

**CLASS ENVIRONMENTAL ASSESSMENT  
DUFFIN CREEK WATER POLLUTION  
CONTROL PLANT OUTFALL PICKERING,  
ON - DESKTOP STUDY OF  
GEOTECHNICAL CONDITIONS**

Region of Durham Works Department  
605 Rossland Road East  
Whitby, ON L1N 6A3

GEOTMARK00171AA  
June 17, 2010

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605 Rossland Road East  
Whitby, ON L1N 6A3

**Attention: Rich Tindall, P.Eng.  
Project Manager**

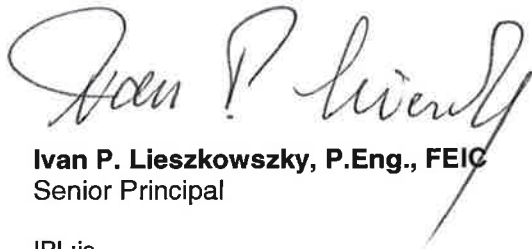
Dear Mr. Tindall,

**Re: Class Environmental Assessment Duffin Creek Water Pollution Control Plant Outfall  
Pickering, Region of Durham, ON – Desktop Study of Geotechnical Conditions**

Enclosed please find five (5) copies of the desktop study report on the geotechnical conditions.

We shall be pleased to discuss any questions that may arise from this report.

For and on behalf of Coffey Geotechnics Inc.



**Ivan P. Lieszkowszky, P.Eng., FEIC**  
Senior Principal

IPL:js

Distribution: 5 copies – Durham Region  
1 copy – York Region  
1 copy – CH2M  
1 copy – Coffey Geotechnics

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## **1 INTRODUCTION**

The Regions of Durham and York have engaged CH2M Hill to proceed with a Class EA to identify a suitable solution for addressing the limitations of the existing outfall at the Duffin Creek WPCP in Pickering. As a possible solution the construction of a 3600 mm diameter new outfall pipe is being considered. To assist CH2M in their work the Regions have retained Coffey Geotechnics Inc. to investigate the subsurface conditions within the area of this potential new outfall pipe reaching out into Lake Ontario about 3000 m. The study was to be carried out in two stages: 1) a desktop study, to be followed by 2) a geotechnical investigation consisting of exploratory boreholes, laboratory testing and the preparation of a geotechnical data and interpretive report. Presented herein are the results of the desktop study.

## **2 SOURCES OF INFORMATION**

For the desktop study we have referred to geological reports and maps, previous geotechnical and geophysical investigations and an unpublished report on the seismic hazard evaluation for the Lake Ontario basin.

## **3 REGIONAL GEOLOGY**

The City of Pickering is located in the Physiographical Region of the Iroquois Plain along the north shore of Lake Ontario and is bordered in the north by the South Slope of the Oak Ridges Moraine. The abandoned old shoreline of post glacial Lake Iroquois, formed as the last glaciers withdrew from the region about 10,000 years ago, lies about 10 km inland from the present Lake Ontario shoreline. The wave-washed Iroquois Plain is characterized by gently rolling, beveled till plain with flat sand and clay plain areas that formed as lake bed deposits in Lake Iroquois. Deeply eroded stream valleys of the Rouge River and the Duffin Creek provide the largest relief in the region.

Upper Ordovician shales of the Whitby and Georgian Formations underlie the region in its east and west portions respectively. The Whitby formation is a grey and black shale and the younger Georgian formation is a grey shale with limestone interbeds. Of these two formations, the Whitby formation is of greater interest since it is expected to underlie the project site as shown on the attached Drawing 1.

Shales of the Whitby Formation are generally medium strong, moderately fissile, and are of medium durability. They are thinly bedded with two sets of nearly vertical joints. The rock comprises three members of which the lowest (oldest) often contains organic gases.

## **4 KNOWN VALLEYS IN THE BEDROCK**

Shown on Drawing 1 is the inferred bedrock topography map which was plotted from available well drilling data. As shown on the drawing, the rock surface topography is complex. In addition to a general trend of the rock surface sloping from the North West to the South East the rock is deeply incised with depressions and buried valleys carved out by the glaciers. Two of these valleys, one to the west, the other to the east of the WWTP site, are shown on Drawing 1.

Based on the records of the 1974 Peto MacCallum geotechnical investigation one of these rock valleys, possibly the one to the east appears to extend into Lake Ontario and intersect the line of the existing and proposed outfall alignments. Based on the records of the 1974 investigation we have attempted to plot the location and depth of the buried rock valley. The interpreted results are shown on the attached SK-1. Based on the limited data, it appears that the valley is trending from the north-east to the south-west and that its deepest point is at about Elevation 45 + m. It is expected that the geophysical survey, which is part of Coffey's assignment, will provide more accurate details of this or any other depressions that may be present in the rock surface.

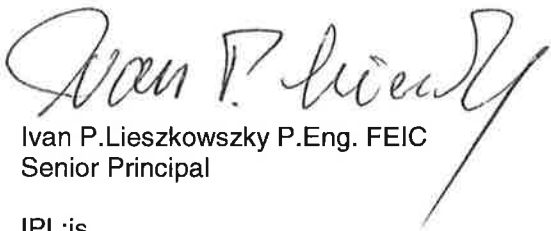
## 5 EVALUATION OF SEISMIC HAZARDS

As part of Coffey's (then Geo-Canada) involvement in the Region of York Long Term Water Project (LTWP) via Durham Gail M. Atkinson, Ph.D. professor at the Ottawa University was retained to evaluate the seismic hazards for the Pickering area. Prof. Atkinson also prepared the seismic hazard evaluation upgrades between 1990 and 1998 for the Pickering Nuclear Power Plant. Without providing the details of this unpublished report Professor Atkinson has reached the following conclusions and recommendations:

" The seismic hazard for the study area of the proposed water supply project is low to moderate. Preliminary estimates of the ground shaking expected at a probability of exceedence of 2% in 50 years indicate relatively modest amplitudes of motion, with peak ground accelerations of about 10% of the acceleration due to gravity. Much work on seismic hazard evaluation has already been done for this area in connection with the Pickering nuclear power plant, and is relevant to the selection of design ground motion levels for this project".

Relevant figures from the above referenced Pickering Power Plant Upgrade Reports, showing the seismicity of the Lake Ontario region, recent (1980-1997) seismicity events, and the Pickering mean ground motion spectrum probability, are shown on the attached Figures 1, 2 and 3 respectively.

For and on behalf of Coffey Geotechnics



Ivan P. Lieszkowszky P.Eng. FEIC  
Senior Principal

IPL:js

Enclosures

## Important information about your **Coffey Report**

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

### **Your report is based on project specific criteria**

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

### **Subsurface conditions can change**

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

### **Interpretation of factual data**

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by

earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

### **Your report will only give preliminary recommendations**

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

### **Your report is prepared for specific purposes and persons**

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

## Important information about your **Coffey** Report

### **Interpretation by other design professionals**

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

### **Data should not be separated from the report\***

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

### **Geoenvironmental concerns are not at issue**

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

### **Rely on Coffey for additional assistance**

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

### **Responsibility**

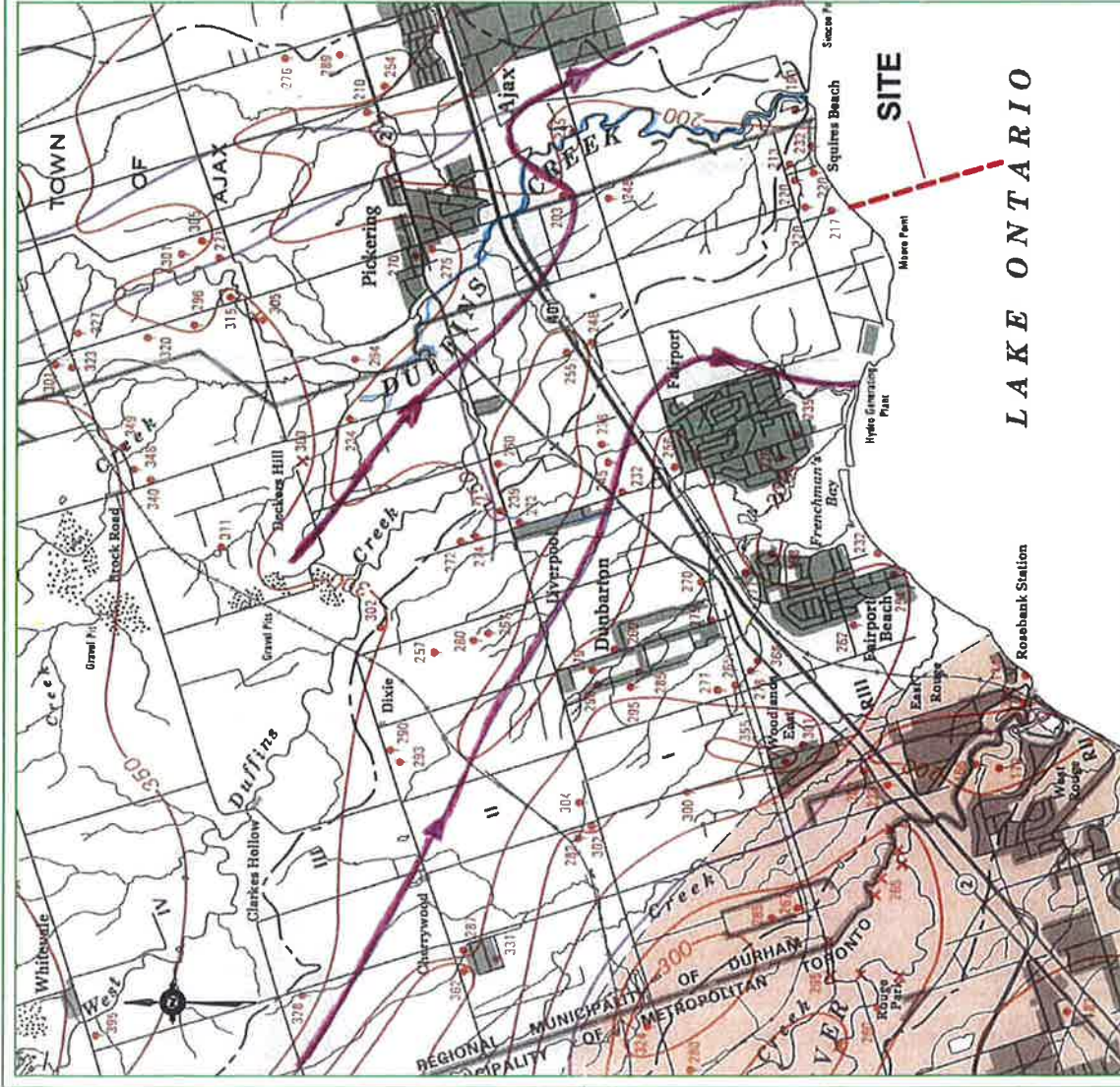
Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

\* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

# Appendix A

**Drawing 1 and SK-1**





### LEGEND

**PALEOZOIC**

**UPPER ORDOVICIAN**

- Georgian Bay Formation: shale with limestone interbeds
- Whitby Formation: shale

Geological boundary, approximate

Bedrock surface contour, interval 50 feet

Bedrock well; approximate elevation of top of rock

Deep overburden well, approximate elevation of bottom of well

Bedrock outcrop, approximate elevation of top of rock (where shown)

Approximate location of assumed bedrock valley

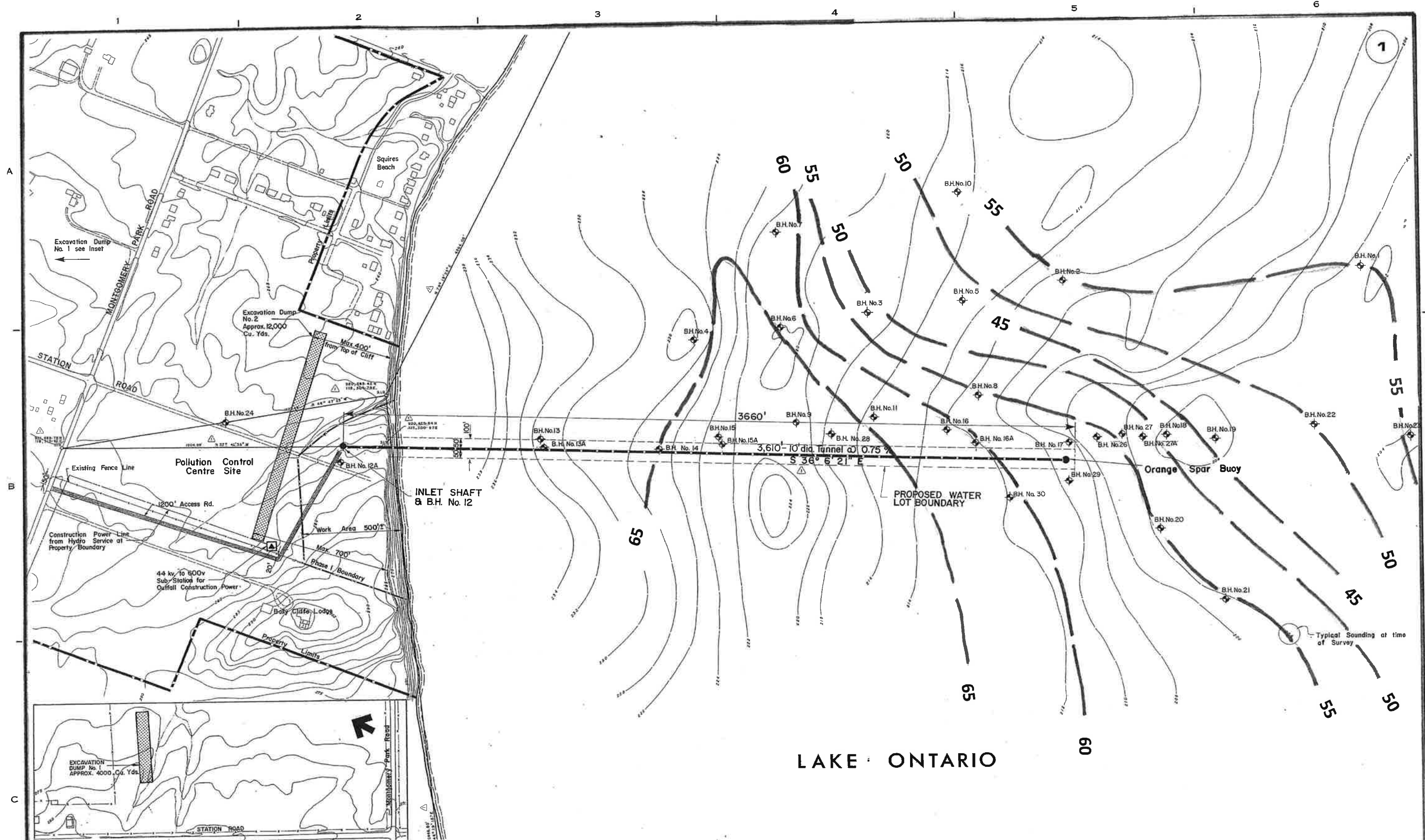
  

**SOURCES OF INFORMATION**

Bedrock geology after Hewitt, 1972; bedrock topography by U. Sibul on the basis of water-well records on file with the Ontario Ministry of the Environment as of December 1974.



drawn	S.S.	<b>coffey geotechnics</b> SPECIALISTS MANAGING THE EARTH	client:	DURHAM REGION
approved	I. L.		project:	DUFFIN CREEK OUTFALL
date	June 2010		title:	BEDROCK GEOLOGY AND TOPOGRAPHY
scale	1: 75,000		project no.:	GEOTMARK00171AA
original size	Letter			drawing no: 1



Note: This Drawing is based on Proctor & Redfern Limited  
 Dwg, No B-74403-G1 Dated Dec. 1974 and on  
 boreholes drilled by Peto MacCallum LTD. July 1974.

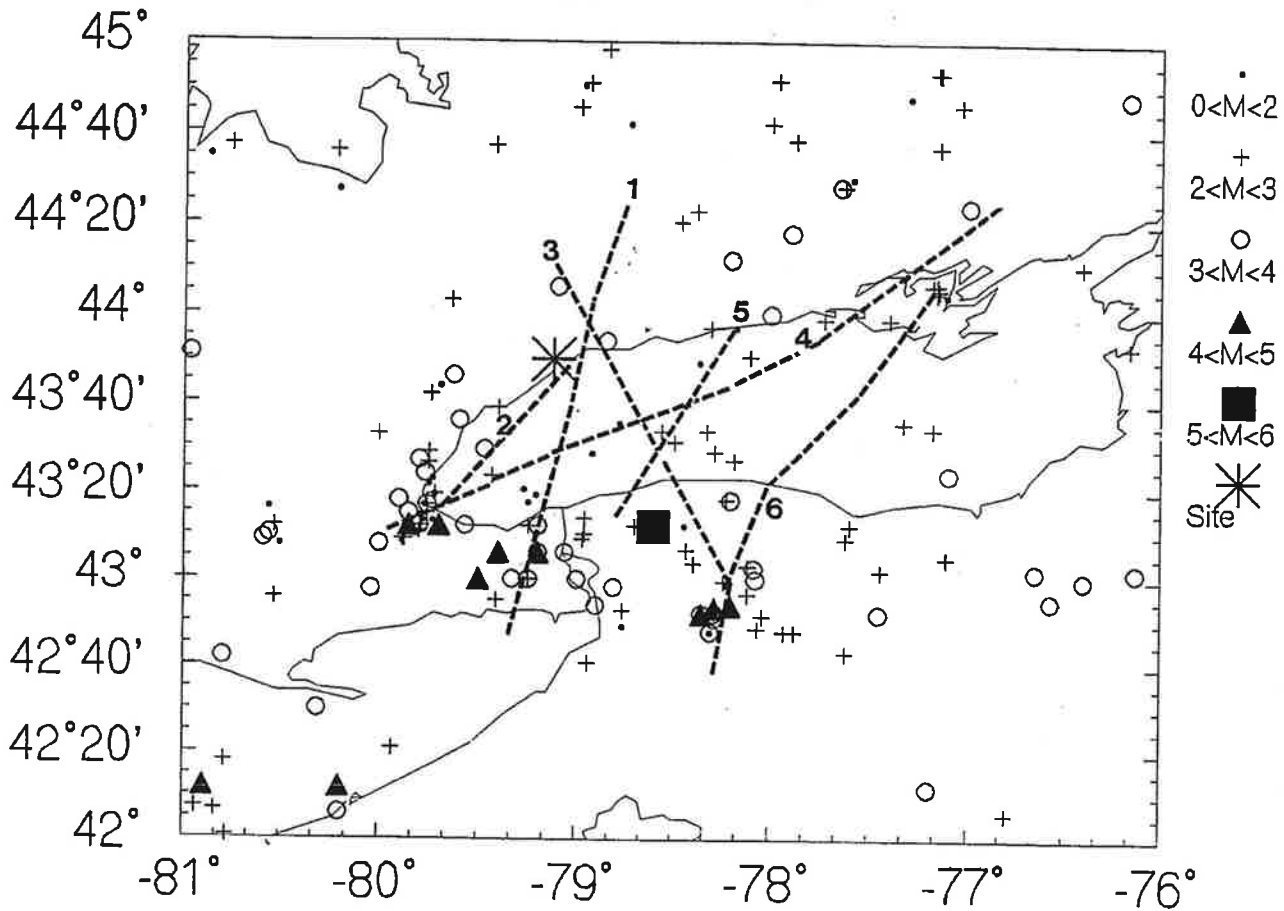
**INFERRED ROCK CONTOUR PLAN**

GEOTMARK00171AA  
 SK-1

# Appendix B

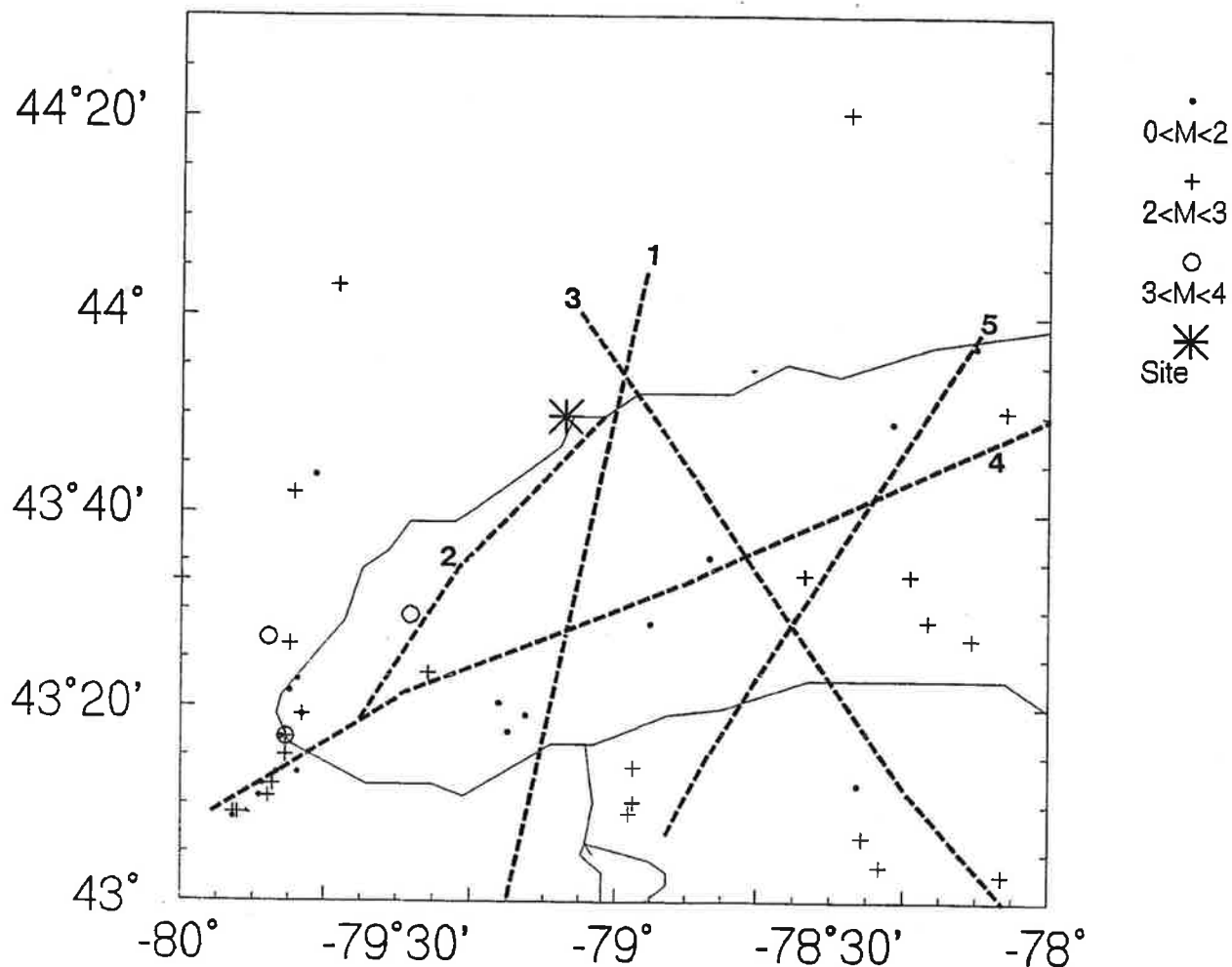
**Figures 1, 2 and 3**

# All events



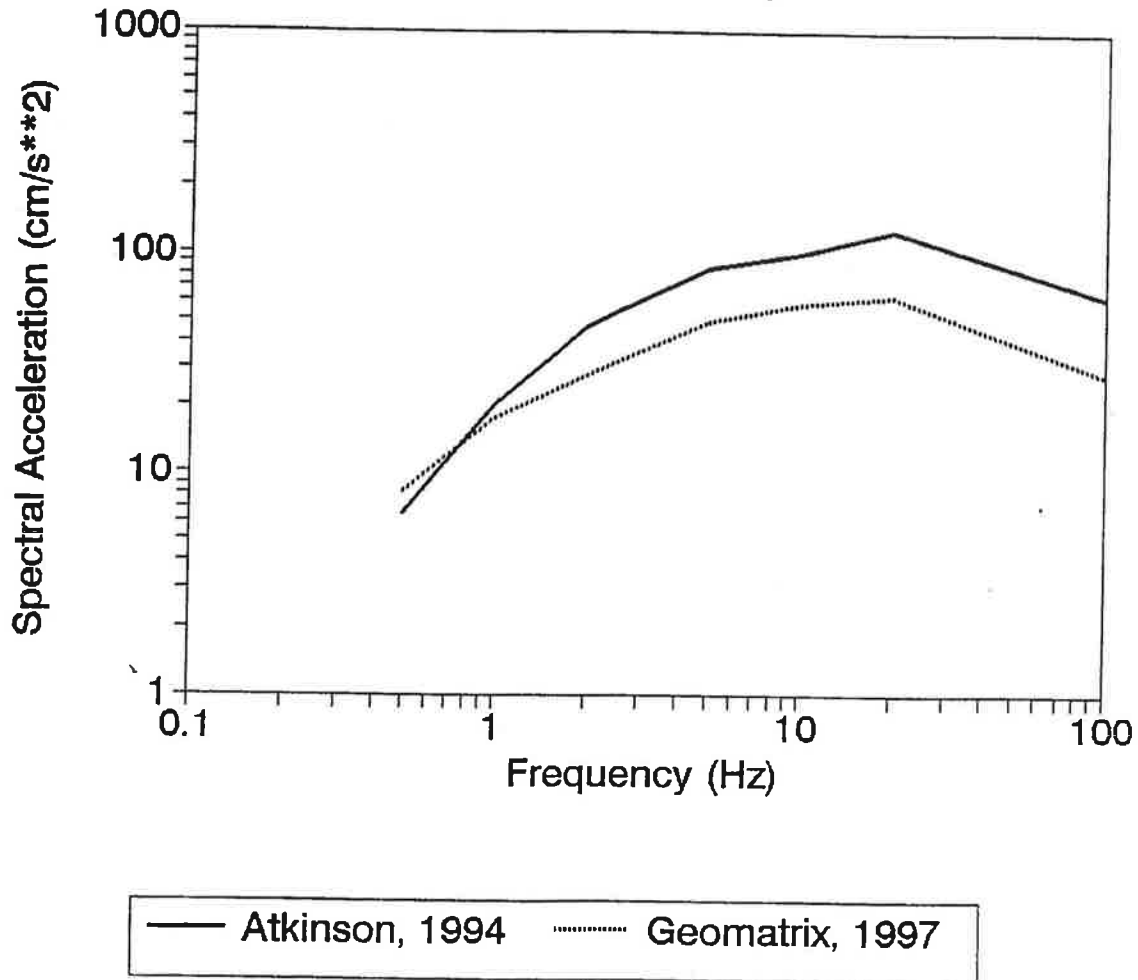
**Figure 1** - Seismicity of Lake Ontario region to 1997 (all known events), and geophysical lineaments described by Mohajer (1993): 1- Niagara-Pickering Linear Zone, 2- Burlington-Toronto Magnetic Lineament, 3-Georgian Bay Linear Zone, 4- Hamilton-Presqu'ile Lineament, 5-Wilson-Port Hope Lineament, 6-Clarendon-Linden fault/lineament.

# Events 1980-1997



**Figure 2** - Recent (ie. accurately-located) seismicity of Western Lake Ontario region (1980-1997), and geophysical lineaments described by Mohajer (1993): 1- Niagara-Pickering Linear Zone, 2-Burlington-Toronto Magnetic Lineament, 3- Georgian Bay Linear Zone, 4-Hamilton-Presqu'ile Lineament, 5-Wilson-Port Hope Lineament.

Pickering Mean Ground Motion Spectrum  
probability = 10% in 100 years



**Figure 3** - Mean seismic hazard results for an exceedence probability level of 10% in 100 years, based on previous studies for Pickering (Atkinson, 1990, 1994; Geomatrix, 1997). Plot shows amplitudes of ground acceleration as a function of vibrational frequency. Note the peak ground acceleration (plotted at 100 Hz) is about 50 cm/s<sup>2</sup>, or 5% of the gravitational acceleration.