residential	**Webequie First Nation Community Members**	**Infant** **Toddler** **Child** **Teen** **Adult**	**Inhalation of Project emissions in air**
Residential	Seasonal Residents	Infant Toddler Child Teen Adult	*Evaluation of the Residential Receptor is protective of seasonal residents*
Undeveloped Lands	People Involved in Hunting, Fishing, Foraging, Trapping	Infant Toddler Child Teen Adult	*Evaluation of the Residential Receptor is protective of people involved in hunting, fishing, foraging and trapping*

BOLD – Retained for Quantitative Evaluation in the HHRA.

Exposures and risks to the Webequie First Nation community members will be quantified in **Sections 4** and **5** respectively.

4. Exposure Assessment

The exposure assessment stage of the HHRA involves the estimation of the quantity of each COPC received by each receptor, typically on a per unit time basis such as a daily intake or dose.

The principal stages of the exposure assessment consist of the following:

- Characterization/estimation of exposure point concentrations (EPCs);
- Receptor characterization including compilation of physical and behavioural characteristics of human receptors that influence intake rates (e.g. body weight, time-activity patterns, media intake rates, dermal contact rates, etc.); and
- Exposure estimation for each receptor, COPC and exposure pathway.

4.1 Exposure Point Concentrations

The EPCs selected for the air COPCs were the maximum concentrations of the air contaminants predicted by the AQIA at a point of impingement of interest (i.e., culturally sensitive area, residence, etc.), as well as the concentrations of metals in TSP conservatively estimated in **Section 3.3** (see **Table 3-4** and **Table 3-6**). A summary of the EPCs for both the construction phase and the operation phase is presented in **Table 4-1**. It is noted that the EPCs include the estimated project related concentrations, as well as the baseline concentrations.

Table 4-1: Exposure Point Concentrations for Air COPCs

COPC	Project Concentration (µg/m^3)	Baseline Concentration (µg/m^3)	Project + Baseline Concentration (µg/m^3)
Construction Phase			
TSP (24-hour)	444	45	489
PM_{10} (24-hour)	250	20	270
$PM_{2.5}$ (24-hour)	36.4	12.6	52
NO_2 (1-hour)	65	28	93
Cr (VI) (24-hour)	0.03	0.003	0.03 (total)
Fe (24-hour)	16.5	1.5	18.0
Operations Phase			
PM_{10} (24-hour)	36	20	56
Cr (VI) (24-hour)	0.006	0.003	0.009
Fe (24-hour)	3.3	1.5	4.8

The EPCs presented in **Table 4-1** will be used to quantify inhalation exposures to Webequie First Nation community members.

4.2 Receptor Characteristics

Age-dependent receptor characteristics were obtained from Health Canada (2024) and are summarized in **Table 4-2**, with the exposure frequency and durations also recommended by Health Canada (2024) for residential scenarios, and assumed for Webequie First Nation community members, presented in **Table 4-3**. Webequie First Nation community members with the potential to be exposed to COPCs in outdoor air in the LSA could include members from any of the age groups listed below. Most COPCs have corresponding inhalation TRVs, and thus exposures were determined as amortized air concentrations (see **Section 4.3** below), in which no age-specific receptor- characteristics are incorporated into the inhalation exposure calculations. However, when inhalation TRVs were not available (i.e., for iron), exposure doses via the inhalation pathway were calculated; as iron is a non-carcinogenic COPC, in accordance with Health Canada (2024) guidance, the toddler was selected as the critical receptor and was retained for quantitative evaluation.

Table 4-2: Summary of Receptor Characteristics

Receptor Characteristic	Infant	Toddler	Child	Teen	Adult	Reference
Age	0 to <6 months	6 months to <5 years	5 to <12 months	12 months to <20 years	≥ 20 years	Health Canada, 2024
Age Group Duration	0.5 years	4.5 years	7 years	8 years	60 years	Health Canada, 2024
Bodyweight	8.2 kg	16.5 kg	32.9 kg	59.7 kg	70.7 kg	Health Canada, 2024
Inhalation Rate	2.2 m^3/day	8.3 m^3/day	14.5 m^3/day	15.6 m^3/day	16.6 m^3/day	Health Canada, 2024

Notes:
kg kilograms.
m^3/day meters cubed per day.

Table 4-3: Receptor Exposure Durations

Receptor Characteristic	Webequie First Nation Community Member	Reference
Hours per Day of Exposure	24	Health Canada, 2024
Days per Week of Exposure	7	Health Canada, 2024
Weeks per Year of Exposure	52	Health Canada, 2024
Life Expectancy	80	Health Canada, 2024

The receptor characteristics and exposure durations presented in the preceding tables have been used along with the following exposure intake equations to estimate inhalation exposures to Webequie First Nation community members.

4.3 Exposure Equations

Exposures via the inhalation of Project emissions were estimated using the following Health Canada (2024) equation:

$$EIA = \frac{C_A \times D_1 \times D_2 \times D_3 \times D_4}{LE}$$

Where:

EIA	=	exposure from the inhalation (µg/m^3; as an “amortized air concentration”)
C_A	=	air concentration (µg/m^3)
D_1	=	hours per day exposed/24 hours (unitless)
D_2	=	days per week exposed/7 days (unitless)
D_3	=	weeks per year exposed/52 weeks (unitless)
D_4	=	total years exposed to site (only used for carcinogens)
LE	=	life expectancy (years) (only used for carcinogens)

Where inhalation TRVs (e.g. Tolerable Concentrations, Inhalation Unit Risks) were not available for a COPC, the following equation (Health Canada, 2024) was used to estimate an exposure dose:

$$EIA = \frac{C_A \times IR_A \times RAF_{Inh} \times D_1 \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:

EIA	=	exposure from the dust inhalation pathway for soil (µg/kg bw/d)
C_A	=	air concentration (µg/m^3)
IR_A	=	receptor air intake (inhalation) rate (m^3/day)
RAF_{Inh}	=	relative absorption factor by inhalation (unitless, chemical-specific)
D_1	=	hours per day exposed/24 hours (unitless)
D_2	=	days per week exposed/7 days (unitless)
D_3	=	weeks per year exposed/52 weeks (unitless)
D_4	=	total years exposed to site (only used for carcinogens)
BW	=	body weight (kg)
LE	=	life expectancy (years) (only used for carcinogens)

The exposure estimates for the Webequie First Nation community members are provided in Tables 1 to 4 in Appendix 3.

5. Toxicity Assessment

The toxicity assessment is completed for all COPCs retained for quantitative evaluation in the HHRA. This stage of the HHRA involves identification toxicity reference values (TRVs) for each COPC. For threshold substances, which are typically non-carcinogenic, the TRVs are presented as an acceptable air concentration (for air and soil particulate inhalation exposures) or dose level (for COPCs with no acceptable air concentration) that was derived such that it is unlikely to be associated with appreciable risks, based on the assumption that these substances act in a threshold manner with an air concentration/exposure dose below which no adverse effects are expected to occur. For carcinogenic chemicals, the TRV was presented as a unit risk estimate or cancer potency factor (i.e., slope factor) based on the assumption that carcinogens act in a non-threshold manner with any exposure capable of producing carcinogenic effects.

TRVs are developed by regulatory authorities such as Health Canada, the US EPA, and the World Health Organization. Given that the Project falls under both federal and provincial jurisdiction, both federal and provincial sources of TRVs were reviewed, with the most scientifically defensible value selected for use. In cases where Ontario MECP or Health Canada TRVs were not available, or were determined not to be suitable (i.e., another agency recommended a TRV based on toxicological data that would not have been available by the agencies at the time they derived their TRV), other international agency TRVs have been considered. The US EPA was given general preference when Ontario MECP or Health Canada TRVs were not available. Various agencies/sources considered in the review and compilation of the available TRVs for the COPCs include:

- US EPA sources including, but not limited to:
  - Integrated Risk Information System (http://www.epa.gov/IRIS/);
  - Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV) from the US EPA Superfund Health Risk Technical Support Center National Center for Environmental Assessment Office of Research and Development (http://hhpprtv.ornl.gov/index.html); and
- World Health Organization (WHO) sources including, but not limited to:
  - http://www.inchem.org/;
  - http://www.euro.who.int/data/assets/pdf_file/0009/128169/e94535.pdf.
- Institute of Medicine (IOM)). National Library of Medicine (NIH) US available at: https://www.nlm.nih.gov/.

The HHRA has considered both acute and chronic inhalation exposures, and as such, TRVs for both exposure durations have been identified, where available. Acute and chronic inhalation TRVs are defined as follows:

- Acute TRV: the air concentration of a chemical that can be tolerated without appreciable health effects on a short-term basis (e.g. 1-hour, 24-hours);
- Non-Cancer Chronic TRV: the air concentration of a chemical that can be tolerated without appreciable health effects for exposures that occur continuously for exposures over an entire lifetime; and
- Cancer Chronic TRV: the air concentration associated with a specified increase in the incremental lifetime cancer risk for exposures that occur for exposures over an entire lifetime.

In addition, where no inhalation TRVs were available (e.g., iron), chronic oral TRVs have been identified.

The TRVs provided by the above listed agencies are protective of critical sub-groups, or sensitive subpopulations (i.e., those with physical characteristics or conditions that may result in an increased likelihood of adverse effect to a given level of exposure, for example, the elderly or persons suffering from existing medical conditions). These sensitive subpopulations are considered by the agencies in the derivation of TRVs; when deriving TRVs, health agencies apply safety or uncertainty factors (i.e., an intraspecies/human variability uncertainty factor) to protect for sensitive subpopulations.

For the CACs, a range of the available acute and chronic air quality guidelines available from Ontario MECP, the CCME and the WHO were used. It is noted, that only for the CACs, the exceedances predicted were only for the short-term exposures (i.e., 1-hour, 24-hour) and thus, only acute TRVs have been presented for these COPCs. Further, while the concentrations of metals were estimated based on exceedances of 24-hour TSP (or PM_{10}) and using the maximum 24-hour concentrations of TSP predicted at a point of impingement of interest, based on a lack of acute TRVs for the metal COPCs (i.e., hexavalent chromium and iron), only chronic exposures and associated risks could be estimated.

For all COPCs, use of a TRV derived specifically for the route of exposure (i.e., inhalation, oral) was preferred over route-to-route extrapolation (e.g., to estimate risks from the inhalation route, it was generally preferential to use an inhalation TRV rather than an oral TRV). Nevertheless, for COPCs where no appropriate inhalation TRVs were available, but oral TRVs were recommended by a recognized health agency, the oral TRVs were used to assess risks associated with inhalation exposures.

The acute and chronic duration inhalation TRVs selected for comparison to receptor exposures are summarized in **Table 5-1**. As no inhalation TRV was identified for iron, an oral TRV recommended by the National Institute of Health's Institute of Medicine (IOM) has been used and is presented in **Table 5-2**. A brief description of the endpoint/target organ (i.e., potential effects) representing the toxicological basis of the TRV is also provided in **Table 5-1** and **Table 5-2**.

Table 5-1: Summary of Inhalation TRVs

Chemical	Inhalation TRV	Endpoint/Target Organ	Reference
Metals			
Chromium VI	UR: 7.6 x 10^{-2} ($\mu g/m^3$)$^{-1}$	Lung cancer	Health Canada (2021)
	RfC: 3.0 x 10^{-2} $\mu g/m^3$	Respiratory effects: ulcerated nasal septum in humans	US EPA (2024)
Criteria Air Contaminants			
PM_{10}	24-hour: 50 $\mu g/m^3$	Reduction in life expectancy: increased cardio-pulmonary and lung cancer mortality	AAQC based on WHO (2006)
$PM_{2.5}$	24-hour: 25 $\mu g/m^3$	Reduced lung function and chronic obstructive pulmonary disease	AAQC & CAAQS based on WHO (2006)
NO_2	1-hour: 79 $\mu g/m^3$	Possible lung metabolism, structure, function, inflammation and host defence against pulmonary infection	CAAQS based on WHO (2006)
TSP	24-hour: 120 $\mu g/m^3$	Not documented. Further discussed in the Uncertainty Section.	AAQC

Notes:
UR – unit risk.
RfC – reference concentration.
$\mu g/m^3$ – micrograms per cubic meter.

As summarized in **Table 5-1**, acute TRVs were identified for the CACs; however, no acute TRVs were identified for hexavalent chromium. Further, no inhalation TRVs were identified for iron. **Table 5-2** below presents an oral TRV for iron, which has been used to estimate exposures to iron via inhalation as a dose.

Table 5-2: Summary of Oral TRVs

Chemical	Oral TRV	Endpoint/Target Organ	Reference
Metals & Metalloids			
Iron	RDA: 3000 µg/day/16.5 kg = 424 µg/kg/day (toddler) 5000 µg/day/70.7 kg = 70 µg/kg/day (adult)	Recommended Daily Allowance	IOM (2001)

Notes:
RDA recommended daily allowance.
µg/kg bw/d – micrograms per kilogram body weight per day.

The TRVs identified above have been used along with the exposure estimates from **Section 4** to estimate non-cancer and cancer health risks associated with exposure to the Project COPCs in air.

5.1 Bioavailability Assessment

Absorption (or bioavailability) factors allow for the comparison of exposures to the same chemical via multiple routes (e.g., dermal and oral). Health Canada (2024) recommends a relative absorption factor (RAF) of 1 (100%) for inhalation exposures. The assumption that the COPCs have an RAF of 100% for all inhalation exposures is conservative and will result in the over-prediction of exposures and therefore associated risks.

5.2 Evaluation of Potential Additive Effects

Where evidence was available to suggest that the critical effects of two or more COPCs occur at the same target site (i.e., tissue or organ system), an assessment of the potential for additive effects at the target site was conducted. If the available data suggested two or more COPCs exert (or could potentially exert) their critical effects by similar mechanisms of action, then the risks associated with exposure to those COPCs were conservatively assumed to be additive. The COPCs evaluated in the HHRA were not considered to be additive.

6. Risk Characterization

Potential risks to each receptor are quantified in the risk characterization stage of the HHRA. Risk characterization is completed for all operable receptor/COPC/exposure pathway combinations identified in the Problem Formulation stage. Non-cancer and cancer risks for Webequie First Nation community members were estimated by integrating the results of the Exposure Assessment (**Section 4**) and the Toxicity Assessment (**Section 5**) to define the magnitude of the health risk.

Non-cancer risks associated with the inhalation of Project emissions were estimated as hazard quotient (HQ) values according to the following formula:

$$HQ = \frac{\text{Amortized Air/Dust Concentration } (\mu g/m^3)}{\text{Reference Concentration } (\mu g/m^3)}$$

Non-cancer risks from inhalation exposures where inhalation TRVs were not available, were estimated as HQ values according to the following formula:

$$HQ = \frac{\text{Estimated Exposure } (\mu g/kg \text{ body weight/day})}{\text{Reference Dose } (\mu g/kg \text{ body weight/day})}$$

Cancer risks from the inhalation of Project emissions were estimated as Incremental Lifetime Cancer Risks (ILCRs) as follows:

$$ILCR = \text{Amortized Air/Dust Concentration } (\mu g/m^3) \times \text{Inhalation Unit Risk } (\mu g/m^3)^{-1}$$

For inhalation exposures where unit risk estimates were not available, ILCRs were evaluated using estimated lifetime daily exposures. Cancer risks were estimated as ILCR values according to the following formulas:

$$ILCR = \text{Estimated Lifetime Daily Exposure } (\mu g/kg/day) \times \text{Cancer Potency Factor } (\mu g/kg/day)^{-1}$$

The resulting chronic HQs and ILCRs were compared to the Health Canada negligible risk levels. Health Canada (2024) guidance indicates that total HQs can be interpreted according to the following general guidelines:

- $\leq$ 0.2 = negligible (i.e., acceptable) human health risks; and
- > 0.2 = potential unacceptable risks which may require mitigation or more detailed assessment.

Health Canada's negligible risk level of 0.2 (or 20% of the TRV) for non-carcinogens allows for 80% of the acceptable exposure level (i.e., as defined by the TRV) to come from other sources; this approach is based on the potential for exposures to a chemical in air, soil, water, food and consumer products (i.e., 20% of the acceptable exposure is typically allocated to each of these 5 media/sources). The non-cancer risk estimates associated with chronic exposures to Project emissions were compared to the Health Canada negligible risk level of 0.2. The interpretation of HQs > 0.2 requires consideration of the overall risk assessment process, including the assumptions used and the uncertainties in those assumptions.

In the case of acute exposures to CACs, risk estimates were compared to an acceptable HQ of 1.0 as background concentrations of the CACs have been considered in the estimation of exposures and risks to the Project (cumulative scenario), and as receptors are only exposed to the CACs in air (i.e., exposures to other media are not relevant).

In addition, Health Canada (2024) indicates that an ILCR less than or equal to 1 x 10^{-5}, or a one in 100,000 increase above background in the potential for developing cancer, is generally considered to represent a negligible risk, while an ILCR greater than 1 x 10^{-5} may indicate that some form of mitigation or more detailed site-specific analysis is required. Like non-cancer risks, interpretation of ILCR estimates greater than 1 x 10^{-5} requires consideration of the overall risk assessment process and assumptions. It is noted that the Ontario MECP recommends the use of a target ILCR of 1 x 10^{-6} (or a one in 1,000,000 increase above background in the potential of developing cancer). While the Health Canada negligible risk level has been used in the HHRA, the Ontario level is discussed in the context of the results of the HHRA for hexavalent chromium, the only carcinogenic COPC evaluated in the HHRA.

In contrast to the estimation of HQs, the estimation of ILCRs is exclusive of background exposures; the HHRA predicted the incremental cancer risk, above background, from exposures associated with the Project emissions.

6.1 Risk Characterization Results

As described throughout the report, the HHRA has used a series of conservative assumptions, including that receptors are exposed to the maximum predicted concentrations of Project emissions at points of impingement of interest, to estimate exposures and associated risks to receptors of concern. The conservative approach undertaken in the HHRA will tend to overestimate potential exposures and associated risks to receptors of concern.

The non-cancer and cancer risk estimates for Webequie First Nation community members are presented in **Table 6-1**. As discussed, while the identified COPCs only exceed short-term air quality guidelines, based on a lack of acute TRVs for hexavalent chromium and iron, chronic exposures and associated risks have been estimated.

Table 6-1: Summary of Risk Estimates – Webequie First Nation Community Member

COPC	HQ (Baseline)	HQ (Project)	HQ (Cumulative)	ILCR (Baseline)	ILCR (Project)	ILCR (Cumulative)
Construction Phase						
Acute Risk Estimates[a]						
$PM_{2.5}$	4.7E-01	**1.5E+00**	**1.9E+00**	-	-	-
PM_{10}	4.0E-01	**5.0E+00**	**5.4E+00**	-	-	-
TSP	3.8E-01	**3.7E+00**	**4.1E+00**	-	-	-
NO_2	3.5E-01	8.2E-01	**1.2E+00**	-	-	-
Chronic Risk Estimates[b]						
Chromium (VI)	1.0E-01	**1.0E+00**	**1.1E+00**	**1.7E-04**	**1.7E-03**	**1.9E-03**
Iron	1.8E-03	2.0E-02	2.1E-02	-	-	-
Operations Phase						
Acute Risk Estimates[a]						
PM_{10}	4.0E-01	6.8E-01	**1.1E+00**	-	-	**-**

Table 6-1 (Cont'd): Summary of Risk Estimates – Webequie First Nation Community Member

COPC	HQ (Baseline)	HQ (Project)	HQ (Cumulative)	ILCR (Baseline)	ILCR (Project)	ILCR (Cumulative)
Chronic Risk Estimates[b]						
Chromium (VI)	1.0E-01	2.0E-01	**3.0E-01**	**1.7E-04**	**3.4E-04**	**5.1E-04**
Iron	1.8E-03	3.9E-03	5.7E-03	-	-	-

Notes:

BOLD Hazard Quotient >0.2 (1.0 for CAC) / ILCR >1E-05
HQ Hazard quotient
ILCR Incremental lifetime cancer risk
[a] Acute risk estimates have been compared to a target risk level of HQ $\leq$ 1.0
[b] Chronic risk estimates have been compared to a target risk level of HQ $\leq$ 0.2
\- Not applicable

As presented in **Table 6-1**, acute exposure risks for TSP, PM_{10}, $PM_{2.5}$ and NO_2 were predicted for the Project construction phase (cumulative exposures). As discussed in the AQIA, the predicted concentrations of these parameters during the construction phase are conservative, and the following should be considered when interpreting the results, as well as the potential for risks to exceed the negligible risk levels:

- Only short-term AAQC (24-hours and less) exceedances were identified, and thus only acute exposures and associated risks were predicted. If the concentrations are reached during construction, they could only occur over a short period (i.e., 1-2 days) at each receptor given that the emission sources will be moving as road construction progresses. No AAQC exceedances and thus, no risks exceeding the negligible risk levels, are predicted at existing residences and institutional buildings in the Webequie area (where people present most frequently).
- While the deposition model considered local topography, it did not consider the presence of vegetation and trees that can act as physical barriers, especially against the dispersion of particulate down-wind. This has the potential to have resulted in exceedances of the AAQC at distances that may not be realized.
- While exceedances of the AAQC were predicted with mitigations, the predictions are highly conservative, and air monitoring will be conducted throughout the Project to ground truth the results of the AQIA. If exceedances of the air quality guidelines are measured, mitigation measures beyond those recommended in The Air Quality and Dust Control Management Plan and assumed in the AQIA, will be implemented. Additional measures that could be used to mitigate dust and exhaust emissions include idling minimization, limitation of unnecessary vehicle and heavy equipment movement, and the wetting of soil and aggregate during dry days. These additional measures could not be properly translated into the air dispersion model and so their potential impact was not accounted for in the predicted construction phase air concentrations.

In addition to the exceedances of the CACs, both non-cancer and cancer risks in excess of the Health Canada (and Ontario MECP) negligible risk levels were estimated for hexavalent chromium. It is noted that as no baseline soil data was available for speciated chromium (i.e., trivalent chromium and hexavalent chromium), and thus the baseline total chromium concentration in soil was conservatively used to predict the baseline soil concentrations of the chromium species. Based on previous estimates provided by Health Canada, it was conservatively assumed that 1/7 of the total chromium was hexavalent chromium, and that the remaining 6/7 is trivalent chromium. This is likely an overestimate of the hexavalent chromium concentration in soil, and thus, also in particulate generated from soil.

To address uncertainty associated with the relevance of available soil quality data, it is recommended that soil samples be collected from the LSA and be submitted for chromium speciation, and that the results of the HHRA be revisited based on the measured hexavalent chromium concentrations in soil. There is additional conservatism in the risk estimates for hexavalent chromium as while only acute exposures are anticipated (based on the AQIA), based on a lack of acute TRVs for hexavalent chromium, only chronic exposures and associated risks could be estimated. This approach assumes that Webequie First Nation community members would be exposed to hexavalent chromium 24 hours a day, seven days a week, 52 weeks a year, for 80 years, while actual exposures to hexavalent chromium in dust generated during the construction phase would be for a maximum of one to two days at a single receptor location. Further, exceedances of the AAQC for TSP, which were used to predict the metals concentrations in particulate, where only predicted as sensitive receptor locations proximate to the road centreline, and not any residences of institutional buildings where Webequie First Nation community members would spend the most time. For risks to human receptors to be realized, community members would have to spend over 24-hours at these receptor locations, approximately 50 m from active construction operations, as the WSR construction occurs adjacent to these locations.

For the operation phase of the Project, the HQ for PM_{10} slightly exceeded the negligible risk level for acute risks of an HQ $\leq$ 1.0 at two points of impingement of interest (at culturally sensitive area CHL25 at 60 m from the road centre line and future residential plot RFP42 at 55 m from the road centre line); with an HQ of 1.1 estimated for both locations. Based on the low magnitude of the exceedance, and given the conservatism in the model, the potential for unacceptable risks is considered to be low to negligible. Further, the predicted PM_{10} concentration did not account for the eventual asphalt or chip-seal surfacing (i.e., the modelling was conducted assuming gravel surfacing), and the AQIA indicated that the PM_{10} concentration will decrease by approximately 50% once the surfacing is in place. Finally, air monitoring is recommended to ground truth the results of the AQIA, and additional dust mitigative measures will be employed as required based on the results of the air monitoring.

As with the construction phase, the potential for non-cancer and cancer risks exceeding the Health Canada (and Ontario MECP) negligible risk levels were predicted for hexavalent chromium for the operation phase. As with the construction phase, a conservative approach was used, including that 1/7 of the total chromium measured in baseline soils is hexavalent chromium and that receptors would be exposed on a chronic basis, although exceedances were only predicted at locations where acute exposures are anticipated. These conservative assumptions have likely grossly overestimated exposures and associated risks, and thus confirmation of hexavalent chromium concentrations in background soils is recommended (with the results of the HHRA revisited). Further, as noted, air monitoring is recommended, with additional dust mitigation measures implemented as required.

Overall, the conservative approach used in the AQIA and in the HHRA exposure assessment has likely resulted in an overestimation of potential air concentrations of COPCs, and of exposures and associated risks to Webequie First Nation community members. Despite this, it is recommended that air monitoring be conducted during both the construction and operation phases, with additional mitigation measures, beyond those assumed in the AQIA, introduced as necessary.

7. Uncertainty Analysis

Some degree of uncertainty is inherent to the prediction of any health risk, regardless of the source of the COPCs or the methods used in the assessment. To be health protective and not under predict potential risks associated with exposures to the Project emissions, the HHRA has been conducted using a series of conservative assumptions intended to reflect reasonable worst-case conditions. As a result, the results of the HHRA will tend to over predict exposures, and therefore associated risks, to Project emissions. Some of the main sources of uncertainty in the HHRA, and their impact on the results of the HHRA, are presented in the following table.

Table 7-1: Main Sources and Impacts of Uncertainty in the HHRA

HHRA Section	Source of Uncertainty	Impact on Results of the HHRA
Problem Formulation	The air dispersion model used in the AQIA (AtkinsRéalis, 2024a) uses both conservative assumptions meteorological conditions to predict emissions, resulting in conservative air quality estimates. The conservatism in the air quality model is described in the AQIA report. The maximum concentrations predicted by the AQIA at a point of impingement of interest were used as exposure point concentrations in the HHRA. The HHRA assumed exposure to maximum predicted concentrations on a continuous basis for both the characterization of acute and chronic exposures and associated health risks.	Use of the AQIA maximum predicted concentrations has the potential to result in an over-prediction of potential exposures. It is noted that the AQIA is based on air dispersion modelling, and as with all models, there is inherent uncertainty. The assumptions and associated uncertainty in the model are detailed in the AQIA report. It is understood that an Air Quality Management Plan will be developed for the Project and will include dustfall monitoring.
	It was assumed that the characterization of exposures and risks to Webequie First Nation community members is protective of other Indigenous communities in the RSA, as well as other people that may visit the LSA and RSA.	Given the proximity of the Webequie First Nation to the Project, of all potential receptors in the region, they are expected to be the most highly exposed. Characterization of exposures and risks to community members therefore is health protective and has the potential to overestimate exposures and risks to other receptors.
	To estimate Project scenario concentrations of metals in dust (i.e., TSP) generated from soils in the Study area, soil data collected as part of the Eagle's Nest Multi-metal Mine Environmental Assessment, located in the Ring of Fire, has been used. Baseline soil data from the project study areas was collected as part of the country foods baseline assessment; however, the data collected is representative of peat, which based on moisture content is less likely to generate dust when disturbed. A review of the Eagle's Nest soil data indicates that concentrations of all metals were higher in the Eagle's Nest soils than in the peat samples collected during the country foods assessment. As such, use of the Eagle's Nest data is considered conservative and health protective. A total of eight soil samples (+ one duplicate) were collected to characterize baseline soil conditions as part of the Eagle's Nest EA. As dusts would be generated from soils from various areas across the LSA and based on the assumption that the soil data is representative of the LSA, dust concentrations from soil were estimated using 95% upper confidence limit of the mean (UCLM) concentrations of the metals in soil. The 95% UCLMs were calculated using US EPA ProUCL Version 5.2, which explicitly considers non-detect observations.	Given that the measured soil concentrations of total metals were higher in the Eagle's Nest dataset than in the peat samples collected from the WSR study area, it is unlikely that particulate concentrations of metals have been underestimated. Further, as the region has received minimal disturbance by anthropogenic activities, it is considered likely that the Eagle's Nest soil data is representative of soils in the general region.
	No baseline soil data was available for speciated chromium (i.e., trivalent chromium and hexavalent chromium); therefore, the baseline total chromium concentration in soil was conservatively used to predict the baseline soil concentrations of the chromium species. Based on previous estimates provided by Health Canada, it was conservatively assumed that 1/7 of the total chromium was hexavalent chromium, and that the remaining 6/7 is trivalent chromium.	As there are no anthropogenic sources of hexavalent chromium in the region, this is likely an overestimate of the hexavalent chromium concentrations in soil, and thus, also in particulate generated from soil. This will have resulted in an overprediction of exposures and risks associated with hexavalent chromium.
Exposure Assessment	The HHRA used maximum predicted concentrations of air COPCs predicted in the AQIA (AtkinsRéalis. 2024a) at the points of impingement of interest to determine exposures to receptors in the Study Area. In addition, the 95%UCLM soil concentrations in the area were used to estimate resulting soil dust concentrations used as exposure point concentrations (EPCs) in the HHRA.	The use of maximum predicted concentrations of air contaminants, as well as 95%UCLM soil concentrations to estimate dust concentrations of metals, has likely resulted in the over-prediction of exposures and associated risks.
	While only acute exposures are anticipated (based on the AQIA and exceedances of TSP and PM_{10}) for hexavalent chromium, based on a lack of acute TRVs, only chronic exposures and associated risks could be estimated. This approach assumes that Webequie First Nation community members would be exposed to hexavalent chromium 24 hours a day, seven days a week, 52 weeks a year, for 80 years, while actual exposures to hexavalent chromium in dust generated during the construction phase would be for a maximum of one to two days at a single receptor location. Further, as only 24-hour exceedances of PM_{10} were predicted for the operations phase, with all other particulate and dustfall predictions less than the AAQC, only acute exposures are anticipated for the operations phase as well.	The receptor exposure duration assumptions used in the HHRA are highly conservative when determining chronic risks due to the Project. It is considered unlikely that a single receptor would be exposed to maximum predicted concentrations to the extent of that assumed in the HHRA. The use of the conservative assumptions will result in the overprediction of exposures and risks for receptors in the Study Area.
	The HHRA assumed continuous exposure to outdoor dust and air concentrations for residents in the project study areas.	Project related soil dust concentrations in the outdoor environment are anticipated to be higher than that of Project sourced COPCs in the indoor environment. Therefore, the assumption that receptors are exposed to outdoor soil dust 24 hours a day will tend to over predict exposures and associated risks.

Table 7-1 (Cont'd): Main Sources and Impacts of Uncertainty in the HHRA

HHRA Section	Source of Uncertainty	Impact on Results of the HHRA
Toxicity Assessment	No acute TRVs were available for hexavalent chromium or iron. As only chronic TRVs were available, only chronic exposures and associated risks could be estimated. Further, as no inhalation TRVs were available for iron, a chronic oral TRV was used to characterize risks.	The assessment of chronic exposures in the absence of acute TRVs will overestimate exposures and associated risks. The use of an oral TRV to characterize risks associated with inhalation exposures, in the absence of an inhalation TRV, is recommended by Health Canada and other regulatory agencies. On this basis, it is considered unlikely that risks have been underestimated.
	The TRVs provided by regulatory health agencies (e.g., Health Canada, US EPA, WHO) are protective of critical sub-groups, or sensitive subpopulations (i.e., those with physical characteristics or conditions that may result in an increased likelihood of adverse effect to a given level of exposure, for example, the elderly or persons suffering from existing medical conditions). These sensitive subpopulations are considered by the agencies in the derivation of TRVs. When deriving TRVs, health agencies apply safety or uncertainty factors (i.e., an intraspecies/human variability uncertainty factor) to protect for sensitive subpopulations. TRVs are determined from responses to exposures observed in toxicity (animal) studies and epidemiology (human) studies. For noncarcinogens, these responses were typically reported as an oral dose (i.e., mg chemical/kg body weight/day), or air concentration (i.e., mg/m^3), associated with a No Observed Adverse Effect Level (NOAEL) or Lowest Observed Adverse Effect Level (LOAEL), which was then adjusted (i.e., reduced) by the application of uncertainty factors. Uncertainty factors are assigned to account for uncertainty of the response between species (e.g., 10-fold), the response within a species population (e.g., 10-fold), the difference in response to sub-chronic versus chronic exposures (e.g., 10-fold), the difference between a LOAEL and the NOAEL (e.g., 10-fold), and the quality of the database for observed effects (e.g., 3-fold). The overall uncertainty associated with an observed response is the product of the individual uncertainty factors and generally ranges from 10 to 1000.	The HHRA used TRVs recommended by regulatory health agencies to determine potential risks resulting from exposure to COPCs. TRVs selected for use in the HHRA have incorporated an uncertainty factor to account for potential inter-individual differences in sensitivity. Uncertainty factors generally result in a 10-to-1000-fold adjustment/reduction to account for sensitivity. Therefore, the TRVs are health protective, and protective of sensitive sub-populations. It is considered unlikely that risks have been under-predicted based on the TRVs used in the HHRA.
Risk Characterization	Health Canada (2024) guidance indicates that total Hazard Quotients are interpreted according to the following general guidelines: ▪ < 0.2 = negligible human health risks; and ▪ > 0.2 = potential unacceptable risks which may require mitigation or more detailed assessment. Health Canada's negligible risk level of 0.2 (or 20% of the TRV) for non-carcinogens allows for 80% of the acceptable exposure level (i.e., as defined by the TRV) to come from other sources; this approach is based on the potential for exposures to a chemical in air, soil, water, food and consumer products (i.e., 20% of the acceptable exposure is allocated to each of these 5 media/sources). However, Health Canada considered a HQ of 1.0 acceptable when background/multimedia exposures are considered. Where available, the HHRA used background exposure data for determining cumulative risks.	The risk estimates in the HHRA assumed air, soil and food exposures and considered background concentrations where available. The Health Canada (2024) essentially negligible human health risks HQ of 0.2 is derived to consider additional background and multimedia sources of COPCs. Therefore, use of a HQ of 0.2 as a target risk level in the HHRA where background and multiple exposure media have been considered is highly conservative.
	The report evaluated potential health risks resulting from the Project using a risk assessment framework. The HHRA was completed using Health Canada risk assessment guidance and is generally consistent with risk assessment methodology used by the US EPA and WHO.	The use of Health Canada guidance and supporting regulatory guidance indicates that the HHRA results are consistent with HHRA's conducted under similar assumptions and scenarios for Projects those seeking regulatory compliance. It is considered unlikely that risks have been under predicted in the context of the regulatory framework.
	Risk characterization uses the results of the previous assessments and assumptions considered in the HHRA (e.g., exposure assessment, toxicity assessment). Therefore, the uncertainties of the previous sections are compounded in the risk characterization stage of the HHRA.	Due to the conservatism in the previous sections, it is considered likely that potential risks due to the Project have been over-estimated.

As summarized in the above table, the conservative approach used to estimate exposures and associated risks to the receptors of concern will, overall, tend to overestimate exposures and risks.

8. Conclusions and Risk-Based Recommendations

****The air quality results used in this HHRA are based on the draft air monitoring data available at the time the assessment was conducted. These data have since been updated. The revised results will be reviewed and incorporated into an addendum to this HHRA. ****

The HHRA has been conducted using methods and guidance recommended by Health Canada, Ontario MECP and other regulatory health agencies, and using a series of conservative assumptions that will tend to overpredict exposures, and therefore risks, to the identified receptors of concern. As noted, the potential for risks exceeding Health Canada and the Ontario MECP negligible risk levels has been predicted for both the construction and operation phases of the Project when cumulative (i.e., baseline + Project) exposures are considered.

The following sections further discuss the results for the construction phase and operation phase of the Project, including a comparison of estimated risks for the baseline scenario, Project scenario and cumulative scenario. Overall, the HHRA has likely overpredicted exposures and associated health risks associated with the construction and operation phases of the Project. When the conservatism and uncertainty in the estimates are considered, it is unlikely that unacceptable health risks will result from the Project.

8.1 Construction Phase

The HHRA estimated exposures to baseline concentrations of the identified air COPCs, as well as associated risks. For all COPCs, except for carcinogenic risks associated with estimated chronic exposures to hexavalent chromium in baseline TSP, estimated risks for the baseline scenario were less than the Health Canada and Ontario MECP negligible risk levels. In the absence of speciated chromium concentrations in soil, the baseline TSP hexavalent chromium concentration was predicted using highly conservative assumptions. Overall, all estimated exposures and risks associated with exposures to hexavalent chromium are considered to be highly conservative and unlikely to represent actual exposures. As noted below, it is therefore recommended that soil samples be collected from the LSA and submitted for analysis of chromium speciation, with the results used to revisit the conclusions of the HHRA for this COPC.

When only predicted emissions from the Project were assessed, risks in excess of negligible risk levels were estimated for all COPCs for the construction phase, with the exception of for NO_2 and iron. Finally, when cumulative exposures are considered, the potential for health risks exceeding regulatory agency negligible risk levels is predicted for all COPCs except iron, based on the conservative results of the AQIA, and the conservative approach used in the HHRA.

As discussed in Section 6.1, the results of the AQIA for the construction phase are conservative and have likely overpredicted Project related emissions. Further, the predicted exceedances are localized spatially to areas proximate to the road centreline and are not predicted at existing residences and institutional buildings in the Webequie area, where people are present most frequently. For risks to human receptors to be realized, community members would have to spend over 24 hours at these receptor locations, approximately 50 m from active construction operations, as the WSR construction occurs adjacent to these locations. An Air Quality and Dust Control Management Plan that will be developed and implemented for the Project will integrate a monitoring procedure for dustfall effects and measures to control or limit particulate emissions. Additional mitigation measures beyond those accounted for in the AQIA will be implemented, as warranted.

8.2 Operation Phase

As noted in **Section 8.1**, except for carcinogenic risks associated with estimated chronic exposures to hexavalent chromium in baseline TSP, estimated risks for the baseline scenario were less than the Health Canada and Ontario MECP negligible risk levels.

When Project emissions from the operation phase alone were assessed, estimated risks for all COPCs, except hexavalent chromium, were less than the regulatory agency negligible risk levels. When cumulative risks are considered for the operation phase, risks associated with PM_{10} slightly exceeded the negligible risk level for acute risks of an HQ $\leq$ 1.0 at two points of impingement of interest (at culturally sensitive area CHL25 at 60 m from the road centre line and future residential plot RFP42 at 55 m from the road centre line); with an HQ of 1.1 estimated for both locations. As discussed in **Section 6.1**, given the conservatism in the model, the potential for unacceptable risks associated with PM_{10} is considered to be low to negligible, and will further decrease once asphalt or chip-seal surfacing is in place.

As with the construction phase, the AQIA has likely overpredicted Project related emissions, and the predicted exceedances are localized spatially to areas proximate to the road centreline and are not predicted at existing residences and institutional buildings in the Webequie area, where people are present most frequently. An Air Quality and Dust Control Management Plan that will be developed and implemented for the Project will integrate a monitoring procedure for dustfall effects and measures to control or limit particulate emissions. Additional mitigation measures beyond those accounted for in the AQIA will be implemented, as warranted.

8.3 Risk-Based Recommendations

The results of the HHRA are contingent upon the application of mitigation measures described in each of the linked VC assessments. Additionally, the following recommendations are provided based on the results of the HHRA.

1. **Soil Sampling for Metals:**
   - To further characterize metals in soil and associated particulates from soil during the Project, it is recommended that soil samples be collected from the LSA and submitted for analysis of total metals, as well as for speciation of chromium. This data should be used to confirm that the soil metals concentrations obtained from the Eagle's Nest EA are representative of the WSR ROW, and to determine concentrations of hexavalent chromium, if any, in soils in the region. This data should be used to update the results of the HHRA.
2. **Air Quality Monitoring**:
   - Install real-time air quality monitoring stations at key locations, specifically near points of impingement of interest where exceedances of the air quality guidelines were predicted by the AQIA.
   - Focus on measuring TSP, PM_{10}, $PM_{2.5}$, and NO_2 levels to ensure they remain within acceptable limits.
3. **Dust Control Measures**:
   - Implement dust suppression techniques if exceedances of the air quality guidelines are measured.

4. **Regular Reporting and Review**:
   - Provide regular updates on air quality data to stakeholders and rightsholders, including the Webequie First Nation, and other First Nation communities.
   - Review monitoring data periodically to identify trends and implement corrective actions if necessary.

By following these recommendations, the Project can effectively manage and mitigate the exposure and risks associated with emissions during both the construction and operation phases. Further, the soil data will allow for a more accurate prediction of metals concentrations in particulate generated from soils, as well as risks associated with exposures to metals in particulate.

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APPENDIX A

Eagle's Nest Multi-Metal Mine Environmental Assessment Baseline Metals Soil Data

TABLE 1: Soil Chemistry from Eagle's Nest Environmental Assessment: Baseline Total Metals

Metals	Units	Detection Limit	Sample ID									Statistic	
			12-SOIL-04-1	12-SOIL-05-1	12-SOIL-05-2 (duplicate)	12-SOIL-07-1	12-SOIL-07-2	12-SOIL-08-1	12-SOIL-08-2	12-SOIL-09-1	12-SOIL-09-2	Maximum Concentration	ProUCL 95%UCLM
Antimony (Sb)	ug/g	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
Arsenic (As)	ug/g	0.20	2.91	5.15	4.87	3.25	0.87	5.36	4.58	2.90	5.07	5	5
Barium (Ba)	ug/g	1.0	61.3	116	104	16.2	40.2	127	117	35.0	109	127	107
Beryllium (Be)	ug/g	0.50	0.62	1.08	0.99	<0.50	<0.50	0.85	0.81	<0.50	0.76	1	1
Boron (B)	ug/g	5.0	10.8	15.3	14.6	<5.0	7.2	14.3	14.9	6.4	19.5	20	15
Cadmium (Cd)	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.54	<0.50	0.54	-
Calcium (Ca)	ug/g	100	26500	7160	7070	6640	53000	6130	61700	2490	96600	96600	50374
Chromium (Cr)	ug/g	1.0	33.8	68.8	63.1	2.9	5.5	79.5	59.5	15.3	52.1	80	60
Cobalt (Co)	ug/g	1.0	eight soil	15.9	14	<1.0	1	17.6	12.9	3.1	12.4	18	14
Copper (Cu)	ug/g	1.0	12	18.5	17.5	1.8	11.8	19.3	28.2	5.9	25.5	28	21
Iron (Fe)	ug/g	50	21000	39700	36000	566	3820	44500	30300	10100	28600	44500	33717
Lead (Pb)	ug/g	1.0	9.8	14.8	12.8	9.3	2.6	14.8	10.3	27.4	10.1	27	17
Lithium (Li)	ug/g	1.0	18.5	42.2	37.1	<1.0	<1.0	43.8	33.1	6.6	32.3	44	35
Mercury (Hg)	ug/g	0.010	0.025	0.023	0.024	0.104	0.084	0.017	0.028	0.121	0.02	0.121	-
Molybdenum (Mo)	ug/g	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
Nickel (Ni)	ug/g	1.0	23.2	43.7	40	2.3	5.7	48.9	36	8.5	33.8	49	38
Selenium (Se)	ug/g	1.0	<1.0	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	<1.0	<1.0	1.3	-
Uranium (U)	ug/g	1.0	<1.0	<1.0	<1.0	<1.0	2.5	<1.0	<1.0	<1.0	<1.0	3	-
Vanadium (V)	ug/g	1.0	37.5	71.3	65.5	<1.0	5.1	79.3	57.8	20.8	55.1	79	62
Zinc (Zn)	ug/g	5.0	58.3	75.1	71.5	20.1	13.2	98.5	66.5	40.2	62.4	99	73

Notes:

Data obtained from Noront Resources Ltd. (Noront). 2013. Eagle’s Nest Project Environmental Impact Statement/ Environmental Assessment Report – Draft Copy.

ProUCL 95% UCLM - 95% upper confidence limit of the mean concentration; calculated using USEPA's ProUCL, Version 5.2.

APPENDIX B

HHRA Worked Calculations and Detailed Results

Example Risk Calculations and Detailed Results

1 Introduction

This appendix provides information to support the Human Health Risk Assessment (HHRA) results presented in this document. Section 2 provides a worked example of the risk estimation procedure. Detailed risk estimates of the HHRA are presented in Section 3.

2 Worked Examples of Risk Calculations

The following worked examples provide the risk estimation for exposure to chromium (VI) and iron in soil dust. The inhalation pathway was assessed for all parameters except for iron for which a suitable inhalation toxicity reference value was not available and was therefore estimated as an ingested dose. The worked examples show calculations for non-carcinogenic exposures in toddlers and carcinogenic exposures in adults (using an amortized air concentration), and the associated risks to chromium (VI).

The following were used as exposure point concentrations for human receptors:

- Cumulative chromium (VI) concentration (construction) = 0.033 µg/m^3.
- Cumulative iron concentration (construction) = 18 µg/m^3.

2.1 Estimation of Risks from Inhalation

For chromium an inhalation TRV (unit risk estimate) was available for characterization of carcinogenic inhalation exposures in addition to the TRV for non-carcinogenic risks. For iron, no inhalation TRV was available and therefore an oral TRV was used and compared to the estimated exposure dose for iron. Chromium (VI) and iron exposures via inhalation of airborne soil particulate was estimated according to the following equation:

$$EID\ (or\ EIC) = \frac{C_{air} \times IR_A\ (for\ dose\ calculations\ only) \times RAF_{INH} \times D_1 \times D_2 \times D_3 \times D_4}{(LE \times BW\ (for\ dose\ calculations\ only))}$$

Where:

EID(C)	=	exposure from the dust inhalation pathway for soil (µg/kg BW/day [dose] or µg/m^3 [concentration])
C_{air}	=	particulate concentration in air (chromium [VI] = 0.033 µg/m^3 and iron = 10 µg/m^3)
IR_A	=	inhalation rate (8.3 m^3/day toddler) (only used for evaluating particulate inhalation as a dose for the toddler receptor for iron)
RAF_{INH}	=	relative absorption factor via inhalation (1.0)
D_1	=	hours per day exposed (24 hours/24hours)
D_2	=	days per week exposed (7 days/7 days)
D_3	=	weeks per year exposed (52 weeks/52 weeks)
D_4	=	total years exposed to (60 years, carcinogenic exposures only for chromium [VI])
BW	=	body weight (16.5 kg toddler) (only used for evaluating particulate inhalation as a dose for the toddler receptor for iron)

LE = life expectancy (80 years, carcinogenic exposures only for chromium [VI])

Non-Carcinogenic Exposures - Chromium (VI)

$$EIC_{toddler} = 0.033\ \mu g/m^3 \times 1.0 \times 24\ hr/24\ hr \times 7\ days/7\ days \times 52\ weeks/52\ weeks$$

$$= 3.3 \times 10^{-2}\ \mu g/m^3$$

Exposure to chromium via the inhalation of soil particulate pathway was estimated as a concentration for the resident receptor at 3.3×10^{-2} µg/m^3. Soil particulate inhalation risk was then estimated as a HQ according to the following equation:

$$HQ = \frac{EIC\ (3.3 \times 10^{-2}\ \mu g/m^3)}{Reference\ \mathrm{Concentration}\ (3.0 \times 10^{-2}\ \mu g/\mathrm{m}^3)}$$

An **HQ of 1.1** was estimated for the Webequie First Nation community memberexposed to the maximum concentration of chromium (VI) in soil via inhalation of soil particulate.

Carcinogenic Exposures - Chromium (VI)

The amortized air exposure concentration estimated for chromium (VI) in soil particulate for the adult resident receptor was estimated as follows:

$$EIC_{toddler} = \frac{0.033\ \mu g/m^3 \times 1.0 \times 24\ hr/24\ hr \times 7\ days/7\ days \times 52\ weeks/52\ weeks \times 60\ years}{80\ years}$$

$$= 2.5 \times 10^{-2}\ \mu g/m^3$$

Soil inhalation particulate carcinogenic risks were then estimated as an ILCR as follows:

$$ILCR = EIC_{adult}\ (2.5 \times 10^{-2}\ \mu g/m^3) \times Inhalation\ Unit\ Risk\ (7.6 \times 10^{-2}\ \mu g/m^3)^{-1}$$

An **ILCR of 1.9 x 10^{-3}** was estimated for an adult resident receptor exposed to chromium (VI) via soil particulate inhalation.

Non-Carcinogenic Exposures (Toddler) – Iron

Exposures to iron in soil particulate for a toddler were estimated as a dose, as follows:

$$EID_{toddler} = \frac{18\ \mu g/m^3 \times 8.3\ m^3/day \times 1.0 \times 24\ hr/24\ hr \times 7\ days/7\ days \times 52\ weeks/52\ weeks}{16.5\ kg}$$

$$= 9.05\ \mu g/kg\ BW/day$$

Exposure to iron via the inhalation of soil particulate pathway was estimated as a dose for the toddler resident receptor at 9.05 µg/kg BW/day. Soil particulate inhalation risk was then estimated as a HQ according to the following equation:

$$HQ = \frac{EID_{toddler}\ (9.05\ \mu g/kg\ BW/day)}{Reference\ Dose\ (4.2 \times 10^2\ \mu g/kg\ \mathrm{BW}/day)}$$

An **HQ of 2.1 x 10^{-2}** was estimated for the toddler resident receptor exposed to the maximum concentration of iron in soil via inhalation of soil particulate.

3 Detailed Risk Estimates

The detailed risk estimates for the human receptors of concern quantitatively evaluated in the HHRA presented in Tables 1 to 4 with a summary presented in Table 5.

Table 1: Criteria Air Contaminants Inhalation Risk Estimates for the Maximum Sensitive Receptor - Construction Phase

Scenario: Baseline

Chemical	Acute TRV ($\mu g/m^3$)		Exposure Concentration ($\mu g/m^3$)	Averaging Time	Hazard Quotient
Criteria Air Contaminants					
$PM_{2.5}$	24 hour AQO:	27	12.6	24 hour	4.7E-01
PM_{10}	24 hour AQO:	50	20	24 hour	4.0E-01
TSP	24 hour AQO:	120	45	24 hour	3.8E-01
NO_2	1 hour AQO:	79	28	24 hour	3.5E-01

Scenario: Project (Construction)

Chemical	Acute TRV ($\mu g/m^3$)		Exposure Concentration ($\mu g/m^3$)	Averaging Time	Hazard Quotient
Criteria Air Contaminants					
$PM_{2.5}$	24 hour AQO:	27	36.4	24 hour	**1.3E+00**
PM_{10}	24 hour AQO:	50	250	24 hour	**5.0E+00**
TSP	24 hour AQO:	120	444	24 hour	**3.7E+00**
NO_2	1 hour AQO:	79	65	24 hour	8.2E-01

Scenario: Baseline+Project (Construction)

Chemical	Acute TRV ($\mu g/m^3$)		Exposure Concentration ($\mu g/m^3$)	Averaging Time	Hazard Quotient	Hazard Quotient Contribution from Baseline (%)	Hazard Quotient Contribution from Construction (%)
Criteria Air Contaminants							
$PM_{2.5}$	24 hour AQO:	27	52	24 hour	**1.9E+00**	24%	70%
PM_{10}	24 hour AQO:	50	270	24 hour	**5.4E+00**	7%	93%
TSP	24 hour AQO:	120	489	24 hour	**4.1E+00**	9%	91%
NO_2	1 hour AQO:	79	93	24 hour	**1.2E+00**	30%	70%

Notes:

BOLD Hazard Quotient >1.0

Table 2: Criteria Air Contaminants Inhalation Risk Estimates for the Maximum Sensitive Receptor - Operation Phase **Scenario: Baseline**

Chemical	Acute TRV		Exposure Concentration	Averaging Time	Hazard Quotient
	(µg/m^3)		(µg/m^3)		
Criteria Air Contaminants					
PM_{10}	24 hour AQO:	50	20	24 hour	4.0E-01

Scenario: Project (Operation)

Chemical	Acute TRV		Exposure Concentration	Averaging Time	Hazard Quotient
	(µg/m^3)		(µg/m^3)		
Criteria Air Contaminants					
PM_{10}	24 hour AQO:	50	36	24 hour	7.2E-01

Scenario: Baseline+Project (Operation)

Chemical	Acute TRV		Exposure Concentration	Averaging Time	Hazard Quotient	Hazard Quotient Contribution from Baseline (%)	Hazard Quotient Contribution from Operation (%)
	(µg/m^3)		(µg/m^3)				
Criteria Air Contaminants							
PM_{10}	24 hour AQO:	50	56	24 hour	**1.1E+00**	36%	64%

Notes:

BOLD Hazard Quotient >1.0

Table 3: Metals Dust Risk Estimates for the Maximum Sensitive Receptor - Construction Phase

Scenario: Baseline

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)		
Metals								
Chromium (VI)	3.0E-02	7.6E-02	-	3.0E-03	2.3E-03	-	1.0E-01	**1.7E-04**
Iron	-	-	4.2E+02	-	-	7.5E-01	1.8E-03	-

Scenario: Project (Construction)

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)		
Metals								
Chromium (VI)	3.0E-02	7.6E-02	-	3.0E-02	2.3E-02	-	**1.0E+00**	**1.7E-03**
Iron	-	-	4.2E+02	-	-	8.3E+00	2.0E-02	-

Scenario: Baseline+Project (Construction)

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR	Risk Estimate Contribution from Baseline (%)	Risk Estimate Contribution from Construction (%)
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)				
Metals										
Chromium (VI)	3.0E-02	7.6E-02	-	3.3E-02	2.5E-02	-	**1.1E+00**	**1.9E-03**	9%	91%
Iron	-	-	4.2E+02	-	-	9.1E+00	2.1E-02	-	8%	92%

Notes:

BOLD Hazard Quotient >0.2 / ILCR >1E-05

- Not applicable

Table 4: Metals Dust Risk Estimates for the Maximum Sensitive Receptor - Operations Phase

Scenario: Baseline

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)		
Metals								
Chromium (VI)	3.0E-02	7.6E-02	-	3.0E-03	2.3E-03	-	1.0E-01	**1.7E-04**
Iron	-	-	4.2E+02	-	-	7.5E-01	1.8E-03	-

Scenario: Project (Operation)

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)		
Metals								
Chromium (VI)	3.0E-02	7.6E-02	-	6.0E-03	4.5E-03	-	2.0E-01	**3.4E-04**
Iron	-	-	4.2E+02	-	-	1.7E+00	3.9E-03	-

Scenario: Baseline+Project (Operation)

Chemical	TRV			Exposure Concentration/Dose			Hazard Quotient	ILCR	Risk Estimate Contribution from Baseline (%)	Risk Estimate Contribution from Operation (%)
	RfC (µg/m^3)	UR (µg/m^3)$^{-1}$	RfD (µg/kg/day)	Non-cancer Air Concentration (µg/m^3)	Cancer (Ammortized) Air Concentration (µg/m^3)	Dose (µg/kg/day)				
Metals										
Chromium (VI)	3.0E-02	7.6E-02	-	9.0E-03	6.8E-03	-	**3.0E-01**	**5.1E-04**	33%	67%
Iron	-	-	4.2E+02	-	-	2.4E+00	5.7E-03	-	31%	69%

Notes:

BOLD Hazard Quotient >0.2 / ILCR >1E-05

- Not applicable

Table 5: Summary of Risk Estimates for the Maximum Sensitive Receptor

Chemical	Hazard Quotient (Baseline)	Hazard Quotient (Project)	Hazard Quotient (Cumulative)	ILCR (Baseline)	ILCR (Project)	ILCR (Cumulative)
Construction Phase						
$PM_{2.5}$	4.7E-01	**1.5E+00**	**1.9E+00**	-	-	-
PM_{10}	4.0E-01	**5.0E+00**	**5.4E+00**	-	-	-
TSP	3.8E-01	**3.7E+00**	**4.1E+00**	-	-	-
NO_2	7.0E-02	1.6E-01	2.3E-01	-	-	-
Chromium (VI)	1.0E-01	**1.0E+00**	**1.1E+00**	**1.7E-04**	**1.7E-03**	**1.9E-03**
Iron	1.8E-03	2.0E-02	2.1E-02	-	-	-
Operations Phase						
PM_{10}	4.0E-01	6.8E-01	**1.1E+00**	-	-	-
Chromium (VI)	1.0E-01	2.0E-01	**3.0E-01**	**1.7E-04**	**3.4E-04**	**5.1E-04**
Iron	1.8E-03	3.9E-03	5.7E-03	-	-	-

Notes:

BOLD Hazard Quotient >0.2 (1.0 for CAC) / ILCR >1E-05

- Not applicable

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