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Gartner Lee Associates Limited

Consulting Engineering Geologists and Hydrogeologists

Toronto-Buttonville Airport ■ Markham, Ontario ■ L3P 3J9 ■ 416-297-4600

WITNESS STATEMENT

OF

E. GRANT ANDERSON, P.ENG.
CONSULTING HYDROGEOLOGIST
GARTNER LEE ASSOCIATES LIMITED

IN THE MATTER OF AN APPLICATION
BY
RIDGE LANDFILL CORPORATION LIMITED
FOR EXTENSION OF SITE OPERATIONS

AUGUST 11, 1981

1.0 STATEMENT BY:

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2.0 STATEMENT FOR:

This statement and other related studies were prepared at the request of M.M. Dillon Limited on behalf of Ridge Landfill Corporation

3.0 QUALIFICATIONS AND EXPERTISE:

I was born and raised on a dairy farm north of Hamilton, Ontario. I left the farm in 1966 and attended Queen's University in Kingston where I received a degree in Engineering Geology in 1970. In 1978, I became designated as a Consulting Engineer in the Province of Ontario.

Since graduation in 1970, I have been employed by firms consulting in engineering geology and hydrogeology. At the present time, I am a Consulting Hydrogeologist and a Principal of Gartner Lee Associates Limited, Consulting Engineering Geologists, Hydrogeologists and Biologists, Markham. During my career, I have kept abreast of technological advances in hydrogeology by attending graduate courses at recognized Universities in Canada and the U.S.

Our Company has been involved in area studies delineating lands that are suitable for waste disposal for over 15

regional municipalities and counties. We have also been involved in hydrogeologic design studies of numerous proposed landfill sites and active facilities. In addition, we have consulted to all levels of Government, both Provincial and Federal on both practical projects and research assignments related to leachate migration in ground water flow systems.

In summary, I feel my experience in waste management as it relates to hydrogeology qualifies me to speak as an expert in this field. I have attached my curriculum vita on the next page for further details as to my qualifications.

4.0 CONTENT OF STATEMENT:

This witness statement will address the hydrogeological setting of the Ridge Landfill Site. Hydrogeological conclusions and recommendations will be summarized pertinent to design of future operations at the site. The evidence is summarized in three sections as follows:

SECTION 5.0 - Introduction of Evidence
SECTION 5.1 - General Hydrogeological Concerns at all Landfills
SECTION 5.2 - Hydrogeological Aspects of The Ridge Landfill Extension.

5.0 INTRODUCTION OF EVIDENCE:

Gartner Lee Associates Limited was retained by M.M. Dillon Limited, on behalf of the Ridge Landfill Corporation, to complete a hydrogeological assessment of the Ridge Landfill property. Our analysis consisted of studying the existing site and proposed expansion lands. Resultant from our investigations, we prepared a report titled "Ridge Landfill Site Hydrogeological Study" dated July 28, 1981. Details of the evidence summarized in this witness statement are contained in the referenced report.

5.1 GENERAL HYDROGEOLOGICAL CONCERNS AT ALL LANDFILLS:

When considering the siting, design and operation of a landfill, one must assess the potential effects on the natural environment.

The following chart, called Landfill Hydrogeologic Concerns, depicts refuse placed below the ground surface in an uncontrolled manner. As noted on the chart, the two primary concerns of hydrogeologists are:

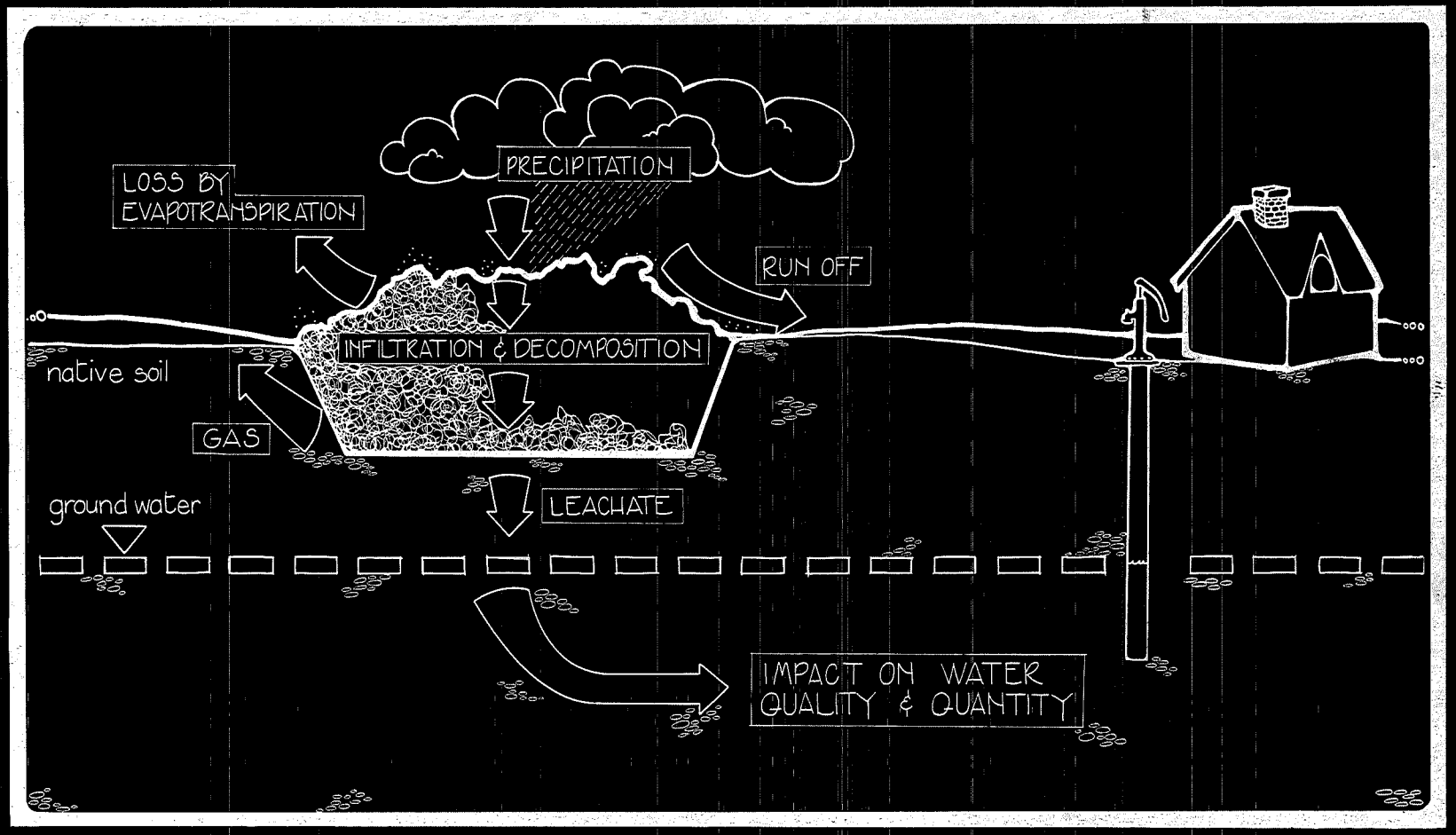
1. the movement of leachate and its potential impact on the ground water and surface water resources adjacent to the site and

2. the movement of gas and its potential impact on developments adjacent to the site.

Water from precipitation infiltrates the refuse and migrates vertically downwards towards the water table. Some of this precipitation will run-off overland and some will evapotranspire back into the atmosphere. That fraction that infiltrates the refuse, during its migration, will suspend and/or dissolve contaminants creating what is commonly referred to as leachate. These physio-chemical reactions also create gases, methane and carbon dioxide being of major concern. Methane is lighter than air and potentially explosive. Carbon dioxide is heavier than air and mixes with the ground water increasing its hardness.

The contaminated water infiltrates to the water table where it enters the ground water and migrates with the flow system.

Simply stated, a site can be considered hydrogeologically suitable for landfilling if it can be shown that leachate and gas will not migrate from the site and impact adjacent properties. Thus it is important to know the hydrogeological setting in the vicinity of any proposed disposal area.



LANDFILL HYDROGEOLOGIC CONCERNS

Gartner Lee Associates Limited

For example, if a landfill was placed within an environment which consisted of sand and gravel, many adverse potential problems would have to be overcome. Leachate generally moves very quickly through these soils (100 to 300 feet per year) and pollution of ground water a long way from the site would be possible. Similarly, methane would also probably migrate long distances creating potential hazards to adjacent development. These are very poor areas to place solid waste.

On the other hand if a landfill was placed in a clayey environment, hydrogeological problems would be minimal. Gases would naturally vent through the garbage and not the adjacent soils (garbage being more permeable than clayey soils). Thus no impact would occur on adjacent development. Also leachate would move less than a foot per year compared to the 100 to 300 feet per year for sands. Thus no impact on ground water quality would likely occur either.

These are generalized concepts with practical application as will be seen in the next part of my witness statement.

5.2 HYDROGEOLOGICAL ASPECTS OF THE RIDGE LANDFILL EXTENSION:

The investigations carried out at this site consisted of:

a) initial overview study, including a literature search, evaluation of Ministry of the Environment water well records and aerial photography interpretation,

b) a field study involving the installation of piezometers and standpipes, site mapping and water well inventory,

c) monitoring of the installations for quality and water level elevations and surface water quality monitoring.

d) preparation of a detailed report defining the hydrogeology and making recommendations for design of the future landfill operations.

The results of this study are described in detail in our report titled "Ridge Landfill Site, Hydrogeological Study" dated July 28, 1981. This report accompanies the witness statement as Appendix 1. It is divided into a descriptive report forming the main body with supportive and analytical data appended.

The existing landfill operation has taken place within a flat glacial till plain since 1963. Excavations are made to about 20 feet into the glacial clayey silt till. Filling has extended to a maximum of 40 feet above the existing terrain. The proposed extension area of this existing facility is also located in the same glacial clayey silt till terrain feature.

This relatively flat glacial till is about 145 feet deep, at the Ridge Site, overlying a black fractured shale bedrock. Most of the domestic water wells in the area receive their water from this shale bedrock aquifer. Discontinuous sand lenses are present sporadically, both within the glacial till, under the till (between the till and the bedrock) and

on top of the till unit locally.

The upper 10 to 12 feet of the till are fractured and lateral ground water velocities of about 3 feet/year can be expected in this stratum. This flow radiates outwards from the existing fill. The underlying dense unweathered till is an effective aquitard, permitting very small quantities of water to move at extremely slow velocities. Our analysis indicates that the minimum flow through time for water originating at the ground surface to the bedrock aquifer would be 650 years. It would not be unreasonable to expect actual flow through times of 3000 years at this site. Ground water movement in the upper fractured portion of the shale bedrock aquifer is faster (66 feet/year) and in an easterly direction. Ground water movement in the confined sand lenses within the glacial till, will be at the same velocity as within the till. Velocities in unconfined sand lenses truncated by local drainage ditches will be about 100 feet/year.

Surface drainage of flat clayey soils is typically poor. At this site drainage has been improved by the excavation of surface drainage ditches along the south edge and through the middle of the site. In addition, tile drains have been placed in the fields to improve soil drainage for agricultural purposes.

As indicated earlier, ground water in the underlying bedrock aquifer supplies most wells for domestic and agricultural uses. On site studies and monitoring carried out by ourselves and off-site studies carried out by the Ministry of the Environment confirm that the glacial till soils have protected the aquifer from contamination originating at the landfill.

Likewise landfill contaminants have not had any impact on water quality in the surface drains.

Because of the very slow ground water movement in the clayey silt soils, it is expected that precipitation infiltrating the refuse will mound or build up since it can't escape as fast as the infiltration rate. This could result in leachate springs forming at the toe of the landfill. We have calculated that infiltration of precipitation into the garbage would have to be reduced to less than 1-3/4 inches per year. It is our opinion that this cannot be achieved. As such we have recommended that a toe drain be incorporated in the design of this site to prevent overland flow of leachate directly to surface drains.

We have recommended allowing leachate to migrate out the bottom of the site and through the upper fractured till with reliance on natural attenuation. As it is not possible to confidently predict the amount of attenuation that will take place in the fractured till, we have recommended that a comprehensive monitoring program be carried out in a recommended 100 foot buffer zone adjacent to the fill. This monitoring will provide a minimum of 33 years lead time to assess the attenuation taking place, assess the need for collecting attenuated leachate and provide for lead time to incorporate the collection system if it is needed.

A contingency collection system that would collect attenuated leachate has been recommended should the need arise.

In addition to the above factors a number of other features

on the site will require modification to ensure safe operations. These features and the suggested modifications are

a) tile drains between the fill and the existing drains should be removed and the trenches backfilled with on site clay soils;

b) all ground water monitors and well casings within the fill area over 50 feet deep should be removed and the holes grouted to surface prior to filling;

c) sand seams encountered between the edge of the fill and the adjacent drains should be excavated and backfilled with on site clay soils.

The recommended buffer zone will provide protection to off site buildings from gas migration. However, monitors between fill areas and on site buildings will be required to check on combustible gas concentrations. At this time no venting system is required at this site to protect on site buildings.

To check on the recommended design, we have outlined a suggested monitoring program. Once the site is finally signed, this program should be completed to incorporate all pertinent concerns.

Based on our analysis, we conclude that if this site is operated as outlined in our detailed hydrogeological report and summarized here, no adverse impacts will occur resulting from leachate or gas movement. As such this site is suitable hydrogeologically for landfilling.

6.0 OTHER EXPERTS:

Gartner Lee Associates Limited has not relied on the opinions of any other experts. Our conclusions and recommendations are based on our own original studies. However, we have supplemented our own data with the chemical analysis data which was provided by the Ontario Ministry of the Environment and Enviroclean Limited. This data, provided to us, we have accepted at face value in carrying out our interpretations. The on-site data is appended to our Hydrogeology Report and the M.O.E. off-site data is appended to the witness statement of Mr. John Luyt.

7.0 WITNESS AVAILABILITY:

I will be available to appear before the Environmental Assessment Board for examination and cross-examination, if required.

Respectfully submitted,

GARTNER LEE ASSOCIATES LIMITED

E. Grant Anderson, P.Eng.,
Consulting Hydrogeologist.