Revision Log

Company	Client Contact	Version	Date Issued	Method of Delivery	Revisions
NextBridge Infrastructure	Corinne Miller	Rev01	September 2018	Email	Commitments revised to remove the phrase “as a priority” from commitment “No herbicides will be used in sensitive areas including reserve lands, provincial parks, within 30 m of water bodies and certain other edible and medicinal plant harvesting areas the communities have identified”.

21. HUMAN HEALTH

This section describes and summarizes an assessment of the effects of the East-West Tie Transmission Project (the Project) on human health. The World Health Organization (WHO) defines health as follows:

"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (WHO 1948).

The assessment follows the general approach and concepts described in Section 5. The main steps in the assessment include:

- considering input from Indigenous communities, government representatives and agencies, other communities, property owners, and people or groups interested in the Project during the ongoing consultation and engagement process (refer to Section 21.1);
- identifying information and data sources used in the assessment (refer to Section 21.2);
- identifying and rationale for selection of criteria and indicators for human health (refer to Section 21.3);
- establishing temporal boundaries (i.e., construction and operation phases) and study areas (i.e., Project footprint and local study area) for the assessment of effects on these criteria (refer to Section 21.4);
- describing the existing environment (i.e., baseline characterization) and identifying environmentally sensitive features specific to each criterion (refer to Section 21.5);
- identifying potential Project-environment interactions (refer to Section 21.6);
- undertaking the net effects assessment (refer to Section 21.7):
  - identifying potential environmental effects;
  - identifying mitigation measures;
  - predicting the net effects; and
  - characterizing the net effects (i.e., after mitigation) of the Project on environmental criteria (refer to Section 21.8).;
- assessing the significance of the net effects (refer to Section 21.9);
- conducting a cumulative effects assessment of the net effects in combination with other past, present, or reasonably foreseeable developments (RFDs) and activities and assessing significance, if applicable (refer to Section 21.10);
- determining the degree of certainty in the net effects prediction and associated assessment of significance (refer to Section 21.11); and
- identifying follow-up, inspection, and monitoring programs that will be completed during and after construction (refer to Section 21.12).

Specifically, this assessment evaluates the change in human health that could result from a change in environmental quality (i.e., specifically from a change in contaminant concentrations), including the following:

- groundwater quality;
- surface water quality; and
- air quality.

Project-related air emissions consist of volatile compounds only; as a result, aerial deposition does not occur and subsequently, the emissions do not bioaccumulate up the food chain. For this reason, changes in soil and food quality (including country foods) are not expected and have not been evaluated further for human health.

This assessment relies on the results of the Human Health Risk Assessment (HHRA) that is provided in Appendix 21-I. The HHRA follows the risk assessment framework endorsed by provincial and federal regulatory agencies (MOE 2005; Health Canada 2012). The framework provides a structured and clear approach for evaluating potential human health risks, if any, to people associated with changes in environmental quality due to contaminant releases from a project.

The change in human health that could result from noise or exposure to electromagnetic fields (EMF) from the Project is not evaluated as part of an HHRA, which evaluates potential risks associated with contaminant exposures. It is noted that the assessment of the acoustic environment (refer to Section 11.8) found the net effect of noise emissions associated with the Project to be negligible to moderate, limited locally to the local study area (LSA), short-term in duration and reversible. Overall, based on the characterization of predicted net effects for noise completed (refer to Section 11.8.) the predicted net effects from noise were assessed as not significant. Exposure to EMF is discussed in Section 21.1 and in Section 4.3.2.7.

21.1 Input from Consultation and Engagement

Consultation and engagement for the Project considered Indigenous communities, regulatory agencies, property owners, interest holders, Crown interests and the general public. Consultation activities are described in Section 2 of the amended environmental assessment (EA) Report. The draft and final EA Reports were each subject to a public review and comment period. Comments received on the draft EA Report, responses and change log are provided in Appendix 1-III. Comments received on the final EA Report and responses are provided in Appendix 1-IV. The following concerns related to human health were raised during consultation and engagement and from comments received on the draft and final EA Reports:

- The Ministry of Environment and Climate Change (MOECC), Ministry of Natural Resources and Forestry (MNRF), and Métis Nation of Ontario expressed concern that many responses to comments on the draft EA Report were provided in Appendix 1-III of the final EA Report and not integrated into the body of the final EA Report. Suggested changes acknowledged in responses to comments on the draft EA Report but not incorporated into the final EA Report have been incorporated into the amended EA Report where appropriate.
- The MOECC, MNRF and Indigenous communities expressed concern with the pathway screening methodology employed in the draft and final EA Reports. The EA methods have been revised and feedback has been incorporated. The terms “effect pathway” and “assessment endpoint” were removed from the amended EA Report. This revision is reflected throughout this section of the amended EA Report. Human Health Assessment methodology identified exposure pathways (i.e., exposure to potential contaminant releases). Exposure pathways are discussed in this section and in the Human Health Risk Assessment (HHRA; refer to Appendix 21-I) and are not related to the pathway screening methodology used in the draft and final EA Reports.
- The MOECC, MNRF and Indigenous communities expressed concerns about the use of the pathway screening method excluding some potential Project effects from being carried forward to the net effects assessment. All potential Project effects are considered in the net effects assessment and a net effects assessment table was added as Table 21-7 to this section.

- Animbiigoo Zaagi'igan Anishinaabek First Nation, Long Lake No. 58 First Nation had concerns about the potential for health effects of the Project, including from radiation and EMF. Additional concerns regarding EMF and potential effects on children and electrical effects on pacemakers were expressed. The concerns related to EMF are not addressed in this section of the amended EA Report. There is no compelling scientific evidence that EMF in living and school environments, regardless of distance from transmission lines, cause ill health. Health Canada (2012) states: "When you are inside your home, the magnetic fields from high voltage power lines and transformer boxes are often weaker than those from household electrical appliances." Based on the available weight of evidence, Health Canada "does not consider that any precautionary measures are needed regarding daily exposures to EMF at [extremely low frequencies] based on the available weight of evidence. There is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those located just outside the boundaries of power line corridors." Potential emissions, discharges and wastes including EMF are discussed in Section 4.3.2.7. A Guide to EMF handout developed for the Project is provided in Appendix 2-V-B.
- Multiple Indigenous communities expressed concerns about the use of herbicides and the potential human health effects as a result of exposure by berry pickers. Requests were received that during the ongoing maintenance of the line, ground cover plants be used to maintain brush control for approximately 50 metres (m) on either side of the road/trail to mitigate trail users or berry pickers being exposed to herbicides. Herbicide application will be used to prevent the establishment and spread of invasive plants in the preferred route right-of-way (ROW) during the operation phase. Effects to human health from herbicide application are addressed in Section 21.7.2. No predicted change in human health from existing conditions was predicted as a result of herbicide application. Effects to traditional use plant and material harvesting sites are assessed in Section 17.7.

Concerns have been considered and addressed in this section of the amended EA Report. Specific responses to concerns expressed by Indigenous communities are also included in Section 2.2.5 of the Amended EA Report and a detailed public and Indigenous consultation and engagement record is provided in Appendices 2-III and 2-IX, respectively.

21.2 Information Sources

Information incorporated into the human health assessment was obtained from the following sources:

- baseline conditions for surface water for surface quality data (refer to Section 7.5);
- baseline conditions for groundwater for groundwater quality data (refer to Section 8.5);
- baseline conditions for air quality data (refer to Section 9.5);
- baseline conditions for traditional land and resource use for information on the communities and types of people present in the study areas and how people use the study areas (refer to Section 17.5);
- baseline conditions for non-traditional land and resource use information for information on the communities and types of people present in the study areas and how people use the study areas (refer to Section 19.5.2); and
- the HHRA (refer to Appendix 21-I) for calculated risk estimates (i.e., hazard quotients [HQs]).

The information presented in the sources listed above was reviewed to understand existing environmental quality, the communities and types of people present in the study areas, how people use the study areas, and existing conditions for human health. For the purposes of the amended EA Report, sufficient information was deemed to be available from the sources listed above to assess the potential effects of the Project on human health.

21.3 Criteria and Indicators

Criteria are components of the environment that are considered to have economic, social, biological, conservation, aesthetic, or ethical value (refer to Section 5.1). The criterion for this assessment is human health. The health of people is important to the well-being of individuals, families, and communities. Different members of communities may have different characteristics (e.g., occupancy, use of land, and consumption of resources) which may result in different exposures and health risks and may potentially affect human health.

Indicators represent attributes of the environment that can be used to characterize changes to criteria in a meaningful way. Project activities can result in changes in environmental quality (i.e., surface water, groundwater, and air quality, and specifically changes in contaminant concentrations in these media) as a result of the release of contaminants to the environment. People near the Project can potentially be exposed to these contaminants to an extent that it may result in health risks to people and therefore could potentially affect human health. The potential effect on human health from exposure to environmental media is quantified via a HHRA (refer to Appendix 21-I). As such, environmental quality (i.e., surface water, groundwater, and air quality, and specifically changes in contaminant concentrations in these media) was selected as an indicator for the human health criterion.

The criterion and indicator selected for the assessment of Project effects on human health, the measurement of potential effects for the indicators, data sources used, and the rationale for their selection, are provided in Table 21-1.

Table 21-1: Human Health Criterion and Indicators

Criterion	Indicator	Measurements of Potential Effects	Data Source(s)[(a)]	Rationale
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health.	The potential effect on human health from exposure to environmental media is quantified via a Human Health Risk Assessment (refer to Appendix 21-I)	■ Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada, Part II: Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0. Health Canada. Ottawa, ON. ■ Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 2.0. 2010 (Revised). Health Canada. Ottawa, ON. ■ MOE (Ontario Ministry of the Environment). 2005. Procedures for the Use of Risk Assessment under Part XV.1 of the *Environmental Protection Act*. PIBs # 5404e. MOE, Standards Development Branch. October 2005.	■ The health of people is important to the well-being of individuals, families, and communities ■ Different members of communities may have different characteristics (e.g., occupancy, use of land, and consumption of resources) which may result in different exposures and health risks that may potentially affect human health

a) The data sources listed were used in support of the HHRA provided in Appendix 21-I,

HHRA = Human Health Risk Assessment.

21.4 Assessment Boundaries

21.4.1 Temporal Boundaries

The Project is planned to occur during two phases (refer to Section 5.2.1):

- **construction phase:** the period from the start of construction to the start of operation (approximately two years); and
- **operation phase:** encompasses operation and maintenance activities throughout the life of the Project, which is anticipated to be indefinite.

The assessment of Project effects on human health considers effects that occur during the construction phase as emissions are considered to be largest during this phase of the Project. These periods are sufficient to capture the effects of the Project.

21.4.2 Study Areas

The study areas for the assessment are provided in Table 21-2.

Table 21-2: Human Health Study Area

Study Area	Area (ha)	Description	Rationale
Project footprint	3,490 ha	The Project footprint is the preferred route ROW, laydown yards, storage yards, construction camps, construction easements, and new access roads	Designed to capture the potential direct effects of the physical footprint of the Project
Human health LSA	Representative 5 km long, 4 km-wide area (2,000 ha)	Defined by a representative 5 km segment of the preferred route ROW and extends 2 km from the preferred route ROW. Equivalent to the air quality LSA (refer to Section 9.4.2)	■ Concentrations of contaminants within this representative 5 km segment were predicted to a distance of 2 km on either side of the preferred route centreline. This 5 km long, 4 km wide area is the air quality LSA. ■ A separate air quality RSA was not considered necessary in the air quality assessment because the air quality LSA is large enough to encompass predicted changes in air quality. The air quality LSA was considered as the human health LSA because changes in air quality were determined to be the major route of exposure in the evaluation of potential changes to human health.[(a)]

a) As indicated in the HHRA (refer to Appendix 21-I, Table 21-I-2), the only complete pathway of exposure by people to contaminant releases from the Project is via inhalation of contaminants emitted to air. All other potential exposure pathways (i.e., ingestion of groundwater as drinking water, ingestion and dermal contact with surface water, ingestion and dermal contact with soil, inhalation of soil dust, and ingestion of fish, plants and animals) were determined to be incomplete and/or negligible and were not evaluated in the HHRA. As such, the air quality LSA was adopted as the human health LSA because the air quality discipline predicted the Project-related change in air quality that was used as the indicator for human health.

ha = hectare; HHRA = Human Health Risk Assessment; km = kilometre; LSA = local study area; ROW = right-of-way; RSA = regional study area.

21.5 Description of the Existing Environment

The existing environment for human health was described using an assessment of the potential human health risks associated with exposure to existing (i.e., baseline or background) contaminant concentrations measured in the environment (i.e., the Base Case). A detailed description of the existing environment for human health for the air quality local study area (LSA is provided in the HHRA (refer to Appendix 21-I).

21.5.1 Baseline Data Collection Methods

Baseline data have been collected for indicators (i.e., surface water, groundwater, and air quality) based on their known potential to contribute to changes in human health, and the possibility that the Project may affect these environmental components known to contribute to a change in human health. The rationale for the inclusion of these human health indicators is presented below:

- **Air quality:** Changes in air quality can affect human health (Government of Ontario 2016). Section 9.5 presents the baseline conditions for air quality in the air quality LSA.
- **Groundwater and surface water quality:** Deterioration of surface and groundwater quality can affect the availability of safe drinking water for human consumption and the health of fish and other aquatic organisms subsequently consumed by people (Environment Canada 2010, 2015). Sections 7.5 and 8.5 present the baseline surface water quality and groundwater quality data in the surface water and groundwater LSAs, respectively.

Existing conditions for human health as it relates to air quality were specifically evaluated as changes to air quality and were determined to be the major source of exposure from the Project (refer to Table 21-I-2, Appendix 21-I). Air quality in the human health LSA was evaluated based on existing contaminant concentrations in air and calculated risk estimates (i.e., Hazard Quotient [HQ], Incremental Lifetime Cancer Risk [ILCR]) presented in the HHRA (refer to Appendix 21-I). The HQ is the ratio of the contaminant exposure likely to be incurred by people under existing conditions (e.g., background air concentrations) and the amount of contaminant exposure that is considered to be safe (i.e., toxicity reference value [TRV]). HQs of less than one are associated with negligible human health risks. HQs of greater than one indicate the potential for human health risks. An ILCR is the product of the exposure (i.e., independent of background sources; Health Canada, 2012) to be incurred by the person and the cancer risk per unit exposure to the contaminant of potential concern (COPC). An ILCR less than or equal to one-in-one million (1-in-1,000,000; MOE 2011) indicates that the estimated exposure is associated with negligible health effects; conversely, when the ILCR is greater than one-in-one million, this does not necessarily indicate that adverse health effects will occur, but that the assumptions and approach relied upon in the HHRA (refer to Appendix 21-I) should be further scrutinized.

Human health TRVs are generally based on the most sensitive endpoints, with the application of uncertainty factors to account for deficiencies in the key study or data set or to protect sensitive subpopulations (refer to Appendix 21-I). The selected TRVs for the assessment of COPC identified in the HHRA (refer to Appendix 21-I), including critical effects and the sources from which the TRVs were obtained, are summarized in Table 21-3.

Table 21-3: Toxicity Reference Values and Critical Effects

COPC	Averaging Period	TRV ($\mu g/m^3$)	Critical Effect(s)	Source
NO_x (as NO_2)	1-hour	190	Health	TCEQ (2016)
PM_{10}	24-hour	63	Health and environment	WHO (2005)
DPM	Annual	5	Pulmonary inflammation and histopathology	US EPA (2016)
		3.0 E-4 [a]	Lung tumour formation in laboratory animals	CalEPA 2016

COPC = contaminant of potential concern; DPM = diesel particulate matter; NO_x = oxides of nitrogen; NO_2 = nitrogen dioxide; PM_{10} = particulate matter less than 10 microns; $\mu g/m^3$ = micrograms per cubic metre; TRV = toxicity reference value. [a] Units = $(\mu g/m^3)^{-1}$

21.5.2 Baseline Conditions

A detailed description of existing conditions for surface water quality is provided in Section 7.5.2 and summarized in this section. Surface water quality in the human health LSA was compared to Provincial Water Quality Objectives (PWQOs) based on available data from the MOECC and Lakehead Region Conservation Authority (LRCA). The PWQOs represent a desirable level of water quality that the MOECC strives to maintain in surface waters in the province. Surface water quality in the human health LSA generally meets relevant guideline values (PWQOs), with the exception in a number of cases for some metals (i.e., aluminium, cadmium, and iron), phosphorus, total suspended solids, and turbidity.

A detailed description of existing conditions for groundwater quality is provided in Section 8.5.1 and summarized in this section. Based on available data from the MOECC, existing conditions for groundwater quality are available for a limited number of parameters, including nitrate, sodium, chloride, iron, manganese, and hardness. Groundwater quality often exceeds Ontario Drinking Water Standards (ODWS) for these parameters; however, this groundwater quality is considered typical for the geology of the area.

A detailed description of existing conditions for air quality is provided in Section 9.5.2 and summarized in this section. Overall, monitoring data indicate that background air quality surrounding the Project is below the relevant provincial and federal ambient air quality guidelines, criteria and standards.

A detailed description of existing conditions for human health as it relates to air quality is provided in the HHRA (refer to Appendix 21-I), and is summarized below:

- Potential human health risks from COPCs in air with available background concentrations were considered to be negligible (i.e., HQs were less than one; HQ = 0.17 for oxides of nitrogen (NO_x) [as nitrogen dioxide {NO_2}] for the 1-hour averaging period, HQ = 0.28 for particulate matter less than 10 µm in diameter (PM_{10}) for the 24-hour averaging period).
- For diesel particulate matter (DPM) for the annual averaging period, potential human health risks could not be determined because background air concentrations were not available.

21.6 Potential Project-Environment Interactions

Potential Project-environment interactions were identified through a review of the Project Description and existing environmental conditions. The linkages between Project components and activities and potential effects to human health are identified in Table 21-4.

Table 21-4: Project-Environment Interactions for Human Health

Criteria	Indicator	Project Phase		Description of Potential Project-Environment Interaction
		Construction (includes access road and ROW preparation, installation, and reclamation activities)	Operation (includes operation and maintenance activities)	
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health	✓	–	Increase in ambient concentrations from CAC and fugitive dust emissions during construction may affect human health
		✓	✓	Reduction in groundwater quality from chemical or hazardous material spills on the Project footprint can contaminate groundwater used for consumption by humans and the natural environment and may affect human health
		✓	–	Reduction in groundwater quality by mobilizing existing groundwater contamination and by increasing the groundwater pH during the curing of concrete. Both can contaminate groundwater used for consumption by humans and the natural environment and may affect human health
		✓	–	Disturbing pre-existing shallow contaminated soils during construction (e.g., new road construction, existing road-widening activities, and vegetation clearing) can contaminate groundwater used for consumption by humans and the natural environment and may affect human health
		✓	–	Change to groundwater quality from blasting (e.g., ammonium nitrate) can contaminate the quality of groundwater used for consumption by humans and the natural environment and may affect human health
		✓	✓	The operation of the construction camp wells can mobilize pre-existing shallow contaminated groundwater during pumping thereby contaminating groundwater used for consumption by humans and may affect human health
		✓	–	Increase to the concentrations of suspended solids and chemical constituents in receiving water bodies from short-term discharges of wastewater may affect human health
		✓	✓	Increase to the concentrations of chemical constituents and suspended solids in receiving water bodies from the transport and delivery of airborne particulate matter may affect human health
		✓	–	Increase to the concentrations of suspended solids and chemical constituents in receiving water bodies from the washoff of trash and leachate at waste handling and storage facilities may affect human health

Table 21-4: Project-Environment Interactions for Human Health

Criteria	Indicator	Project Phase		Description of Potential Project-Environment Interaction
		Construction (includes access road and ROW preparation, installation, and reclamation activities)	Operation (includes operation and maintenance activities)	
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health	✓	✓	Increase to the concentrations of chemical constituents in receiving water bodies from the washoff of fluids from accidental spills and leaks may affect human health
		✓	–	Increase to the concentrations of chemical constituents in receiving water bodies from the washoff of explosives spills and residues from blasting activities may affect human health
		✓	–	Increase to the concentrations of suspended solids in receiving water bodies due to increased rates of erosion, transport and delivery of organic debris and sediments from disturbed and exposed areas may affect human health
		✓	✓	Reduction in soil, surface water, groundwater and food quality (e.g., berries) from use of herbicides may affect human health

✓ = A potential Project-environment interaction could result in potential effects to human health.

_ = No plausible interaction was identified.

For the Project components and activities affecting groundwater (refer to Section 8.0) net effects predicted based on effective implementation of mitigation measures were determined to be negligible or low, limited locally to the groundwater LSA and medium-term in duration. Overall, based on the characterization of predicted net effects for groundwater completed (refer to Section 8.8.1), the predicted net effects on groundwater were assessed as not significant. Furthermore, with respect to interactions with human health, groundwater was determined to not be an exposure pathway of concern in the HHRA (refer to Table 21-I-2, Appendix 21-I). Therefore, net effects to human health from changes in groundwater quality as a result of the Project components and activities are not expected and further assessment of groundwater quality is not warranted as it relates to a change in human health. Potential effects related to human health from changes in groundwater quality identified in Table 21-4 are not discussed further in this assessment.

For the project components and activities affecting surface water (refer to Section 7.0) net effects predicted based on effective implementation of mitigation measures were determined to be negligible, limited locally to the surface water LSA and short-term in duration and reversible. Overall, based on the characterization of predicted net effects for surface water completed (refer to Section 7.8.2.2) the predicted net effects on surface water were assessed as not significant. Furthermore, with respect to interactions with human health, surface water was determined to not be an exposure pathway of concern in the HHRA (refer to Table 21-I-2, Appendix 21-I). Therefore, net effects to human health from changes in surface water quality as a result of the Project components and activities are not expected and further assessment of surface water quality is not warranted as it relates to a change in human health. Potential effects related to human health from changes in surface water quality identified in Table 21-4 are not discussed further in this assessment.

21.7 Potential Effects, Mitigation and Net Effects

This section presents the potential effects, appropriate mitigation measures, and predicted net Project effects for human health.

21.7.1 Increase in Ambient Concentrations from CAC and Fugitive Dust Emissions during Construction May Affect Human Health

21.7.1.1 Potential Effect

The assessment of the potential change in human health that could result from an increase in ambient concentrations from criteria air contaminants (CACs) and fugitive dust emissions from construction activities is based on predicted contaminant concentrations in air and calculated risk estimates (i.e., HQs) presented in the HHRA (refer to Appendix 21-I).

As described in Appendix 21-I, the HHRA follows the risk assessment framework endorsed by provincial and federal regulatory agencies (MOE 2005; Health Canada 2012). The framework provides a structured and clear approach for evaluating potential human health risks, if any, to people associated with changes in environmental quality due to contaminant releases from a project. For there to be a potential health risk, the following three conditions must be met (refer to Figure 21-1):

- A receptor (i.e., people) must be present,
- There must be a way by which the receptor can come into contact with the contaminant (i.e., an exposure pathway); and
- A contaminant must be present at concentrations that could be harmful (i.e., a COPC).

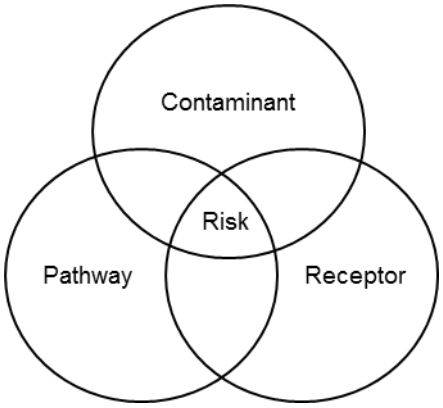

Figure 21-1: Three Conditions for Potential Health Risk

If any of these three conditions are not present, there would be no potential for health risks. For example, if a receptor and a COPC are present but there is no way for the receptor to come into contact with the COPC (i.e., an exposure pathway is not present), there would be no potential health risk.

For the Project, the potential change in human health that could result from an increase in ambient concentrations from CACs and fugitive dust emissions (i.e., reduced air quality) during construction was assessed for potential receptors in the air quality LSA that could be directly exposed to COPCs in air via inhalation. Note, the inhalation pathway was determined to be the only applicable exposure pathway of concern from the Project (refer to

Table 21-I-2, Appendix 21-I). Human health receptors may include people living in (e.g., residents), working in, or visiting (e.g., recreational users) the area that may be exposed to COPCs in the air quality LSA. These receptors include people of all ages, including those at sensitive life stages such as infants, children and the elderly. A resident was selected as the main human health receptor for evaluation given that people may reside in the air quality LSA. Workers were not identified as human health receptors for the assessment because the potential change in health of workers is protected through compliance with appropriate workplace practices following requirements defined in the Ontario *Occupational Health and Safety Act* and other applicable regulatory instruments.

Taking into consideration the implementation of mitigation measures and using a number of conservative assumptions, the air quality assessment predicted air concentrations of NO_x (as NO_2), carbon monoxide (CO), sulphur dioxide (SO_2), total suspended particulates (TSP), PM_{10}, particulate matter less than 2.5 µm in diameter ($PM_{2.5}$) and DPM at approximately 100 m intervals from the centreline of the preferred route to the outer boundary of the air quality LSA (to a distance of approximately 2 km on either side of the preferred route centreline) over a representative 5 km segment of Project construction using a screening dispersion model. Air concentrations were predicted based on a 1-hour averaging period and converted to a 24-hour averaging period using conversion factors. Annual air concentrations were also predicted. The predicted air concentrations were used as input to the HHRA to evaluate potential health risks associated with short-term or acute (1-hour and 24-hour) and long-term or chronic (annual) exposures by people.

Potential health risks were evaluated through comparison of predicted air concentrations 1) against air quality thresholds available from regulatory agencies and 2) through the calculation of risk estimates (i.e., HQs, ILCRs). Comparison to air quality thresholds was considered to represent a conservative evaluation of the potential for the predicted concentrations to result in adverse effects; consequently, contaminants with concentrations less than air quality thresholds were considered to pose a negligible risk to human health. Contaminants with predicted concentrations greater than air quality thresholds were identified as COPCs and were evaluated further through the calculation of HQs and ILCRs.

For the potential effects from the Project, the following summary of potential human health risks from construction activities is based on the results of the HHRA (refer to Appendix 21-I):

- Potential for human health risks from short-term or acute (i.e., 1-hour) exposure to NO_x (as NO_2) were identified based on predicted maximum concentrations from Project construction activities and from predicted maximum concentrations from Project construction activities in combination with background air concentrations (calculated HQs of 1.9 and 2.1, respectively).
- Potential for carcinogenic human health risks from long-term or chronic exposure to DPM during the Project construction activities (calculated ILCR of 1.64E-05).
- Potential for human health risks from other contaminants over the averaging times (1-hour, 24-hour, and annual) were considered to be negligible.

Although the potential for health risks from short-term or acute exposure to NO_x (as NO_2) were identified in the HHRA (refer to Appendix 21-I), there is a low likelihood of any receptor being exposed when the following points are considered. Exposures and health risks to people were determined based on predicted maximum concentrations of NO_x (as NO_2) in air. The maximum concentrations may occur anywhere along a representative 5 km long section of Project construction and are not necessarily representative of concentrations at a specific location (e.g., residences or commercial/industrial buildings). Furthermore, for a potential health effect to occur, a person must be present at the exact location and time that the predicted maximum concentration is occurring. For example, during project construction, concentrations of NO_X (as NO_2) above the health-based TRV (i.e., HQ >1) are predicted to occur 2% of the time modelled over the five-year air quality modelling period;

thus, 98% of the time the concentration of NO_x (as NO_2) is anticipated to meet the health based TRV (i.e., HQ <1). Moreover, as noted, the location of the maximum concentration was not predicted to occur at a specific location along the transmission line but represents instead the maximum concentration produced along a representative 5 km segment of the transmission line construction area; consequently, in order for a risk to occur, a receptor must be present during the exact time (i.e., hour) and location when the maximum concentration of NOx (as NO_2) occurs over the five-year modelled period. The likelihood of these conditions occurring is considered to be negligible and unacceptable short-term or acute risks to human health are not expected.

Although the potential for carcinogenic health risks from DPM were identified in the HHRA (refer to Appendix 21-I), for the potential for a long-term or chronic health effect to be likely, there is a low likelihood of any receptor being exposed when the following points are considered:

- Exposures and health risks to people were determined based on predicted maximum annual average concentrations of DPM in air. The maximum annual average concentration of DPM is not representative of a specific location (e.g., a residence or commercial/industrial building), but represents the annual average concentration of DPM along a representative 5 km segment of Project construction.
- With respect to any carcinogenic exposures, a person would need to be exposed at the maximum annual average concentration of DPM in the 5 km segment continuously for a one-year period of construction for the potential for predicted health risk (i.e., ILCR = 1.64E-05) to exist. Given the transient nature of project construction activities along the representative 5 km segment, a continuous receptor exposure to the maximum annual average concentration of DPM over 1 year is not expected.
- Note that the maximum annual average DPM concentration of 1.9 µg/m³ is lower than the published mean DPM exposure in the United States (2 µg/m³) and published levels from vehicular emissions (20 to 25 µg/m³; Ghio et al. 2012).

21.7.1.2 Mitigation

Mitigation measures planned to further reduce the effects of air emissions associated with the Project include measures to control dust and other air emissions (e.g., wind erosion control, maintenance of vehicles and equipment, coordination of worker transportation, spray dust control solution that holds moisture for a long period of time minimizing the generation of fugitive dust and compliance with regulatory approvals and permits). In areas where there are residences or sensitive receptors (e.g., hospitals, elderly centers, healthcare facilities) located within approximately 100 m of the Project footprint, emphasis will be placed on comprehensive implementation of mitigation measures, in particular dust suppression activities such as watering and dust suppressants. Fugitive dust controls on unpaved roads and material handling activities range from a 10% to 90% control (Western Governors' Association 2006). In this assessment, a conservative mid-range control efficiency of 65% was assumed.

NextBridge will identify and confirm the potential receptors within 100 m of construction activities prior to construction of each segment. If the receptor is confirmed to be an occupied residence and the construction activities are anticipated to be negligible sources of fugitive dust and tailpipe emissions (e.g., surveying and flagging, geotechnical investigations, conductor stringing and tensioning, decommissioning of temporary infrastructures, and clean up and reclamation) then no further action is required. However, construction activities that may trigger the need for monitoring include site access development, material hauling, transmission foundation and anchor construction, transmission structure assembly and erection. If these activities are being undertaken within 100 m of the confirmed occupied residence, NextBridge will assess the construction schedule, environmental conditions, and season and evaluate the need for monitoring. Monitoring will be undertaken when emission generating activities have the potential to impact the receptor. Handheld portable monitors will be used by a qualified person within approximately 10 m of confirmed occupied residences to provide real-time concentrations that can be compared to ambient air quality criteria.

These mitigation measures are expected to minimize potential effect to human health. Mitigation measures are summarized in Table 21-5. The effectiveness of mitigation will be evaluated during construction and post-construction, and measures will be modified or enhanced as necessary through adaptive management.

21.7.1.3 Net Effect

After implementation of the mitigation measures described above and in Table 21-5, there is a potential for human health risks from short-term or acute (i.e., 1-hour) exposure to NO_x (as NO_2) and from long-term or chronic exposure to DPM based on Project construction activities; therefore, there is a net effect of reduced air quality that may affect human health. This effect (reduced air quality may affect human health) is carried forward to the net effects characterization (refer to Section 21.8).

21.7.2 Change to Soil, Surface Water, Groundwater and Food Quality from Use of Herbicides May Affect Human Health

21.7.2.1 Potential Effect

Initial clearing of the Project footprint is planned to be completed through manual and mechanical means. Once cleared, compatible vegetation height will be maintained using mechanical, manual, and/or chemical (herbicide) means to maintain compatible vegetation at an appropriate height (e.g., below 2 m in height) to protect the facility and improve public and worker safety. Herbicides use for vegetation maintenance could infiltrate into soils, surface water, groundwater, and food quality (e.g., berries), which may affect human health.

21.7.2.2 Mitigation

The potential for herbicide leaching into the soil and contaminating groundwater will be minimized by mitigation measures related to herbicide application. Storage, handling, and application of herbicide will comply with the Ontario *Clean Water Act* (2006). Herbicides will be applied under the direction of a provincially licensed applicator. Herbicide use within the 30 m water body buffer will be prohibited unless the herbicide application is conducted by ground application equipment or otherwise approved by the relevant regulatory agency. No aerial application of herbicides is planned in the preferred route ROW. The potential for herbicide to affect food quality will be minimized by public notification of herbicide application. NextBridge will post relevant information about the application of herbicide (e.g., anticipated dates, areas to be sprayed, sprayed dates) on their website (www.nextbridge.ca) to advise the public of herbicide use along the ROW. Mitigation measures are summarized in Table 21-5. These mitigation measures are expected to minimize potential effect to human health. Mitigation measures are summarized in Table 21-5. The effectiveness of mitigation will be evaluated during construction and post-construction, and measures will be modified or enhanced as necessary through adaptive management.

21.7.2.3 Net Effect

Changes to soil, surface water, groundwater and food quality were not identified as exposure pathways of concern as it relates to human health as detailed in the HHRA (refer to Table 21-I-2, Appendix 21-I). Furthermore, although herbicide application may be used to control invasive plants and people may consume vegetation (e.g., berries) that have received herbicide application, after implementation of the mitigation measures described above and in Table 21-5, a net effect to human health from Project use of herbicides is not expected and further assessment is not warranted as it relates to a change in human health.

This effect (change to soil, surface water, groundwater and food quality from use of herbicides may affect human health) is not carried forward to the net effects characterization (refer to Section 21.8).

21.7.3 Summary of Potential Effects, Mitigation and Net Effects

A summary of the potential effects assessment is provided in Table 21-5, which is based on the assessment discussion and the implementation of mitigation measures identified above and further supplemented in the table below.

Table 21-5: Potential Effects, Mitigation and Predicted Effects for Human Health

Criteria	Indicators	Project Component or Activity	Potential Effect	Mitigation	Inspection and Monitoring Details	Net Effect
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health	Project activities during the construction phase, including: ■ site access development, site preparation and soil salvage (e.g., clearing and grubbing); ■ material handling and hauling; ■ vehicular exhaust; ■ construction of infrastructure (e.g., access roads and temporary workspaces); ■ decommissioning of temporary access roads and workspaces; and ■ clean-up and reclamation.	Increase in ambient concentrations from CAC and fugitive dust emissions during construction may affect human health	**Construction Phase:** <u>Air Quality/Emission Mitigation</u> ■ Turn off vehicles and equipment when not in use and minimize idling, unless weather and/or safety conditions dictate the need for them to remain turned on and in a safe operating condition. ■ Noise abatement, emission and pollution control equipment on machinery should be in place, properly maintained and in good working order. ■ Keep equipment well-maintained. ■ Burning of slash will be in accordance with regulatory approvals and permits and subject to agreements with landowners, SFL holders (e.g., overlapping agreements). ■ Implement dust control measures (e.g., spray dust control solution that holds moisture for a long period of time causing dust to settle) as advised by the Environmental Inspector. ■ To minimize drifting soils and loss of topsoil in areas prone to wind or water erosion stabilize the disturbed area as soon as practicable by: ▪ spreading wood chips or straw crimping (weed-free straw); ▪ sowing a fast growing ground cover (e.g., cereal crop); ▪ installing erosion control blankets; or ▪ walking down tree and shrub debris over exposed soils (rollback). ■ Retain compatible vegetation (e.g., below 2 meters (m) in height) where practicable on areas prone to wind erosion, steep slopes, drainage ways or next to a water body. ■ Tackify, cover, seed, apply water or pack the topsoil stockpiles and windrows with approved equipment, if soils prone to wind erosion ■ Use multi passenger vehicles to transport workers to site when practicable. ■ Where occupied residences are confirmed within 100 m of construction, schedule activities within 5 km radius in a manner that reduces the number of construction activities occurring at the same time.	■ Construction Phase: ■ The Owner will appoint qualified Environmental Inspector(s) to guide implementation, monitor and report on the effectiveness of the construction procedures and mitigation measures for minimizing potential impacts ■ Identify and confirm the potential receptors within 100 m of construction activities prior to construction of each segment. If the receptor is confirmed to be an occupied residence, implement the following measures: ▪ If the construction activities are anticipated to be negligible sources of fugitive dust and tailpipe emissions (e.g., surveying and flagging, geotechnical investigations, conductor stringing and tensioning, decommissioning of temporary infrastructures, and clean up and reclamation) then no further action is required. ▪ Construction activities that may trigger the need for monitoring include site access development, material hauling, transmission foundation and anchor construction, transmission structure assembly and erection. If these activities are being undertaken within 100m of the confirmed occupied residence, the Owner will assess the construction schedule, environmental conditions, and season and evaluate the need for monitoring. ▪ Monitoring will be undertaken when emission generating activities have the potential to impact the receptor. Handheld portable monitors will be used by a qualified person within approximately 10 m of confirmed occupied residences to provide real-time concentrations that can be compared to ambient air quality criteria.	Net change – Reduced air quality may affect human health

Table 21-5: Potential Effects, Mitigation and Predicted Effects for Human Health

Criteria	Indicators	Project Component or Activity	Potential Effect	Mitigation	Inspection and Monitoring Details	Net Effect
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health	Project activities during the operation phase, including: ■ maintenance of access roads, transmission line, and preferred ROW.	Change to soil, surface water, groundwater and food quality from use of herbicides may affect human health	**Construction Phase:** The use of herbicides is prohibited. **Operation Phase:** <u>Use of Herbicide Mitigation:</u> ■ Use of herbicides/pesticides will follow requirements under the Pesticides Act. ■ Necessary permits will be obtained for the application, transportation, storage, and disposal of pesticides. Only herbicide products registered for use in Canada by the Pest Management Regulatory Agency of Health Canada will be used. ■ Storage, handling and application of herbicide will comply with the Ontario Clean Water Act. ■ Do not use herbicides within 100 m of identified wells. ■ No aerial application of herbicides is planned in the ROW. If herbicide use is necessary it will be applied on the ground as spot application. ■ Apply approved herbicides under the direction of a provincially-licensed applicator. ■ Prohibit the use of herbicides within the 30 m water body buffer unless the herbicide application is conducted by ground application equipment or otherwise approved by the relevant regulatory agency. ■ No herbicides will be used in sensitive areas including reserve lands, provincial parks, within 30 m of water bodies and certain other edible and medicinal plant harvesting areas the communities have identified. ■ Restrict the general application of herbicide near rare plants or rare ecological communities. Spot spraying, wicking, mowing, or hand-picking are acceptable measures for weed control in these areas. ■ Restrict the general application of herbicide in CLVAs to the extent practicable. ■ NextBridge will post on their website (www.nextbridge.ca) relevant information about the application of herbicide (e.g., anticipated dates, areas to be sprayed, sprayed dates) to advise the public of herbicide use along the ROW.	**Operation Phase:** NextBridge will oversee implementation of the environmental management measures described in the OEMP during operation and maintenance	No net effect

CAC = Criteria Air Contaminants; OEMP = Operation Environmental Management Plan; ROW = right-of-way.

21.8 Net Effects Characterization

21.8.1 Approach

The net effects assessment approach followed the general process described in Section 5.5 (methods section).

Net effects on human health from reduced air quality during construction activities are described using the significance factors identified in Table 5-7. Effects levels are defined for the magnitude of effects characteristics for human health in Table 21-6.

Table 21-6: Magnitude Effect Levels for Human Health

Indicator / Net Effect	Effect Level Definition			
	Negligible	**Low**	**Moderate**	**High**
Human health	Project-related environmental exposures do not result in a change in human health	Project-related environmental exposures are unlikely to substantially result in a change in human health	Project-related environmental exposures may result in a long-term, substantive change in human health	Project-related environmental exposures are likely to result in a long-term, substantive change in human health

21.8.2 Results

A summary of the characterization of net effects of the Project on human health is provided in Table 21-7. Net effects are described after the implementation of effective mitigation measures, and summarized according to direction, magnitude, geographic extent, duration/irreversibility, frequency/timing, and likelihood of the effect occurring following the methods described in Section 5.5.1. Effective implementation of mitigation measures summarized in Table 21-5, the Construction Environmental Protection Plan (CEPP; refer to Appendix 4-II), and the Operation Environmental Management Plan (OEMP; refer to Appendix 4-III) is expected to reduce the magnitude and duration of net effects on air quality and by extension net effects on human health.

Table 21-7: Characterization of Predicted Net Effects on Human Health

Criteria	Indicators	Net Effect	Direct/ Indirect	Significance Factors					
				Direction	Magnitude	Geographic Extent	Duration/ Irreversibility	Frequency	Likelihood of Occurrence
Human health	Changes in environmental quality, including surface water, groundwater, and air quality, and specifically contaminant concentrations in these media that could affect human health	Reduced air quality may affect human health	Indirect	Negative	Negligible	Local - LSA	Short-term / Reversible	Infrequent	Unlikely

21.8.3 Reduced Air Quality May Affect Human Health

With the implementation of the mitigation measures outlined in Table 21-5, construction activities associated with the Project have the potential to reduce air quality. The net effect of a reduction in air quality on human health was considered to be indirect, negative in direction and negligible in magnitude as exposure was not anticipated to result in a change in human health. Furthermore, the effect was characterized as local in geographic extent because it would be confined to the human health LSA. The effect was considered to be short-term and reversible because it was anticipated to occur only during the construction stage when a reduction in air quality may occur and is reversible soon after the operation stage begins when a reduction in air quality is not expected. The effect was considered to be infrequent because the Project may result in a reduction to air quality and thus human health throughout construction stage activities; however, it was not expected to affect any one receptor throughout the full construction stage. Overall the net effect was considered unlikely for the following reasons:

- Exposures and health risks to people were determined based on predicted maximum concentrations (NO_x, DPM) in air. The maximum concentrations may occur anywhere along a representative 5-km segment of Project construction and are not necessarily representative of concentrations at a specific location (e.g., residences or commercial/industrial buildings);
- For a potential short-term or acute health risk to exist, a person must be present at the exact location and time that the predicted maximum concentration of NOx (as NO_2) is occurring for the potential for the predicted health risk to exist and by extension for a potential health effect to be realized; and
- For a potential long-term or chronic health risk to exist, a person would need to be exposed at the maximum annual average concentration of DPM in the 5 km segment continuously for a one-year period of construction for the potential for the predicted health risk to exist and by extension for a potential health effect to be realized.

21.9 Assessing Significance

The assessment of significance of net effects of the Project is informed by the interaction between the factors of significance, with magnitude, duration and geographic extent being the most important factors. Consideration is also given to concerns of interested agencies, groups and individuals raised during consultation and engagement. Implementation of proven mitigation measures is expected to avoid or reduce the duration and magnitude of net effects on air quality and therefore, by extension, net effects on human health. The magnitude of the predicted net effect on human health is negligible.

Net effects to a criterion would be considered to be significant if the net effect was assessed as high magnitude, long-term or permanent duration, at any geographic extent and represent a management concern. The predicted net effect on human health is not anticipated to result in a change to the criteria that will alter the sustainability of the criterion beyond a manageable level and the net effects do not result in changes that are not in accordance with provincial and federal guidelines. Therefore, the predicted net effect on human health was assessed as not significant.

21.10 Cumulative Effects Assessment

The net effect on human health from a reduction in air quality was predicted to be unlikely. The cumulative effects assessment focused on net effects that are likely to occur. Therefore, net effects assessed as having a likelihood of occurrence of ‘probable’ and ‘certain’ were carried forward while net effects assessed as ‘unlikely’ and ‘possible’ were not considered to be likely net effects and were not carried forward to the cumulative effects assessment.

Also, considered with the limited geographic extent, short duration, and intermittent frequency, this effect was considered unlikely to additively or synergistically contribute to effects of other past, present, or RFDs. Therefore, a cumulative effects assessment was not completed for this net effect (reduced air quality may affect human health).

21.11 Prediction Confidence in the Assessment

The confidence in the effects assessment for human health is high, considering that the mitigation measures described in the CEPP (refer to Appendix 4-II) are based on accepted and proven best management practices that are well understood and have been applied to transmission line projects throughout North America. Uncertainty in the assessment has been further reduced by making conservative assumptions as detailed in the HHRA (refer to Appendix 21-I) and summarized below:

- Human health TRVs that are used to characterize potential risks to people are generally considered to be conservative. As such, use of the TRVs may overestimate toxicity and potential health risks.
- The TRV used to characterize potential risks to human health from short-term or acute exposure to NO_2 is the most stringent of the available TRVs for this COPC, and lower than the available TRVs from the Canadian Council of Ministers of the Environment and Ontario MOECC, the relevant federal and provincial jurisdictions for the Project.
- Exposures and health risks to people were determined based on predicted maximum concentrations of contaminants in air. Statistics on the predictions, which would provide a reasonable maximum estimate of exposures taking into account the variability in concentrations across a site, would result in lower exposures and health risks to people.
- The assessment relied on predicted air concentrations provided by the air quality discipline. A number of conservative assumptions were used in the air quality modelling such that predicted concentrations have likely been overestimated. For a summary of the conservative assumptions used in the air quality modelling, refer to Section 9.11.
- Uncertainty in the assessment has been further reduced by planning adaptive management measures to address unforeseen circumstances should they arise.

Given the conservative approach of the assessment described above, the results of the assessment are unlikely to underestimate the effects of the Project on human health.

21.12 Follow-Up, Inspection, and Monitoring Programs

The objectives of follow-up, inspection, and monitoring programs include:

- Evaluating the effectiveness of mitigation and reclamation, and modifying or enhancing measures as necessary through adaptive management;
- identifying unanticipated potentially adverse effects, including possible accidents and malfunctions; and
- contributing to continual improvement.

Monitoring and post-monitoring activities are described in Section 23 and the CEPP (refer to Appendix 4-II). A summary of the monitoring activities relevant to the protection of the human health is described below:

- The Owner will appoint qualified Environmental Inspector(s) to guide implementation, monitor and report on the effectiveness of the construction procedures and mitigation measures for minimizing potential impacts.

- If the construction activities such as site access development, material hauling, transmission foundation and anchor construction, transmission structure assembly and erection are being undertaken within 100 m of the confirmed occupied residence, NextBridge will assess the construction schedule, environmental conditions, and season and evaluate the need for monitoring. Monitoring will be undertaken when these emission generating activities have the potential to impact the receptor. Handheld portable monitors will be used by a qualified person within approximately 10 m of confirmed occupied residences to provide real-time concentrations that can be compared to ambient air quality criteria.
- NextBridge will oversee implementation of the environmental management measures described in the OEMP during operation and maintenance.

21.13 Information Passed on to Other Components

Results of the human health assessment were reviewed and incorporated into the following components of the amended EA Report:

- Indigenous Current Use of Lands and Resources for Traditional Purposes (refer to Section 17).