

March 1, 1988

Reference No. 1354-10

Mr. Mike J. McQuaid
Weir & Foulds
Barristers & Solicitors
2 First Canadian Place
P.O. Box 480
Toronto, Ontario
M5X 1J5

Dear Mr. McQuaid:

Re: CRA Witness Statement
Hydrogeologic Evaluation
Halton Consolidated Hearing

This letter provides CRA's witness statement for Mr. Anthony J. Crutcher and Mr. John M. Petrie prepared for the above hearing as well as enclosing their respective curricula vitae.

Messrs. Crutcher and Petrie present CRA's technical reports entitled "Evaluation of Halton Region Landfill Technical Studies, Site F - Burlington, Hydrogeologic Report" and "Evaluation of Halton Region Landfill Technical Studies, Site D - Milton Hydrogeologic Report". These reports were prepared to document CRA's interpretation of the hydrogeologic suitability of each site and comment on Trow's reports and interpretations.

1. Mr. Crutcher will review the history of CRA's involvement with the City of Burlington. He will outline the project team and discuss the format of CRA's technical reports. Mr. Crutcher will present Part A and Mr. Petrie will present Part B of both reports. Part C of the reports will be presented jointly by Messrs. Crutcher and Petrie. Overall conclusions will be presented by Mr. Crutcher.
 2. Mr. Crutcher will refer to the previous studies addressing the landfill suitability at Site F. He will indicate that the Cherry and Lush, Cartwright, Morrison and Beatty, and Proctor and Redfern studies were considering a smaller area for landfilling and secondly, were not comparing the proposed site to a second site.
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3. Mr. Crutcher will discuss the site selection criteria prepared by Dr. Charlesworth for Peel Region and indicate that he is in general agreement with these criteria.
4. Mr. Crutcher will indicate that it is not appropriate to consider the hydrogeology of Site F on a regional basis in order to assess the suitability for landfilling as is postulated by Dr. Charlesworth.
5. Mr. Petrie will indicate that the volume of water pumped from PW-1 at Site F is significant with respect to the 1 mm/year of infiltration into the bedrock as determined by Dr. Rowe.
6. Mr. Petrie will address the modelling undertaken for Site F by Dr. Rowe. He will indicate that the homogeneous system modelled consisting of a uniform interconnected fractured network is inconsistent with the available data.
7. Mr. Petrie will also question Dr. Rowe's use of Gartner Lee Well No. 24 to provide calibration for his contaminant transport model. It has not been demonstrated that this or indeed any other of the Gartner Lee wells located downgradient from the Burlington Landfill are screened in the most active fracture zones that underlie the site. He therefore questions the validity of the results generated by Dr. Rowe's model.
8. Mr. Petrie will comment of Paragraph 14 of the joint Rowe-Charlesworth Witness Statement. Dr. Rowe herein indicated that if only a few fractures are carrying the bulk of the contaminant then it is unlikely to be of any significant impact. Mr. Petrie will point out that the modelling undertaken by Dr. Rowe requires that all the contaminant mass pass through the available fractures. If only a few fractures are carrying the contaminants, there is likely to be significant impact due to the high groundwater velocities required in order to maintain a conservation of mass.

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9. Mr. Petrie will discuss attenuation mechanisms at Site F. He will indicate that for relatively rapid groundwater movement within the interconnected fractures the effects of matrix diffusion may not be significant. He will further indicate that given the effects of this process has not been quantified at Site F it would be conservative to ignore this process for contaminant transport modelling.
10. Mr. Crutcher will comment of Paragraph No. 16 of the joint Rowe-Charlesworth Witness Statement. Therein it is indicated that relatively straightforward engineering devices, such as toe drains can control migrating contaminants in the weathered shale. However, Mr. Crutcher will indicate that for thickness of as much as 15 meters of weathered shale that such toe drains are not relatively straightforward. He will further indicate that such drains will require pumping and may have to be set a significant depth in order to control contaminant migration.
11. Mr. Petrie will comment on Paragraph No. 78 of the joint Rowe-Charlesworth Witness Statement. Herein Dr. Charlesworth concludes that the leachate will migrate to depth and not surface between the site and the lake. Mr. Petrie will point out that the primary pathway for lateral migration from the site is the upper weathered bedrock mantle and further that this mantle can be expected to extend off site beneath the till toward Lake Ontario. He will indicate that at HC10, HC11 and HC12, upward hydraulic gradients have been measured. He will therefore conclude that it cannot be reasonably demonstrated that leachate infiltrating into the shale will go to depth and not come to surface between the site and the lake.
12. Mr. Petrie will comment on Paragraph 65 of the joint Rowe-Charlesworth Witness Statement. Herein, Drs. Rowe and Charlesworth indicated that the proposed Site D is at least as complex as Site F and there is uncertainty regarding the value of relevant parameters at both sites. Mr. Petrie will point out that Dr. Charlesworth, in considering the hydrostratigraphy of both Sites D and F indicated that the contaminant pathways at Site D were clearly defined. Mr. Petrie will indicate that in contrast the contaminant flow paths, hydraulic conductivity and groundwater velocities at Site F are not well defined.

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13. CRA will indicate that two other landfill sites are situated on fractured shales in southern Ontario. These sites are the Walker Brothers and Glenridge sites in the St. Catharines area. While these sites have their own unique characteristics, both were completed with a compacted clay liner. CRA will discuss the applicability of these situations to the proposal for landfilling at Site F.
14. CRA will discuss the suitability of weathered shale at Site F for a liner material. As indicated in the Morrison Beatty Ltd. Phase II Hydrogeological Investigation, Appendix D, the variation of the grain-size distribution and possible inclusion of shale fragments within a fill area that the actual permeability in the field could be greater than the 1×10^{-7} determined from laboratory testing.
15. Mr. Petrie will comment on Paragraph 26 of the joint Rowe-Charlesworth Witness Statement. Mr. Petrie will indicate that he does not consider it possible that the ponds and surface drainage could be fed by groundwater discharge from the granular units beneath Site D.
16. CRA will comment on the modelling undertaken by Dr. Rowe on Site D and indicate his Cases 2 to 10 are based on unreasonable assumptions, namely that:
- A) The permeability of the waste is 1×10^{-5} cm/sec; and/or
 - B) A total failure of the under-drain system.

Cases 11 and 12 assuming a partial failure of the engineered system, and Case 1 in which he modelled the site using Trow's numbers, are based on reasonable assumptions.

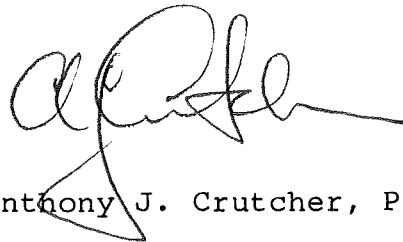
Yours truly,

CONESTOGA-ROVERS & ASSOCIATES



John M. Petrie, M.Sc.

JMP/jh
Encl.



Anthony J. Crutcher, P. Eng.

ANTHONY J. CRUTCHER, M.A.Sc., P. Eng.

EDUCATION:

B.A.Sc. University of Waterloo, Civil Engineering, 1976
M.A.Sc. University of Waterloo, Civil Engineering, 1977

EMPLOYMENT:

1982 -
Present Principal, Conestoga-Rovers & Associates Limited
1979-82 Associate, Conestoga-Rovers & Associates Limited
1976-79 Project Engineer, Conestoga-Rovers & Associates
1976-77 Teaching Assistant, University of Waterloo
1975-76 Junior Engineer, Frank A. Rovers & Associates Ltd.
1974-75 Research Assistant, University of Waterloo
1973 Engineer Assistant, Water Pollution Control Directorate,
Environment Canada, Ottawa

AFFILIATIONS:

Association of Professional Engineers of Ontario
Member of Canadian Water Resources Association
Member of National Solid Wastes Management Association
Member of Governmental Refuse Collection & Disposal Association

PROFILE OF PROFESSIONAL ACTIVITIES:

- Design of solid waste disposal sites
- Hydrogeologic Investigations
- Groundwater hydraulic modelling

PROFILE OF PROFESSIONAL ACTIVITIES: (continued)

- Research into computer model analysis of leachate migration from waste disposal sites including finite element and mass balance techniques
- Applying mass transport modelling techniques to predict future contaminant plume configurations
- Groundwater availability and interference studies
- Design of groundwater monitoring programs
- Design of landfill gas monitoring programs
- Engineering management of waste disposal operations
- Design of pits and quarries
- Environmental impact evaluation of aggregate extraction operations
- Environmental impact evaluations of hazardous waste disposal sites
- Design and implementation of remedial action construction for hazardous waste sites
- Design of wastewater disposal systems
- Landfill gas recovery and utilization research
- Design of landfill gas recovery and utilization systems
- Expert testimony at Environmental Assessment Board Hearings, Ontario Municipal Board Hearings and Niagara Escarpment Commission
- Several papers presented across Canada and U.S.A.

PUBLICATIONS

A. Published Refereed Papers

1. "The Numerical Analysis of Contaminant Migration from Sanitary Landfills" proceedings of the Twelfth Canadian Symposium on Water Pollution Research, University of Toronto, February 1977 (with J. F. Sykes)
2. "Methane Gas Utilization from a Landfill Site", Journal of the Energy Division, ASCE, May, 1981 (with E. A. McBean and F. A. Rovers)
3. "The Impact of Gas Extraction of Landfill-Generated Methane Gas Levels", Water, Air, and Soil Pollution, Vol. 16, 1981, pg. 55 - 66 (with E. A. McBean and F. A. Rovers)
4. "Leachate Collection Design for Containment Landfills", Journal of the Environmental Engineering Division, ASCE, Vol. 108, No. EE1, February, 1982 (with E. McBean, R. Poland and F. A. Rovers)
5. "Temperature as an Indicator of Landfill Behavior", Water, Air and Soil Pollution, Vol. 17, 1982, pg. 51-59 (with E. A. McBean and F. A. Rovers)
6. "Influence Assessment of Landfill Gas Pumping", Water, Air and Soil Pollution, Vol. 22, 1984, pg. 227-239 (with E.A. McBean and F. A. Rovers)

PUBLICATIONS (continued)

B. Papers

1. "Modelling Sanitary Landfill Leachates Using a Chemical Mass Balance Technique", paper presented at AGU Spring Annual Meeting, Washington, D.C., May 1977 (with J. F. Sykes)
2. "Landfill Site Selection", paper presented at the 16th Annual International Seminar & Equipment Show, Governmental Refuse Collection & Disposal Association, Calgary, Alberta, August, 1978 (with F. A. Rovers, H. Mooij)
3. "The Design of a Natural Leachate Attenuation System", Proceedings of The First Annual Conference of Applied Research and Practice on Municipal and Industrial Waste, Madison, Wisconsin, September 10 - 13, 1978 (with F. A. Rovers)
4. "Safety Procedures for Hazardous Waste Remedial Works", Proceedings of the Second Annual Conference of Applied Research and Practice on Municipal and Industrial Waste, Madison, Wisconsin, September 17 - 21, 1979 (with D. H. Haycock, F. A. Rovers, W. J. McDougall)
5. "Methane Gas, A Heat Source for Municipal Greenhouses", paper presented at Ontario Parks Association Annual Educational Conference, Toronto, Ontario, February, 1980
6. "Extraction and Utilization of Unprocessed Landfill Generated Methane Gas", paper presented at AGU Spring Annual Meeting, Toronto, Ontario, May, 1980 (with F. A. Rovers)
7. "Statistical Analysis of Landfill-Generated Methane Gas Data", paper presented at AGU Spring Annual Meeting, Toronto, Ontario, May 1980 (with E. A. McBean)
8. "Recovery & Utilization of Landfill Gas", Conference Papers, ENERGO'83 - Ontario Energy Opportunities in Biomass Conference, sponsored by the Ministry of Energy, Sheraton Centre, Toronto, Ontario, March 6 to 9, 1983
9. "Landfill Gas Recovery and Utilization in Canada", Proceedings from the Technical Sessions of the GRCDA 21st Annual International Seminar and Equipment Show, Winnipeg, Manitoba, Canada, August 29 through September 1, 1983
10. "Canadian Activities in Landfill Gas Recovery and Utilization", paper presented at GRCDA 7th International Landfill Gas Symposium, Sheraton Regal Inn, Piscataway, New Jersey, April 9-13, 1984

PUBLICATIONS: (continued)

B. Papers (continued)

11. "PCB Migration from a Buried Lagoon", presented at the GAC-MAC Joint Annual Meeting, May 14 - 16, 1984, Holiday Inn London City Centre Complex, London, Ontario, (with A. W. Van Norman)
12. "Commercial Operation and Cost of the Kitchener Landfill Gas Utilization System, Ontario, Canada", paper presented at Energy Biomass and Waste, IX, Institute of Gas Technology, Lake Buena Vista, Florida, January 28 to February 1, 1985 (with W. Graziani)
13. "Landfill Gas Horizontal Trench Collection System - Keele Valley", paper presented at GRCD 9th International Landfill Gas Symposium, Newport Beach, California, March 17-21, 1986 (with W. Graziani)
14. "Pottersburg Creek Watershed PCB Remediation", paper presented at the Joint Annual Conference, APCA/PCAO, Hamilton, Ontario, April 27 - 29, 1986 (with G. Ferraro)
15. "Pottersburg Creek Watershed PCB Remediation", paper presented at 33rd Ontario Industrial Waste Conference, Toronto, Ontario, June 15-18, 1986 (with G. Ferraro)
16. "Making Landfills Pay: Harnessing Methane Gas for Municipal and Industrial Energy", paper presented at Municipal Waste Management, Toronto, Ontario April 1-2, 1987 (with W. Gaherty)
17. "Environmental Considerations at Former Manufactured Gas Plant Sites: A Health and Safety Perspective", paper presented at Haztech Canada, Mississauga, Ontario May 12-14, 1987 (with R. Schwark, W. Gaherty)
18. "Remediation of Lees Avenue Transitway Station and Rideau River Coal Tar Contamination", papers presented at 34th Ontario Industrial Waste Conference, Toronto, Ontario, June 14-17, 1987 (with W. Gaherty, R. Schwark)

PUBLICATIONS: (continued)

C. Published Reports

1. "Groundwater Contaminant Modelling - A State of the Art Review", Environment Canada, 1977 (with J. F. Sykes, F. A. Rovers and G. J. Farquhar)
2. "Contaminant Migration in Three Great Lakes Drainage Basins - Mississauga Landfill Site", Fisheries and Environment Canada, 1977 (with J. F. Sykes, F. A. Rovers and G. J. Farquhar)
3. "Small Municipal Waste Disposal Site Selection", Fisheries and Environment Canada, 1978 (with F. A. Rovers)
4. "Gas Recovery & Utilization from a Municipal Waste Disposal Site - Final Report", Environment Canada, Technical Development Report EPS 4-EC-81-2, November 1981 (with F. A. Rovers)

ONTARIO LANDFILL EXPERIENCE

1) MISSISSAUGA LANDFILL SITE

Client: Environment Canada (M.A.Sc. Thesis)

Location: Mississauga

Date: 1976

Responsibilities: ° undertook a research study on modelling contaminant migration from the existing site.

2) HANOVER LANDFILL SITE

Client: Environmental Canada (M.A.Sc. Thesis)

Location: Hanover

Date: 1976

Responsibilities: ° undertook a research study on modelling contaminant migration from the existing site.

3) ST. THOMAS LANDFILL SITE

Client: Environment Canada/Ministry of the Environment/Ministry of Energy

Location: St. Thomas

Date: 1977 - 1980

Responsibilities: ° undertook a research study on behalf of Environment Canada, Ontario Ministry of the Environment/Energy on recovery and utilization of landfill gas.
° preparation of final grading plans on the landfill.

4) AURORA LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Aurora

Date: 1977 - present

Responsibilities: ° undertook and presently oversee a groundwater and surface water monitoring program.
° conducted a detailed hydrogeologic investigation of site.
° prepared site development and closure plans and provide advice to owner on the same.

5) EAST GWILLIMBURY LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Township of East Gwillimbury

Date: 1977 - present

Responsibilities: ° undertook and presently oversee a groundwater, surface water and gas monitoring program.
° conducted a hydrogeologic investigation on impact assessment of the site.
° prepared site development and closure plans and provide advice to the owners on the same.

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ONTARIO LANDFILL EXPERIENCE (continued)

6) WEST GWILLIMBURY LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Township of West Gwillimbury

Date: 1977 - present

Responsibilities: ° undertook and presently oversee a groundwater, surface water and gas monitoring program.
 ° conducted a hydrogeologic investigation and impact assessment of the site.
 ° prepared site development and closure plans and provide advice to the owners on the same.

7) STOUFFVILLE LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Town of Whitchurch-Stouffville

Date: 1977 - present

Responsibilities: ° undertook a groundwater and surface water monitoring program.
 ° conducted a detailed hydrogeologic investigation of site.
 ° prepared site development and closure plans and provide advice to owner on the same.

8) KINCARDINE LANDFILL SITE

Client: Town of Kincardine

Location: Kincardine

Date: 1978 - present

Responsibilities: ° oversee a groundwater monitoring program and related reporting.
 ° advice on site development.

9) KEELE VALLEY LANDFILL SITE

Client: Waste Management of Canada Inc./Metropolitan Toronto

Location: Town of Vaughan

Date: 1979 - present

Responsibilities: ° preparation of engineering design plans on: base grade and liner elevations;
 ° leachate collection system; landfill gas control system; final contours; surface water drainage and leachate recirculation.
 ° ongoing liaison with Metro Toronto on the development of the site on the same.
 ° monitoring data evaluation and reporting on landfill gas migration.
 ° preparation and attendance at a hearing under Consolidated Hearings Act on a proposed revision to the site boundary.

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ONTARIO LANDFILL EXPERIENCE (continued)

10) KITCHENER LANDFILL SITE

Client: Regional Municipality of Waterloo

Location: Kitchener

Date: 1979 - 1984

Responsibilities: ° conducted feasibility studies on the potential for landfill gas.
° designed and constructed Canada's first commercial full scale landfill gas recovery facility for landfill gas sale to a nearby industry.

11) PETROLIA LANDFILL SITE

Client: Town of Petrolia

Location: Petrolia

Date: 1979 - present

Responsibilities: ° conducted a hydrogeologic investigation of the existing landfill and assess the potential for expansion.
° prepared a design for the operation and management of the existing landfill and proposed expansion areas.
° attended and testify at an EPA hearing on the above.
° oversee a groundwater and surface water monitoring program and related reporting.

12) 20 ACRE MAPLE LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Town of Vaughan

Date: 1979 - 1983

Responsibilities: ° conducted monitoring of groundwater at the then closed landfill.

13) TRICIL LANDFILL SITE

Client: Tricil Limited

Location: Coronna

Date: 1979

Responsibilities: ° conducted a hydrogeologic investigation of a hazardous waste landfill site.

14) LUCAN LANDFILL SITE

Client: C.H. Lewis Sanitation Limited

Location: Lucan

Date: 1980 - 1983

Responsibilities: ° undertook a hydrogeologic investigation of site and impact assessment (not finalized).
° preparation of conceptual site development plans.

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ONTARIO LANDFILL EXPERIENCE (continued)

15) TARA LANDFILL SITE

Client: Village of Tara

Location: Tara

Date: 1980

Responsibilities: ° undertake a hydrogeologic investigation of proposed impact assessment (not finalized).
° preparation of conceptual site development plans.

16) ST. MARYS LANDFILL

Client: Town of St. Marys

Location: St. Marys

Date: 1980 - present

Responsibilities: ° conducted a hydrogeological investigation of a potential landfill site.
° prepared a design for the operation and management of the new site.
° attended and testified at EPA hearing on the above.
° oversee a groundwater and surface water monitoring program and related reporting.

17) ESSEX COUNTY LANDFILL SITE #1

Client: Essex County Conservation Authority

Location: Essex County

Date: 1981

Responsibilities: ° development of conceptual end use plan.

18) ESSEX COUNTY LANDFILL SITE #2

Client: Essex County Conservation Authority

Location: Leamington

Date: 1981

Responsibilities: ° development of conceptual end use plan.

19) ESSEX COUNTY LANDFILL SITE #3

Client: Essex County Conservation Authority/County of Essex

Location: Township of Maidstone

Date: 1981/1987

Responsibilities: ° development of conceptual end use plan.
° evaluation of leachate treatment alternatives.

continued....

ONTARIO LANDFILL EXPERIENCE (continued)

20) ADELAIDE LANDFILL SITE

Client: Township of Adelaide

Location: Adelaide

Date: 1981 - 1985

Responsibilities: ◦ undertook a hydrogeologic investigation of existing landfill site and assess potential for expansion.
 ◦ designed a conceptual operation and management plan.
 ◦ prepared Environmental Assessment documents for the same.

21) ADJALA LANDFILL SITE

Client: Township of Adjala

Location: Loretto

Date: 1981 - 1982

Responsibilities: ◦ undertook a hydrogeological suitability investigation of a proposed landfill site.

22) BRANTFORD LANDFILL SITE

Client: Town of Seaforth

Location: Seaforth

Date: 1981 - 1986

Responsibilities: ◦ undertook research study on modelling of contaminant migration from landfill.
 ◦ conducted an on-going hydrogeologic investigation of site and expansion of same.
 ◦ advice to owner on site development.

23) SEAFORTH LANDFILL SITE

Client: Town of Seaforth

Location: Seaforth

Date: 1981 - 1986

Responsibilities: ◦ oversaw a small scale hydrogeologic investigation of the existing site.
 ◦ provided advice to another engineering consultant on site development.
 ◦ undertook a site selection procedure under the Environmental Assessment Act pertaining to hydrogeologic suitability for landfilling.

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ONTARIO LANDFILL EXPERIENCE (continued)

24) CHESLEY LANDFILL SITE

Client: Town of Chesley

Location: Chesley

Date: 1981 - 1986

Responsibilities: ◦ undertook a hydrogeologic investigation of a proposed expansion to a small landfill site.
 ◦ prepared a site development plan for the same.
 ◦ provided evidence at an Environmental Assessment Board hearing under EPA.

25) WATERLOO LANDFILL SITE

Client: Regional Municipality of Waterloo

Location: Waterloo

Date: 1981 - present

Responsibilities: ◦ undertook a preliminary hydrogeologic investigation of a proposed expansion of the existing site and subsequently oversaw detailed hydrogeologic evaluation of the existing site.
 ◦ preparation of overall site development plans.
 ◦ oversee the design and construction supervision of the west side leachate collection system.
 ◦ provide advice to Region on operations at the landfill site.

26) BEARE ROAD LANDFILL SITE

Client: Metropolitan Toronto

Location: Toronto

Date: 1981

Responsibilities: ◦ conducted a landfill gas recovery feasibility analysis, landfill gas to be used by nearby Metro Zoo or other users.

27) SARNIA LANDFILL SITE

Client: City of Sarnia

Location: Sarnia

Date: 1981 - present

Responsibilities: ◦ conducted a hydrogeologic investigation of the existing landfill.
 ◦ prepared design and operations plans for site.
 ◦ evaluated alternatives for leachate disposal.
 ◦ overseeing a pilot scale leachate treatability study.

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ONTARIO LANDFILL EXPERIENCE (continued)

28) SOUTHWOLD LANDFILL SITE

Client: St. Thomas Sanitary Collection Services Limited

Location: Southwold

Date: 1982

Responsibilities: ° oversee an on-going groundwater, surface water and gas monitoring program and related reporting.
 ° oversaw site development pertaining to base elevation, leachate collection system, and final contours.
 ° evaluated the site for potential for landfill gas utilization.

29) UPPER OTTAWA STREET LANDFILL SITE

Client: Upper Ottawa St. Landfill Site Committee/Regional Municipality of Hamilton-Wentworth

Location: Hamilton

Date: 1982 - 1984

1987 - present

Responsibilities: ° conducted feasibility studies on the control of landfill gas emission.
 ° evaluated the closed landfill for integrity of the final cover.
 ° overseeing the predesign of landfill gas control system.

30) OLD WELLAND CANAL LANDFILL SITE

Client: City of Thorold

Location: Thorold

Date: 1982 - present

Responsibilities: ° investigated landfill gas generation at this closed landfill.
 ° oversaw the design and supervision of the installation of a number of landfill gas control systems to protect nearby structures.

31) TOWNSHIP OF HAY LANDFILL SITE

Client: Township of Hay

Location: Township of Hay

Date: 1982

Responsibilities: ° conducted hydrogeologic investigation of existing landfill site.
 ° provided advice to another engineering firm on site design to closure.

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ONTARIO LANDFILL EXPERIENCE (continued)

32) ONAPING FALLS LANDFILL SITE

Client: Regional Municipality of Sudbury

Location: Onaping Falls

Date: 1982

Responsibilities: ° undertook a hydrogeologic investigation of potential landfill sites for the Region.

33) BURLINGTON LANDFILL SITE

Client: City of Burlington

Location: Burlington

Date: 1984 - present

Responsibilities: ° reviewed the hydrogeologic design plans of an application from the Region of Halton for the expansion of the landfill.
° attendance and testimony at EPA hearing on the above.

34) NORTH BAY LANDFILL SITE

Client: City of North Bay

Location: North Bay

Date: 1984 - 1985

Responsibilities: ° undertake a hydrogeologic investigation of the existing landfill site.

35) BAYVIEW LANDFILL SITE

Client: City of Burlington

Location: Burlington

Date: 1985 - present

Responsibilities: ° investigate source of contamination of Indian Creek which originates in the vicinity of landfill.
° oversaw the concept, predesign and design of a leachate collection system with associated connection to the distant sanitary sewer.
° oversee a surface water and groundwater monitoring program and related reporting.

36) MCKILLOP LANDFILL SITE

Client: Township of McKillop

Location: Township of McKillop

Date: 1985 - 1987

Responsibilities: ° undertook a hydrogeologic suitability investigation for a proposed landfill site.

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ONTARIO LANDFILL EXPERIENCE (continued)

37) HOLMESVILLE LANDFILL SITE

Client: Township of Goderich

Location: Holmesville

Date: 1985 - present

Responsibilities: ° oversaw a hydrogeologic investigation impact assessment of an existing landfill site to support continued use of the site.

38) BROCK WEST LANDFILL

Client: Fiba-Canning Limited

Location: Pickering

Date: 1987 - present

Responsibilities: ° undertook a detailed investigation of landfill gas production and feasibility of gas utilization.

39) SPANISH RIVER LANDFILL SITE

Client: Spanish River

Location: Spanish River

Date: 1987

Responsibilities: ° oversee a hydrogeologic investigation of a small landfill site.

JOHN M. PETRIE, M.Sc.

EDUCATION:

- 1982-84 M.Sc (hydrogeology), University of Waterloo
Thesis "Field Response of a Clay Till in a Layered Aquifer System at Waterloo, Ontario."
- 1977-78 Diploma in Groundwater Development, Hebrew University of Jerusalem, Israel
- 1971-74 M.Sc (geology), University of Canterbury, New Zealand
Thesis "Chaotic Mesozoic Rocks of the Studleigh Range, North Canterbury."
- 1967-69 B.Sc (geology), University of Canterbury, New Zealand

EMPLOYMENT:

- 1984-
Present Senior Hydrogeologist
Conestoga-Rovers & Associates Limited
- hydrogeologic investigations of municipal landfills and hazardous waste sites in Canada and the USA
 - hydrogeologic evaluation of remedial alternatives at waste disposal sites
 - design and performance evaluation of groundwater remediation systems utilizing purge wells and lateral collectors
- 1982 Groundwater Geologist
Piteau and Associates
- evaluation and development of groundwater resources for industrial and municipal supply
- 1981 Groundwater Geologist
Pacific Hydrology Consultants
- evaluation and development of groundwater resources for municipal and irrigation supplies
- 1978-81 Project Groundwater Geologist
Associated Engineering Services Limited
- evaluation and development of groundwater resources for rural water supply in southern Ethiopia

EMPLOYMENT: (continued)

1975-77 Groundwater Geologist
 B.C. Ministry of the Environment

- evaluation and development of groundwater resources for irrigation supplies
- evaluation of pumping tests for municipal, rural and domestic water supplies
- evaluation of regional groundwater level trends
- evaluation of regional groundwater contamination problems

1974 Mine Geologist
Consolidated Churchill Copper Corporation, B.C.

- evaluation of ore grade
- evaluation of ore reserves

1970-71 Exploration Geologist
Layton and Associates Ltd. (N.Z.)

- geochemical and geological mapping of hard rock and unconsolidated formations

AFFILIATIONS:

Member - International Association of Hydrogeologists

Member - Association of Groundwater Scientists and Engineers

RELEVANT HYDROGEOLOGIC EXPERIENCE WITH WASTE DISPOSAL

1) WATERLOO LANDFILL SITE

Client: Regional Municipality of Waterloo

Location: Waterloo

Date: 1985 - present

Responsibilities:

- hydrogeologic evaluation of existing site and proposed expansion
- evaluation of ongoing monitoring

RELEVANT HYDROGEOLOGIC EXPERIENCE WITH WASTE DISPOSAL (continued)

2) HIGHWAY 48 LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: Town of Whitchurch-Stouffville

Date: 1984 - 1985

Responsibilities: ° evaluated all available hydrogeologic data and
 prepared final report
 ° installation of observation wells

3) WEST GWILLIMBURY LANDFILL SITE

Client: Waste Management of Canada Inc.

Location: West Gwillimbury

Date: 1987

Responsibilities: ° reviewed existing hydrogeologic reports and
 prepared a monitoring program and an additional
 study

4) CITY OF BRANTFORD LANDFILL SITE

Client: City of Brantford

Location: Brantford

Date: 1987 - present

Responsibilities: ° developed work program to assess
 hydrogeology for site expansion

5) CANADA CEMENT LANDFILL SITE

Client: Canada Cement Lafarge

Location: Woodstock

Date: 1985 - present

Responsibilities: ° completed hydrogeologic evaluation of site
 ° evaluation of ongoing monitoring

6) BAYVIEW PARK LANDFILL SITE

Client: City of Burlington

Location: Burlington

Date: 1986 - present

Responsibilities: ° evaluation of ongoing monitoring program

RELEVANT HYDROGEOLOGIC EXPERIENCE WITH WASTE DISPOSAL (continued)

7) HOLLYWOOD LANDFILL SITE

Client: Velsicol

Location: Memphis, Tennessee

Date: 1985

Responsibilities:

- negotiations with USEPA to develop work program
- implementation of the hydrogeologic investigation

8) WHITE BEAR LAKE LANDFILL SITE

Client: Popham, Haik, Schnobrich, Kaufman & Doty, Ltd.

Location: St. Paul, Minnesota

Date: 1987 - present

- Responsibilities:
 - hydrogeologic evaluation and assessment of remedial alternatives

9) LA BOUNTY LANDFILL SITE

Client: Salisbury Laboratories Inc.

Location: Charles City, Iowa

Date: 1984 - 1985

Responsibilities:

- observation well installation
- hydrogeologic evaluation of site and assessment of remedial alternatives

10) WDE SANITARY LANDFILL SITE

Client: WDE Group

Location: Anoka County, Minnesota

Date: 1985

- Responsibilities:
 - hydrogeologic evaluation of site and assessment of remedial alternatives

11) WAUCONDA LANDFILL SITE

Client: PRP Group

Location: Wauconda, Illinois

Date: 1985 - present

- Responsibilities:
 - hydrogeologic evaluation of site and assessment of remedial alternatives

RELEVANT HYDROGEOLOGIC EXPERIENCE WITH WASTE DISPOSAL

(continued)

12) FREEWAY LANDFILL SITE

Client:

Location: Burnsville, Minnesota

Date: 1987 - present

Responsibilities	° oversee evaluation of site hydrogeology
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13) TWIN CITIES ARMY AMMUNITION PLANT

Client: Honeywell Inc.

Location: St. Paul, Minnesota

Date: 1985 - present

Responsibilities:

- hydrogeologic investigation of a major TCE plume
- design, implementation and evaluation of a 1200 gpm purge well system
- evaluation of subsurface disposal options of treated water

14) SYNERTEC CORPORATION

Client: Honeywell Inc.

Location: Santa Clara, California

Date: 1986 - present

Responsibilities:

- review of available hydrogeologic data and recommended additional studies
- design and assessment performance of purge well system

15) BELL POLE SITE

Client: Bell Pole and Lumber

Location: St. Paul, Minnesota

Date: 1985 - present

- Responsibilities:
 - evaluated hydrogeology and remedial alternatives for clean up of wood treating plant
 - design of purge well system

PUBLICATIONS:

"Well Design and Aquifer Analysis at Fairview Heights Irrigation District", Cawston, B.C. Presented to the Geological Association of Canada Annual Meeting, Vancouver, 1977

"Evolution of Brackish Groundwaters, Saanich Peninsula, Vancouver Island, British Columbia". Presented by senior author to the Geological Association of Canada Annual Meeting, Toronto, 1978 (with A.P. Kohut)

