HALTON REGION LANDFILL TECHNICAL STUDY

AIR QUALITY ANALYSIS

Site F

Schedule I - F

H-30

SENES Consultants Limited
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Willowdale, Ontario
M2H 2C9

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EXECUTIVE SUMMARY

Following the Stage 2B, Selection of Candidate Sites, the Stage 2C study evaluated six candidate sites relative to each other and to applicable criteria. From Stage 2C, two preferred sites , Site D and Site F, were identified. This report describes the further work completed for Site F. Both Stage 2B and 2C are part of the Region of Halton's Landfill Environmental Assessment Study.

Site F is predicted to have an acceptable impact on the ambient air quality in the area surrounding it. No impact is predicted at any existing residential area near Site F. It is possible that there may be infrequent occurrences of elevated levels of total suspended particulate matter on the Bayview Park area, and on the existing Regional landfill in Burlington. However, because most events at Bayview Park take place on weekends, the activity level at the landfill site is reduced on Saturday and the site is closed on Sunday, it is unlikely that there will be adverse impacts on the primary park users. Odour from fresh garbage is predicted to be undetectable at site boundaries.

The following mitigation measures were necessary to ensure that the levels of total suspended particulate matter were acceptable. All of the permanent roads within the landfill should be paved and all of the gravel or dirt roads should be watered on a regular basis during dry weather. The areas where the loaders and bulldozers operate should also be watered regularly during dry weather. All exposed soil should be seeded or grassed at the earliest opportunity. Odour is controlled with the normal practice of properly covering the raw refuse each day.

1.0 REVIEW OF STAGE 2C WORK

The Stage 2C, Technical Report No. 6, Air Quality Assessment (Senes, 1985), was submitted to Halton Region as part of its Environmental Assessment Study. That report assessed six Candidate Sites, identified at Stage 2B, Selection of Candidate Sites, for the potential impact in their vicinities of suspended particulate matter and odour which would arise during the landfill operations. The Stage 2C report was comparative, in that it attempted to distinguish between the sites based on air quality impacts, and their compliance with applicable criteria.

For the purpose of the Stage 2C report, operating procedures, site layout and the equipment likely to be in operation were assumed based on current operating practices in the Region of Halton and on information from Hydrology Consultants, regarding site design and operational procedures, and from Giffels Associates Limited, regarding transportation. This information was used to generate emission rates of both dust and odour from the landfilling operation. These emission rates were combined with meteorological data to derive expected atmospheric impacts.

From the Stage 2C analysis it was determined that odour would not be readily detectable except under certain, uncommon meteorological conditions, in the short term. The long term impact of gas generated in the landfill as the garbage decomposes was not addressed.

impact of gas not addressed

From the Stage 2C analysis it was determined that elevated levels of total suspended particulate matter (TSP) could be observed at the landfill site boundaries. However, these elevated levels were associated with the unusual conjunction of dry weather, and high levels of activity near the site boundary.

It was concluded that any of the six sites would be acceptable from an air quality point of view. The sites were differentiated only by the proximity of local residences, parks and other areas likely to be affected by the emissions of total suspended particulate matter and odour. It was also noted that some mitigative measures could be used to reduce the impacts.

2.0 METHODOLOGY

The assessment of odour and dust impacts from a landfill operation is based on fairly standard estimating procedures described below. The existing conditions at the site were documented using both a field air quality monitoring program and air quality monitoring data published by the Ontario Ministry of the Environment (MOE). An air quality monitoring station was established on top of the Waterdown Road reservoir, just north of the North Service Road on Waterdown Road to monitor existing air quality. For a 30 day period a meteorological station was also operated at the same location. Meteorological data ~~was also~~ were obtained from nearby stations operated by the Atmospheric Environmental Service of Environment Canada.

Using descriptions of the proposed landfill and the proposed operating procedures, emission rates for both dust and odour were calculated. The proposed operating procedures were based on current practices at Halton's landfill and on information from by Hydrology Consultants, regarding site design and operational procedures, and from Giffels Associates Limited, regarding transportion. These emission rates and meteorological data were combined in an atmospheric dispersion model to generate estimates of total suspended particulate matter and odour concentrations at neighbouring locations, especially the Bayview Park, populated subdivisions and other residential locations.

The predicted concentrations of total suspended particulate matter were compared to criteria established by the MOE. Estimated occurrences of detectable odour were judged on their frequency and severity of occurrence. Mitigating measures were examined and proposed where necessary.

3.0 CRITERIA USED FOR EVALUATION

Total suspended particulate matter (TSP) and odour impacts, beyond the boundaries of the landfilling operation are regulated under the Environmental Protection Act, and Regulation 308 (Ontario, 1985).

TSP is evaluated relative to three criteria.

1. The regulated (Reg. 308) half hour point of impingement of 100 $\mu g/m^3$. A source should not exceed the point of impingement standard, when its impact is calculated using the procedures described in the regulation.

2. The ambient air quality criteria of

   (a) 120 $\mu g/m^3$ for 24 hours and

   (b) 60 $\mu g/m^3$ annual geometric mean are used to evaluate longer term impacts (Ontario, 1985).

Because of the difficulty of measuring odours, odour impact is addressed in the nuisance sections of the Environmental Protection Act. An odour can be considered to be a nuisance if it is detectable, and is judged to be unpleasant (Ontario, 1985). Where odour emission rates are available, they can be used to model atmospheric odours. An odour level greater than 35 odour units per cubic metre (OU/m^3) (1 OU/ft^3) can be considered to be detectable.

4.0 IMPACT ASSESSMENT

4.1 Introduction

This section describes the potential suspended particulate matter and odour emissions from the proposed landfill and the predicted impacts. The first section will describe the existing air quality in the area. The meteorological and climatological parameters that are important in determining odour and suspended particulate matter impacts are described next and the remaining three sections will describe the potential emissions, predicted impacts and mitigation measures for suspended particulate matter and odour.

4.2 Existing Ambient Air Quality

4.2.1 Introduction

The primary air contaminant of concern from a landfill operation is particulate matter. In Ontario, airborne particulate matter is measured in two ways, as dustfall and as total suspended particulate matter. Dustfall consists of particulate matter which is of sufficient weight to settle from the atmosphere by gravity; this is generally regarded as airborne dust that is greater than 20 micrometers (µm) in diameter (Ontario, 1984). Total suspended particulate matter is the dust in the atmosphere that is sampled with a high volume sampler. It is generally considered to consist of the suspended dust particles less than about 44 µm in aerodynamic diameter (Ontario, 1979).

The applicable ambient air quality criteria for dustfall and total suspended particulate matter are presented below (Ontario, 1985).

Dustfall grams per square metre per 30 days (g/m^2/30 days)	7 g/m^2/30 days - monthly 4.6 g/m^2/30 days - annual mean
Total Suspended Particulate Matter micrograms per cubic metre ($\mu g/m^3$)	120 $\mu g/m^3$ - 24 hours 60 $\mu g/m^3$ - annual geometric mean

In the sections that follow, ambient air quality measurements have been drawn from the Ontario Ministry of the Environment air quality monitoring stations, and an air quality monitoring station established for this study near Site F. The location of the landfill site, the SENES air quality monitoring station and a number of the MOE air quality monitoring stations are shown on Figure 4.1.

4.2.2 Total Suspended Particulate Matter

Examination of the data accumulated by MOE since 1969, has shown that the Halton, Peel and Hamilton Wentworth Regions experienced similar trends with respect to the levels of total suspended particulate matter (TSP). Except for those areas in Hamilton which were impacted on by the large industrial sources, there was a steady decrease in the measured TSP levels until the early 1980's. From 1982 onwards the ambient concentrations in the suburban and rural areas have remained steady or shown a slight decrease, with annual geometric means of between 45 and 60 $\mu g/m^3$. Tables 4.1 and 4.2 summarize the last five years data for these locations which are the closest MOE monitors to the proposed landfill site.

Only occasionally does the MOE monitor in areas where there is not a specific need to examine a problem, or where problems are not anticipated. Short term studies may be made for such purposes, as to define the limits of areas affected by known sources of emissions, or to ensure that certain areas are free of pollution. Because of this there is very little information about the air quality in the immediate neighbourhood of the site. The only sampling

FIGURE 4.1

LOCATION OF AIR QUALITY MONITORING STATIONS

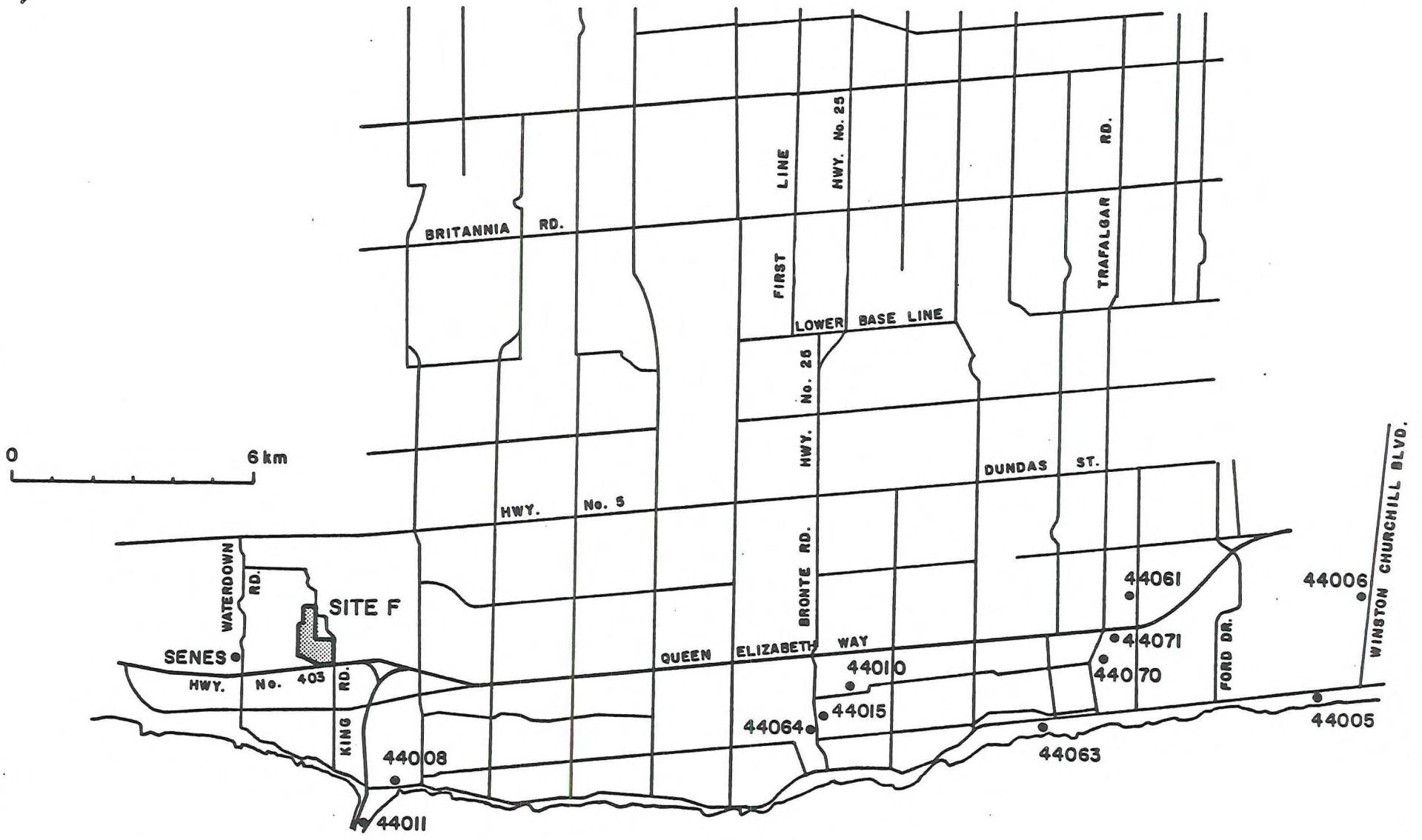


Table 4.1

REGIONAL ANNUAL TOTAL SUSPENDED PARTICULATE MATTER CONCENTRATIONS
(Geometric Mean, $\mu g/m^3$)

	HAMILTON WENTWORTH								BURLINGTON	OAKVILLE
Location	Hughson/ Hunter	City Centre	450 Hughson St. North	Upper Wellington/ Inverness	405 Cumberland Ave.	Barton/ Nash	Westdale Library	Bay/ Main	North Shore Blvd.	Woburn Cres.
MOE Monitor Ref. No.	29001	29007	29067	29085	29087	29089	29090	29098	44008	44015
1981	62	57	56	55	65	58	59	na	45	50
1982	67	60	54	57	58	60	53	na	46	45
1983	64	68	57	53	61	57	50	59	49	40
1984	75	na	58	53	59	57	66	55	57	47
1985	61	na	43	44	56	58	55	45	55	45
Average	65.8	61.7	51.6	52.4	59.8	58.0	56.6	53.0	50.4	45.4

Table 4.2

REGIONAL 24 HOUR TOTAL SUSPENDED PARTICULATE MATTER CONCENTRATIONS
($\mu g/m^3$)

Maximum	250	251	320	324	333	185	29	168	286	210
Minimum	19	13	0	18	20	22	7	18	2	8
No. of Times >120	33	20*	14	15	21	9	12	7*	40	11
No. of times >120 in 1985	1	na	1	2	2	0	1	0	9	6

Notes

* Data available for only 3 years

na - not available

location which can be considered to closely resemble, in terms of local air quality, the potentially affected areas was at 24 Lorne Scots Drive in Milton, but this station was only operated during 1975 and no recent data are available.

Comparison of the data obtained at this station with those from other suburban stations is made in Table 4.3. Results from only a few comparable stations are available, this table therefore includes the information for the year nearest to 1975 during which those stations operated. It can be seen that the air quality at the Lorne Scots Drive site was as good as or better than that at any of the other sites. Most of the other monitors are located near known sources of suspended particulate matter emissions.

In order to obtain current information on the air quality in the close vicinity of the proposed landfill site, SENES has established an air quality monitoring station near Site F. This station was operated in accordance with MOE procedures (Ontario, 1979; Ontario, 1984). The monitoring station for Site F is located on top of the Waterdown reservoir on Waterdown Road, north of the QEW approximately 2000 m southwest of Site F. The location of this station is shown on Figure 4.1.

The results obtained to date are summarized in Tables 4.4 and 4.5. Although the levels are lower than those at any of the MOE sites these results should not be construed as representing the average annual air quality of the sites. Seasonal variations in wind speed, wind direction and precipitation all may affect the levels of TSP encountered. The levels of TSP in the atmospheric range from a low of 9 to a high of 99 $\mu g/m^3$. The geometric mean of the data collected to date is 28 $\mu g/m^3$. These data are typical of suburban and rural areas, for the time of year that has been sampled. These data indicate satisfactory ambient air quality with respect to TSP.

4.2.3 Dustfall

Table 4.6 summarizes the dustfall data obtained from the MOE monitoring

Table 4.3

SUBURBAN AND RURAL TOTAL SUSPENDED PARTICULATE MATTER CONCENTRATIONS
($\mu g/m^3$)

Monitor Number	44032	29001	29007	29067	29085	29087	29089	29090	44005	44008	44010	44011	44012	44015	44030	44031
Geom. Mean	44	75	71	63	61	73	70	67	55	61	39	46	58	62	72	74
Maximum	231	250	208	210	150	184	182	138	431	254	284	220	224	266	237	215
Minimum	14	21	29	20	23	23	22	31	15	7	2	17	20	19	14	17
No. of times >120	4	13	7	4	3	6	3	1	7	5	4	2	6	8	12	17
Year	1975	1975	1975	1975	1979	1979	1980	1980	1975	1979	1976	1982	1982	1980	1975	1975

44032 Lorne Scots Drive - Milton
29001 Hughson/Hunter - Hamilton
29007 City Hall - Hamilton
29067 450 Hughson St. - Hamilton
29085 Wellington/Inverness - Hamilton
29089 Barton/Nash - Hamilton
29090 Westdale Library - Hamilton
44005 Lakeshore E/Brikbank - Oakville
44008 Hwy 2/North Shore Blvd. - Burlington
44010 1298 Rebecca St. - Oakville
44011 110 Omaha Burlington
44012 964 Lakeshore Blvd. - Burlington
44015 Bronte/Woburn Cresc. - Oakville
44030 706 Main St E., Milton
44031 Works Dept. Nipissing Rd. - Milton

TOTAL SUSPENDED PARTICULATE MATTER CONCENTRATIONS - SITE F ($\mu g/m^3$)

Date	
07/09/85	49.6
10/09/85	23.5
13/09/85	Invalid due to sampler failure.
16/09/85	43.0
19/09/85	72.8
22/09/85	31.1
25/09/85	36.7
28/09/85	29.1
01/10/85	23.9
04/10/85	54.6
07/10/85	24.6
10/10/85	34.2
13/10/85	20.3
16/10/85	12.1
19/10/85	18.9
22/10/85	36.7
25/10/85	18.0
28/10/85	19.8
31/10/85	31.4
03/11/85	12.6
06/11/85	9.2
09/11/85	12.3
12/11/85	50.8
15/11/85	21.5
18/11/85	50.3
21/11/85	23.3
24/11/85	25.9
27/11/85	25.8
30/11/85	24.3
03/12/85	38.2
09/12/85	41.1
15/12/85	29.1
21/12/85	27.3
27/12/85	24.4
02/01/86	49.9
08/01/86	37.1
14/01/86	30.1
20/01/86	14.3
26/01/86	33.1
01/02/86	38.9
07/02/86	11.0
13/02/86	40.6
20/02/86	29.7
25/02/86	22.3
03/03/86	98.8
Geometric Mean	28.2

Table 4.5

DISTRIBUTION OF TOTAL SUSPENDED PARTICULATE MATTER DATA - SITE F

Range ($\mu g/m^3$)	No. of Samples	Cumulative
90-100	1	1
80-90	0	1
70-80	1	2
60-70	0	2
50-60	3	5
40-50	5	10
30-40	10	20
20-30	15	35
10-20	8	43
0-10	1	44

See insert

Table 4.6

Halton Regional Annual Dustfall Data

Site F - 30 day averages (g/m^2/30 days)

Station No.	44005	44006	44008	44015	44043	44061	44063	44064	44070	44071
Year										
1979	5.2	3.8	3.6	--	5.1	2.6	--	3.1	9.3	4.3
1980	3.2	3.2	2.4	2.5	3.4	2.7	4.5	3.4	8.0	6.3
1981	3.4	2.8	2.9	2.5	3.5	2.1	4.5	5.0	6.9	4.8
1982	4.5	4.1	3.0	2.8	3.6	2.8	4.7	4.9	7.8	4.5
1983	2.4	4.4	2.9	1.8	3.2	2.5	4.2	3.7	5.7	4.2
1984	3.2	3.1	3.2	2.4	5.4	3.5	4.8	4.5	10.9	4.1
1985	2.9	3.3	3.1	2.3	5.2	3.5	5.0	3.9	6.7	4.4
Overall Mean	3.5	3.5	3.0	2.4	4.2	2.8	4.6	4.1	7.9	4.7
No. of Time >7g/m^2/30 days	7	11	10	1	15	2	8	9	45	8
No. of Samples	84	82	70	81	77	82	70	84	76	82

44005 - Lakeshore East/Birkbank, Oakville
44006 - 494 Winston Churchill Blvd., Oakville
44008 - Highway Δ2/Northshore Blvd. East, Burlington
44015 - Bronte Road/Woburn Crescent, Oakville
44043 - 5043 Guelph Line, Burlington
44061 - 8th Line Road, Oakville
44063 - George/Robinson Streets, Oakville
44064 - 395 Bronte Street, Oakville
44070 - Allan/Pine Streets, Oakville
44071 - South Service Road, Oakville

network at the nearest locations to Site F. The values at these stations ranged from 0.4 g/m^2/30 days (Station No. 44015) to 30.0 (g/m^2/30 days) (Station No. 44006) but at only two (Station No. 44070, 44063) has the annual mean exceeded the criterion of 4.6 g/m^2/30 days in recent areas. It must be noted that in most cases dustfall samplers are located in urban areas or near to potential problem areas for the purpose of determining whether or not high dustfalls occur. Of the monitors listed, numbers 44015 and 44016 most closely approximate rural or suburban locations insofar as they are not situated in the most densely populated downtown areas of Oakville.

In addition to monitoring total suspended particulate matter information at the Waterdown air quality monitoring dustfall measurement were also taken. The dustfall data for the Waterdown station are summarized on Table 4.7.

The dustfall measured to date has ranged from 0.5 to 4.4 g/m^2/30 days. The mean of the data collected to date is 1.9 g/m^2/30 days. These levels are within the ambient air quality criteria and are typical for the area and time of year.

4.2.4 Odour

Odour measurements are not routinely made because of the difficulties of measurement and quantification. The nearby existing Regional Landfill Site in Burlington to the west of the proposed site has the potential to generate odour. On visits to the existing landfill, weak odours were detected infrequently and were not noticed at any appreciable distance from landfill operations (Ontario, 1986). Throughout the suspended particulate matter sampling program carried out from 07 September 1985 to date odours were undetectable at the sampling location at the Waterdown reservoir. Other nearby sources, including industry, commercial and transportation sources are not significant sources of odour. In the surrounding populated area, a qualitative assessment indicates the air to be largely odour-free.

Table 4.7

DUSTFALL DATA - SITE F

September	A	2.8 g/m^2/30days
	B	3.3 g/m^2/30days
October	A	1.7 g/m^2/30days
	B	2.0 g/m^2/30days
November	A	4.4 g/m^2/30days
	B	1.1 g/m^2/30days
December	A	1.7 g/m^2/30days
	B	1.7 g/m^2/30days
January	A	1.6 g/m^2/30days
	B	1.1 g/m^2/30days
February	A	0.5 g/m^2/30days
	B	1.4 g/m^2/30days
Mean		1.9 g/m^2/30days

4.2.5 Summary of Air Quality Data

In general the dustfall, total suspended particulate matter and odour related air quality parameters that have been measured in the area of Site F are within existing MOE air quality criteria. The estimated air quality can be summarized as follows.

Contaminant	Sampling period	Estimated Range	MOE Criteria
Total Suspended Particulate Matter:	Annual Geometric Mean	25 to 40 $\mu g/m^3$	60 $\mu g/m^3$
	24 hour maximum	150 to 200 $\mu g/m^3$	120 $\mu g/m^3$
	24 hour minimum	5 to 15 $\mu g/m^3$	120 $\mu g/m^3$
Dustfall:	Annual Arithmetic Mean	1 to 2 $g/m^2/30$ days	4.6 $g/m^2/30$ days
	Maximum Monthly	4 to 5 $g/m^2/30$ days	7 $g/m^2/30$ days
	Minimum Monthly	0 to 1 $g/m^2/30$ days	7 $g/m^2/30$ days
Odour:		No detectable odours.	Detectable.

4.3 Meteorology and Climatology

4.3.1 Introduction

The effects of climatic and meteorological variations on the dispersion of contaminants and the formation of suspended particulate matter are large, variable and complex. Some examples of these effects are briefly described below.

Rainfall not only collects contaminants from the atmosphere and deposits them on the ground, but it reduces the formation of dust by earth moving equipment. Soils, which in a dry state are readily broken down into small particles which can be transported by the wind, form aggregates which are less readily disintegrated when they are wet. Heavy rains produce muds which although not easily converted into wind-transported suspended particulate matter, can

become attached to vehicles and vehicle tires, removed from their original locations and deposited on roadways, from which they can later be dispersed as suspended particulate matter when dry conditions occur.

In dry weather winds can create suspended particulate matter by erosion of soils and by entrainment of dusts from surfaces upon which they have been deposited. High wind speeds result in the dilution of contaminants which are released at a constant rate, but also increase the erosion and entrainment of particulate material. As a general rule winds of less than 5 m/s do not result in erosion and below that speed the dilution effect of the wind results in lower concentrations of contaminants as the wind speed increases. At very high wind speeds erosion can become a dominant factor if large areas of exposed soil are affected.

High temperatures and high winds increase the rate of drying of soils and reduce the final water content of the soil to low levels thereby creating conditions which give rise to increased emissions created by the movement of vehicles on the soil or from mud previously deposited on roadways.

Meteorological conditions affect the extent of dispersion of airborne contaminants. Turbulent conditions increase the rate of dispersion of materials while stable atmospheric conditions limit the rate of dispersion. In this context, atmospheric conditions are categorized into six stability classes shown in the table below. Class A is the most unstable, turbulent condition; Class F is the most stable class. In turn, these are related to wind speeds, the time of day, the incoming solar radiation and the cloud cover (Turner, 1967).

KEY TO STABILITY CATEGORIES

Surface Wind Speed (at 10 m), m/s	Day			Night	
	Incoming Solar Radiation			Thinly Overcast or >4/8 Low Cloud	≤3/8 Cloud
	Strong	Moderate	Slight		
< 2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
6	C	D	D	D	D

The neutral class, D, should be assumed for overcast conditions during day or night.

The interaction of these factors renders the forecasting of contaminant concentrations for any specified short period an impossibility. Only general average concentrations can be predicted with any degree of assurance.

4.3.2 General Climatic Parameters

Site F is located southwest of King Road and northwest of the North Service Road, to the northeast of the existing Halton landfill.

Site F lies within the Lake Ontario Climate Region (Brown et al., 1980). The major physiographic features affecting the climate of the site are Lake Ontario and the Niagara Escarpment. The general climatic characteristics of site F are presented in Table 4.8.

A number of meteorological stations exist in the general area of site F. Three stations which surround the site are Hamilton Royal Botanical Gardens (RBG), Burlington Transformer Station (TS), and Milton Kelso. Using data from the Canadian Climate Normals 1951-1980 (Environment Canada, 1982, 1982a) temperature and precipitation conditions on Site F were approximated by taking

Table 4.8

GENERAL CLIMATIC CHARACTERISTICS OF THE SITE F AREA

Annual mean daily temperature (°C)	8.1
Annual mean daily maximum temperature (°C)	12.9
Annual mean daily minimum temperature (°C)	3.3
Extreme maximum temperature (°C)	37.1
Extreme mimimum temperature (°C)	30.2
Mean annual degree days above 0°C	3515.0
Mean annual degree days below 0°C	535.3
Mean date of last frost in spring	May 5
Mean date of first frost in fall	Oct 10
Mean annual frost free period (days)	156
Mean annual rainfall (mm)	703.3
Mean annual snowfall (cm)	137.7
Mean annual total precipitation (mm)	845.3
Mean number of days with measurable rainfall	96
Mean number of days with measurable snowfall	35

Source: Canadian Climate Normals 1951-1980
Environment Canada, 1982, 1982a, 1982b

the average of the values from the above 3 stations. For the remainder of this section any reference to temperature or precipitation conditions on site F is in actuality an approximation using the average of the values from the above 3 meteorological stations.

Wind conditions on Site F were approximated with data from Hamilton Royal Botanical Gardens (RBG). (Environment Canada, 1982b)

Temperature

Based on data from the Burlington TS, Hamilton RBG, and Milton-Kelso stations December and January are the coldest months at Site F while July and August are the warmest. The mean daily temperature for the general area of Site F is 8.1°C. The extreme maximum temperature at Site F was recorded in July (37.1°C), the extreme minimum temperature was recorded in January (-30.2°C). Monthly variations in temperature at Site F are presented in Table 4.9.

Precipitation

Based on data from the Hamilton RBG, Burlington TS and Milton Kelso stations (Environment Canada, 1982a) the mean annual total precipitation at Site F is 845.3 mm occurring over an average of 126 days of measurable precipitation per year. Table 4.10 shows the monthly variations in total precipitation, mean rainfall, mean snowfall, and mean number of days with measurable values of each. Site F experiences a mean annual rainfall of 703.3 mm and a mean annual snowfall of 137.7 cm. On average there are 96 days/year with measurable rainfall and 35 days/year with measurable snowfall. The greatest number of days of measurable rainfall occur in April and May with the number of days remaining relatively constant from June to November. On average there are 10 days with measurable snowfall in January.

Figure 4.2 shows the monthly variations in total precipitation, mean rainfall and mean snowfall.

FIGURE 4.2

TOTAL PRECIPITATION, RAINFALL, AND SNOWFALL SITE F AREA

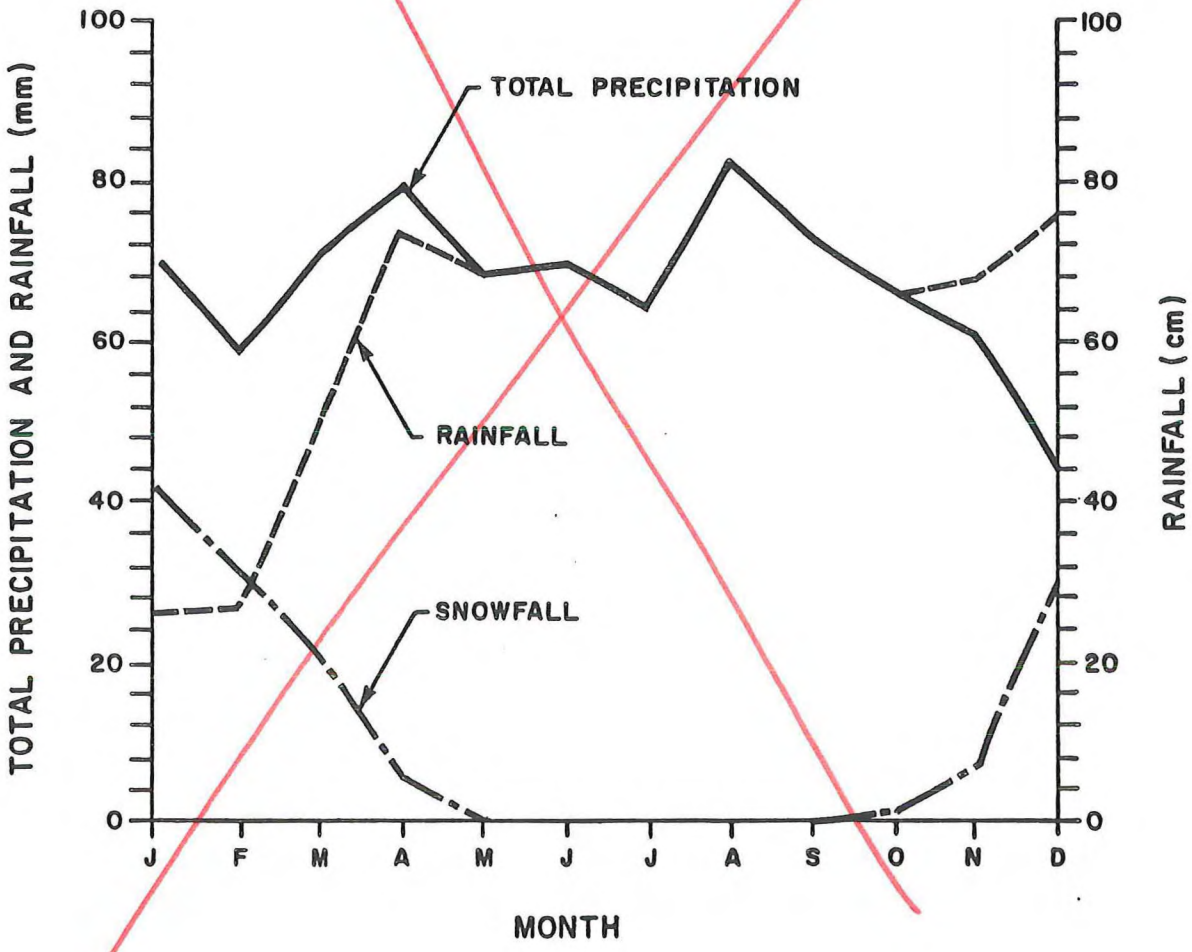


Table 4.9

MONTHLY VARIATIONS IN TEMPERATURE - SITE F AREA*

Mean daily temperature (°C) 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-5.7	-5.0	-0.2	6.7	12.8	18.5	21.4	20.5	16.3	10.1	4.0	-2.5	8.1

Mean daily maximum temperature (°C) 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-1.9	-0.9	-3.8	11.8	18.6	24.3	27.2	26.1	21.7	15.0	7.7	1.0	12.9

Mean daily minimum temperature (°C) 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-9.5	-9.1	-4.2	1.6	7.0	12.7	15.5	14.9	10.9	5.2	0.4	-5.9	3.3

Extreme maximum temperature (°C) 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
13.9	15.0	24.2	29.8	33.7	35.2	36.9	36.7	35.9	30.9	24.6	18.0	37.1

Extreme mimimum temperature (°C) 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-27.2	-28.2	-23.4	-13.7	-3.1	1.4	5.6	2.9	-1.7	-7.2	-14.6	-27.2	-30.2

All values are averages of values from the Hamilton RGB, Burlington TS and Milton-Kelso meteorological stations.

Reference: Environment Canada, 1982

Table 4.10

MONTHLY VARIATION IN PRECIPITATION - SITE F AREA*

Total precipitation monthly means 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
69.3	58.4	71.1	79.5	68.2	69.3	64.3	82.3	72.9	66.3	68.1	75.6	845.3

Number of days with measurable precipitation 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
12	10	11	11	10	9	8	9	9	10	11	13	126

Mean rainfall (mm) monthly means 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
26.0	26.5	49.6	74.0	68.2	69.3	64.3	82.3	72.9	65.5	60.7	44.0	703.3

Number of days with measurable rainfall 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
4	3	7	10	10	9	8	9	9	10	9	6	96

Mean snowfall (cm) monthly means 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
41.8	31.1	19.9	5.4	0.0	0.0	0.0	0.0	0.0	1.2	7.6	30.7	137.7

Number of days with measurable snowfall 1951-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
10	8	5	2	0	0	0	0	0	0	2	8	35

* All values are averages of values from the Hamilton RGB, Burlington TS and Milton-Kelso meteorological stations.

Reference: Environment Canada, 1982a

Severe Weather

The Great Lakes Basin in Ontario lies in the path of storm tracks of low pressure systems. Lows which form in the southwestern United States very often move across the Great Lakes. These storms usually involve tropical or subtropical air streams and are quite often associated with thunderstorms and, on rare occasions, tornados. Lawryniuk (1969) comments, "Tornado occurrences in Ontario are relatively infrequent... The conditions actually analyzed have been recognized as favourable for severe storms by various investigators in recent years but they co-exist only infrequently in Ontario". As well, low pressure systems moving across northern Canada dragging cold fronts southward may produce severe weather during summer months.

4.3.3 Atmospheric Stability and Dispersion

Wind

Wind data from the Hamilton RBG station are presented in Table 4.11. Wind conditions at Site F were approximated with data from the Hamilton RBG station (Environment Canada, 1982b). Although the wind data from Hamilton RBG are of lower quality than that available from the airport weather stations, the proximity of the station to Site F, and its location in similar terrain make the data the most representative.

The predominant wind direction at the Hamilton RBG station is southwest. Southwest winds occur 35.5% of the time, northeast winds occur 17.7% of the time annually. The average wind speed is 14.1 km/hr from the southwest direction and 13.2 km/hr from the northeast direction. Strong winds (14.1 km/hr) also occur from the northwest direction with an annual frequency of 12.2%. The most infrequent wind directions are east, southeast, and south occurring 4.6%, 2.0%, and 3.3% respectively. Calm conditions occur on average 0.4%. The highest average wind speeds occur in January (15.1 km/hr) the lowest in August (10.1 km/hr). The maximum recorded hourly windspeed is 61 km/hr from the southwest.

Table 4.11

WIND DATA HAMILTON RBG, ONTARIO

HAMILTON RBG ONT.

PERIOD 1963-80 PERIODE

Lat. 43°17'N Long. 079°53'W

Elevation 102 m Altitude

	JAN JANV	FEB FEV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEPT	OCT OCT	NOV NOV	DEC DEC	YEAR ANNUEL	
PERCENTAGE FREQUENCY FRÉQUENCE EN %														
N	6.7	8.2	7.9	8.3	5.7	6.8	5.2	6.1	7.8	5.8	7.2	8.9	7.1	N
NE	12.1	13.8	22.7	22.5	23.6	19.9	14.4	17.1	19.6	16.9	14.9	14.7	17.7	NE
E	2.2	2.2	4.4	7.5	9.3	6.5	4.9	4.5	4.1	3.8	2.7	3.0	4.6	E
SE	1.6	1.5	1.4	1.8	2.5	2.6	2.4	2.0	2.0	2.6	2.2	2.0	2.0	SE
S	3.7	4.1	2.6	2.6	3.7	3.8	3.4	2.5	2.6	3.6	3.4	3.5	3.3	S
SW	48.9	39.5	30.3	25.9	27.1	32.3	37.8	35.5	31.8	35.8	40.4	41.2	35.5	SW
W	15.6	18.7	17.0	15.8	16.1	15.8	19.2	19.6	18.2	18.6	16.8	14.9	17.2	W
NW	9.0	11.9	13.6	15.3	11.6	11.8	12.3	12.4	13.3	12.0	11.9	11.5	12.2	NW
Calm	0.2	0.1	0.1	0.3	0.4	0.5	0.4	0.3	0.6	0.9	0.5	0.3	0.4	Calme
MEAN WIND SPEED IN KILOMETRES PER HOUR VITESSE MOYENNE DES VENTS EN KILOMÈTRES PAR HEURE														
N	10.3	11.2	10.8	10.6	8.5	7.5	6.6	6.3	7.8	7.1	9.0	10.0	8.8	N
NE	15.3	14.8	16.2	15.0	12.1	11.1	10.6	10.6	12.0	11.8	13.2	15.1	13.2	NE
E	13.9	11.7	9.4	10.8	9.9	9.0	9.9	9.3	9.8	9.5	11.1	14.5	10.7	E
SE	10.2	9.1	7.8	8.6	7.9	8.5	8.2	8.0	8.4	9.3	12.0	10.4	9.0	SE
S	14.0	14.3	12.9	13.5	14.1	11.6	10.6	9.8	9.4	12.6	14.1	12.3	12.4	S
SW	17.3	15.6	15.4	15.6	13.8	12.3	11.4	11.3	11.7	13.3	15.4	15.5	14.1	SW
W	11.5	12.8	13.0	13.8	11.4	9.5	8.5	8.2	7.9	9.2	11.1	10.7	10.6	W
NW	14.0	14.7	17.3	16.5	14.8	13.5	12.5	11.8	12.1	13.2	13.7	14.8	14.1	NW
All Directions														Toutes directions
	15.1	14.2	14.6	14.3	12.3	11.0	10.4	10.1	10.5	11.5	13.4	13.9	12.6	
Maximum Hourly Speed														Vitesse horaire maximale
	61	51	55	56	47	47	42	37	37	51	55	51	61	
	SW	SW	SW	W	SVL	NW	N	W	SVL	SW	SW	SVL	SW	

Height of anemometer 17.7 m hauteur de l'anémomètre

STATION INFORMATION

Located at Royal Botanical Gardens, Administration Building at the western end of and 0.4 km north of Hamilton Harbour. Lake Ontario is 6.5 km to the east and the Niagara Escarpment lies 4 km distant to the northwest and 6.5 km to the south. Surrounding country is flat in immediate vicinity. Anemometer on building.

DONNÉES RELATIVES À LA STATION

Situé aux Royal Botanical Gardens, sur l'édifice de l'administration, à l'extrémité ouest et à 0.4 km au nord du port Hamilton. Le lac Ontario se trouve à 6.5 à l'est, et l'escarpement du Niagara, à 4 km au nord-ouest et à 6.5 km au sud. Les alentours immédiats sont plats.

Reproduced from: Environment Canada, 1982b

Atmospheric Stability

Atmospheric stability affects the ability of the atmosphere to disperse and dilute pollutants, and is a function of the windspeed and temperature lapse rate in the lower layers of the atmosphere. In a standard or neutral atmosphere, the temperature decreases with height while in a stable atmosphere, temperature increases with height and winds are light (an inversion). In an unstable atmosphere, the temperature decrease with height is greater than for the neutral case. The more unstable the atmosphere is, the greater the mechanical and thermal turbulence, and therefore the greater the dispersive capacity of the atmosphere. Stability is commonly reported in a stability array or STAR data set which provides a joint frequency distribution of windspeed, direction, and stability class. Stability is estimated from surface meteorological observations and classified into six atmospheric stability classes, A - F, according to the Pasquill-Gifford categories. Class A is the most unstable, turbulent condition; Class F is the most stable class.

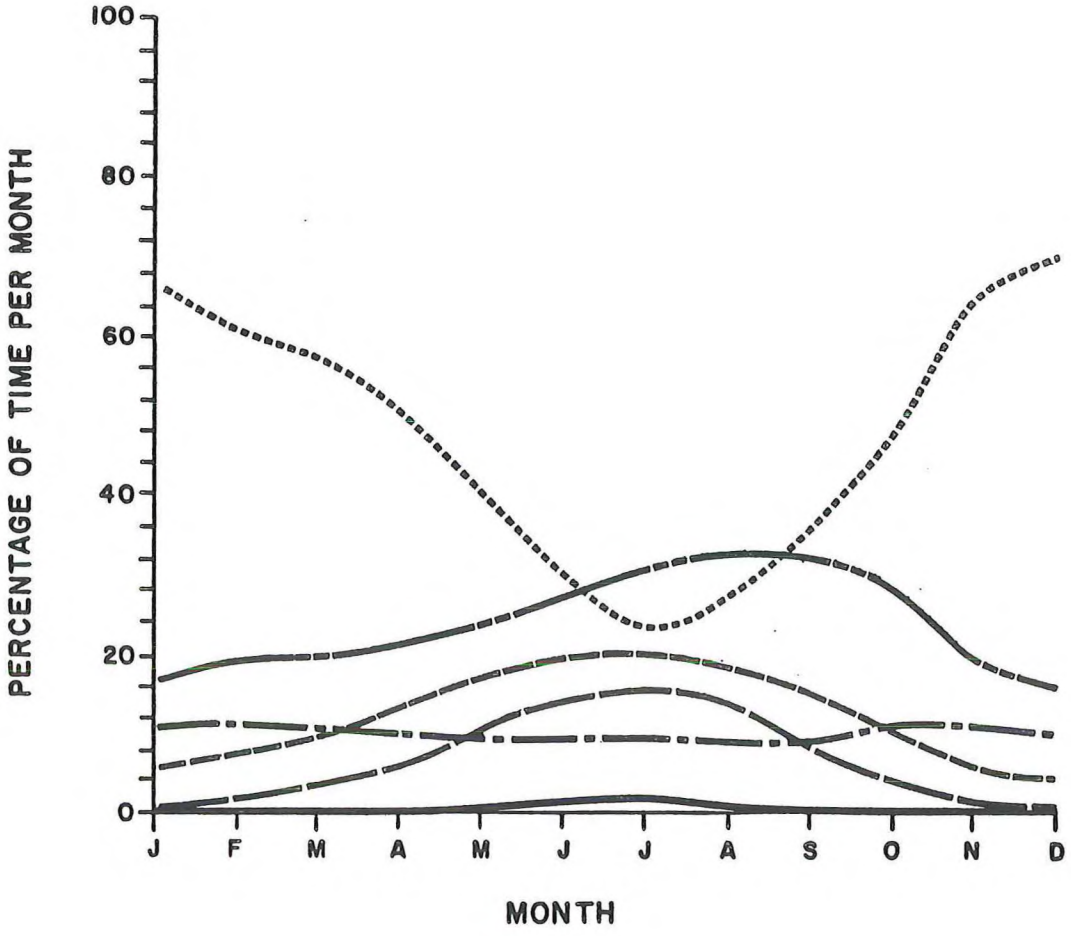
The stability array for the Hamilton RBG station was obtained for the period of record 1953-1984. Stability conditions at site F were approximated with Hamilton RBG values. The annual stability class distributions for Hamilton RBG are summarized on Table 4.12.

Neutral (class D) stability occurs most frequently at the Hamilton RBG station, 47.5%, followed by extremely stable (F class) conditions, 23.8%. Extremely unstable conditions occur only 0.4% of the time. Overall neutral to extremely stable conditions are dominant.

Monthly variations in frequency of occurrence of stability class are presented in Figure 4.3.

FIGURE 4.3

FREQUENCY OF OCCURRENCE OF ATMOSPHERIC STABILITY CLASS HAMILTON ROYAL BOTANICAL GARDENS



LEGEND:

- A STABILITY CLASS
- B STABILITY CLASS
- C STABILITY CLASS
- D STABILITY CLASS
- E STABILITY CLASS
- F STABILITY CLASS

Table 4.12

ANNUAL FREQUENCY OF OCCURRENCE OF STABILITY CLASSES

Hamilton Royal Botanical Gardens

	Stability Class	Annual Frequency of Occurrence(%)
A	Extremely unstable	0.4
B	Moderately unstable	6.5
C	Slightly unstable	12.0
D	Neutral	47.5
E	Moderately	9.9
F	Extremely stable	23.7

4.4 Predicted Emissions

4.4.1 Total Suspended Particulate Matter

Emissions of dusts or suspended particulate matter occur mainly as a result of earth moving operations, but also arise from the erosion of exposed soil surfaces by the wind. The mechanical action of earth moving equipment breaks down the soil and releases fine particles which can escape directly into the environment or be disturbed and propelled into the air by the action of the wheels or tracks of vehicles moving across the open soil. The quantities released are dependent not only on the nature of the activities but on the type of soil and climatic conditions. In wet weather and while the soil remains moist the creation of dust is minimized. Dry warmer weather and activities which expose large areas of soil to the drying action of the wind result in high emissions. There is no method by which the quantities of dust released at any particular time can be predicted. Evaluations, however, resulting from the observation of a variety of construction equipment has led to the development of a series of empirical equations which may be used to estimate the general level of emissions from the operation of this equipment.

The equations used in this evaluation are shown on Table 4.13. Where these equations take cognizance of precipitation data these have been incorporated into the estimates. Where no such explicit allowance is made it has been assumed that the equations are developed from general information collected in all weather. A review of the available literature indicates that most, if not all, these equations are related to weather during which precipitation was not occurring. Thus, the emission estimates used in this report are worst case estimates.

Using information from the Design and Operations Report for Site F (Hydrology Consultants, 1986), the following site preparation work will be carried out:

- installation of perimeter fencing and gates
- construction of storm drainage ditches, diversion channels and

Table 4.13

EMISSION ESTIMATES OPERATION - SITE F

	Basis of Estimate	Estimated Value	Uncontrolled Emission Rate	Possible Emission Reduction %	Controlled Emission Rate kg/h
Scraper: Removal (small)	0.026 kg/T	0.026 kg/T	1.3 kg/h	0	1.3
Scraper: Haul	$9.6 \times 10^{-6} (S)^{1.3} (W)^{2.4}$ kg/VKT	1.1 kg/VKT	1.3 kg/h	0	1.3
Scraper: Discharge	0.02 kg/T	0.02 kg/T	0.96 kg/h	0	1.0
Bulldozers (2)	$\frac{2.6 (S)^{1.2}}{(m)^{1.3}}$ kg/h	2.69 kg/h	1.3 kg/h	0	1.3
Front End Loader	18 g/m^3	18 g/m^3	0.62 kg/h	25%	0.5
Compactor	4.6 g/s	4.6 g/s	8.3 kg/h	0	8.3
Truck Traffic	$E=1.7\ K \frac{S}{12} \frac{V}{48} \frac{W}{2.7}^{0.7} \frac{w}{4}^{0.5} \frac{365-p}{365}$ kg/VKT	0.28 to 1.8 kg/VKT	46.2 kg/h	75%	11.6
Soil Haul to Pile	$E=1.7\ K \frac{S}{12} \frac{V}{48} \frac{W}{2.7}^{0.7} \frac{w}{4}^{0.5} \frac{365-p}{365}$ kg/VKT	3.4 kg/VKT	10.5 kg/h	75%	2.6
Soil Drop	$0.73 \times 0.0009 \frac{S}{15} \frac{U}{2.5} \frac{H}{1.5}$ kg/T $\div \frac{M}{2}^{2} \frac{Y}{4.6}^{0.33}$	3.8×10^{-5} kg/T	<0.1 kg/h	0	<0.1 kg/h

28.2 kg/h

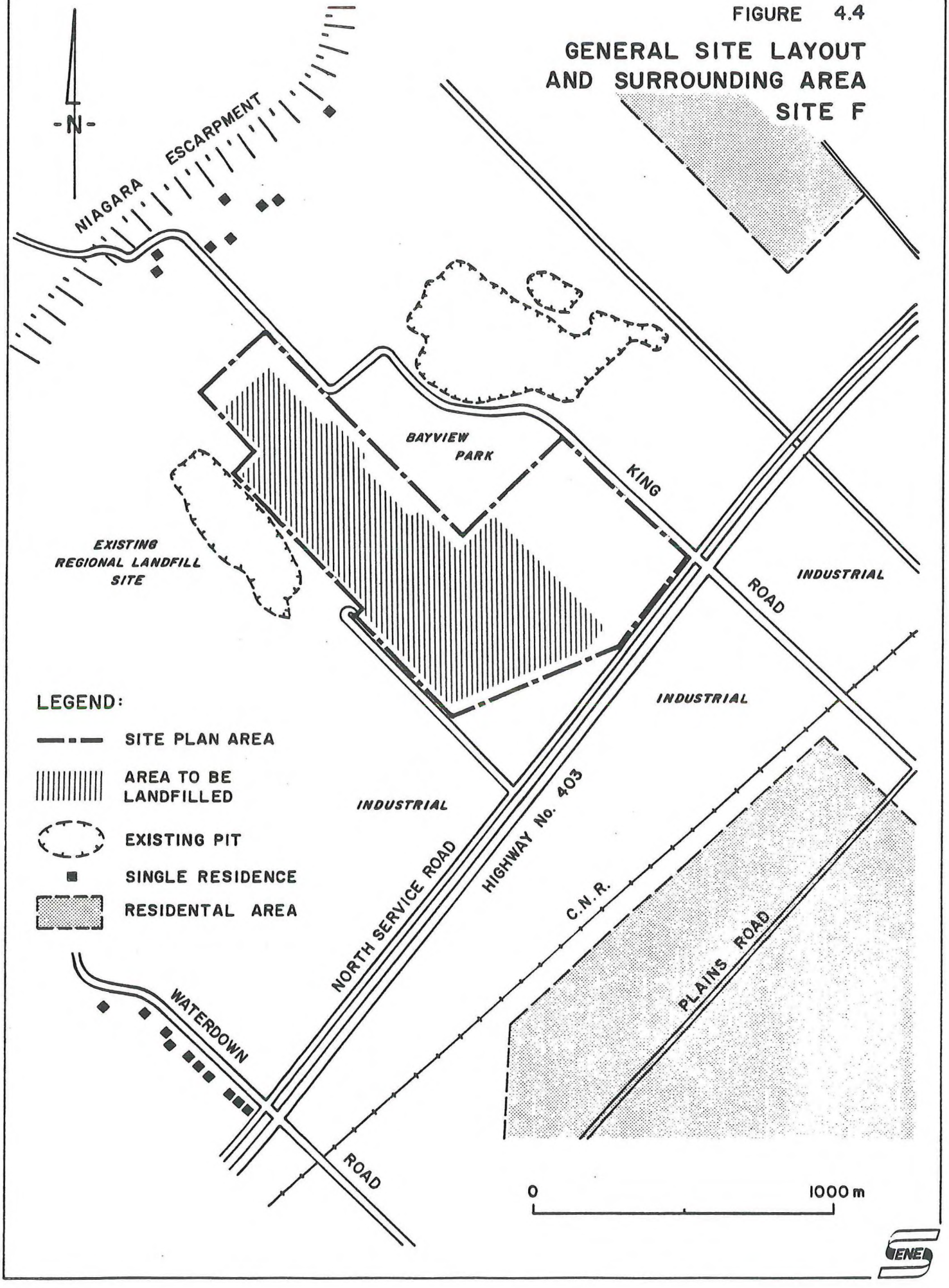
References: CDOH, 1981; U.S. EPA, 1981; U.S. EPA,1985.

KEY TO TABLE 4.13

Symbol	Definition		Assumed Volume
S =	Silt content of soil		15%
m =	Moisture content of soil	- topsoil	8%
		- subsoil	12%
K =	Factor for particle size distribution		0.8
V =	Speed of vehicle		30 km
w =	No. of wheels	- haul truck	8
		- others	4
W =	Weight of vehicle	- scraper loaded	40 T
		- scraper empty	24 T
H =	Height of soil drop		1 m
Y =	Weight of soil dropped		2 T
u =	Wind speed		2.2 m/s
p =	Number of days with measurable precipitation		126

FIGURE 4.4

GENERAL SITE LAYOUT AND SURROUNDING AREA SITE F



retention ponds.

- excavation of part of the first cell
- installation of part of the leachate collection system
- construction of perimeter roads
- construction of the screening berm adjacent to Bayview Park

Using this information and current general practices probable construction activities were assumed.

The general layout of Site F, and its surrounding areas is shown in Figure 4.4. It is assumed that the full site will be developed commencing at the northwestern site boundary and operations will progress steadily initially to the southeast then to the northeastern boundary of the site over a period of twenty years. Operations are assumed to be confined to an area of 25,000 to 30,000 square metres. Traffic is expected to enter the site from an existing road at the southwestern corner of the site and as far as possible to follow the site boundaries before proceeding to the tipping area.

Based on normal operations at other sites, it was assumed that the equipment in use for the site operation will be comprised of:

- 2 compactors
- 1 frontend Loader
- 1 bulk lift truck
- 2 bulldozers
- 1 scraper
- 1 dump truck

During Saturday working periods this will be reduced to one compactor and one small bulldozer.

Operating hours are assumed to be 8:00 A.M. to 5:30 P.M. on weekdays and from 8 A.M. to noon on Saturdays. On Saturdays the bulk bin area will be open to individual haul until 5:30 P.M. More incoming vehicles are expected on Saturdays but these will be primarily light vehicles and private cars.

Emissions for earth-moving equipment and traffic, have been estimated using

factors developed by the U.S. EPA and are listed in Table 4.13. These factors generally represent average emissions during working periods although in some cases (wind erosion and traffic) allowance is made for the reduction in emissions due to the occurrence of precipitation.

Because the berm is constructed gradually and does not require that a large volume of soil be excavated in a short period, it is assumed that a steady rate of excavation and landfilling will occur throughout the site's 20-year life. Thus no distinction is made between construction and operational impacts.

4.4.2 Odour

Raw Refuse

As described in the Phase 2, Stage 2C Air Quality Assessment (SENES, 1985), quantification of odour emission rates for raw refuse are not readily available. The rate of 2 odour units per min per square foot (2 OU/ft^2/min) used in the Stage 2C report has been accepted and therefore it is used in this report in predicting the odour source generation rate during landfilling carried out during the day.

It is estimated that the area of raw refuse exposed each day during landfill operations is 500 m^2. Thus, the total odour emission rate is estimated to be 180 odour units per second.

Landfill Gas

Landfill gas is produced as a result of biological decomposition of sanitary landfill wastes. Unlike controlled fermentation or digestion where the variables of the process are controllable, landfill mixing and placement are unpredictable thus gas generation and composition can vary widely and are not easily predicted. Values reported for recovered gas indicate that the major constituents are methane which can range from 40 to 60 percent, and carbon

dioxide which can vary from 30 to 50 percent. The amount of nitrogen present changes according to the amount of air entering the landfill. Trace compounds including the organics are quite complex and usually represent in the order of one percent of the landfill gas.

4.5 Atmospheric Impacts

4.5.1 Total Suspended Particulate Matter

Using the assumed operating conditions described in Section 4.4.1, average emission rates were estimated and dispersion modelling was carried out using the Industrial Source Complex Model for Long and Short Time periods (U.S. EPA, 1979, 1979a) ISCLT and ISCST. These models, developed by the U.S. EPA, require the input of meteorological data and a detailed description of point, area and line sources.

For the short term modelling only those conditions having highest potential for creating elevated levels of suspended particulate matter downwind were considered for comparison with the MOE standards. Under the regulation (Ontario, 1985) atmospheric stability classes C and D need to be considered. Of these, the use of the "D" stability class results in the highest concentrations, at ground level.

For the long term annual averages estimates, the meteorological conditions were taken from STAR data files created from the Hamilton Royal Botanical Gardens meteorological station readings.

The only potentially sensitive area of impact in the immediate vicinity of the site is the Bayview Park Area. The most densely populated districts are at Waterdown and the developments to the south/southeast and the north/northeast of the site and are about 750 metres distant. Less heavily populated districts close to the site exist at the edge of the escarpment to the northwest of the site and on the North Service Road to the south of the site.

Calculated point of impingement concentrations ranging from 140 to 200 $\mu g/m^3$ may occur in Bayview Park at some stage in the site's history. These concentrations will arise when winds are 5 m/s or less, under D stability conditions, the wind is blowing from the site operations towards the park and the distance between the park and operations on the site is at a minimum. These conditions are quite rare and the meteorological conditions occur for less than four percent of the time. The landfill site is in operation for less than one third of the time and the full impact is felt only for a part of the site's life. Concentrations at the nearest residences are predicted to be below 40 $\mu g/m^3$.

Average annual concentrations estimated by the ISCLT model indicate that concentrations will be well below the MOE Ambient Air Quality Criteria and will not exceed 12 $\mu g/m^3$ at the nearest residence.

4.5.2 Odour

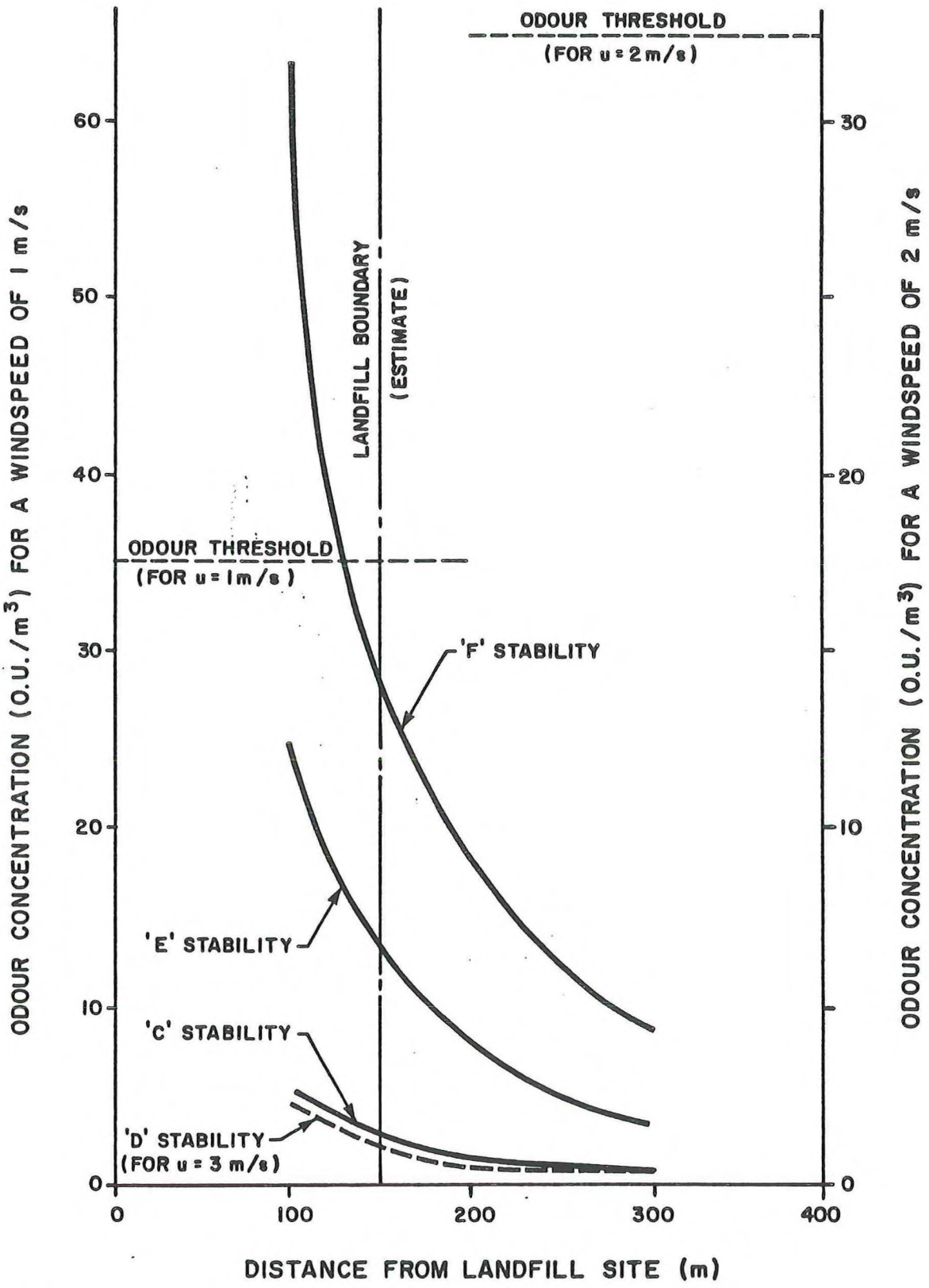
Raw Refuse

Short-term calculations of downwind concentration from the landfill site based on the assumptions outlined in Section 4.4.2 were made for near neutral, neutral and stable atmospheric stability conditions. Only under the more stable conditions were odours estimated to be detectable beyond a hundred metres from the source. The estimated concentrations are presented in Figure 4.5 and show odours would be detected primarily under the most stable conditions, atmospheric stability class "F", at a downwind distance of about 130 metres and a windspeed of 1 m/s. At other less stable atmospheric conditions, better dispersion dilutes the odour to below detectable levels more rapidly. Odour appears to be a localized potential problem and probably, would not be detected off-property unless odour emission rates exceeded 2 O.U./ft^2/min.

The foregoing estimate agrees with measurements carried out at other landfilling operations in southern Ontario (Ontario Research Foundation).

FIGURE 4.5

ODOUR CONCENTRATIONS vs. DOWNWIND DISTANCE



NOTE:

SOURCE EMISSION RATE = 2 O.U./FT.^{2}/MIN.

Because the meteorological conditions under which odour is estimated to be detectable off the site occur infrequently (12-153 hours per year depending on wind direction) odour is not expected to be a problem at site F.

In the long-term, raw refuse will be covered continuously with cover material to a depth of 2 metres or more and there should be no odour due to raw refuse.

Landfill Gas

In the short-term, landfill gas will not likely be generated in appreciable quantities, however with the passage of time, the generation rate will increase to some maximum level and thereafter it is expected to decrease slowly as feed materials are transformed (used up).

Malodorous compounds constitute a very small fraction, about 1 percent or less, of the generated gas. These malodorous compounds are expected to react with the soil cover (Vogel, 1985), thereby being reduced to non-malodorous by-products. Migration of landfill gas is unlikely to pose problems because of the remoteness of residences.

4.6 Recommended Mitigation Measures

4.6.1 Total Suspended Particulate Matter

The main measures which can be used to reduce dust production involve techniques designed to reduce the abrasive effects, on the soil, of traffic movement by the use of paved roads wherever possible, gravel roads where it is not, and surface treatment of both gravel and unpaved traffic routes. The most cost effect method of reducing emission is to spray the travelled surfaces with water. By this means emissions can be reduced by as much as 75%. The use of oil to treat roads is somewhat more effective but, as with watering the surface require repeated treatment, and unless waste oils, which may contain undesireable impurities, are used the cost becomes prohibitive. Calcium chloride which retains moisture more strongly than does soil also

requires repeated applications, and with time reacts with the soil and results in the formation of other calcium salts which contribute to the dusting problem. The most generally accepted method is in fact the use of water while limiting as far as practicable the use of untreated surfaces for traffic movement. Available suspended particulate matter suppression techniques are summarized on Table 4.14.

Since, the emission rate of suspended particulate matter is directly dependent on the amount of soil moved and the height from which it is dropped onto stockpiles or the ground, efforts must be made to reduce the amount of movement to a minimum and to keep the height from which material is deposited on to stock piles or the ground as small as possible.

Wherever possible unused open surfaces should be seeded. However, the use of trees to intercept the dust is unlikely to be effective to any noticeable degree. The dusts consist of fine particles which do not settle readily. The main value of tree planting, with respect to the reduction of dust concentrations, is to create turbulence which assists the dispersion and short term concentrations but has little effect on the long-term concentrations.

4.6.2 Odour

No off-property odour impacts are predicted so no further mitigation measures, other than the normal operating procedures of covering the refuse is considered.

Table 4.14

SUSPENDED PARTICULATE MATTER SUPPRESSION TECHNIQUES

Method	Effectiveness	Comments
1. Road paving	> 95%	Costly for temporary roads. Effectiveness reduced if vehicles deposit mud on the surface.
2. Gravel paving	90%	The gravel gives rise to dust by attrition. Effectiveness reduced by mud and soil deposited by vehicles.
3. Surface oiling	85%	Costly. May result in emissions of contaminants if waste oils are used. Needs repeated treatment.
4. Water sprays	75%	Needs repeated application If excessively sprayed can produce muddy conditions. Most commonly used technique. Cost effective.
5. Calcium chloride	80%	Needs repeated treatment. Washes from surface can eventually create some dust and water quality problems. Costly.
6. Revegetation		Effective in preventing wind erosion but ineffective on constantly travelled areas.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Site F can be developed into an acceptable landfilling operation from an air quality point of view. Limiting activities in the area of the landfill closest to Bayview Park during days when the park is in use will reduce any predicted impacts to acceptable levels. Except for infrequent elevated levels of dust and detectable odours in Bayview Park, no other off-site impacts are predicted. All of the predicted impacts are summarized on Tables 5.1 and 5.2.

On Tables 5.1 and 5.2 the terms "nil", "low", "medium" and "high" are defined below;

nil: no emission and no possible impact

low: suspended particulate emissions are present but no exceedances of provincial air quality criteria (Section 4.2.1) are predicted

medium: suspended particulate emissions are present but no exceedances of provincial air quality criteria (Section 4.2.1.) are predicted at residences
some exceedances (less than 10 percent of the time) are posible at the site boundaries depending on the meteorology

high: predicted suspended particulate concentrations are likely to exceed provincial air quality criteria (Section 4.2.1) more than half the time

Table 5.1

IMPACTS ON AIR QUALITY FACTORS FOR SITE F

Air Quality Factor		Impact
Total Suspended Particulate Matter		
. Construction	- no construction related emissions	No impact.
. Operation		Some impacts above provincial air quality criteria (Section 4.2.1.) in Bayview Park. Expected frequency of occurrence is low.
Odour		
. Construction	- no construction related emissions	No impact.
. Operation	No impact at residences. Not detectable at site boundaries.	

Table 5.2

Site F
SUMMARY OF NET ENVIRONMENTAL IMPACTS

Air Quality Impact	Level of Impact			
	Nil	Low	Medium	High
Suspended Particulate Matter				
. Construction	no construction related emissions			
. Operation			Occasional elevated levels at Bayview Park depending on meteorology.	
Odour				
. Construction	no construction related emissions			
. Operation		Predicted to be undetectable at site boundaries.		

BIBLIOGRAPHY

Brown, D.M., McKay, G.A., Chapman, C.J., 1980. "The Climate of Southern Ontario." Climatological Studies, No. 5, Atmospheric Environment Service. Toronto.

Colorado Deptartment of Health, 1981. "Fugitive Dust Emissions". Memorandum from Tom Tistinic, Colorado Department of Health, 30 September.

Environment Canada, 1982. "Canadian Climate Normals, Volume 2, Temperature 1951-1980". Atmospheric Environment Service.

Environment Canada, 1982a. "Canadian Climate Normals, Volume 3, Precipitation 1951-1980". Atmospheric Environment Service.

Environment Canada, 1982b. "Canadian Climate Normals, Volume 5, Wind 1951-1980". Atmospheric Environment Service.

Government of Ontario, 1985. Environmental Protection Act, February

Hydrology Consultants, 1986. "Design and Operations Report for Site F."

Lawrynink, W.D., 1969. "Southwestern Ontario Tornadoes". TEC-720, Department of Transport, Meteorology Branch.

Ministry of the Environment,1979. "Method for High Volume Sampling and Determination of Total Suspended Particulate Matter in Ambient Air, Report AMP - 101". December.

Ministry of the Environment, 1984. "Method for Sampling and Determination of Atmospheric Dustfall, Report AMP - 142". February.

Ministry of the Environment, 1986. Personal communication from George Nelson, Oakville Office, April.

Ontario Research Foundation, date unknown. "Community Odour Study at the Brock West Landfill."

SENES, 1985. "Air Quality Assessment". Final Technical Report No. 6, Phase 2, Stage 2C, Environment Assessment, Landfill Component of Solid Waste Management, SENES Consultants Limited, June, 1985.

Turner, D. Bruce, 1967. "Workbook of Atmospheric Dispersion Estimates." U.S. Department of Health Education and Welfare.

U.S. EPA, 1979. "Industrial Source Complex (ISC) Dispersion Model, User's Guide, Volume 1". United States Environmental Protection Agency, Report No. EPA 450/4-79-030, December.

U.S. EPA, 1979a. "Industrial Source Complex (ISC) Dispersion Model, User's Guide, Volume 2, Appendices A through I". United States Environmental Protection Agency, Report No. EPA 450/4-79-031, December.

U.S. EPA, 1981. "Improved Emission Factors for Fugitive Dust From Western Surface Coal Mining Sources". 2 Volumes, EPA Contract No. 68-03-2924, July.

U.S. EPA, 1985. "Compilation of Air Pollutant Emission Factors, Volume 1, Stationary Point and Area Sources". United States Environmental Protection Agency, September.

Vogel, 1985. "Air Emission Control at Hazardous Waste Management Facilities". JAPCA, Vol. 35, No. 5, pp. 558-566, May.