Design & Consultancy for natural and built assets

Harrington McAvan Limited

AIR QUALITY ASSESSMENT OF THE MCCORMICK PIT

July 2020

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EXECUTIVE SUMMARY

Atmospheric dispersion modelling was undertaken to determine the maximum impact of the proposed McCormick Pit on ambient particulate matter concentrations in the area. The AERMOD model was used to simulate the emissions of all significant sources of particulate matter at the facility, in combination with emissions from surrounding public roads. The two phases (Phase C and Phase D) that could most significantly affect the sensitive receptors in the vicinity of the proposed pit were analyzed, which were based on high activity levels occurring near sensitive receptor locations. The estimated emissions from each phase will be quite similar, but due to the fact that the extraction pit location varies between phases, it was necessary to model the two phases separately to properly assess the maximum impact on all of the sensitive receptors. The maximum 24-hour and annual average dust concentrations in three size ranges (TSP, PM_{10}, and $PM_{2.5}$) were evaluated specifically at the eight sensitive receptors located closest to the boundary of the proposed site.

The analysis showed that even using a conservative emission scenario (i.e., an overestimate), the applicable standards for TSP, PM_{10} and $PM_{2.5}$ were not predicted to be exceeded during site operations at any of the nearby sensitive receptors. Exceedances of these criteria were limited to a small area along the northwest edge of the property boundary where an existing aggregate pit Caledon Sand and Gravel Inc. (CSG) is located. A dustfall analysis showed that both the 30 day and annual criteria are met at all discrete receptors.

Due to the conservative modelling approach used in this study, where all significant sources are operating at their expected individual maximum rates and also due to the presence of vegetation and berms around the site, the maximum concentrations will likely be lower than predicted.

The analysis was conducted considering a reasonable level of mitigation, including efficient dust control (e.g., watering) of unpaved roads and excavation areas as appropriate. Good dust management practices will ensure that any effect associated with material handling and transportation of materials is minimized. These practices are outlined in the Best Management Plan (BMP).

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1.0 INTRODUCTION

Arcadis Canada Inc. (Arcadis) was retained by Harrington McAvan on behalf of Blueland Farms Ltd. to assess the potential dust impacts of a proposed sand and gravel extraction operation near Caledon, Ontario.

The proposed operation is to be located on the west side of Heart Lake Road, approximately 500 metres north of Escarpment Side Road, from hereinafter referred to as the “Site”. The surrounding area of the Site is relatively flat towards the north and rolling terrain to the south. An existing aggregate pit Caledon Sand and Gravel Inc. (CSG) is located to the west of the site. The remainder of the lands surrounding the site are rural residential.

Arcadis developed an emissions inventory for particulate matter, based on a maximum annual extraction limit of 750,000 tonnes/year of gravel and related product. Particulate matter (PM) is a term used for both solid and liquid particles of small size in the atmosphere. Primary PM is directly emitted to the atmosphere, and secondary PM is chemically formed from other pollutants. Particulate matter varies considerably in size. Total Suspended Particulate (TSP) describes all particles with aerodynamic diameters less than 44 µm; PM_{10} describes all particles with aerodynamic diameters less than 10 µm; and $PM_{2.5}$ describes all particles with aerodynamic diameters less than 2.5 µm. The larger diameter fraction of PM is commonly made up of crustal material (for inland locations) and can be emitted to the atmosphere by erosion by the wind, or disturbance of soil due to anthropogenic activity. The smaller diameter fraction of PM is most often attributed to combustion sources. Whereas larger particulate matter tends to be deposited relatively close to the source(s) of emission, fine particulate matter can stay airborne for days and can be transported significant distances from the source(s). Currently, there is a provincial ambient air quality criterion specified for TSP, but not for PM_{10} or $PM_{2.5}$. There is however, a (federal) Canada-Wide Standard for $PM_{2.5}$, and an Ontario Ministry of the Environment, Conservation and Parks (MECP) interim guideline for PM_{10}.

The objective of the dust impact assessment is to conservatively predict the highest levels of airborne particulates (dust) that are likely to result from the added industrial activity at the proposed McCormick Pit. The predicted air quality impacts were compared to relevant criteria and guidelines, as discussed above. The potential impact of particulate matter emissions on air quality in the vicinity of the operation was evaluated using dispersion modelling to determine maximum predicted ambient air concentrations of total suspended particulate matter (TSP), inhalable particulate matter (PM_{10}), and respirable particulate matter ($PM_{2.5}$). The modelling analysis focused on potential impacts in the vicinity of nearby residential properties, since these will be most sensitive to any dust emissions originating from the proposed operation.

The U.S. EPA AERMOD regulatory short range air dispersion model which is an approved model under the Ontario Regulation (O.Reg.) 419/05 (Local Air Quality) was used with the projected emissions to predict ambient particulate matter concentrations, as well as dustfall, in the area surrounding the site. AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. It includes the capability to model emissions originating from open pit sources.

1.1 Air Quality Criteria

1.1.1 Total Suspended Particulate (TSP)

Total Suspended Particulate (TSP) is often used to characterize air quality near a dust source. TSP is typically measured with a high-volume (Hi-Vol) sampler over 24-hours and consists of particles less than 44 µm in diameter. An annual average is typically calculated as the geometric mean of these samples measured every six days.

Ontario's Ambient Air Quality Criteria (AAQC) was released in April 2012 (PIBS #6570e01). The AAQC for TSP is 120 µg/m^3 averaged over 24-hours, and the annual geometric mean of the 24-hour samples is 60 µg/m^3.

The ambient TSP criteria were set to prevent a reduction in visibility. Particles suspended in the atmosphere reduce visibility or the visual range by reducing the contrast between an object being viewed and its background. This reduction is a result of particles scattering or absorbing light coming from both the object and its background, and from particles scattering light into the line of sight. Particles with a radius of 0.1 to 1.0 µm are most effective at reducing visibility. In a rural area where particulate levels are in the order of 30 µg/m^3, the visibility would be about 40 km. At 150 µg/m^3, the range would be reduced to about 8 km. The MECP 24-hour criterion of 120 µg/m^3 is based on a visual range of about 10 km.

1.1.2 Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Many studies over the past few years have indicated that fine particulate matter (PM_{10} and $PM_{2.5}$) in the air is associated with various adverse health effects in people who already have compromised respiratory systems such as asthma, chronic pneumonia and cardiovascular problems. However, the available studies have not been able to link the adverse health effects in such people to any one component of the pollution mix. PM_{10} is a mixture of chemically and physically diverse dusts and droplets, and some of these components may be important in determining the effects of PM_{10} on health.

Particulate Matter less than 2.5 µm – $PM_{2.5}$ is known as respirable particulate as "respirable" since the particles are generally small enough to be drawn in and deposited into the deepest portions of the lungs. Anthropogenic sources, such as combustion of fossil fuels, tend to be the largest contributor to $PM_{2.5}$ levels in the environment.

The MECP has an Interim AAQC for PM_{10} of 50 µg/m^3 based on a 24-hour average. The Canadian Council of Ministers of the Environment (CCME) has published Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ which includes a 24-hour limit of 27 µg/m^3 and an annual limit of 8.8 µg/m^3. The table below presents the AAQCs and CAAQSs used in this study. Table 1.1 presents the particulate matter ambient air quality assessment criteria used in this study.

Table 1.1 Particulate Matter Air Contaminant Benchmark

Pollutant	Averaging Period	Source	Air Quality Criteria
TSP	24-hour	AAQC or ACB	120
	Annual	AAQC or ACB	60
$PM_{2.5}$	24-hour	CAAQS	27 [a]
	Annual	CAAQS	8.8 [b]
PM_{10}	24 Hour	AAQS	50

Notes:

[a] The Canadian Ambient Air Quality Standard (CAAQS) for 24-hr $PM_{2.5}$ is 28 µg/m^3 in 2015 and 27 µg/m^3 in 2020 based on the 98th percentile of 24-hour average concentrations, averaged over 3 consecutive years (CCME 2012). Since the Project will operate beyond 2020, the 2020 CAAQS was used.

[b] The Canadian Ambient Air Quality Standard (CAAQS) for annual $PM_{2.5}$ is 10 µg/m^3 in 2015 and 8.8 µg/m^3 in 2020. Since the Project will operate beyond 2020, the 2020 CAAQS was used.

1.2 Dustfall Criteria

Dustfall, or dust deposition, involves the settling of particles from the air due to gravitational force. It is a total amount of dust, inclusive of all particle categories. Dustfall or dust deposition includes those particles of sufficient weight to settle from the air by gravity. These particles are generally larger than 20 µm in diameter. TSP deposition generally provides a good estimate of total dustfall. The AAQC for dustfall is 7.0 g/m^2/30 days for an averaging period of one month and 4.6 g/m^2 for an averaging period of 1 year.

In developing an Ambient Air Quality Criterion for dustfall, the MECP used soiling data (i.e. surface build-up of dust) from various towns located in Ontario between the time period of 1951 and 1955, which indicated areas of relatively low soiling (11 – 15 g/m^2/30 days), relatively moderate soiling (17-24 g/m^2/30 days) and relatively heavy soiling (26-34 g/m^2/30 days) (WHO, 1961).

Table 1.2 presents the dustfall ambient air quality assessment criteria used for this study.

Table 1.2 Dustfall Ambient Air Quality Assessment Criteria

Pollutant	Averaging Period	Source	Air Quality Standard (g/m^2)
Dustfall	30 Day	AAQC	7
	Annual	AAQC	4.6

1.3 Other Criteria Air Contaminants

Criteria Air Contaminants (CACs) including nitrogen oxides, sulphur oxides and carbon monoxide are common pollutants released into the air by activities such as the combustion of fossil fuels.

Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). NOx, the term used to describe the sum of NO, NO_2, and other oxides of nitrogen, plays a major role in the formation of ozone. NO_2 has adverse health effects at much lower concentrations than NO. Consequently, the MECP AAQC is based on the health effects of NO_2. The AAQC for NOx is 400 µg/m^3 for a 1-hour averaging period and 200 µg/m^3 on a 24-hour basis.

SO_2 is a colourless gas that can be oxidized to sulphur trioxide, which in the presence of water vapour, is readily transformed to sulphuric acid mist. SO_2 can be oxidized to form acid aerosols and is a precursor of particulate sulphates, which are one of the main components of respirable particulates in the atmosphere. The AAQC for SO_2 is 690 µg/m^3 for a 1-hour averaging period, 275 µg/m^3 for a 24-hour averaging period, and 55 µg/m^3 for an annual averaging period.

CO is a colourless, odourless gas formed when the carbon in fuel is not fully combusted. It is a component of motor vehicle exhaust, with high concentrations of CO generally occurring in areas with heavy traffic congestion. The AAQC for CO is 36,200 µg/m^3 for a 1-hour averaging period and 15,700 µg/m^3 for an 8-hour averaging period.

There are some minor sources of CACs at the proposed McCormick pit. These sources include mobile equipment such as haul trucks and front-end loaders, as well as stationary equipment such as diesel generators. These sources are not expected to be significant contributors to concentrations of these contaminants at nearby residential locations, due to the proximity of local public roads (which are larger sources of these contaminants). The site is also subject to O.Reg. 419/05 and as such will apply for an Environmental Compliance Approval permit from the MECP. This will require that the site comply with MECP's Point of Impingement regulatory standards for all significant contaminants. As such, CACs were not included in the dispersion modelling assessment at this time.

2.0 BACKGROUND CONCENTRATIONS

Existing air quality in the area surrounding the proposed McCormick Pit, is a combination of emissions from sources in the area (other pits and traffic) plus a component that flows into the area from other areas (Toronto, the USA, etc.). When a modelling assessment is completed these other "background" sources must be included in order to get an accurate representation of the air quality after the proposed McCormick Pit is in operation. The historical rural background concentrations for TSP, PM_{10} and $PM_{2.5}$ were added to model-predicted concentrations to capture the upwind portions of background. Consequently, the concentrations presented in this report include potential effects from the background dust sources in the area as well as other upwind sources.

2.1 Air Concentrations

The proposed McCormick Pit site will be located north of Escarpment Side Rd. The predominant land uses are agriculture, residential and aggregate extraction. Monitors from MECP Air Quality Stations and Environment Canada's National Ambient Pollution Surveillance Program (NAPS) were reviewed. Based on the proximity to the Site, Newmarket Air Quality station (48006) was selected to obtain representative ambient background concentrations for the Study Area. Data was obtained for the most recent available consecutive five years from the selected monitoring station. The Newmarket air quality monitoring station collects only the $PM_{2.5}$ size fraction. Table 2.1 presents latest five years of 90^{th} percentile 24-hour measurements for $PM_{2.5}$. Historical measurements across Ontario show that PM_{10} is approximately 50% of TSP. Similarly, $PM_{2.5}$ measurements have historically been observed to be 50% of PM_{10} measurements. As such, the background concentrations of PM_{10} and TSP were estimated by multiplying the $PM_{2.5}$ and PM_{10} measurements by a factor of 2, respectively. The 90^{th} percentile values are values that will only be exceeded 10% of the time under adverse meteorological conditions. The background concentrations used in this assessment are shown in Table 2.2 below.

Table 2.1 Background Concentration for TSP, PM_{10} and $PM_{2.5}$

Monitoring Station	Contaminant	2011	2012	2013	2014	2015	5-yr avg
Newmarket (48006)	**$PM_{2.5}$ (µg/m³)**						
	24-hr 90th percentile	11.0	11.4	13.4	13.5	14.0	12.7
	Annual	5.5	5.6	7.3	7.3	7.1	6.6
	PM_{10}(µg/m³)						
	24-hr 90th percentile	22.0	22.9	26.8	27.0	28.1	25.4
	TSP (µg/m³)						
	24-hr 90th percentile	43.9	45.7	53.7	54.1	56.1	50.7
	Annual	21.9	22.3	29.2	29.2	28.6	26.2

Table 2.2 Selected Background Concentrations for TSP, PM_{10} and $PM_{2.5}$

Averaging Time	Contaminant Background Concentration (µg/m^3)		
	TSP	PM_{10}	$PM_{2.5}$
24-hour	50.7	25.4	12.7
Annual	26.2	n/a	6.6

2.2 Dustfall Concentrations

A measured background dust deposition rate was not available. However, a background value may be estimated from a 30-day average TSP air concentration combined with an assumed particle settling velocity. The annual TSP concentration of 26.2 µg/m^3 presented in Table 2.2 was used as a surrogate for the 30-day average concentration. The background deposition rate was estimated using a settling velocity of 4 cm/s. This was added to the model predicted monthly and annual average deposition rates.

$$Deposition = \frac{26.2\mu g}{m^3} \times \frac{0.04m}{s} \times \left(30days \times \frac{24hr}{day} \times \frac{60min}{hr} \times \frac{60s}{min}\right) \times \frac{g}{1{,}000{,}000\mu g}$$
$$= \frac{2.7g}{m^2 \times 30days}$$

3.0 DISPERSION MODELLING PARAMETERS

3.1 Introduction

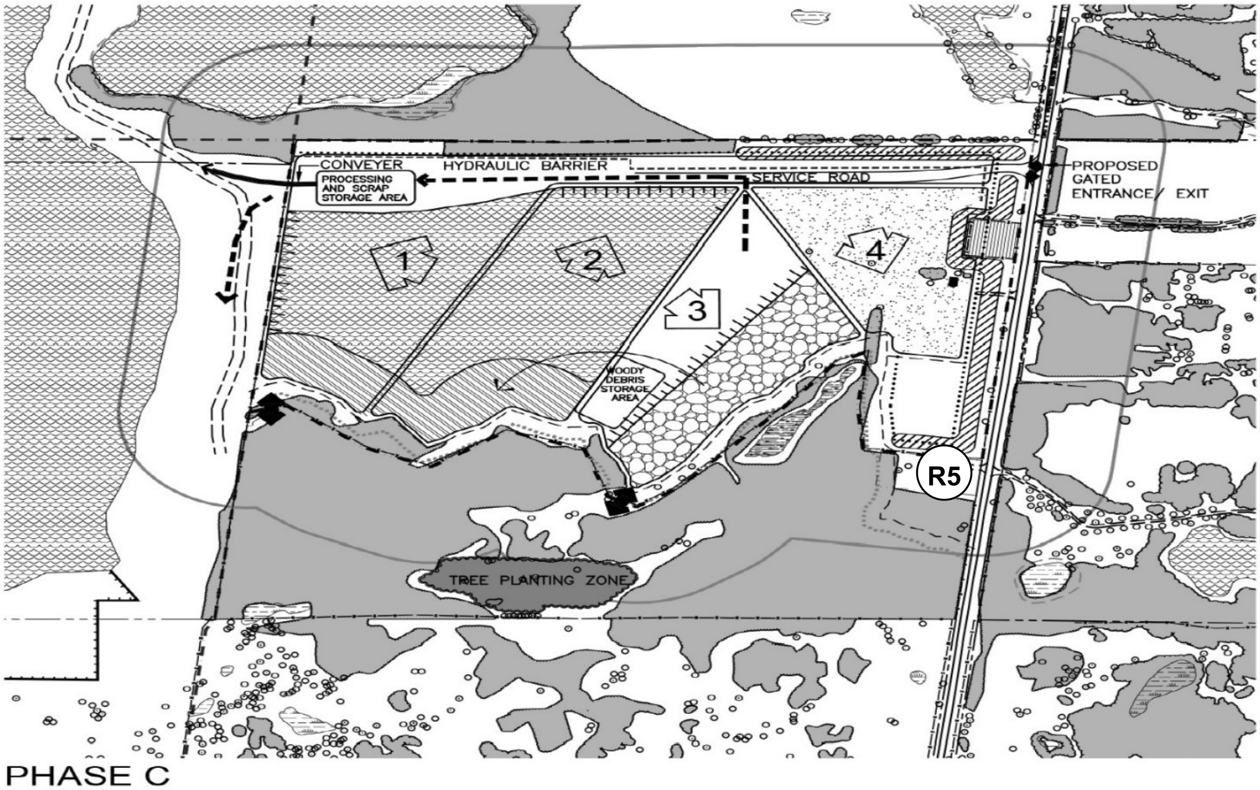
Arcadis used the 'Operations Plan, Phases B-G Number 02-48' (dated August 2017) provided by Harrington McAvan Ltd. to obtain the details on the planned phases needed for dispersion modelling. The Plan included the locations of the Plant Site, where processing will occur and the on-site haul road. Additional information was provided through personal communication with Harrington McAvan staff.

An emission inventory was developed for each particulate matter size fraction (TSP, PM_{10}, and $PM_{2.5}$) and modelled separately with AERMOD using a variable spaced receptor grid as defined in O.Reg. 419/05. Nearby residences were added as 'discrete' receptors.

At the proposed McCormick Pit location, the water table is located at approximately +/-405.0 - 411.0 m above sea level, which is approximately 8 to 20 m below the existing grade (depending on location within the property). The planned maximum depth of extraction is approximately 384 m above sea level. Therefore, a considerable amount of gravel will be extracted from beneath the water table. Removal and processing of gravel when it is wet results in negligible dust emissions in comparison to removal and processing of gravel above the water table, which would be relatively dry. Therefore, material handling emissions were only considered for phases in which above water extraction occurred and emissions were conservatively estimated assuming total extraction and processing above the water table. However, emissions resulting from equipment operation (i.e. tailpipe/exhaust) during below water extraction were considered.

During the lifetime of the undertaking, the working face will be located in different regions of the site. The permanent plant (secondary crushing and screening) site will be located off-site, in an existing license next door to the west. The primary jaw crusher and the conveyor will be relocated in the north-west side of the pit. The primary haul route is proposed from the site, through the existing Caledon Sand and Gravel Inc. (CSG) internal haul route within the existing licensed pit (located east and west of Kennedy Road) then out to their existing CSG pit entrance at Highway 10. Figure 3.1 provides a visualization of the McCormick Pit, showing the extraction areas. Berms will be constructed along the northwest and northeast fence lines to reduce adverse noise and visual impacts (Figure 3.1). The berms will be a minimum of 3 m in height (berms vary in height). Of the residential dwellings near the McCormick Pit, receptor location, identified as "R5" has the greatest potential to experience elevated dust levels due to pit operations. The berm and existing trees and shrubs surrounding R5 will act to reduce horizontal dust transport from the Pit area.

Figure 3.1 Phase C of McCormick Pit Development



During the lifetime of the Pit, there will be seven different phases of operation. During Phases E through G, progressive rehabilitation of processed areas will occur in addition to extraction. A basic description of each operating phase is provided in Table 3.1.

Table 3.1 Operating Phases at McCormick Pit

Operating Phase	Description of Activities
A	Removal of overburden in Area 1, preparation of the permanent plant site, construction of berm along NW fence line and along Heart Lake Road adjacent to the archaeological site. Begin above water extraction in Area 1. Establish processing plant and stockpiling area.
B	Removal of overburden in Area 2. Above water extraction in Area 1 and Area 2, below water extraction in Area 1. Construction of berm along Heart Lake Road adjacent to R5 property line. Progressive rehabilitation of side slopes and shorelines in Area 1.
C	Removal of overburden in Area 3. Complete construction of acoustical berm along Heart Lake Road and the acoustical berm along the east perimeter of Area 3 and Area 4. Above water extraction in Area 3, continue below water extraction in Area 1, complete above water extraction in Area 2. Continue progressive rehabilitation of Area 1
D	Begin removal of overburden in Area 4. Begin below water extraction in Area 3. Complete below water extraction in Area 2. Begin above water extraction in Area 4. Begin progressive rehabilitation of side slopes and shoreline in Area 2 and Area 3.
E	Complete below water extraction in Area 3. Continue above and below water extraction in Area 4. Complete rehabilitation in Area 3. Begin progressive rehabilitation in Area 4.
F	Complete below water extraction for Area 4. Complete rehabilitation of Area 4. Continue rehabilitation of Area 1 and Area 2.
G	Complete all remaining rehabilitation for entire site.

Note: Shaded Phases were modelled

Phases C and D were chosen to be modelled as they are the operating scenarios that potentially will result in the highest particulate concentrations at each of the nearby sensitive receptors (due to the proximity of the activities to these receptors). The processing plant will be located off-site, in the existing license next door to the west, only the primary crusher and the conveyor will be located at the north-west side of the pit. Material extracted from the proposed McCormick Pit will be shipped under the existing Caledon Sand and Gravel licensed gravel pit and then out to their existing CSG pit entrance at Highway 10. Figure 3.1 (presented earlier) shows the layout for Phase C and Figure 3.2 shows the layout for Phase D. All other phases are expected to result in equivalent or lower ground-level dust concentrations due to locations of emission sources and/or below water extraction. The rehabilitation process is progressive throughout most phases of the project and emissions at any point in time will be low in comparison to other on-going activities. As such these emissions were not considered for modelling.

Figure 3.2 Phase D of McCormick Pit Development

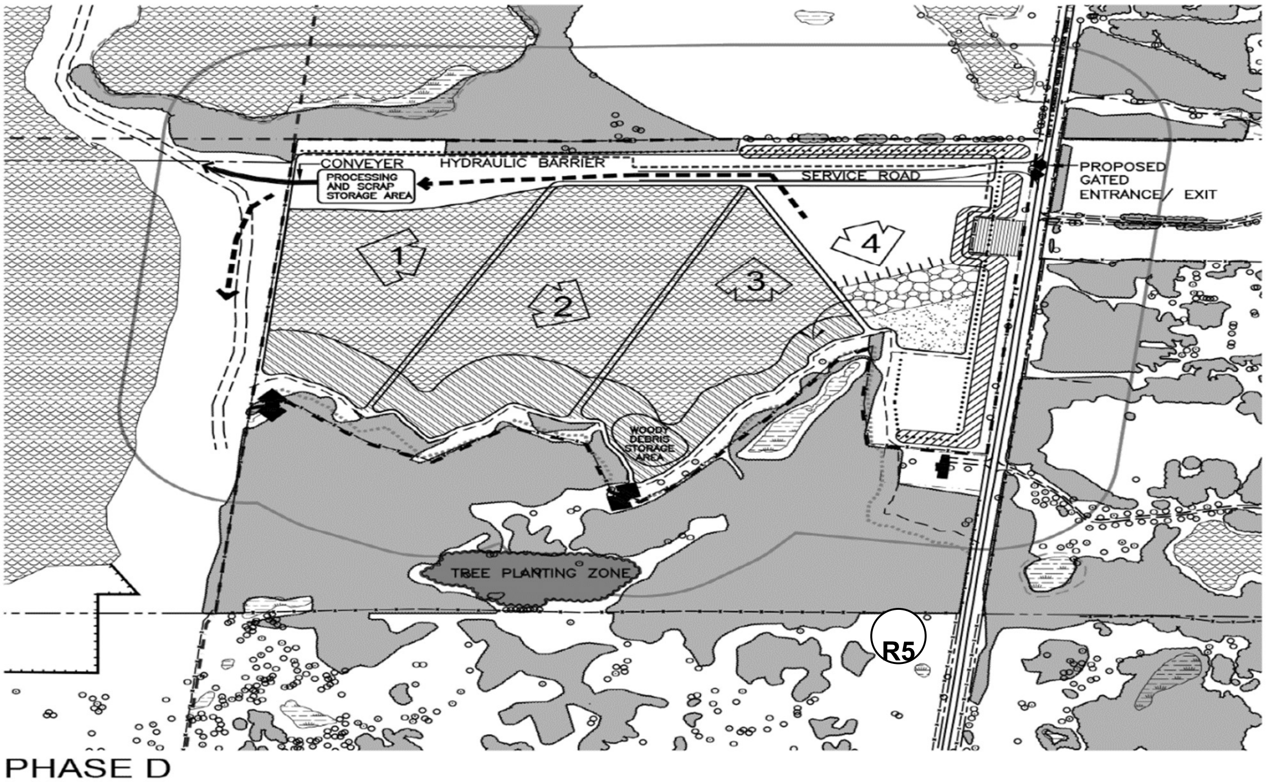


Table 3.2 shows the planned hours of operation for the McCormick Pit.

Table 3.2 Site Activity Timings

Activity	Timing	
	Weekdays	Saturdays
Site Preparation and Rehabilitation	07:00 – 19:00 h	07:00 – 15:00 h
Excavation and Processing	07:00 – 19:00 h	
Shipping	06:00 – 19:00 h	06:00 – 15:00 h

3.2 Meteorology

The AERMOD model accepts hourly meteorological data records to define the conditions for plume rise, transport and dispersion. The model estimates the concentration or deposition value for each source-receptor combination, for each hour of input meteorology, and calculates short-term averages, such as one-hour, eight-hour and 24-hour averages. The hourly averages can also be combined into longer averages (1-month, seasonal, annual or period).

In this assessment, the AERMOD model was run using an MECP pre-processed 5-year dispersion meteorological dataset (i.e., surface and profile files), last updated in 2014, using AERMET version 14134.

As the Site is in the geographical coverage of the MECP Toronto District Office, the meteorological dataset for the central region was used. The land use immediately surrounding the Site is characterized as agricultural with some residential areas nearby, thus the MECP's "Crops" meteorological dataset was used.

3.2.1 Wind

Wind is the primary driver that carries air pollutants away from a source towards a receptor. The direction and speed of the wind dictates the location and distance from the source that a pollutant may travel, and the receptors that may be impacted. Higher wind speeds disperse gases and particulates throughout the atmosphere more effectively and as a result, concentrations generally decrease with increasing wind speed due to dilution. However, high wind speed conditions can lead to increased wind erosion and re-suspension of surface-based dust sources. Low wind speeds or no winds can lead to very high pollutant concentrations at ground level. Wind speed also induces mechanical turbulence (which affects dispersion) as a result of flows around obstacles on the surface (topography, buildings, etc.). The amount of mechanical turbulence created depends on the roughness of the surface and the wind speed.

Figure 3.3 presents the wind rose that shows the frequency of the direction that winds blow from for the 5 years of hourly meteorological data used in this assessment. It shows the predominant wind directions are from the west to north.

Figure 3.3 Wind Rose (1996-2000)

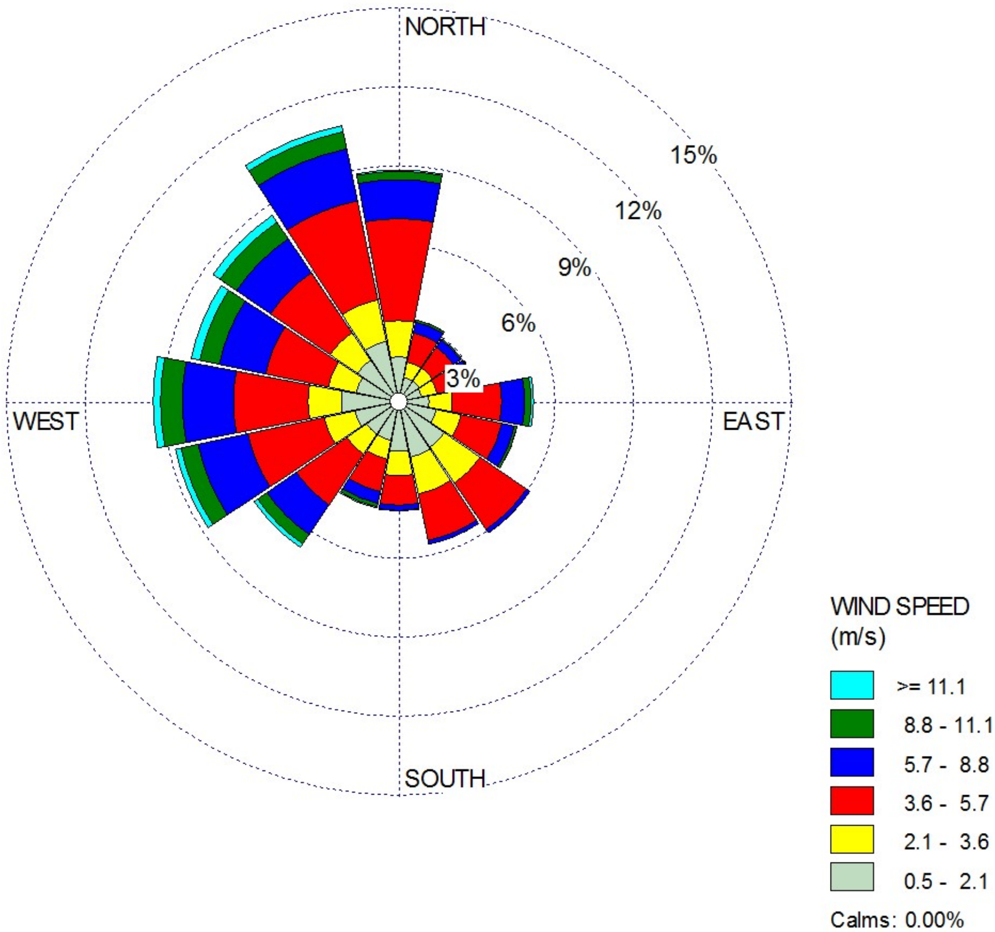
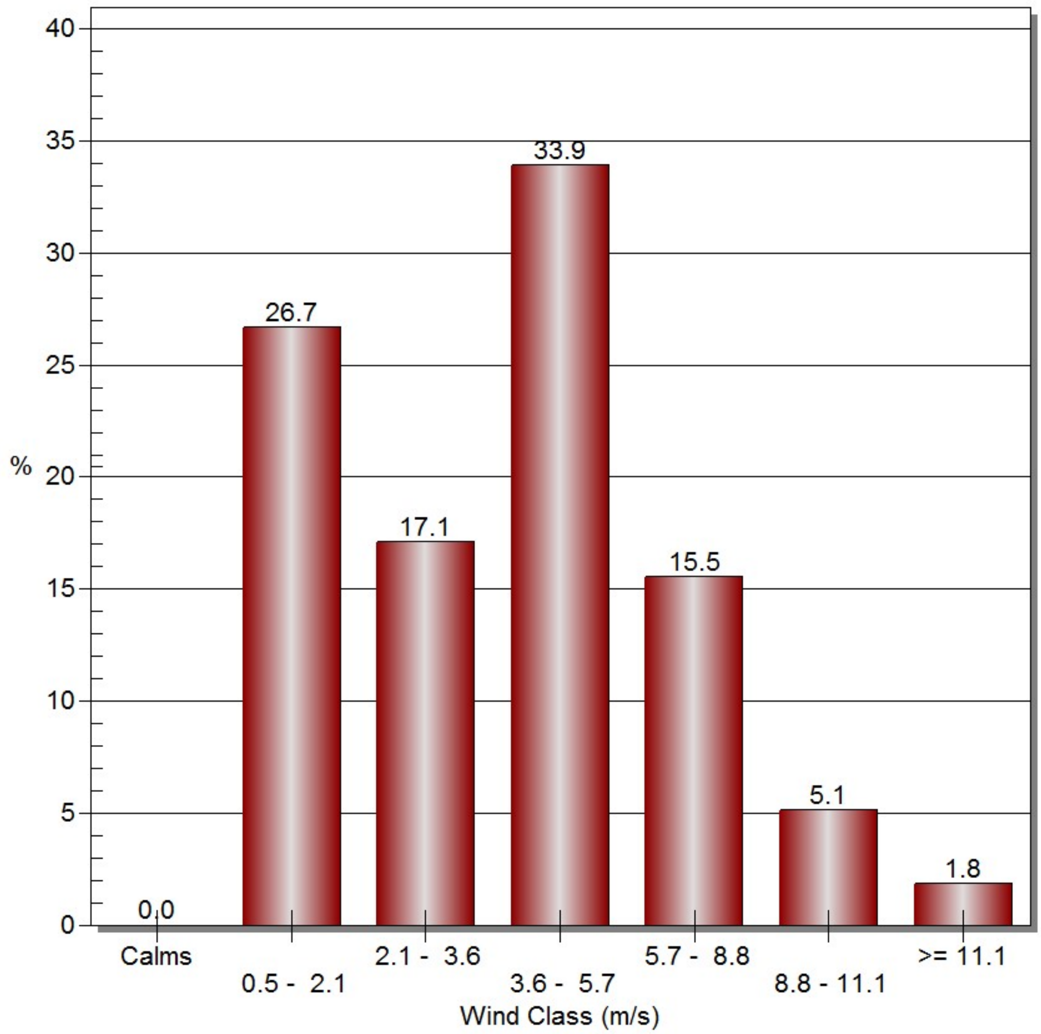


Figure 3.4 presents the wind speed class frequency distribution for the meteorological data used for modelling. It shows that the predominant wind speed is in the range 3.6-5.7 m/s.

Figure 3.4 Wind Speed Class Frequency Distribution (1996-2000)



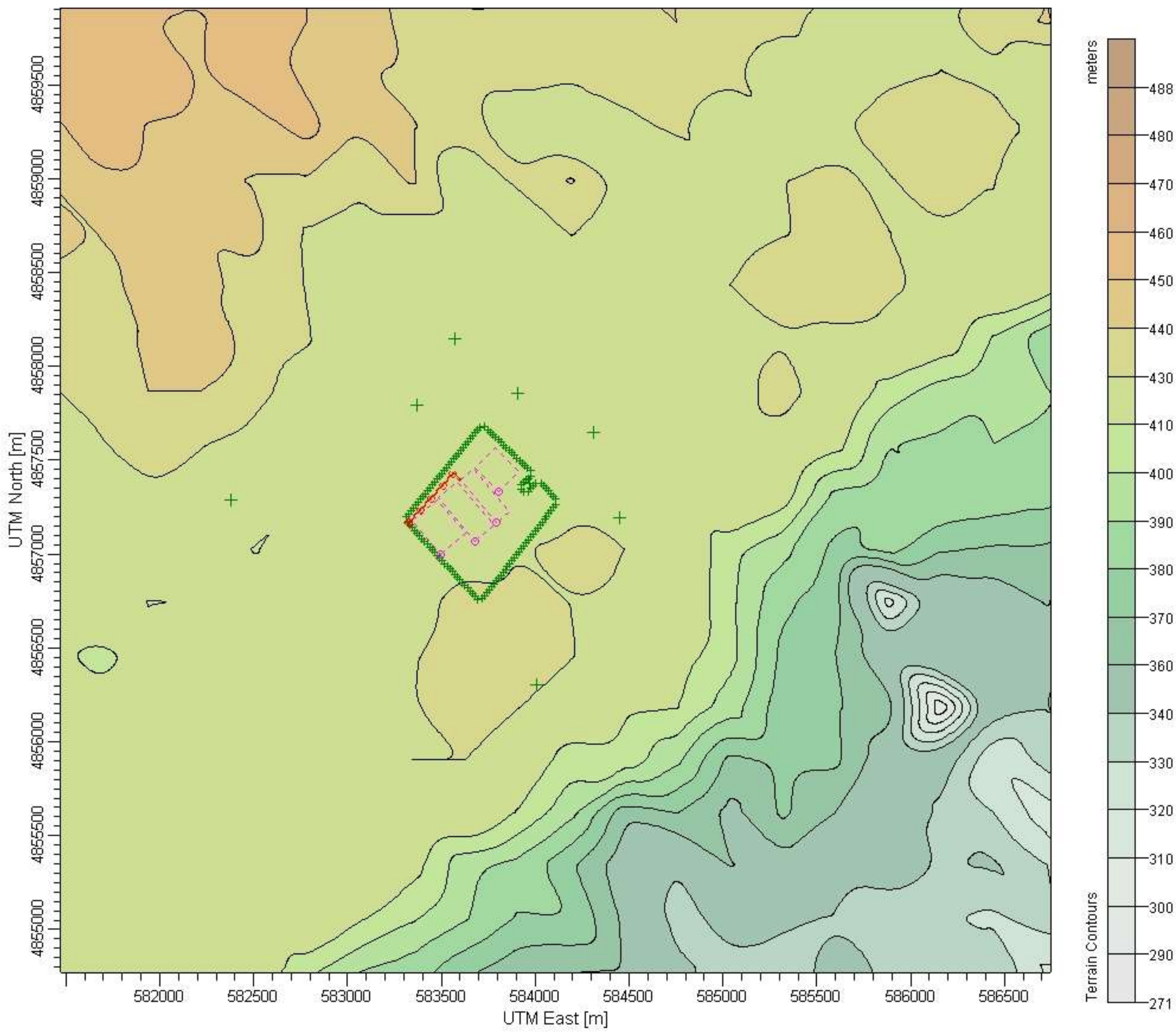
3.2.2 Atmospheric Stability and Mixing Heights

Atmospheric stability is tied to vertical temperature structure, and is a measure of the amount of vertical motion in the atmosphere, and hence its ability to mix pollutants. A stable atmosphere has little vertical motion (is less turbulent) and cannot disperse pollutants as well as a more turbulent, unstable atmosphere. The AERMOD model uses a series of calculated parameters to describe the stability of the atmosphere in a continuous manner which is different than previous models (such as the Industrial Source Complex [ISC] model) which used a series of 6 classes of stability. In Ontario, the atmosphere is defined as having neutral stability approximately 70% of the time. Stable conditions, which exist in Ontario about 25% of the time, can produce higher concentrations of contaminants because of reduced turbulent mixing.

3.3 Modelling Terrain and Grid

The AERMOD model can take advantage of terrain information with heights being applied to all receptors and sources. MECP's prepared terrain data is used in the modelling and is presented as Figure 3.5. It can be seen that the land elevation rises gently from the southeast to the northwest with the Niagara Escarpment forming a distinct ridge across the modelling domain.

Figure 3.5 Terrain Data

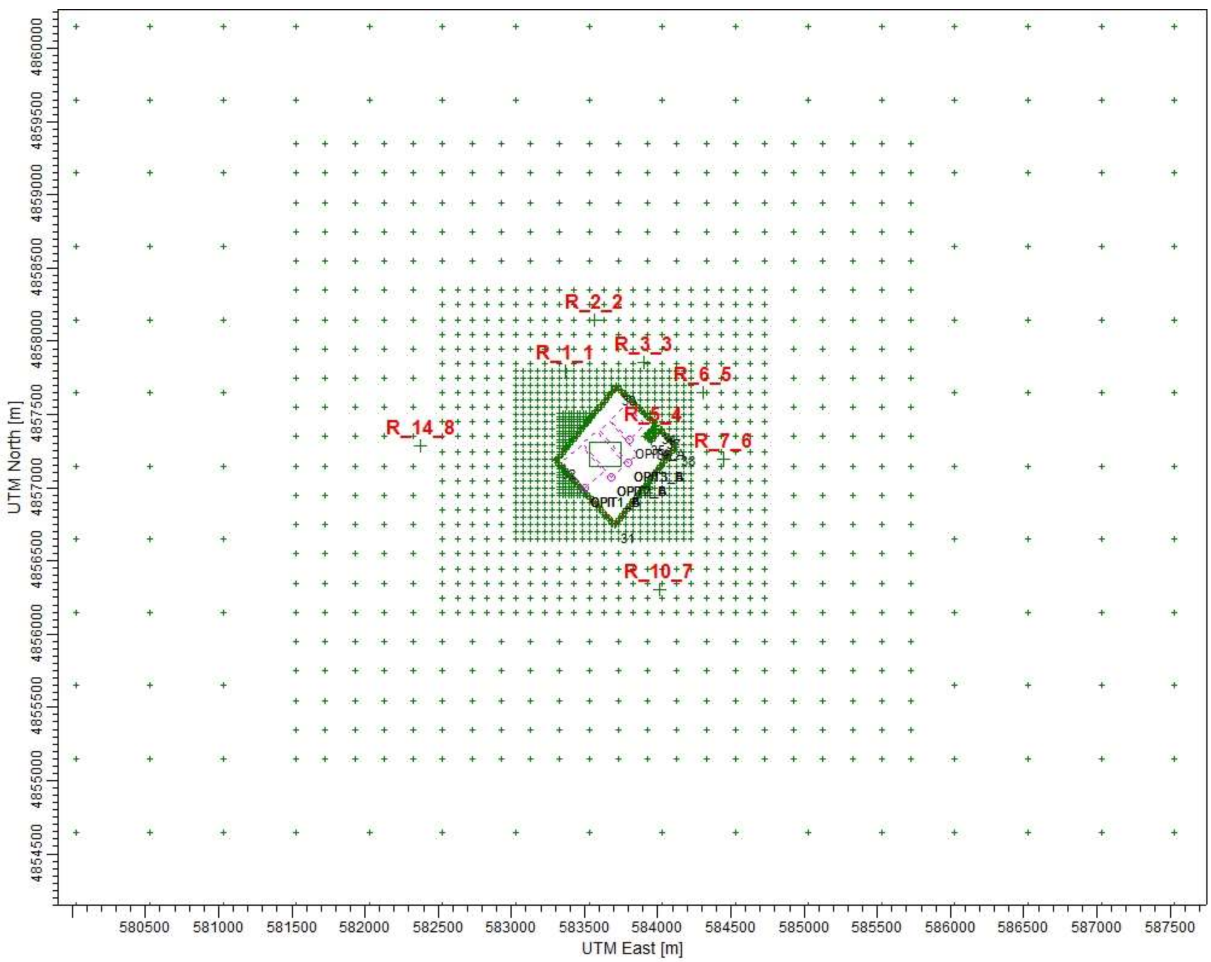


The AERMOD model calculates output at a series of receptors entered into the model. A variable spaced grid was used in the assessment as specified in MECP O.Reg. 419/05 and the MECP's Air Dispersion Modelling Guidelines for Ontario. The grid spacing from middle of site is as follows:

- 0-200 m 20 m
- 200-500 m 50 m
- 500-1000 m 100 m
- 1000-2000 m 200 m
- 2000-5000 m 500 m

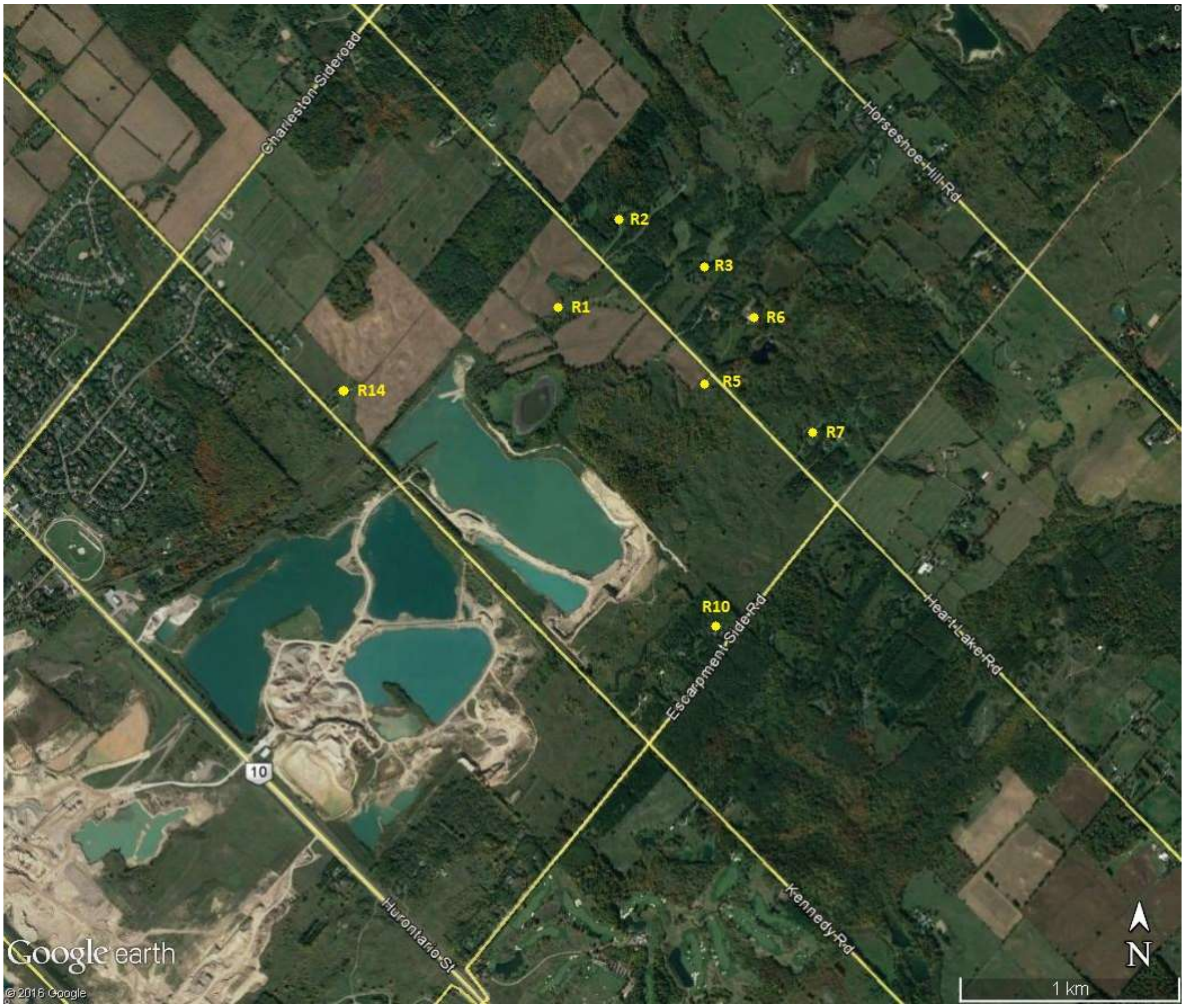
All of the variable spaced receptors that fell within the property boundary were removed. Figure 3.6 graphically shows the receptor grid used.

Figure 3.6 Modelling Receptor Grid



A further set of discrete receptors that were labelled the same as in the noise assessment of this pit were added to represent the location of nearby residences so that results could be presented in tabular format. These are shown in Figure 3.7 below.

Figure 3.7 Model Discrete Receptors



3.4 Particle Fallout

Dust deposition resulting from the pit activities and traffic was also predicted using the AERMOD model and the TSP particle size distribution shown in Table 3.3.

Table 3.3 TSP Particle Size Distribution used for Dust Deposition Calculations

Particulate Matter Class	Particle Density	Parameter Diameter	Mass Fraction
TSP	2.0	1.6	0.181
		3.9	0.112
		7.8	0.205
		12.7	0.205
		17.2	0.097
		22.1	0.10
		27.4	0.10

3.5 Sources of Particulate Matter

All significant sources of particulate matter were characterized and included in the emission inventories for the gravel pit. Most of the emissions are fugitive in nature. Fugitive dust involves the suspension of dust by material or machinery movement, or erosion by wind. The source emissions are based on seasonal daily maximum extraction rates and include those due to operating machinery and conveyor transfers/drops, road-based emissions due to the movement of shipping trucks on-site, and particulate emissions due to exhaust from internal combustion engines. Windblown dust due to the erosion of exposed surfaces was also determined and included in the total emissions.

Since the pit does not operate during the late fall/winter/early spring, emissions were estimated on a monthly basis, over the period of May - October. For each source, the months with the highest activity (based on projected shipping and production) and therefore highest emission rate, was used to determine an average hourly emission rate, which was then applied over all daily operating hours over the entire period. The monthly activity rates (expressed in percent of peak activity) are shown in Table 3.4 below.

Table 3.4 Monthly Site Activity Levels

Month	Percent of Peak Activity Level (%)
January	0
February	0
March	0
April	0
May	62.5
June	100
July	100
August	100
September	100
October	62.5
November	0
December	0

Operations will not occur at the proposed pit during the winter months due to freezing conditions, and thus the activity level factor was set to zero. The operating hours assumed for modelling purposes were shown earlier in Table 3.2. A summary of the individual sources included in the dispersion modelling analysis is provided in Table 3.5. Specific individual parameters used in the dispersion model are detailed in Tables A.1 and can be found in Appendix A.

Table 3.5 Summary of Emission Sources Used in Dispersion Model

Activity	Emission Factor Equation	Units	Reference	Comments
Haul Roads and Loader Travel on Unpaved Roads	E_{24hr} = 281.9 x k x (s/12)^a x (W/3)^b E_{annual} =281.9 x k x (s/12)$^{0.8}$ x (W/3)$^{0.4}$ x ((365-P)/365)	g/VKT	AP-42 13.2.2, November 2006	Unpaved Roads, Area 1
Scraping & Dozing	E_{TSP} = 2.6 x (s)$^{1.2}$ x (M)$^{-1.3}$ E_{PM10} = 0.75 x 0.45 x (s)$^{1.5}$ x (M)$^{-1.4}$ $E_{PM2.5}$ = 0.105 x 2.6 x (s)$^{1.2}$ x (M)$^{-1.3}$	kg/hr	AP-42 Table 11.9-2, October 1998	removes overburden – technically can be considered a construction activity, however emissions considered for this study
Washing/size classifying	Wet - negligible emissions			1 at Permanent Plant
Wind Erosion - Storage (Surge) Piles	E = 1.9*s/1.5	kg/ha/day	U.S. EPA	Only applied when wind speed > 5.4 m/s at anemometer height.
Wind Erosion - Unvegetated Areas	E = 1.9*s/1.5	kg/ha/day	U.S. EPA	Only applied when wind speed > 5.4 m/s at anemometer height.
Tailpipe Emissions (excavators and loaders)	E_{10} = 0.189	g/hp-hr	U.S. EPA non-road, 2011, Tier 1	Excavator and 1 dragline at working face feeding conveyor, 2 loaders at plant
(dozers) (dragline)	E_{10} = 0.252 E_{10} = 0.337			
Tailpipe Emissions (diesel generators for crushers)	E_{10} = 0.193	g/hp-hr	U.S. EPA non-road, 2011, Tier 1	2 generators at permanent plant

Notes: AP-42 is a U.S. EPA compilation of air contaminant emissions due to various activities. See http://www.epa.gov/ttn/chief/ap42/index.html.

EPA non-road is a compilation of (industrial) emissions from non-road activities. See above site.

3.5.1 On-site Emissions

In order to be conservative, a maximum emission scenario was developed to capture expected worst-case maximum daily particulate emissions from the proposed McCormick pit. The previous license extraction application was issued with a processing capacity of 1,500,000 tonnes per year (now reduced to 750,000 tonnes per year). Based on this extraction limit, the maximum operating scenario was based upon a maximum daily extraction rate of 5250 tonnes/day and an hourly maximum extraction rate of 438 tonnes/hour during the summer months. The modelling assumed that these conditions occurred during every operational hour throughout the months of June through September, and during the months of May and October, the activity levels were assumed to be at 62.5% of the peak levels to account for lower product demands during these months. These assumptions highlight the conservative nature of the assessment, as the facility is unlikely to experience maximum levels of operation on a continuous basis.

Shipping was conservatively assumed to occur 5-days per week and part of the day on Saturdays. Also, this scenario also incorporated an estimated maximum daily shipping rate of 16 trucks per hour. Production was assumed to occur 5-days per week.

On-Site Road Dust Emissions

Unpaved roads

Silt content and fleet average vehicle weight are the most important parameters needed for estimating fugitive roadway emissions in the Pit. The silt content on the unpaved routes travelled by the trucks and loaders around the processing plant (i.e. stockpile to shipping truck, etc.) was conservatively assumed to be 7.1%, which is the mean silt content from AP-42 Table 13.2.2-1 for sand and gravel processing material storage areas.

The proposed McCormick Pit haul road operations would utilize the internal haul route within the existing licensed James Dick pit (located east and west of Kennedy Road) then out to their existing CSG pit entrance at Highway 10. A crossing of the existing Kennedy Road Crossing would be required to facilitate this proposal. McCormick Pit trucks would not be traveling along any Town of Caledon roads. The only public road in the immediate vicinity of the McCormick Pit is the Heart Lake Road, which runs adjacent to the northeast boundary of the Pit. All haul traffic leaving the Pit will turn left (northwest) and continue along this road.

The loaders onsite were assumed to be Caterpillar 980H front end loaders [Caterpillar2000] having an operating weight of 29.5 tonnes and a load capacity of 21 tonnes. Material was assumed to be transferred off-site by 19.4 tonnes shipping trucks having a load capacity of 39 tonnes. Raw materials were assumed to be transferred from active pits to the processing area off site using shipping trucks. While precipitation acts as a natural dust control, modelling was undertaken excluding this effect to determine the worst-case situation. As such, annual emissions and their resulting concentrations will be overstated.

On-Site Tailpipe Emissions

Tailpipe emissions for industrial machinery and heavy-duty vehicles were included in the fugitive emissions from the McCormick Pit. Appropriate emission factors were obtained for each vehicle type or piece of machinery from the U.S. EPA [U.S. EPA non-Road 2010]. For shipping trucks, the emissions estimates are proportional to the total vehicle kilometres travelled per day, which were calculated from the maximum daily number of loads shipped and the on-site road lengths. For loaders, dozer and excavator the emissions estimated were based on the vehicle power rate and equipment utilization. The crusher diesel generator was assumed to be located in the north-west side of the pit. Primary/secondary screening and the secondary crusher were assumed to be located off-site, thus were not included in this assessment.

Material Handling and Processing Emissions

Fugitive dust emissions resulting from material handling, primarily from material drops onto and off of vehicles and equipment, have been estimated using U.S. EPA emission factors [U.S. EPA 2006] in conjunction with maximum hourly extraction rates. These emissions are based on the hourly wind speed (i.e. the higher the wind speed, the higher the emissions). The WSPEED variable emission option was used in the AERMOD model to simulate differing levels of emissions at the different wind speeds, specified under this option.

The moisture content of the raw material extracted from similar pits in the area is typically greater than 4%. When the moisture content is greater than 2.5%, “controlled” emission factors may be used to estimate the emissions for handling operations, since less dust is generated from damp materials.

Wind Erosion

Wind eroded dust is typically an event-driven emission, whereby particles are not suspended unless a sufficient wind speed is reached. As a result, wind dependent emissions were calculated and modelled based on actual hourly wind speeds. As mentioned previously, an emission factor equation for continuously active piles and unvegetated areas was used[1]. In this assessment, the WSPEED variable emissions function was used to limit wind erosion from storage piles and unvegetated disturbed areas to wind speeds greater than 5.4 m/s (at 10 m anemometer height). At speeds less than 5.4 m/s, it was assumed there would be no emissions caused by wind erosion. This value of threshold wind velocity corresponds to the ground level wind speed at which wind erosion and particulate suspension would occur for overburden type material, which is a conservative estimate for this site, since most exposed areas would contain processed materials (crushed and/or washed aggregate which have a reduced fines content), or a mixture of sand and gravel.

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[1] “Continuously active” piles and areas mean that areas available for wind erosion are all freshly exposed, and contain erodible particulate (e.g. surface is not crusted).

Figure 3.8 Modelled Emission Sources

4.0 MODELLING RESULTS

A total of nine air dispersion modelling runs were conducted to predict maximum 24-hour and annual ground-level concentrations at both sensitive receptor locations and gridded receptor locations. Results are presented graphically as isopleths over entire modelling domain and in tabular format at nearby model receptors presented in Figure 3.7. It should be noted that for the 24-hour average concentrations, these are the maximum modelled concentrations that occur only once in the 5 years (1,825 days) of meteorological data used. For the tabular results, all cells that are over the applicable criteria are shaded grey.

4.1 Total Suspended Particulate (TSP)

24-hour TSP Concentrations

To demonstrate the spatial distribution of the area of elevated maximum concentration several isopleths were prepared. The isopleths for TSP are presented in this report. The concentration isopleths for PM10 and PM2.5 are very similar in shape and were not reproduced in this report.

All figures showing isopleths show the maximum modelled concentration that occurs once in the 5 years of meteorological data used in the model. These concentrations cannot occur at the same time everywhere. For example, for receptors to the east of a source can only be influenced by the source when the wind is blowing from the west.

Table 4.1 presents the maximum predicted 24-hour average TSP concentrations at modelled discrete receptors for both phases assessed based on the five years of MECP meteorological data used. Table 4.2 presents similar results for annual concentrations.

It can be seen that including regional background, the 24-hour MECP AAQC for TSP of 120 µg/m^3 and the annual MECP AAQC for TSP of 60 µg/m^3 are both met at all discrete sensitive receptors. However, the resulting maximum concentration from the site operation for both phases will exceed the MECP criteria for the 24-hour average. The maximum concentration occurs along the northwest site of the property boundary, where the Caledon Sand and Gravel Inc. (CSG) licensed gravel pit is in operation. Moreover, it should be noted that the modelling does not consider the effect of the 4-m high berm that will be constructed around the property boundary. As such, the maximum concentration is likely to be lower. The annual TSP incremental concentrations at all discrete receptors are only a small fraction of the current existing background.

To demonstrate the spatial distribution of the area of elevated maximum concentration several isopleths were prepared. The isopleths for TSP are presented in this report. The concentration isopleths for PM_{10} and $PM_{2.5}$ are very similar in shape and were not reproduced in this report.

All figures showing isopleths show the maximum modelled concentration that occurs once in the 5 years of meteorological data used in the model. These concentrations cannot occur at the same time everywhere. For example, for receptors to the east of a source can only be influenced by the source when the wind is blowing from the west.

Table 4.1 Modelled and Cumulative Maximum 24-Hour TSP Concentrations (μg/m³)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	50.7	23.3	74	24.3	75
R2		13.8	65	13.8	65
R3		18.3	69	30.4	81
R5		54.6	105	48.0	99
R6		21.3	72	20.9	72
R7		17.8	69	16.7	67
R10		14.7	65	13.1	64
R14		11.5	62	10.4	61
Max		185.0	236	185.0	236

Note: MECP TSP 24-hour AAQC = 120 μg/m³

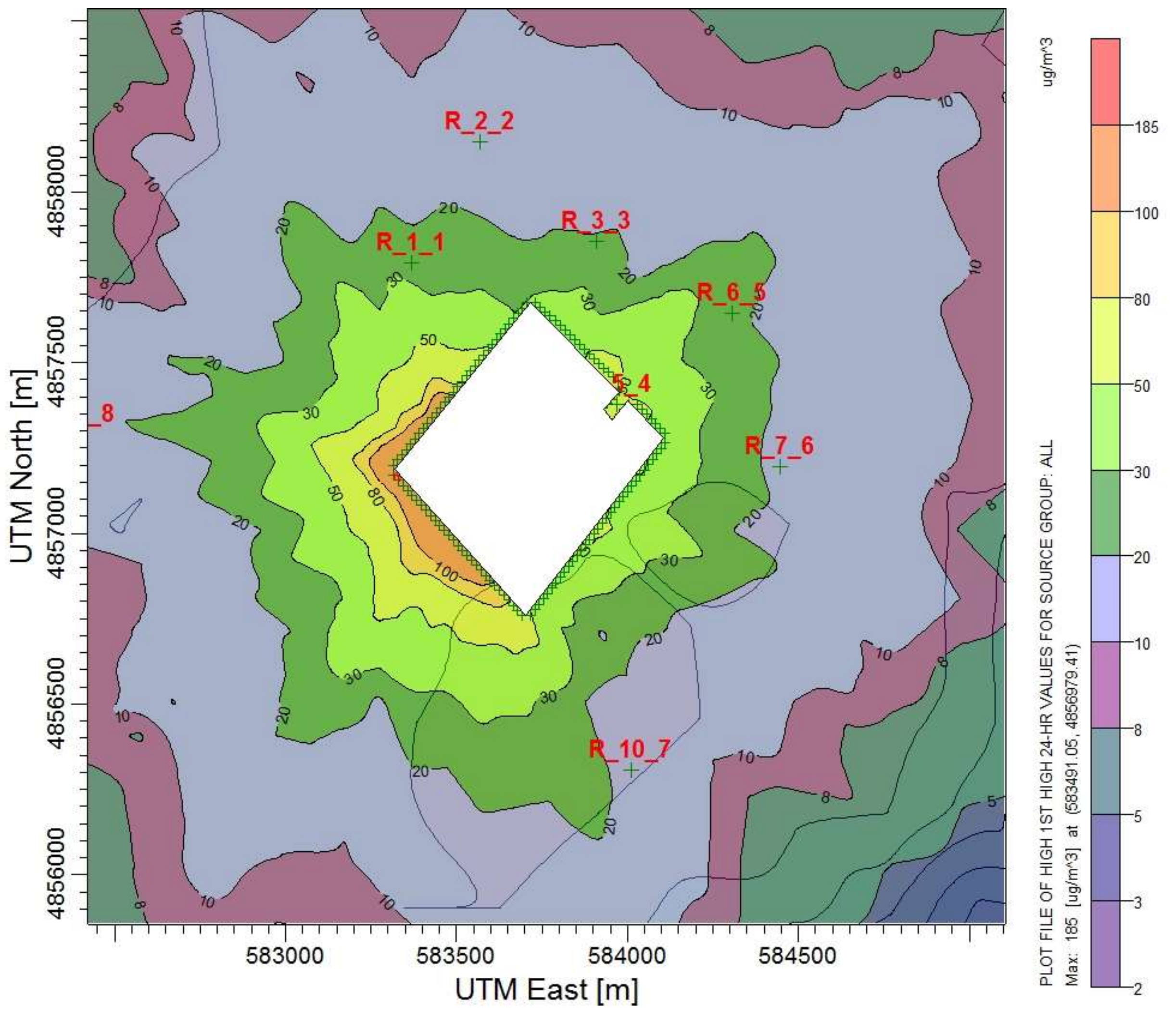
Table 4.2 Modelled and Cumulative Annual TSP Concentrations (μg/m³)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	26.2	2.5	29	2.6	29
R2		1.3	28	1.4	28
R3		2.1	28	2.7	29
R5		10.7	37	14.8	41
R6		2.3	29	3	29
R7		2.8	29	2.7	29
R10		2.2	28	2.1	28
R14		0.9	27	0.8	27
Max		49.0	75	48.9	75

Note: MECP TSP Annual AAQC = 60 μg/m³

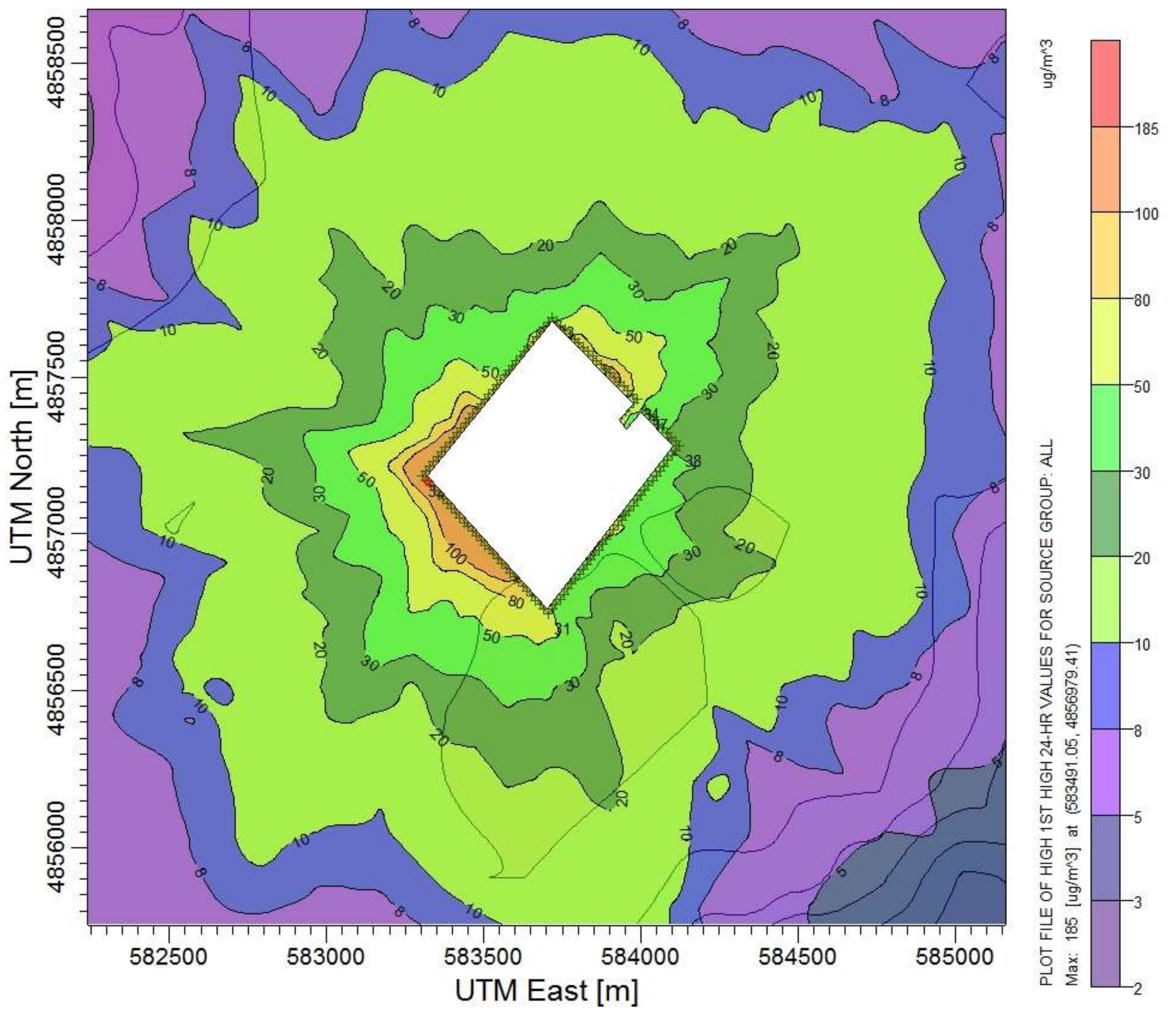
Figure 4.1 and Figure 4.2 present the maximum 24-hour average TSP incremental concentrations isopleths for Phase C and Phase D, respectively. These isopleths include the effect of the facility, but do not include the regional background of 50.7 µg/m³. Therefore, the 80 µg/m³ isopleth (80 + 50.7 = 130.7 µg/m³) can be used to show the area where the 24-hour AAQC for TSP would be exceeded. It can be seen that the highest concentrations are occurring, for both phases, along the northwest boundary of the site, near Area 1.

Figure 4.1 Phase C Maximum 24 hr TSP Incremental Concentration (µg/m³)



Note: Regional TSP 24-hour background = 50.7 µg/m³

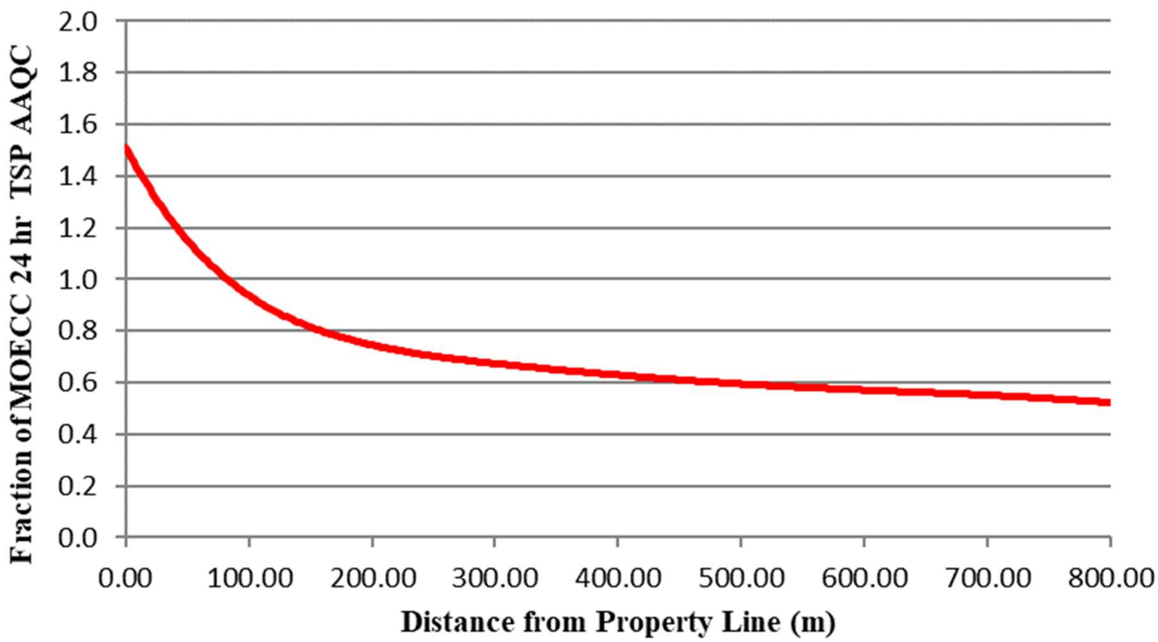
Figure 4.2 Phase D Maximum 24 hr TSP Incremental Concentration (µg/m³)



Note: Regional TSP 24- hour background = 50.7 µg/m3

Figure 4.3 shows how quickly cumulative TSP concentrations drop off with distance maximum 24-hour average concentrations were plotted along a line northwest side of the property boundary of the site. The graphic shows that after 100 m the maximum cumulative TSP concentrations drop down to the MECP AAQC levels.

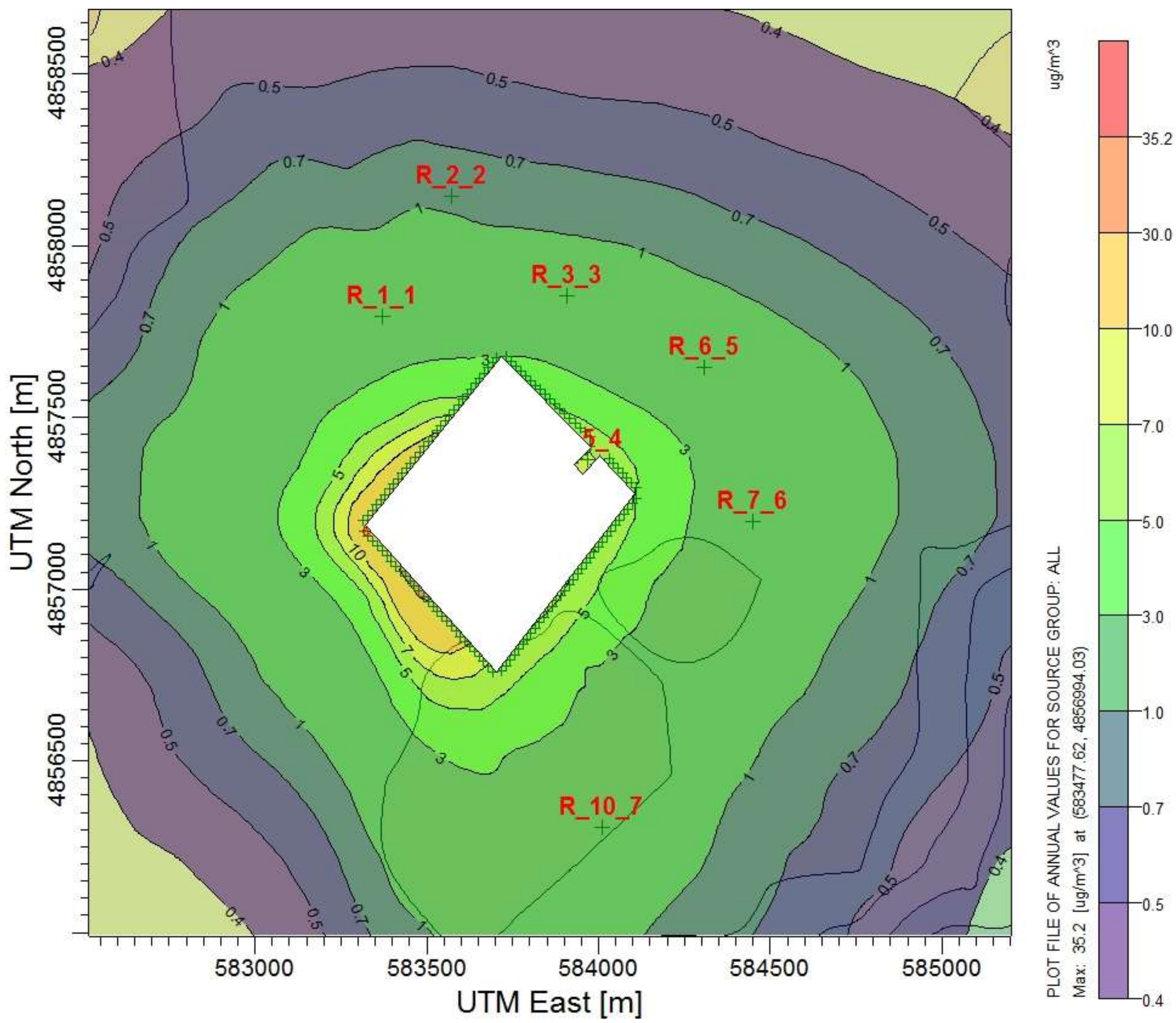
Figure 4.3 Maximum 24 hr TSP Cumulative Concentration with Distance Northwest from Maximum Location



Annual TSP Concentrations

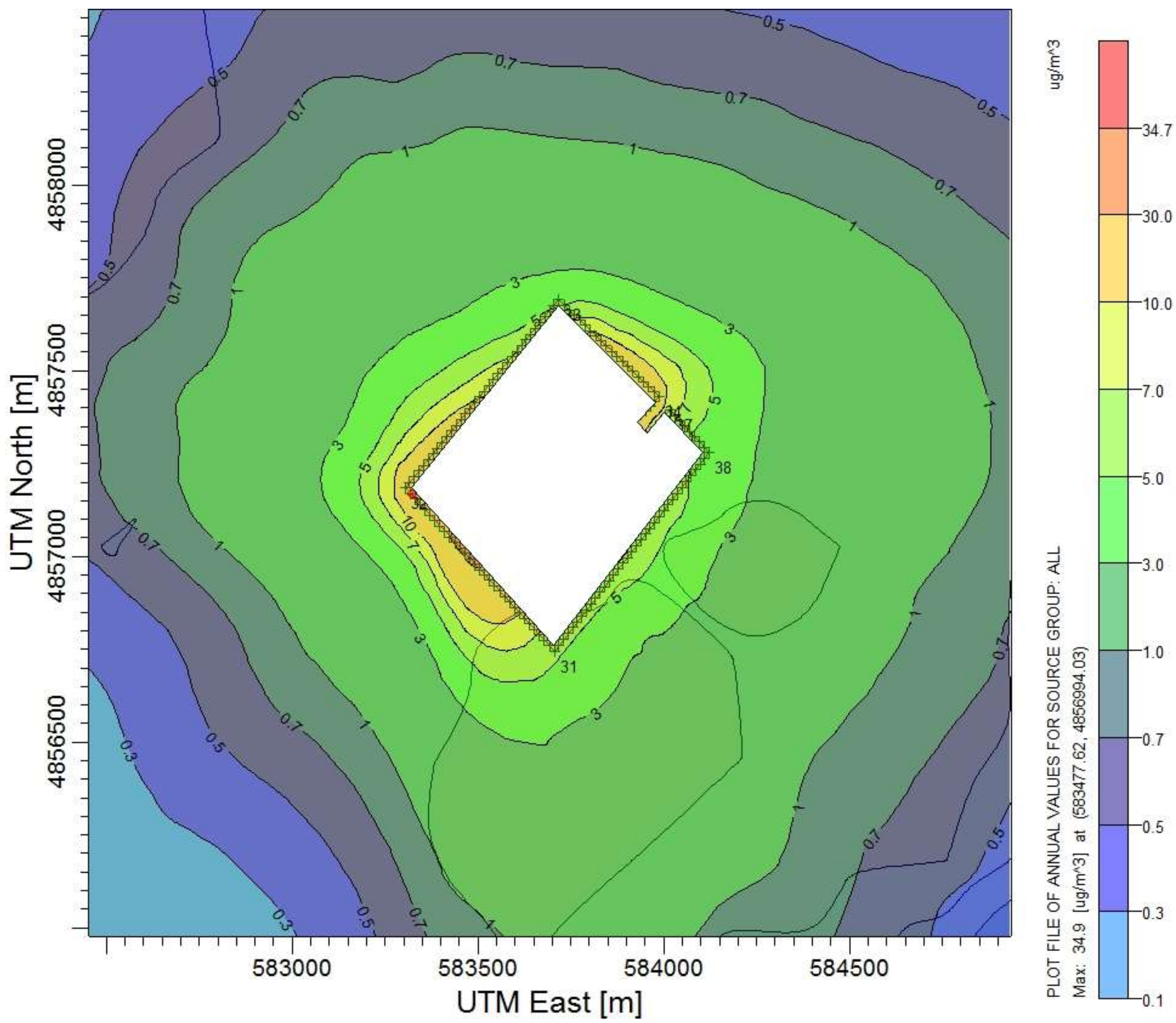
Figure 4.4 and Figure 4.5 present the increment annual TSP concentrations for Phase C and Phase D, respectively. These figures better represent the overall impact of the facility. It can be seen in comparison to the existing regional annual TSP concentration the incremental effect of the pit operation is relatively small on an annual basis. To assess contaminants with annual air standards, the maximum annual POI was multiplied by 140%. When the estimated annual TSP background concentrations of 26.2 $\mu g/m^3$ is added to the modelled results show no exceedances at the discrete sensitive receptors and similar to the 24-averaging period, the highest concentrations are occurring, for both phases, along the northwest boundary of the site.

Figure 4.4 Phase C Annual TSP Incremental Concentration (µg/m³)



Note: Regional TSP annual background = 26.2 µg/m3

Figure 4.5 Phase D Annual TSP Incremental Concentration (µg/m³)



Note: Regional TSP annual background = 26.2 µg/m3

4.2 Particulate Matter Less Than 10 Microns (PM_{10})

Table 4.3 presents the maximum predicted 24-hour average PM_{10} concentrations at modelled discrete receptors for both phases assessed based on the five years of MECP meteorological data used. It can be seen that including the regional background contribution, the 24-hour CCMECAAQS for PM_{10} of 50 µg/m^3 are met at all discrete sensitive receptors for the two phases.

The predicted maximum concentrations shown in Table 4.3 are the highest concentrations that are predicted to occur in 5 years. These maxima generally occur along the northwest side of the property boundary and not at residential locations. Also, it should be noted that the modelling does not consider the effect of the 4-m high berm that will be constructed around the property boundary. As such, the maximum concentration is likely to be lower.

Table 4.3 Modelled and Cumulative Maximum 24 Hour PM_{10} Concentrations (µg/m^3)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	25.4	11.1	36	11.5	37
R2		6.5	32	6.5	32
R3		8.7	34	10.8	36
R5		24.0	49	22.8	48
R6		10.1	35	9.8	35
R7		8.3	34	7.8	33
R10		6.9	32	6.2	32
R14		5.4	31	4.9	30
Max		86.4	112	86.4	112

Note: MECP 24-hour Interim Guideline = 50 µg/m3

4.3 Particulate Matter Less Than 2.5 Microns ($PM_{2.5}$)

Table 4.4 presents the maximum predicted 24-hour average $PM_{2.5}$ concentrations at modelled discrete receptors for both phases assessed based on five years of MECP meteorological data used. With the inclusion of the existing regional $PM_{2.5}$ concentrations, the modelled maximum 24-hour $PM_{2.5}$ concentrations are below the MECP Guideline of 30 µg/m^3 at all receptors. The Canada Wide Standard is based on the 98th percentile of all daily averages for a year and averaged over 3 years. As a surrogate of this type of calculation, the maximum 24-hour average concentration was determined and the model was rerun for that year only and the 98th percentile (8th highest) concentration at the maximum location was determined. Table 4.4 shows that at the maximum concentration, the $PM_{2.5}$ 24-hour criterion will be met at all residential receptors including existing background.

Table 4.4 Modelled and Cumulative Maximum 24 Hour $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	12.7	2.25	15	1.9	15
R2		1.18	14	1.8	15
R3		2.5	15	4.8	18
R5		5.82	19	4.6	17
R6		1.54	14	2.5	15
R7		1.97	15	1.3	14
R10		1.49	14	1.1	14
R14		0.83	14	0.8	14
Max		13.6	26	14	27
Max 8th		9.79	22	10	23

Note: MECP 24-hour Assessment Value = 30 µg/m3

4.4 Dustfall Deposition

Table 4.5 presents the maximum predicted 30-day dustfall deposition rates modelled at the discrete receptors for both phases assessed based on the five years of MECP meteorological data used. It can be seen that with the inclusion of the estimate of the existing regional dustfall rates, the modelled maximum monthly dustfall rates are below the MECP Assessment criteria of 7 g/m^2/30days at all of the receptors.

Table 4.5 Maximum 30 Day Modelled and Cumulative Deposition (g/m^2/30days)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	2.7	0.18	2.9	0.18	2.9
R2		0.06	2.8	0.07	2.8
R3		0.18	2.9	0.21	2.9
R5		1.80	4.5	2.05	4.8
R6		0.51	3.2	0.60	3.3
R7		0.36	3.1	0.34	3.1
R10		0.21	2.9	0.20	2.9
R14		0.11	2.8	0.10	2.8
Max		5.1	7.8	5.1	7.8

Note: MECP Dustfall monthly AAQC = 7g/m2/30days

Table 4.6 shows that the modelled maximum annual dustfall rates are below the MECP Assessment criteria of 4.6 g/m^2/30days at all of the discrete receptors.

Table 4.6 Maximum Annual Modelled and Cumulative Deposition (g/m^2/yr)

Receptor	Regional Background	Phase C		Phase D	
		Facility without Local Background	Cumulative	Facility without Local Background	Cumulative
R1	2.7	0.07	2.8	0.07	2.8
R2		0.03	2.7	0.03	2.7
R3		0.08	2.8	0.09	2.8
R5		0.60	3.3	0.95	3.7
R6		0.12	2.8	0.15	2.9
R7		0.13	2.8	0.14	2.9
R10		0.10	2.8	0.09	2.8
R14		0.04	2.8	0.03	2.7
Max		2.6	5.3	2.6	5.3

Note: MECP Dustfall Annual AAQC = 4.6g/m2

4.5 Perspective on Fugitive Dust and Air Dispersion Modelling

In summary, the dispersion modelling results indicate that the maximum expected activity at the proposed McCormick Pit during any of the two phases assessed will not result in any exceedances of the relevant Provincial or Federal standards for TSP, PM_{10} or $PM_{2.5}$ at any of the eight nearby discrete residential receptor locations. The predicted maximum concentrations occur along the northwest side of the property boundary of the site, where the Caledon Sand and Gravel Inc. (CSG) licensed gravel pit is in operation. Moreover, due to the conservative nature of the assessment, where all significant sources are operating at their expected individual maximum rates, the model predicted concentrations are expected to be greater than those that will likely occur in reality.

A comprehensive review of fugitive dust and air dispersion modelling was conducted in 1998 involving a panel of experts including several members of the U.S. EPA [Watson and Chow, 2000]. One of the statements the panel made was to indicate that suspendable particles are not necessarily transportable particles, and that the majority (60-90%) of suspended TSP and PM_{10} remains within one to two metres above the ground. As a result, deposition to the ground or impaction to a vertical structure occurs within a few minutes of suspension.

Although the development of a vegetated barrier (berm and trees) along the east and north property boundary would likely have a significant impact on ambient dust concentrations beyond the property fenceline, models such as AERMOD currently are not able to parameterize such a feature. Indeed, one of the suggestions from the workshop mentioned above was to account for the fact that (AP-42) road emission factors can over estimate effective emissions from these sources. In addition, the workshop concluded that

> *"there is insufficient accounting for deposition losses and horizontal impaction in dispersion models"*

Since up to 90% of the horizontal flux of suspended dust will remain within 2 m of the ground, it is probable that most of this amount will be prevented from being transported up and over a berm, particularly if there is sufficient vegetation to act as an impaction source.

As a result, Arcadis proposes that the required berms surrounding the property on the east and north sides be adequately vegetated with species of varying heights to act as an impaction source. This is expected to significantly reduce the transport of fugitive dust from the pit area, and has been incorporated into the study recommendations, and the proposed Dust Management Plan (DMP) for the site, which is presented in Appendix B.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

AERMOD air dispersion modelling was undertaken following MECP dispersion modelling guidelines for two phases of the pit operation that were anticipated to have the maximum impact of the nearby sensitive receptors. The modelling represented the maximum operation during the operating months of May to October. It is not possible to model the mitigating impacts of berms, trees and bushes as the site is progressively rehabilitated. As a result, the actual impacts from this pit are expected to be lower than modelled.

The analysis illustrated that even considering a very conservative emissions scenario (e.g. a likely overestimate of emissions), the potential for significant impacts at nearby receptors has been minimized. The predicted maximum 24-hour average cumulative for TSP, PM_{10} and $PM_{2.5}$ concentrations, as well as dustfall are below the MECP AAQC at all identified sensitive receptors.

5.2 Recommendations

The analysis was conducted considering a reasonable level of mitigation, including efficient dust control (e.g., watering) of unpaved roads and excavation areas as appropriate. The intent is to ensure that only limited amounts of dust are carried out of the site. In addition, good dust management practices will ensure that any effect associated with material handling and transportation of materials is minimized. These practices are outlined in the Best Management Plan (BMP) that is presented in Appendix B.

In order to ensure that the conclusions of this study remain valid, the following recommendations are made:

- dust mitigation activities on site shall meet or exceed those used in this assessment
- any on-site roads that are paved to reduce dust emissions shall be kept clean and free of dust through water flushing, as appropriate;
- vehicle speeds on all on-site haul roads shall remain at 20 km/h or less.

6.0 REFERENCES

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APPENDIX A: DETAILED EMISSIONS TABLES

Emissions Calculations For McCormick Pit

On-Site Non-Road Truck Traffic	**K (g/VKT) PM_{30}**	**K (g/VKT) PM_{10}**	**K (g/VKT) $PM_{2.5}$**	**s %**	**W (tons)**	**a for TSP**	**b for TSP**	**M (%)**	**p (days/yr)**	**Units**	**TSP (g/VKT)**	**PM_{10} (g/VKT)**	**$PM_{2.5}$ (g/VKT)**	**Total # Trips per hr**	**Road Length (km)**	**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
On site Haul Road (assumed all in pit) - unpaved road	1381.31	422.85	42.285	7.1	41	0.7	0.45	4.8		g/VKT	3092	334	33	11	0.400	3.7791	0.4081	0.0408
On-Site Non-Road Traffic	**K (g/VKT) PM_{30}**	**K (g/VKT) PM_{10}**	**K (g/VKT) $PM_{2.5}$**	**s %**	**W (tons)**	**a for TSP***	**b for TSP**	**M (%)**	**p (days/yr)**	**Units**	**TSP (g/VKT)**	**PM_{10} (g/VKT)**	**$PM_{2.5}$ (g/VKT)**	**Total # Trips per hr**	**Length (km)**	**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
Loader - Crusher loading - unpaved road	1381.31	422.85	42.285	7.1	44	0.7	0.45	4.8		g/VKT	3205	334	33	21	0.01	0.1860	0.0194	0.0019
Loader - Shipping Truck Loading - unpaved road	1381.31	422.85	42.285	7.1	44	0.7	0.45	4.8		g/VKT	3205	334	33	11	0.01	0.0979	0.0102	0.0010
Bulldozer - Removes overburden				**s %**				**M (%)**	**p (days/yr)**	**Units**	**TSP (kg/hr)**	**PM10 (kg/hr)**	**PM2.5 (kg/hr)**	**% of Operating Hours Active**		**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
Bulldozer - Removes overburden	--	--	--	7.1	--	--	--	4.8	--	kg/hr	3.54	0.71	0.37	50%	--	0.4911	0.0981	0.0516
Material Handling - non-wind dependent	**K PM_{30}**	**K PM_{10}**	**K $PM_{2.5}$**			**a**	**b**	**M (%)**	**U (m/s)**		**TSP (kg/tonne)**	**PM_{10} (kg/tonne)**	**$PM_{2.5}$ (kg/tonne)**	**Tonnes Loaded per Hour**		**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
Excavator - working face	0.74	0.35	0.053	--	--	1.3	-1.4	4.8	3.9	--	0.00073	0.00034	0.00005	438	--	0.0885	0.0419	0.0063
Loader - working face	0.74	0.35	0.053			1.3	-1.4	4.8	3.9		0.00073	0.00034	0.00005	438		0.0885	0.0419	0.0063
Conveyor Transfer Points	--	--	--	--	--	--	--	--	--	--	0.00007	0.00002	0.00001	438	--	0.0085	0.0028	0.0008
Conveyor Drop - onto surge pile	0.74	0.35	0.053	--	--	1.3	-1.4	4.8	3.9	--	0.00073	0.00034	0.00005	438	--	0.0885	0.0419	0.0063
Loader - Loading material into crusher	0.74	0.35	0.053	--	--	1.3	-1.4	4.8	3.9	--	0.00073	0.00034	0.00005	438	--	0.0885	0.0419	0.0063
Loader - Loading from pile to truck	0.74	0.35	0.053	--	--	1.3	-1.4	4.8	3.9	--	0.00073	0.00034	0.00005	438	--	0.0885	0.0419	0.0063
Crushing & Screening											**TSP (kg/tonne)**	**PM_{10} (kg/tonne)**	**$PM_{2.5}$ (kg/tonne)**	**Tonnes Loaded per Hour**		**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
Primary Crusher Controlled	--	--	--	--	--	--	--	--	--	--	0.00060	0.00027	0.00005	438	--	0.0730	0.0329	0.0061
Tailpipe Emissions	**(g/hp-hr) PM_{30}**	**(g/hp-hr) PM_{10}**	**(g/hp-hr) $PM_{2.5}$**	**TAF**	**SPM Adj g/hp.hr**	**BSFC (lb/hp.hr)**	**Power Rating (hp)**	**Average Speed (km/h)**	**Road Length (km)**		**Total # Passes per day**	**Hours of Operation per Day**	**TSP (g/VKT)**	**PM_{10} (g/VKT)**	**$PM_{2.5}$ (g/VKT)**	**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
On site Haul Road (assumed all in pit) - unpaved road	NA	NA	NA	NA	NA	NA	NA	NA	0.40	--	11	13	0.0456	0.0456	0.0231	4.29E-06	4.29E-06	2.17E-06
1 Loaders - Crusher loading and Truck Loading	--	--	--	--	--	--	355	NA	NA	--	NA	13	NA	NA	NA	0.0139	0.0139	0.0135
1 loaders at the working face for above-water excavation	--	--	--	--	--	--	355	NA	NA	--	NA	13	NA	NA	NA	0.0139	0.0139	0.0135
1 dragline loader at working face for below-water extraction	--	--	--	--	--	--	355	NA	NA	--	NA	13	NA	NA	NA	0.0139	0.0139	0.0135
1 loader at the working face for below-water excavation	--	--	--	--	--	--	355	NA	NA	--	NA	13	NA	NA	NA	0.0139	0.0139	0.0135
1 excavator at the working face							355	NA	NA			13	NA	NA	NA	0.0139	0.0139	0.0135
Dozer - removing overburden	--	--	--	--	--	--	200	NA	NA	--	NA	13	NA	NA	NA	0.0078	0.0078	0.0076
Diesel Generator - Crusher (Permanent Plant)	--	--	--	--	--	--	600	NA	NA	--	NA	13	NA	NA	NA	0.0160	0.0160	0.0155
Wind Erosion - non wind dependent	**K PM_{30}**	**K PM_{10}**	**K $PM_{2.5}$**	**s %**		**f**	**% Disturbed**	**area (ha)**			**TSP Adh. (kg/ha/day)**	**PM_{10} (kg/ha/day)**	**$PM_{2.5}$ (kg/ha/day)**			**Uncontrolled TSP (g/s)**	**Uncontrolled PM_{10} (g/s)**	**Uncontrolled $PM_{2.5}$ (g/s)**
Wind Erosion - Stockpile before Processing Plant (Surgepile)	1.00	0.50	0.075	3.58	--	--	50	1.44	--	--	2.27	1.13	0.17	--	--	0.0377	0.0188	0.0028
Wind Erosion - Unwashed Final Stockpile	1.00	0.50	0.075	5.99	--	--	50	0.72	--	--	3.79	1.90	0.28	--	--	0.0315	0.0158	0.0024
Wind Erosion - Stockpile at working face	1.00	0.50	0.075	3.58	--	--	75	0.36	--	--	3.40	1.70	0.26	--	--	0.0141	0.0071	0.0011
Wind Erosion - Unvegetated Area - Permanent Plant	1.00	0.50	0.075	7.1	--	--	75	0.00	--	--	6.75	3.37	0.51	--	--	0.0000	0.0000	0.0000
Wind Erosion - Unvegetated Area - Area 2	1.00	0.50	0.075	7.1	--	--	50	3.29	--	--	4.50	2.25	0.34	--	--	0.1713	0.0857	0.0128
Wind Erosion - Unvegetated Area - Area 3 -Phase C	1.00	0.50	0.075	7.1	--	--	50	1.00	--	--	4.50	2.25	0.34	--	--	0.0519	0.0259	0.0039

APPENDIX B: PROPOSED BEST MANAGEMENT PLAN FOR FUGITIVE DUST

APPENDIX B: PROPOSED BEST MANAGEMENT PLAN FOR FUGITIVE DUST

The following presents potential sources of fugitive dust at the McCormick Pit as well as actions to control and mitigate these sources.

B.1 Potential Sources of Fugitive Dust

Due to the nature of activities at a sand and gravel operation, there are several on-site sources at the McCormick Pit that could potentially contribute to fugitive dust emissions. These are as follows:

- Shipping trucks and Loaders travel on unpaved haul routes
- material processing and handling (conveying, loading and crushing of aggregate)
- stockpiling (raw and processed materials)

The fugitive dust generated by these sources and activities arises from processing or pulverizing crustal materials, and thus generally does not have significant amounts of other contaminants associated with it. Also, a significant portion of the fugitive dust from these sources is in the coarse fraction which tends to result in nuisance effects; only a small fraction of the dust is in the respirable range, which is of most concern from a health perspective.

In many instances, fugitive dust emissions are dependent on the wind speed at any given time as well as the activity rates. Thus, the amount of effort necessary to control such emissions is greater during windy conditions in comparison to calm conditions.

B.2 Required Control Actions

In general, most approaches for controlling fugitive dust involve the application of water to prevent the fugitive emissions from being generated. Depending on the source, there are other measures that are used to remove the source of the dust, and/or reduce the impact of the emissions when they occur. These are discussed in the following sections.

B.2.1 Application of Water to the Site Entrance Road and Internal Haul Route

As required by the Ministry of Natural Resources (MNR), water and/or calcium chloride will be applied to the site entrance road and internal haul/loader routes to mitigate fugitive dust. In the assessment, sufficient water was assumed to be applied to achieve a control efficiency of 90% on all unpaved site roads travelled by non-road equipment (loaders, rock trucks, etc.) and by product trucks that will be used to ship finished materials off site. These levels of control are reasonably achievable, and necessary to prevent excessive off-site emissions.

In order to achieve the level of control that is required to meet the assumptions that were used in the completion of this study, the following elements should be included this Best Management Plan:

- all unpaved roads should be watered at a sufficient frequency to control dust generation due to vehicle travel;
- vehicle speeds on unpaved haul roads should remain at 20 km/h or less;
- a site water truck should be equipped with both drip/spray bars to water unpaved roads, and;
- any on-site paved roads should be cleaned periodically using high pressure flushing with a canon spray and/or vacuum sweeping (as practicable) to prevent mud track out.

An operational watering scheme that is based on the activity levels and meteorological conditions should be developed and followed by trained site personnel, to ensure that watering is completed frequently enough to adequately control fugitive dust emissions. For the purpose of illustration, the following scheme is included as an example of the type of system that could be developed at the McCormick Pit.

B.2.1.1 Example Operational Watering Scheme

Internal haul routes (both within the pit and at grade) will be treated with water as necessary for dust control. The capability for main internal haul truck watering will provide for up to 2 passes per hour with a minimum 7,200 L water truck, as needed to achieve the recommended dust control efficiency.

For operational purposes, a scheme based on the type of day (hot/dry/windy, warm/overcast, cool/overcast, rainy) that prescribes the recommended watering frequency based on the number of truck passes and the length of road, is suggested, as presented below:

- During very hot, dry and sunny conditions (typical of July or August) or windy days (i.e. greater than 20 km/h), sufficient water will be applied to all in-pit roads, that is equivalent to approximately one load of water (7200 L) every hour, depending on the traffic level;
- During moderately warm, dry conditions (late spring & fall), sufficient water will be applied to in-pit unpaved roads at that is equivalent to approximately one load of water (7200 L) applied to all site roads, every two hours, depending on the traffic level;
- During wet or rainy periods, the roads generally will not be watered.

The scheme presented above should be adjusted as conditions dictate. For example, roads will definitely be watered regardless of the “rules” if there is visible, or blowing dust.

B.2.2 Application of Water to Material Handling and Processing

In addition to road watering, material processing equipment will be equipped with water sprays to reduce the generation of fugitive dust. The assessment was completed assuming that secondary crushers and beyond, as well as all screening equipment will have these controls. The assessment assumed that no controls will be used on material drops from loaders, excavators and stackers. However, should problems with fugitive dust arise, installation of spray bars on conveyor transfer points and stackers will be considered.

B.2.3 Application of Water to Material Storage Piles

Depending on the amount of “fines” present in the material, windblown dust from material storage piles can occur. The assessment was completed assuming that wind erosion will only occur above a threshold windspeed of 10 m/s at anemometer height, which generally corresponds to a wind speed of approximately 5 m/s at mid-pile height. In addition, it was conservatively assumed that no controls will be specifically employed to control this source. Should emissions from storage piles become a problem, the piles will be sprayed with water or another approved dust suppressant on a daily basis to reduce windblown dust.

B.2.4 Record Keeping

A daily log of water applications and other dust control procedures and observations should be kept at the site to demonstrate, if necessary, that dust control actions are being taken.

B.2.5 Control of On-site Contractors

On-site contractors will be required to meet the same requirements as set out in this Best Management Plan at all times that they are on-site.

B.3 Considerations for Improved Control

In addition to the procedures outlined above, Arcadis offers these following optional considerations to further reduce the potential for off-site dust emissions:

- Apply calcium chloride or other chemical dust suppressants annually or semi-annually, if permitted by the ARA license; and
- Ensure that the site perimeter berms and surrounding area be sufficiently vegetated. It is recommended to place some plants in front of the berms where possible.

B.4 Environmental Complaint Documentation and Response Procedure

Arcadis recommends that a complaint documentation and response procedure be established for the McCormick Pit, such that standardized procedures are followed in the event that a complaint is made by a member of the public. The documentation should include the date and time of the complaint, the nature of the problem, and whether any follow-up action was taken. The complaint information should be maintained in an on-site log that is available for review by the MECP, if requested.

A sample form is included on the following page.

RECORD OF ENVIRONMENTAL COMPLAINT AND RESPONSE

1. Location: ____

2. Date and Time Complaint Received: ______________________________

3. Name of Complainant: ______________________________________

   Address: ____

   Telephone Number: _______________________________________

4. Form of Complaint and Summary: Visit:[ ] Telephone Call:[ ] Letter:[ ] Attach Copy
   Other ____

5. Complaint Referred to Technical Services: No [ ] Yes [ ] and provide details:
   ____

6. Contact Made With Government Official(s): No [ ] Yes [ ]
   If Yes, Complete and Attach Record of Government Environmental Official Contact Form -- Yes [ ]

7. Details Concerning Investigation Made by Company Concerning Complaint:
   ____
   ____

8. Response to Complainant:
   Letter [ ] Date ______________________ Attach copy of letter to this form.

   Telephone Call [ ] Date ___________________ Time ____________________

   Summary of Telephone Call:
   ____
   ____

9. Follow-up Action Required and/or Taken by Company: None [ ] Details:
   ____
   ____
   ____

10. Filed Original Form in the Plant Environmental Manual: Yes [ ]

    Date ______________________ ________________________________
    Employee Signature, Name & Position

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