

Haldimand Against Landfill Transfers (HALT)  
c/o Ms. Anne Vallentin  
19 Chippewa Street  
Cayuga, Ontario

January 5th, 2005

**Re: Planned Alteration and Expansion of Edwards Landfill**

Dear members of HALT,

At your request I have recently reviewed a series of documents pertaining to the planned alteration and expansion of the Edwards Landfill near Cayuga, Ontario.

I have the following initial comments/recommendations pertaining to the information and site documentation which you have provided to me:

**1) Review of Background Information**

a) The Edwards Landfill is a badly contaminated site, and appears to have had a checkered history. On-site investigations have revealed that large quantities of industrial wastes have been disposed of at the site by a previous owner, at levels which could prove hazardous to the environment.

Intact and leaking drums as well as drum remnants have been found on the property. Free product petroleum hydrocarbons were noted in TP9-01, and free product solvent was observed in TP56-01. There are also two major waste trenches on the site (at least 10 meters and 6 meters deep respectively), with no report of any meaningful investigation of their contents.

The following contaminant concentrations were found in samples of wastes/soils from the site:

- benzo(a)pyrene at levels as high as 56.6 ug/g (micrograms per gram, or parts per million), in sample S05 from test pit TP15-01 ;
- naphthalene levels as high as 6,260 ug/g, in sample S28 from test pit TP63-01;
- total petroleum hydrocarbon (TPH) levels as high as 56,000 ug/g, in sample S28 from test pit TP63-01;
- acetone levels as high as 187 ug/g in sample S32 from test pit TP17-01.

The following contaminant concentrations were found in samples of leachate or contaminated groundwater from the site:

- benzo(a)pyrene at levels as high as 1,400 ug/L (micrograms per liter, or parts per billion), in a sample taken from well OW4B-91;
- naphthalene at levels of 392,000 ug/L, in a sample taken from well OW4B-91;
- phenanthrene at levels of 33,200 ug/L, in a sample taken from well OW4B-91;
- tetrachloroethylene at levels as high as 807 ug/L, in a sample taken from well OW4B-91;
- benzene at levels as high as 558 ug/L, in a sample taken from well OW4B-91;
- xylene at levels as high as 6,550 ug/L, in a sample taken from well OW4B-91.

The following table helps to put the some of the numbers listed above into perspective, by providing maximum on-site levels together with the Ministry of the Environment (MOE) standards which could be expected to be applied to contaminants moving in groundwater or surface water across the site property boundaries.

**Table 1: Contaminant Levels in Groundwater/Leachate at the Edwards Landfill**

parameter	on-site levels (maximum to date)	ODWS limit (applies to groundwater)	PWQO limit (applies to surface water)
benzo(a)pyrene	1,400	0.01	NS
naphthalene	392,000	NS	7
phenanthrene	33,200	NS	0.03
tetrachloroethylene	807	30	50
benzene	558	5	100
xylenes	6,550	300	2 to 40

**Notes:**

- all units in micrograms per Liter (ug/L), equivalent to parts per billion
- ODWS = Ontario Drinking Water Standards
- PWQO = Provincial Water Quality Objectives
- NS = no standard or objective

b) The Ministry of the Environment (MOE) in May 2004 gave the current owners (Haldimand-Norfolk Sanitary Landfill Inc., who are hereafter referred to as “the owners”) an amendment to the Certificate of Approval (C of A) for the site, allowing the owners to significantly alter and expand the landfill.

In essence, the owners will be required to dig up the old landfill and dispose of the non-hazardous portion of the waste in a new fully engineered waste cell elsewhere on-site. The hazardous portion of the waste is to be taken off-site for disposal at an approved facility.

c) The owners’ consultants have calculated that there may be 35,000 to 60,000 cubic meters of waste currently buried at the site which would need to be classified and moved (either off-site or into the new cell on-site). They have also estimated that some 200 drums, and about 7,500 to 15,000 tonnes of hazardous material may need to be removed from the site.

The details of the data and assumptions behind these estimates have not been provided in the site documentation, so I have no way to check them. I am concerned that there may be significant problems with the data, the assumptions and/or the calculations that are the basis for these estimates.

**Recommendation 1**

**The owners of the Edwards Landfill should provide details of the calculations of the amounts of waste, and of the amounts of hazardous waste, in the landfill.**

- d) The local geology can be summarized as follows:
- ◇ the site is underlain by a thick layer of about 14 to 18 meters (m) of silt/clay overburden;
  - ◇ below this there is a discontinuous layer of sand which can be up to several meters thick, with varying amounts of gravel, silt, and clay;
  - ◇ the underlying bedrock surface is generally found at about 17 meters below ground surface (mbgs), with observed depths to bedrock ranging from about 15 to 20 mbgs;
  - ◇ the upper bedrock layers are composed of rocks of the Salina Formation, which is comprised of beds of dolostone, shale and gypsum (the gypsum was mined in the area and a gypsum mine shaft with a tunnel network of unknown extent may have been situated within about 100 meters of the site).

- e) Key aspects of the site hydrogeology can be summarized as follows:
- ◇ the upper 3 to 5 meters (m) of the silt/clay is heavily fractured and weathered, and as with other such deposits in Ontario the fractures will allow the fairly rapid lateral movement of groundwater (and contaminants) if there is a hydraulic gradient to move the water;
  - ◇ fractures have also been noted in the deeper silt/clay (eg. a reference to oxidation stained fissures/partings at 10.67 m depth is found on the log for borehole BH1-01, and fractures were mentioned in descriptions of units with depths of 10 m or more in borehole logs for OW5B\*, OW6A, OW8A, and OW9A);
  - ◇ the deeper fractures noted above will facilitate the downward movement of contaminants, in particular if the fracture network fully penetrates the silt/clay overburden unit;
  - ◇ the basal sand and upper bedrock can be expected to form a single “basal aquifer” unit;
  - ◇ the Hydrogeologic Performance Assessment indicates that this basal aquifer is a confined aquifer (one that is under pressure), but my review of groundwater level data suggests that it is not;
  - ◇ in my view, the water table in the upper fractured silt/clay should be seen as a perched water table - a situation that will facilitate deeper fracture growth in the silt/clay;
  - ◇ the hydrogeology of the site will be much more complicated if there are gypsum mine tunnels or significant karst features beneath the site, and these features could make the site less desirable or in fact undesirable for landfilling.

f) Most local wells within 1.5 km of the site will be drilled wells, and will utilize the basal sand/bedrock aquifer as their water source. These wells are registered with the MOE when the wells are drilled. The upper fractured silt/clay can also provide water supplies to large-diameter dug wells - these are not registered with the MOE, and can only be found through door-to-door surveys.

Condition 45 of the new Certificate of Approval for the site requires a survey of wells within 1 km of the site and of any nearby features associated with gypsum mining to be completed and submitted in writing to the District Manager of the MOE by July 4, 2004.

This survey was completed and submitted on time, but the MOE is apparently requesting that further work be carried out before accepting the report. The findings of this report could have quite an important bearing on various issues pertaining to the site. It is my sense that local residents may be able to provide important insights into some of the issues being considered.

## **Recommendation 2**

**Expanding the survey of water supply wells (out to a distance of 1.5 km from the landfill) should be considered by the MOE, in light of the degree of contamination of this site. The report on the well survey and gypsum mine survey should be provided to the public for review and comment before it is finalized and accepted by the MOE.**

## **2) Key Issues of Concern**

I have identified a number of key issues which I would like to bring to your attention following my initial review of the site documentation:

### **a) Do the Fractures go through the Silt/Clay, and is the Planned Depth of Landfilling Appropriate?**

The original Certificate of Approval (C of A) for the site was based on an application to bury wastes up to a depth of 10 feet or about 3 meters below ground surface (mbgs). The ground surface is at about 199.5 meters above sea level (masl), so the original approval would have allowed landfilling to an elevation of about 196.5 masl.

The alteration and expansion of the landfill which appears to have been approved by the MOE, will allow a minimum elevation of 190.5 masl for the landfill base. The resulting separation between the base of the landfill and the basal aquifer will be reduced under the proposal from more than 10 meters to a minimum of less than 5 meters.

A justified question about the proposal is whether it is too aggressive in terms of the planned depth of the new landfill cells. It is a simple rule of thumb that the thicker the clay layer you have beneath a landfill, the greater the protection it will provide to the underlying groundwater flow systems.

The owners' consultants have carried out calculations and done modelling which suggest that the greater depth of landfilling which is inherent in the new site design would not cause unacceptable groundwater impacts at the site boundary. A major assumption in the calculations and the modelling is the assumption that the silt/clay is not fractured (or that fractures are not in significantly affecting the permeability of the silt/clay). I am not confident that this major assumption is justified.

I am concerned that the issue of fractures in the silt/clay has not been addressed in a careful and conservative fashion. If the fracture network fully penetrates the silt/clay beneath the site, then groundwater flow (and contaminant transport) rates several orders of magnitude higher than have been calculated and modelled are possible.

Relevant to the issue of the depth of fractures in the landfill area is the fact that the water table found in the silt/clay overburden appears to be "perched" (though this should be confirmed through further monitoring). A perched water table simply means that there is an unsaturated layer at the top of the basal sand/bedrock aquifer, below the silt/clay. This will allow the silt/clay to drain freely downwards, and could promote the growth of fractures - possibly to the extent that they fully penetrate the silt/clay layer in places.

At any rate it is likely that there are a significant number of deep fractures in the landfill area. Any fractures at depth in the silt clay will facilitate the downward movement of contaminants from the landfill, especially if any part of the fracture network goes through the entire thickness of the silt/clay. In my view the issue of fracture depths requires considerable further research before the alteration and expansion of the landfill is allowed to proceed.

### **Recommendation 3**

**A detailed assessment of the depth of fractures in the area of the landfill site should be carried out. This assessment should include use of angled boreholes (and water sampling from wells installed in such angled holes), and excavation of at least one deep test pit for the purpose of mapping fracture depths. The alteration and expansion of the site should not be undertaken until this assessment has been completed and accepted by the MOE.**

## b) Adequacy of the Site Remediation Proposal

A key aspect of the current proposal is the plan to excavate all of the existing landfill and relocate it - either into the new fully engineered waste cell on-site, or to licensed off-site facilities (for wastes found to be hazardous).

I am very concerned that the documentation supporting the current proposal does not provide adequate detail about the plans to excavate and relocate the existing wastes. These wastes appear to consist of about 25% hazardous materials (7,500 to 15,000 tonnes in total ), judging by the owners' consultants' estimates.

The methods and criteria for determining whether to dispose of the existing wastes and contaminated soils on-site or off-site (or whether to leave contaminated soils in place) are not clearly defined in the documentation. For example, the Nov. 2003 Site Decommissioning Plan does not clearly specify the sampling methods or frequencies (eg. how many samples per truckload of waste)

Likewise, the Site Decommissioning Plan does not clearly specify the precise lists of chemicals to be tested for, or the criteria which will be used for each chemical to determine whether to investigate in more detail or to take wastes off-site for disposal. I am therefore not in a position to advise HALT members on the adequacy or reasonableness of the frequency of testing or the parameters to be tested for during the waste excavation, because these are not specified in the Site Decommissioning Plan.

As a result, it is in my view quite possible that most of existing wastes will simply be repackaged into the new landfill cell. The issue of whether or not this course of action (disposing of the existing wastes in a new, deeper engineered cell) would be appropriate is explored further in the next section of this review.

### **Recommendation 4**

**Before approval is given to start waste excavations, the owners should be required by the MOE to specify in detail the planned methods and frequencies of waste sampling, and the precise lists of parameters and the criteria proposed to be used to determine how the excavated wastes from the existing landfill will be processed.**

## c) Appropriateness of the Proposal to put the Existing Wastes into the New Cell

It should be noted that there will be a strong financial incentive for the owners to retain in the new landfill cell as much as possible of the wastes and contaminated soils which are presently on the site. The question of whether or not the existing wastes should be retained on-site and disposed of in the new engineered landfill cell is therefore worth considering at this point.

The Hydrogeological Performance Assessment prepared by the owners' consultants came to the conclusion that it was appropriate for all but hazardous wastes to go into the new landfill cell. This conclusion was based on a set of calculations and modelling which are discussed in the document, and which appear themselves to be based on 2 key assumptions:

- i. the fractures in the silt/clay will not increase the rate of groundwater and contaminant movement in the landfill area;
- ii. the leachate from the new landfill will have certain assumed characteristics.

i) The issue of whether the deeper fractures which are present in the silt/clay will facilitate the downward movement of contaminants was discussed in Section 2a above. Further work is needed and recommended to address this key question.

ii) Some of the critical modelling and calculations discussed in the Hydrogeological Performance Assessment are based on a set of “anticipated leachate characteristics” used to define the expected source concentrations of leachate from the new landfill. These estimates of the quality of leachate for the planned landfill are outlined in Table 7.3 of the Hydrogeological Performance Assessment.

I am concerned that the anticipated leachate characteristics (which were used as source concentrations for calculations and modelling of the site performance) do not appear to take into account the quality of leachate which could be expected from the existing wastes at the landfill (which are to be excavated and relocated into the new landfill cell).

As I understand the Site Decommissioning Plan, only wastes that produce leachate whose strength exceeds the TCLP test criteria in Schedule 4 of Regulation 558/00 would be taken off-site. Any wastes which produce leachate below the criteria would by default thus be acceptable to stay on-site.

The following table compares the “anticipated leachate characteristics” from Table 7.3 of the Hydrogeological Performance Assessment (used for modelling potential site impacts) with the Regulation 558/00 leachate quality criteria for 2 key parameters: benzene and vinyl chloride.

**Table 2 - Comparison of Measures of Leachate Quality, Edwards Landfill Site**

<u>Parameter</u>	<u>Anticipated Leachate Characteristics</u> (used to model site impacts)	<u>Leachate Quality Criteria</u> (used to determine what can go in)
benzene	15 ug/L	500 ug/L
vinyl chloride	10 ug/L	200 ug/L

As can be seen from Table 2, the owners’ consultants appear to be indicating that existing wastes with fairly potent potential leachate strengths will be allowed to be retained on site and landfilled in the new cell. However when modelling the potential impacts of the new site on the environment, the consultants have used an assumed leachate strength which is only a fraction of what they are saying would be permissible in the existing wastes to be retained at the site.

For example, the calculations and modelling in the Hydrogeological Performance Assessment assumed concentrations of benzene in the future landfill’s leachate of 15 ug/L. At the same time, the consultants are indicating that wastes with potential leachate concentrations of up to 500 ug/L of benzene will be acceptable to be retained in the landfill. This is not a conservative approach to the modelling and site design, and in my view it needs to be re-examined.

It may be that any of the existing wastes and contaminated soils which are to be retained in the landfill should be placed in a special segregated cell which is designed to a higher standard than the rest of the site, or that the criteria for wastes being retained in the site should be more stringent than the Regulation 558/00 TCLP leachate quality criteria.

### **Recommendation 5**

**The MOE should review the appropriateness of the site design, given that calculations and modelling in the Hydrogeological Performance Assessment may have been based on unrealistically low estimated landfill source levels of critical contaminants such as benzene and vinyl chloride.**

#### **d) The PAH Issue**

A further concern pertaining to the question of whether the Site Decommissioning Plan's soil and waste classification criteria are appropriate, is the potential lack of criteria for many PAHs (polynuclear aromatic hydrocarbons).

The Waste Characterization Report shows that PAH contamination is widespread in the existing wastes on the site. My understanding of the Site Decommissioning Plan is that there are no criteria for screening PAH wastes from being re-landfilled into the site with the exception of benzo(a)pyrene. This means that many PAH-contaminated wastes could simply be re-landfilled, regardless of how severely contaminated they are with PAHs.

For example, one of the contaminants which is most widespread across the site and which is found at high levels is naphthalene. Naphthalene levels as high as 6,260 ug/g (parts per million) were found in soil/waste sample S28 from test pit TP63-01, and naphthalene levels of 392,000 ug/L were found in a water sample taken from well OW4B-91. There is no leachate quality criterion for naphthalene in Regulation 558/00, so until and unless it is otherwise specified it is possible that any wastes and soils which are laced with naphthalene (regardless of the concentrations) could be deemed acceptable for re-landfilling into the site.

Likewise there are no criteria for any of the other PAHs known to be in the site (except benzo(a)pyrene), including acenaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluorene, fluoranthene, pyrene, and others.

This is a concern because the calculations and modelling used in the site design work did not appear to consider the fact that some of the critical contaminants at this site may be PAHs.

### **Recommendation 6**

**The MOE should require explicit consideration to be given to developing appropriate soil and waste screening criteria for those PAHs known to be present at significant levels on site. The MOE may need to provide advice or assistance in setting such criteria.**

#### **e) Migration of Leachate from the Existing Site**

A persistent puzzle in the site documentation is the unanswered question of where leachate from the existing waste disposal area is going.

“Leachate” is the technical term for the contaminated liquid which is generated inside a landfill, when water seeping into the landfill (from rainfall or melting snow) comes into contact with the landfill's wastes and “leaches” chemicals from the wastes.

Leachate composition is strongly linked to the composition of the wastes that the leachate is derived from. Leachate from the existing wastes will contain hundreds of chemicals. Some of these chemicals will be harmless, but some are problematic if they get into the environment, and a few are considered hazardous if present even in minute amounts.

The leachate from many parts of the wastes currently found at the Edwards Landfill is therefore a noxious liquid which should not be ingested, and which should be prevented from coming into contact with plants, fish or animals in the natural environment. It include potent carcinogens such as benzene and benzo(a)pyrene.

Landfill leachate is formed when precipitation (rain or melted snow) comes into contact with a landfill's wastes, thus the total amount of leachate which may be generated in a given year is determined by the amount of precipitation in that year and by the size of the waste footprint.

For example, it appears that the Edwards Landfill currently has wastes spread over an area or "footprint" of about 2.5 hectares or 25,000 square meters. Average annual precipitation in the area is about 900 mm/year, and it is my sense that at least one third of that amount is currently seeping into the wastes.

Thus at least 300 mm (or 0.30 meters) of precipitation per year could form leachate, and total leachate currently generated by precipitation onto the landfill would be at least:

$$0.30 \times 25,000 = 7,500 \text{ cubic meters or about 7.5 million liters of leachate per year.}$$

There are currently no leachate collection facilities at the landfill, thus all of this leachate is entering and causing contamination of the groundwater flow system and or/surface water system in the vicinity of the site.

As mentioned at the start of this section, a persistent puzzle in the site documentation is the unanswered question of exactly where these 7.5 million liters per year of leachate from the existing waste disposal area are going.

There appears to have been no serious attempt made by the owners' consultants over the 3 1/2 years that they have been working on this file to derive a leachate balance and to investigate likely contaminant transport pathways, to try to account for the 7.5 million liters annually of leachate being generated at the site.

There may be significant environmental problems or potential problems associated this leachate (which contains potent carcinogens), depending on where it has gone. I consider it highly unlikely that all of the leachate has somehow remained in place.

As said, this question has received almost no attention in the site documentation which I have reviewed. For example:

- The January 2002 report on "Waste Characterization Activities" documents heavy contamination of soil and groundwater in the immediate area of the wastes, but does not look into where the contamination might be moving to.
- The October 2002 "Hydrogeologic Performance Assessment" does not seriously examine the issue of where leachate from the site might be going, but provides a statement on page 29 that "it is concluded that the leachate is likely isolated to the waste trenches and the water table unit in the immediate vicinity of the deep trenches and pockets of thick refuse deposit outside the deep trenches". There is also a statement on page 2 that "the environmental issues pertaining to the existing on-site waste disposal areas are to be addressed as part of the Site Decommissioning Plan".
- Review of the Site Decommissioning Plan reveals that the question of where leachate from the site might be going is not dealt with in that document, but reference is made to a September 2003 investigation of soil and groundwater quality along Brooks Road immediately west of the site.

- Review of the October 2003 report “Edwards Landfill Site - Off-Site Investigation, Brooks Road” shows that the investigation had a very narrow focus (as set out on page 1 of the document) to only investigate the “potential presence ... of soil and shallow groundwater impacts beneath Brooks Road”.
  - The Off-Site Investigation document found evidence of movement of benzo(a)pyrene in shallow groundwater flowing off-site to the west.
  - It then in my view inappropriately compared the benzo(a)pyrene levels to the non-potable groundwater criteria from Ontario Regulation 558/00, rather than the Ontario Drinking Water Standards (ODWS) which are normally applied at landfill site boundaries.
  - The benzo(a)pyrene is found in the 3 wells at levels of 70, 10 and 40 nanograms per Liter (ng/L) or parts per trillion, compared to the ODWS of 10 parts per trillion.
  - The Ontario Drinking Water Standards describe benzo(a)pyrene as having “strong carcinogenic properties”.

So the only investigation to actually look into whether contaminants were moving off-site, found evidence of significant contaminant migration in the pathway investigated (the shallow fractured silt/clay). The investigation did not look for the presence of contaminants in surface water flows nor did it evaluate their presence in groundwater flows in the basal aquifer (both pathways are of regulatory interest).

It is my view that only a fraction of the groundwater and surface water contamination which is on the move from this site was found by this investigation.

In my view, there are at least 5 possible pathways for leachate to move outward from the waste disposal site:

- I. lateral migration through the fractured silt/clay, with discharge to surface water features;
- II. lateral migration through the fractured silt/clay groundwater flow system, onto adjacent properties;
- III. groundwater discharge and/or overland flow directly to surface water features, followed by surface water flow via local ditches;
- IV. vertical downward migration through deeper fractures in the silt/clay (if these fully penetrate the silt/clay unit), causing contamination of the underlying basal aquifer;
- V. vertical downward migration through sink holes related to underlying gypsum mine tunnels or karst features, in turn leading to extensive contamination of deeper groundwater including the basal aquifer beneath and around the site.

In my opinion, the monitoring done to date can not be used to rule out any of these scenarios, and it has substantiated one of them (Scenario II). Detailed monitoring should be done to determine what is currently happening to leachate from the landfill, as this monitoring may provide information which is crucial to assessing the potential impacts of the plans to alter and expand the landfill site.

### **Recommendation 7**

**The MOE should require an assessment of the fate of leachate which has been generated (at a rate of millions of liters per year) at the site for decades. In particular, this assessment should investigate all possible pathways of leachate migration and possible hitherto undetected off-site contamination problems.**

#### **f) Gypsum Mines and Karst Features**

A final major issue of concern is the reported occurrence of gypsum mining in the immediate area, and in particular the reported presence of a gypsum mine shaft (with an unmapped tunnel/shaft network) within about 100 meters of the site.

Information provided by Ms. Ilse Kraemer of the Grand River Heritage Mines Society indicates that there was a mine in operation on Lot 25 (just across Brooks Road to the northwest of the site) in the 1940s. Apparently in 1948/1949 a mine shaft was dug in the corner of Lot 25 near the intersection of the rail line and Brooks Road (within a few hundred meters from the northwest corner of the landfill property). To date, no maps of the mine tunnels/shafts have been found.

The possible presence of a nearby gypsum mine complicates matters considerably. Operations in the Lot 25 mine were at a depth of 83 feet (about 25 meters), which is close enough to the ground surface that post-closure subsidence and caving of the worked out mine could have a significant effect on the overlying units.

To understand the potential impacts of the existing site properly, it is vital to know whether any of the mine tunnels extended beneath the site and if so where. This is because any subsidence/caving caused by the tunnels could affect the permeability of the silt/clay layer beneath the site, and thus make that clay layer much less effective for containing any leakage out of the existing wastes.

There are a couple of incongruities in the site hydrogeology which could be indicative of the influence of the former mine and/or local karst features (which could be related to the mine):

1. Water level observations for the basal aquifer at the site indicate that there is little or no hydraulic gradient across the western half of the site. For example, Figure 5.7 in the Hydrogeologic Performance Assessment shows identical water levels for 5 of the 6 wells on the west half of the site, and a difference of only 3 cm from that water level in the 6th well. This is quite uncommon, and could suggest the influence of the flooded mine on local groundwater levels.
2. The borehole logs for OW5A-91 and OW5B-91 (which were drilled a few meters apart) are remarkably different from one another, and could be providing an indication that subsidence/caving has occurred in the vicinity. In particular, the borehole log for OW5B-91 is quite different from the other borehole logs for the site (with repeated mention of red coloured silt/clay, and of stones and gravel clasts/layers throughout the overburden profile). The bedrock surface at OW5A-91 is at about 180 masl (and for some reason this was not shown on the bedrock surface contour map on Figure 5.4 of the Hydrogeologic Performance Assessment) - the inferred bedrock surface in OW5B-91 is 1.8 meters higher at 181.8 masl.

The possible presence of mining tunnels and/or karst features beneath the site is a potentially very significant issue, which should be researched properly before any major work is started on the site. Any substantial subsidence/caving due to unmapped mine tunnels or karst features beneath the site could of course undermine the effectiveness of the proposed expanded landfill's liner and leachate collection system.

### **Recommendation 8**

**Before approval is given to start waste excavations or landfilling, the owners should complete a thorough investigation of the potential for gypsum mine tunnels and/or karst features to be present beneath the site. The investigation should also evaluate possible anomalous surface topography in the area as to the possibility of its being related to subsidence or caving of such features.**

This completes my comments and recommendations at this point. As you can see, I am recommending that considerable additional work needs to be done before waste excavations and/or landfilling begin at the site.

I am not currently in a position to advise HALT members about whether to oppose the plans for excavating the existing wastes and then altering and expanding the landfill operations at the site, or to simply work toward achieving the best possible safeguards for any such operations.

My advice on that question will depend on the outcome of the additional work which I am recommending. If the owners decide to move forward with getting excavation and/or landfilling operations going without first doing the recommended work, then I would probably recommend opposition on the basis that the plans to move forward are premature.

Please feel free to contact me if you have any questions about these comments and recommendations. I wish you all the best in the meantime.

Sincerely,

A handwritten signature in black ink that reads "WRuland". The letters are cursive and somewhat stylized.

(Wilf Ruland, P. Geo.)

766 Sulphur Springs Road  
Dundas, Ontario  
L9H 5E3  
(905) 648-1296  
deerspring@hwcen.org