Geokwan Environmental Ltd
ENVIRONMENTAL ENGINEERS

FINAL REPORT

PHASE 1

OFFSITE ENVIRONMENTAL ASSESSMENT

CANADIAN TIRE PROPERTY

BRANDON, MANITOBA

Distribution:

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March 18, 1993

E254-5.1

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ATTENTION: Mr. Nabil Guirguis, P.Eng

Dear Sir,

RE: Phase 1 - Offsite Environmental Assessment
Canadian Tire Property, Brandon, Manitoba
Our Project No. E254-5.1

1.0 INTRODUCTION

As verbally authorized by Mr. Nabil Guirguis, P.Eng. of Canadian Tire Corporation Ltd., a phase 1 offsite environmental assessment was carried out by our firm for the Canadian Tire Property in Brandon, Manitoba. This work was initiated during the meeting on September 10, 1992 between Mr. Dave Ediger, P.Eng., Regional Supervisor - Dangerous Goods of Manitoba Environment, Mr. Hugh Law of Canadian Tire Corporation Ltd., Mr. John King of Petro-Canada, the solicitors of both Canadian Tire Corp. Ltd. and Petro-Canada and the writer.

The purpose of this work was to determine the potential presence of hydrocarbon contamination in the subsoils and groundwater and land usage in the area located downstream of the Canadian Tire property, and based on our findings, provide environmental comments on the potential impact of the detected contaminants upon the human health aspects.

2.0 SURFACE FEATURES AND EXISTING LAND USE

The area investigated during this phase 1 offsite assessment is bounded by Richmond Ave. to the north, Aberdeen Ave. to the south, 14th St. to the west and 10th St. to the east. In addition, the assessment included a small area extending two blocks south of Aberdeen and from 10th St. to 9th Street. The general site location is shown on Plate 1A appended.

The investigated area is made up of residential, commercial and light industrial areas, as shown on the attached land use map, Plate 1 and on the Brandon zoning plan, Plate 2.

The land located immediately to the east and northeast of the Canadian Tire property is zoned as highway commercial (C3) and consists of a number of small businesses including a lumber yard, an auto parts supplier and a plumbing and heating company. Further to the east, between 10th and 13th streets, there is a lumber yard and a large manufacturing company (Cancade) which constructs steel truck boxes. This area is zoned as restricted industrial (M1).

To the north of Canadian Tire (although not investigated through monitoring wells at this time), the land is zoned as highway commercial and contains a Petro-Canada service station, a Petro Canada bulk storage compound, a Burger King restaurant and a car dealership. Further to the

north, across Richmond Avenue, there is the Keystone Fair Grounds and a Fire Hall.

To the south and southeast of the Canadian Tire property, there is a cemetery and a large piece of undeveloped swampy land owned by Gulf Canada. Both of these areas are zoned as open space (OS). The majority of the Gulf Canada land becomes swampy in the spring and summer months and is used as a storm drainage outlet for most of the investigated area (refer to attached City of Brandon storm sewer plan, Plate 3). To the southeast of the Gulf Canada property, there is a small playground which contains a paddling pool and a soccer pitch. This area is zoned as parkland (PR).

The main residential districts in the investigated area are located to the east of Cancade (i.e along 10th St. and to the east) and also to the east of the Gulf Canada property. In addition, there is a small residential area located to the northeast of The Canadian Tire property, approximately between 12th and 13th Streets. This area mainly consists of older homes constructed prior to the incorporation of this area into the City of Brandon. The zoning for this area ranges from R2 to R5, and contains single to multiple family dwellings.

The main areas of concern from an environmental standpoint are the above mentioned residential areas which are considered highly sensitive. The commercial and restricted industrial areas and the parkland have a moderate to low sensitivity and are of a lesser concern.

3.0 POTABLE WATER

The source of drinking water in the investigated area is treated surface water taken from the Assiniboine River, which is located approximately 2 km to the north of the site. To our knowledge, no homes in the area rely on groundwater for domestic use at present, although prior to the incorporation of this area into the City of Brandon, most homes south of Richmond Avenue had water wells for drinking purposes. A plan showing the current City of Brandon water distribution lines in the area is on Plate 4.

4.0 SITE CHARACTERIZATION

4.1 Procedures

The procedures engaged in this study included a door to door water well survey, an existing land use and zoning study, a field exploration and soil sampling program, installation of 6 offsite monitoring wells and chemical analysis of selected soil and water samples.

Monitoring well locations were selected on the basis of available land area (i.e. City of Brandon right of ways), drill rig accessibility and expected groundwater flow directions from the old refinery area. In this regard, an attempt was made to place the monitoring wells along expected groundwater flow directions and in areas of high sensitivity. All monitoring well locations were cleared by the City of Brandon Works and Operation Dept. and the various utility companies, prior to drilling.

4.2 Field Work

On December 3, 1992, 6 monitoring wells were installed with the aid of a 6" diameter truck mounted power auger, at locations shown on the attached plan, Plate 1. The subsoils encountered were visually classified to the full depth of each boring. Soil samples were recovered at regular intervals and checked for visual evidence of hydrocarbon staining, odor and flammable soil vapour.

The flammable vapour concentration of each soil sample was determined using an organic vapour analyzer and the headspace technique. The worst sample from each borehole (i.e that with the most visible evidence of staining or the sample with the highest vapour concentration) was retained for chemical testing. For those boreholes where there was no visual evidence of hydrocarbon staining nor any significant flammable vapours, the soil sample was chosen from the saturated zone where the dissolved contaminants may be present due to transport by the ground water from the contaminated site. Any caving and or groundwater seepage in the boreholes was noted.

At each of the 6 borehole locations, a 2" diameter PVC monitoring well was installed. The annular space was filled with pea gravel and the top 2' to 3' was sealed with a bentonite plug. The monitoring well was protected with a steel casing, which was cemented flush with the ground surface.

Groundwater levels and flammable vapour concentrations (both total flammable vapour and total flammable vapour excluding methane, refer to Table D) inside the monitoring wells were determined on December 4, 1992. In addition, a water sample was obtained from each of the 6 monitoring wells for hydrochemical testing.

The ground surface and top of pipe elevations were determined by our survey crew at each of the monitoring well locations and were referenced to a previously determined geodetic benchmark indicated on Plate 1.

4.3 Laboratory Testing

In the laboratory, soil moisture contents were determined for all recovered soil samples, the results of which are shown on the borehole logs, Plate 6 to 11.

As mentioned in Clause 4.2, 6 soil and 6 water samples were retained during the field investigation. These samples were submitted for the following chemical analyses:

a) SOIL - (MW 191 @ 12.5', MW 192 @ 12.5', MW 193 @ 10', MW 194 @ 5', MW 195 @ 7.5' and MW 196 @ 10') tested for volatile organics, total extractable hydrocarbons (C7 to C30) and gasoline concentration using GC/FID.

b) WATER - (MW 191 to MW 196) tested for volatile organics (BTEX) using GC/FID.

- (MW 191 and MW 192) tested for phenol and lead concentrations.

4.4 Water Well Survey

On November 28, 1992, a water well survey was carried out in the investigated area. The search consisted of door to door interviews with area residents in order to determine water well locations and water usage. At locations where residents could not be interviewed, a brief visual search was undertaken to determine if a water well was visible on the property.

In total, 18 water wells were identified at locations shown on the attached plan, Plate 5. The majority of the wells were located between Richmond and Aberdeen, which is an area of older homes. Of the 18 wells identified, 14 are no longer in use.

Of the 4 wells currently being used, two were located at a community garden plot which is located south of #1510 12th Street. Although the owner was not contacted, it is assumed that the two wells are used for irrigating purposes. The remaining two wells, located at #1509 of 13th Street, were used for lawn watering and laundry purposes, respectively.

Based upon the water well usage, it appears that the two areas of potential environmental concern are the community garden plot (2 water wells) and the home where the water is used for laundry purposes.

5.0 SOIL STRATIGRAPHY

A detailed description of the subsoils encountered at the 6 specific monitoring well locations can be found in the enclosed borehole logs, Plate 6 to 11. In addition, 5 geotechnical cross-sections, A-A to E-E are included, Plate 12 and 13.

Considerable variations in the subsurface conditions were encountered in the upper 0.5 to 7.5′ of the soil profile. Within these depths the subsoils consisted of varying thicknesses of topsoil, fill materials and clay.

Underlying these varying materials was a fine to medium brown sand which generally became coarser and saturated with depth. Below the sand, at depths ranging from 6.5 to 15′ from grade was either a silty clay (MW 191, 192, 194 and 195) or a clay till (MW 193 and 196). At MW 194 and 195, the clay was underlain by a clay till and the clay and/or clay till extended to the depths explored at all monitoring well locations.

A variation in the above noted soil profile was encountered at MW 191, 193 and 196, where a 3 to 5′ thick saturated gravel layer was encountered between the sand and clay/clay till layers.

6.0 GROUND WATER

A relatively shallow, ground water table was encountered in the sand and gravel layers in each of the six monitoring wells put down. The water

levels, as measured on December 4, 1992, varied from 4.9 to 9.6' from grade.

Based upon the groundwater levels measured on December 4, 1992, the overall flow direction located downstream of the Canadian Tire property, is generally to the east, as shown on the estimated groundwater contour plan, Plate 14. The groundwater flow direction is similar to that previously determined for the Canadian Tire property.

7.0 CONTAMINATION DELINEATION

7.1 Vapour Phase Hydrocarbons

The flammable vapour concentrations in the soil samples determined at the time of the field drilling with an organic vapour analyzer and the headspace technique are shown on the borehole logs, Plate 6 to 11. The measured vapour concentrations are very low (about 20 to 150 ppm) and are considered in the background range.

The maximum flammable soil vapour concentration of approximately 150 ppm was detected at the 2.5 to 7.5' depth, in MW 193. In the remaining boreholes, the flammable soil vapour levels were generally between 100 ppm and 20 ppm.

The total flammable vapour concentrations measured inside the monitoring wells on December 4, 1992 varied from 20 ppm at MW 196 to 200 ppm at MW 191 and MW 195. In addition to the total flammable vapour measurements, the concentrations neglecting methane were also measured. Based upon these results, it appears that methane accounts for approximately 40 % of the flammable vapours detected in the monitoring wells, except for MW196 where the flammable soil vapour seems to be totally related to methane gas (Table C). It should be noted that the presence of methane gas in the monitoring well may be related to the organic materials in the subsoils or degradation of the residual petroleum hydrocarbons under anaerobic conditions.

7.2 Free Phase Hydrocarbons

Free phase liquid hydrocarbons floating on the water table were not detected in any of the 6 monitoring wells put down. However, during drilling at MW 192, the lower sand and gravel layers were saturated with black oily hydrocarbons.

7.3 Dissolved Phase Hydrocarbons

To evaluate for the possible presence of dissolved phase hydrocarbons in the shallow ground water table, water samples were recovered from each of the 6 monitoring wells and tested for volatile organics. In addition, the samples from MW 191 and 192 were also tested for lead and phenol concentrations. The hydrochemical results are listed below, Table A. For reference purposes, the hydrochemical data are tabulated against the Quebec groundwater clean up criteria, the Alberta MUST remediation guidelines and the CCME-RC potable water and freshwater-aquatic life guidelines. It should be noted that Manitoba Environment usually follows

the aforesaid guidelines, and is in the process of drafting its own clean up criteria.

TABLE A - HYDROCHEMICAL DATA

	Benzene	Ethylbenzene	Toluene	Xylene	Phenols	Lead
MW 191	ND	1	ND	0.8	66	<.02mg/L
MW 192	0.2	4	ND	17	1300	<.02mg/L
MW 193	0.2	0.8	7	2	--	--
MW 194	ND	ND	0.8	1	--	--
MW 195	ND	0.8	ND	3	--	--
MW 196	2	0.6	ND	3	--	--
Quebec-Level A	0.5	0.5	0.5	0.5	1	10
Quebec-Level B	1	50	50	20	3	50
Quebec-Level C	5	150	100	60	20	100
Alberta-Level I	5	2	24	300	2	10
Alberta Level II	50	10,000	40,000	5,000	NS	NS
Alberta-Level III	250	50,000	100,000	20,000	NS	NS
CCME-RC (Potable Water)	5	<2.4	<24	<300	NS	10
CCME-RC (Freshwater Aquatic Life)	300	700	300	NS	1	1-7 200*

Notes:

1) ND = Not Detected * irrigation criterion
2) NS = Not specified
3) all concentrations are in ug/l (ppb) unless noted

The investigated area is located in an area of mixed land uses, with site sensitivity varying from low to moderate (commercial, industrial and parkland) to high (residential). The measured constituent concentrations meet the Alberta Level I (high sensitivity) and CCME-RC drinking water and freshwater aquatic life remediation guidelines with respect to all parameters, with the exception of ethylbenzene at MW192 which slightly exceeds the Alberta Level I and CCME-RC potable water guidelines. In addition, the total phenol concentrations at MW191 (66 ppb) and MW192 (1300 ppb) have exceeded the Quebec Level A, Alberta Level I and the Federal CCME (freshwater aquatic life) remediation guidelines.

7.4 Soil Chemistry Data

One soil sample was retained from each of the six monitoring wells during the field investigation and sent for chemical analyses of organic volatiles (BTEX), gasoline and extractable hydrocarbon concentrations. The results of the soil chemistry analyses are shown in Table B. For reference purposes, the Quebec, Alberta and CCME soil clean up guidelines are also provided in Table C.

TABLE B - SOIL CHEMISTRY DATA

Indicator	MW 191 12.5'	MW 192 12.5'	MW 193 10'	MW 194 5'	MW 195 7.5'	MW 196 10'
Benzene	ND	ND	0.1	ND	ND	ND
Ethylbenzene	ND	ND	0.02	ND	ND	ND
Toluene	ND	ND	0.1	ND	ND	ND
Xylene	ND	ND	0.1	ND	ND	ND
Gasoline	ND	ND	2	ND	ND	ND
TEH	ND	ND	ND	ND	ND	ND
TPH	ND	ND	2	ND	ND	ND

Notes:

1) ND = Not Detected
2) TEH = Total Extractable Hydrocarbons
3) TPH = Total Petroleum Hydrocarbons (total purgeables plus total extractables)
4) All concentrations are in ug/g (ppm)
5) Detection limits for BETX, gasoline and extractable hydrocarbons are 0.005, 0.2 and 10 ug/g, respectively.

TABLE C - SOIL REMEDIATION GUIDELINES

	Quebec			Alberta			CCME RC	
Indicator	A	B	C	I	II	III	Resid.	Commerc.
Benzene	0.1	0.5	5	0.05	0.5	2	0.5	5
Ethylbenzene	0.1	5	50	0.5	5	100	5	50
Toluene	0.1	3	30	1	10	100	3	30
Xylene	0.1	5	50	1	5	50	5	50
TPH	100*	150*	800*	40	400	2000	NS	NS

Notes:

1) * TPH as gasoline only
2) NS = Not specified

Based upon the above noted soil chemistry test results, our field drilling and soil vapour survey, hydrocarbon contamination in the subsoils in terms of BTEX, gasoline, TEH and TPH are generally low to insignificant at all borehole locations.

8.0 ENVIRONMENTAL OFFSITE RISK ASSESSMENT

The risk assessment usually involves in hazard identification (i.e. identify the contaminants of concern), potential receptors, exposure pathway assessment and risk characterization.

As the soil and ground water contamination in the Canadian Tire property is mainly related to the old oil refinery operation (i.e. a dead source) the hazard identification would be mainly involved in petroleum hydrocarbons in the subsoils and ground water.

For petroleum products, it is generally recognized that BTEX (Benzene, toluene, ethybenzene and xylene) are of greatest environmental concern due to their volatility, solubility and toxicity. Benzene is a carcinogen which may lead to the development of cancer. Toluene, ethybenzene and xylene are classified as non-carcinogens which display a threshold level. No adverse effects are observed for TEX concentrations which are below the threshold levels. Lead and phenol are also of environmental concern from a toxicity standpoint. For the purpose of this report, the contaminants of concern are limited to BTEX only.

As per the terms of reference of this study, the offsite risk assessment is limited to human receptors and comment on the potential effects of the contaminants (i.e. BTEX) upon human health.

As shown on Plate 15, potential exposure pathways relating to a contaminated site include:

- ingestion of water, food items and non-food items (for example soil or dust)

- inhalation of vapours and particulate matter and

- dermal contact

For evaluating the environmental risk imposed by the contaminants (i.e. BTEX) of the old refinery upon human health with respect to the areas located downstream (i.e. east and southeast) of the Canadian Tire property and on the basis of the hydrogeological conditions and our environmental findings to-date, the most applicable exposure pathway is the migration of dissolved contaminants in groundwater and ingestion of some later.

Inhalation of toxic vapours migrating from contaminated ground water or soils, ingestion of contaminated soils/produce/surface water, inhalation of particulates and skin absorption, as well as vapour inhalation from

the free product have been reviewed and not considered as the critical exposure pathways.

On the basis of the hydrochemical (Table A) and soil chemistry (Table B) data, the soil vapour survey of the 6 offsite monitoring wells, the present land use and the critical exposure pathway identified, the potential risk upon human health associated with the dissolved BTEX in the ground water in rated low, provided that the offsite environmental conditions and land usage remain unchanged in the future. This statement is further substantiated by the fact that potable water in the areas investigated is from the City of Brandon water distribution system and that the majority of the water wells have either been abandoned or restricted to the use for irrigation.

9.0 CONCLUSIONS

9.1 It can be inferred from the soil chemistry data (Table B) that the degree of hydrocarbon contamination (in terms of BTEX, TEH and TPH) in the subsoils of the 6 offsite wells is slight to very slight, and is generally below the Quebec Level A (contaminants present at background level), Alberta MUST Level I for high sensitivity site (except for benzene which is 0.05 ppm higher) and the Federal CCME interim soil remediation guidelines for commercial and residential properties. In general, visual evidence of hydrocarbon contamination in terms of odor and oily stain is relatively higher for those monitoring wells (i.e. MW 191 and 192) located immediately downstream of the Canadian Tire property.

9.2 With the exception of the ethybenzene concentration (4 ppb) at MW 192, the hydrochemical results of the tested constituents (BTEX) generally meet the Quebec Level B (contaminants present at moderate level), Alberta Level I (high sensitivity site) and the CCME potable water and freshwater aquatic life guidelines.

The benzene concentration (2ppb) at MW 196, ethylbenzene concentration (4ppb) at MW192, toluene concentration (7ppb) at MW193 and xylene concentrations of 0.8 (MW 191) to 17 ppb (MW192) in all 6 monitoring wells have exceeded the Quebec Level A guideline of 0.5 ppb.

The lead concentrations in MW 191 and 192 are insignificant and meet all the listed guidelines.

The phenol concentrations of 66 and 1300 from MW191 and 192 respectively have exceeded all listed applicable guidelines. However, they are still below the EPA health criterion of 3500 ppb.

9.3 The water well survey indicates that the majority of the wells in the area are no longer in use, as a result of the installation of a water distribution system by the City of Brandon. Based upon the information acquired to date, there may be some environmental concern related to the use of well water for plant watering (i.e community vegetable garden) and laundry purposes. In this regard, the direct health implications, if any, cannot be properly assessed unless water samples are taken from the water wells in question for further analysis.

9.4 From a land use standpoint, the area of high sensitivity is the residential houses. Residential houses are generally located at considerable distances (Plate 1 & 1A) from the Canadian Tire property, where the degree of soil and ground water contamination by petroleum hydrocarbons is generally slight to insignificant. Therefore, the potential for adverse environmental impact on the existing residential houses is rated low at present.

9.5 Based on the hazard identification, potential receptors, the critical exposure pathway (i.e. migration of dissolved BTEX in the ground water) and preliminary risk characterization and assuming that the existing land and water usage and the environmental conditions remain unchanged in the future, the possible environmental risk imposed by the old refinery operations upon human health in the offsite areas investigated, is rated low.

10. RECOMMENDATIONS

To ensure that the potential impact upon human health and the environment related to the old refinery operations is kept to an absolute minimum, the following provisions should be considered:

1) The offsite and on site monitoring wells should be monitored at regular intervals, on an "ongoing" basis. The monitoring should include the measurements of flammable vapour concentrations, ground water elevation and free product thickness (if any). In addition, water samples should be recovered regularly from selected wells for the determination of BTEX, phenol and lead.

2) To obtain and assess all environmental data and formulate a complete picture on a global basis, exchange of information with present and past land owners (i.e. Petro-Canada, Burger King, the Car Dealership, Gulf Canada, etc.) located in the old refinery complex should be implemented as soon as possible.

3) Permission should be obtained from Gulf Canada for reactivating their monitoring wells which were installed in 1985 by others in the swampy land (Plate 1A), which also forms part of the downstream watershed from the Canadian Tire property.

4) Once all available and adequate environmental data are obtained and reviewed on a global basis, a meeting should be organized with Manitoba Environment, the City of Brandon, all land owners located in the old refinery for discussing strategy in reducing the environmental impact upon the downstream properties. Once a work plan is formulated, a public hearing may be worthwhile for informing the general public of the problem and alternaitve measures which may be used to minimize any adverse environmental impact associated with residual petroleum hydrocarbons of the old oil refinery.

5) Negotiation with the City of Brandon should be made to impose appropriate restrictions on the future land use and the type of building (basementless preferred) in the potentially affected areas located downstream of the Canadian Tire property.

6) With the implementation of item 1 to 5 above, the environmental risks imposed by the old refinery operations upon the downstream users are systematically managed and can be greatly minimized.

7) No offsite clean up is deemed necessary at the present time. The requirements on the time and extent of the on site remedial measures (for example, clean up or containment) will depend on the future land use, government regulation and degree of potential change in the environmental conditions. Unless the ground water aquifer in the old refinery site is remediated, it is possible that a widely spread problem of the petroleum contaminated ground water may occur in the downstream areas, on a long term basis.

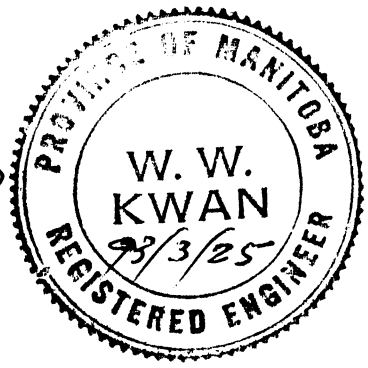
11.0 FINAL REMARKS

This report has been prepared for the exclusive use of Canadian Tire Corporation, and any copying and reproduction of this report without the consent of Geokwan Environmental Ltd. is strictly prohibited.

The information contained in this report is considered representative of the general environmental conditions of the area investigated at the time of the fieldwork. Any queries should be directed to the attention of the writer.

Yours truly,

GEOKWAN ENVIRONMENTAL LTD.
per:



Walter Kwan, M.Eng., P.Eng.

WK:HP/ws Encl.

TABLE D

FLAMMABLE VAPOUR READINGS
OFF-SITE RISK ASSESSMENT
BRANDON, MANITOBA

Monitoring Well	Total Flammable Vapour Concentration	Total Flammable Vapour Concentration Excluding Methane
191	200 ppm	120 ppm
192	180 ppm	100 ppm
193	100 ppm	70 ppm
194	70 ppm	40 ppm
195	200 ppm	110 ppm
196	20 ppm	0 ppm

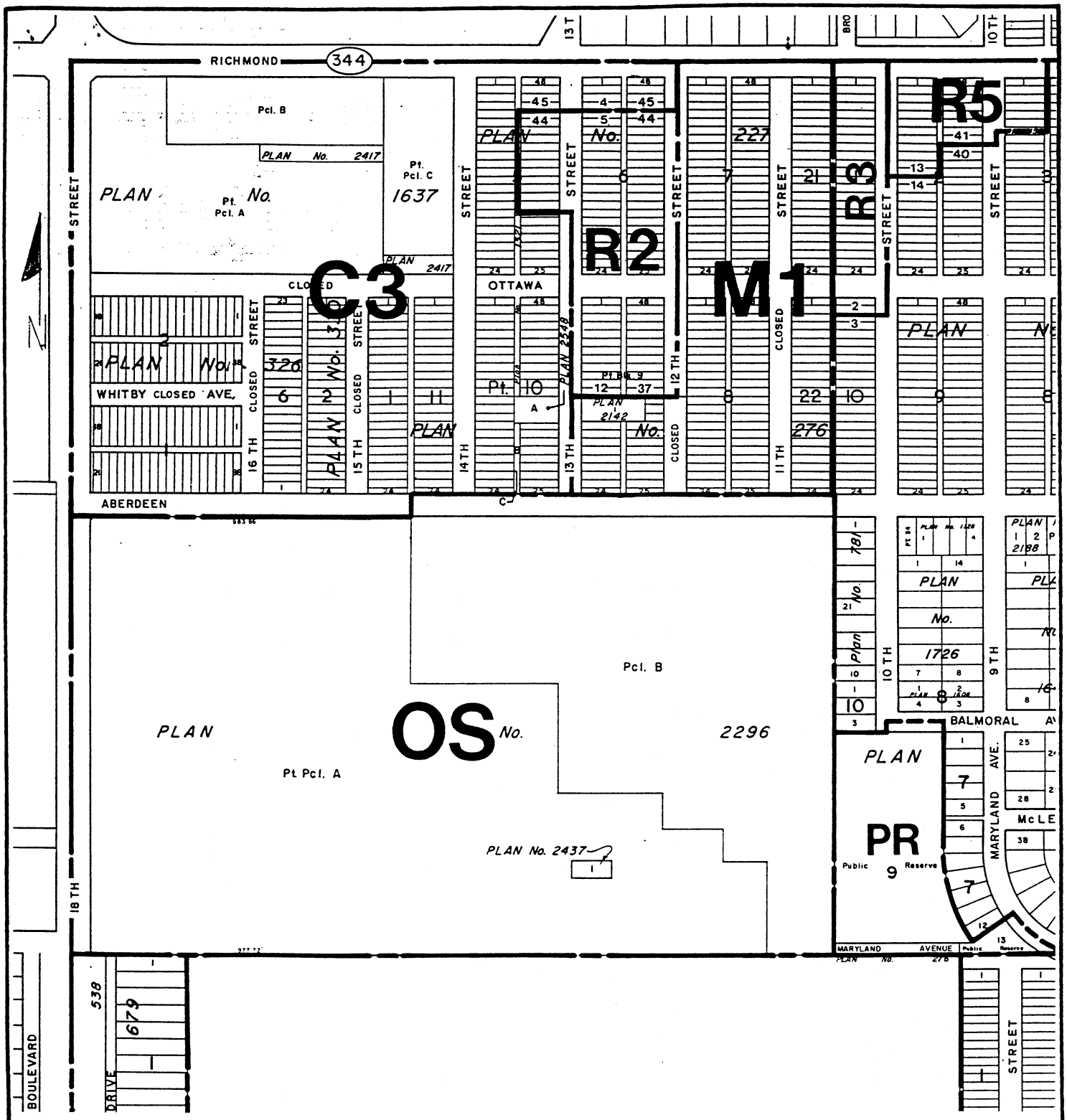
Notes:

1) Readings taken on December 4, 1992
2) Groundwater measurements are shown on testhole logs, Plate 6 to 11.

Geokwan Environmental Ltd

TITLE
GENERAL SITE LOCATION PLAN
CANADIAN TIRE PROPERTY
BRANDON MANITOBA

SCALE: 1"=1485'	DATE: 93/3/18	MADE: WK	CHKD.: WK	JOB: E254-5.1	PLATE: 1A



LEGEND

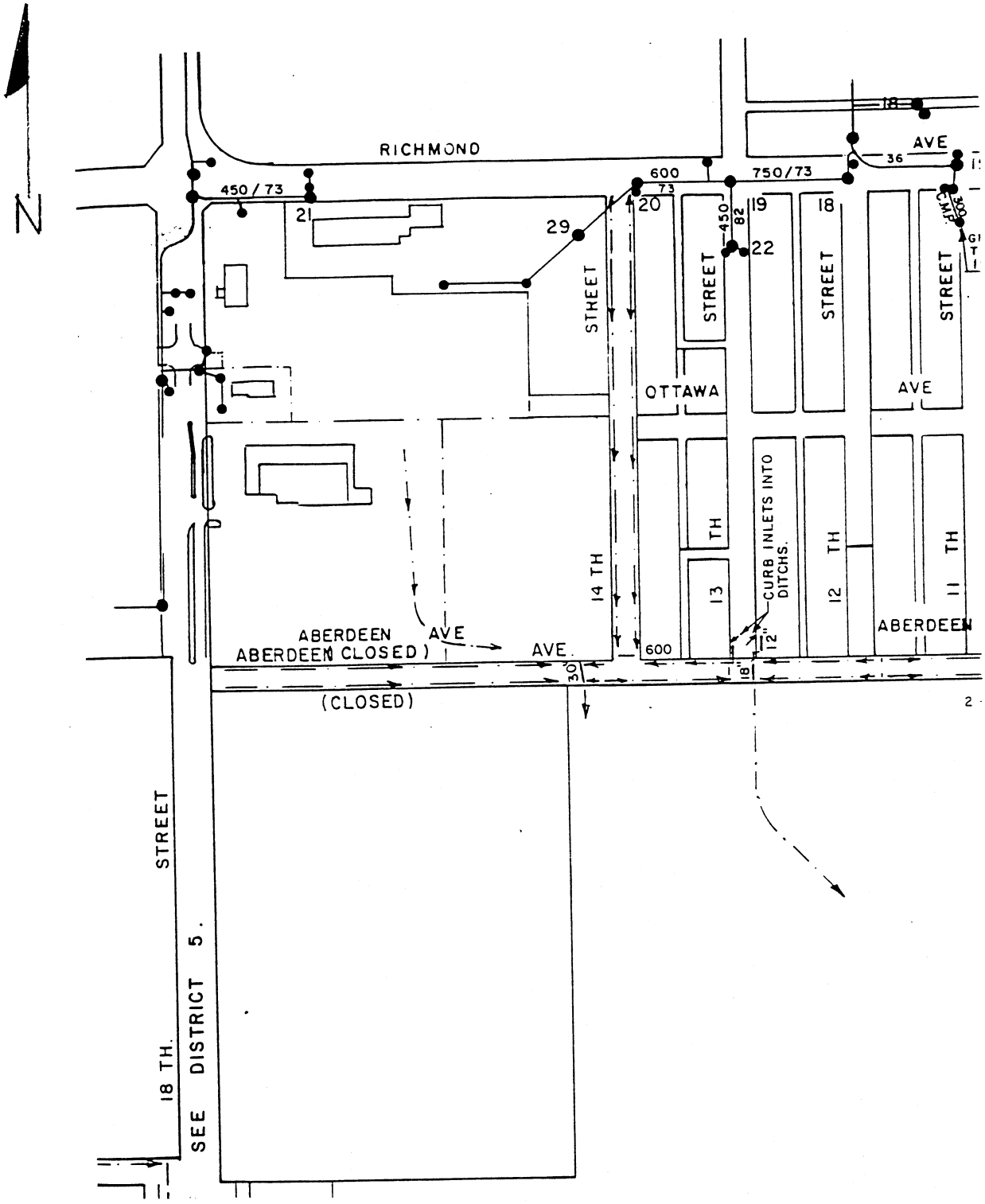
C3 - Highway Commercial
M1 - Restricted Industrial
OS - Open Space
PR - Park

R2 - Residential-Up to Side By Side
R3 - 3 to 4 Family Residential
R5 - Multiple Family Residential

Geokwan Environmental Ltd

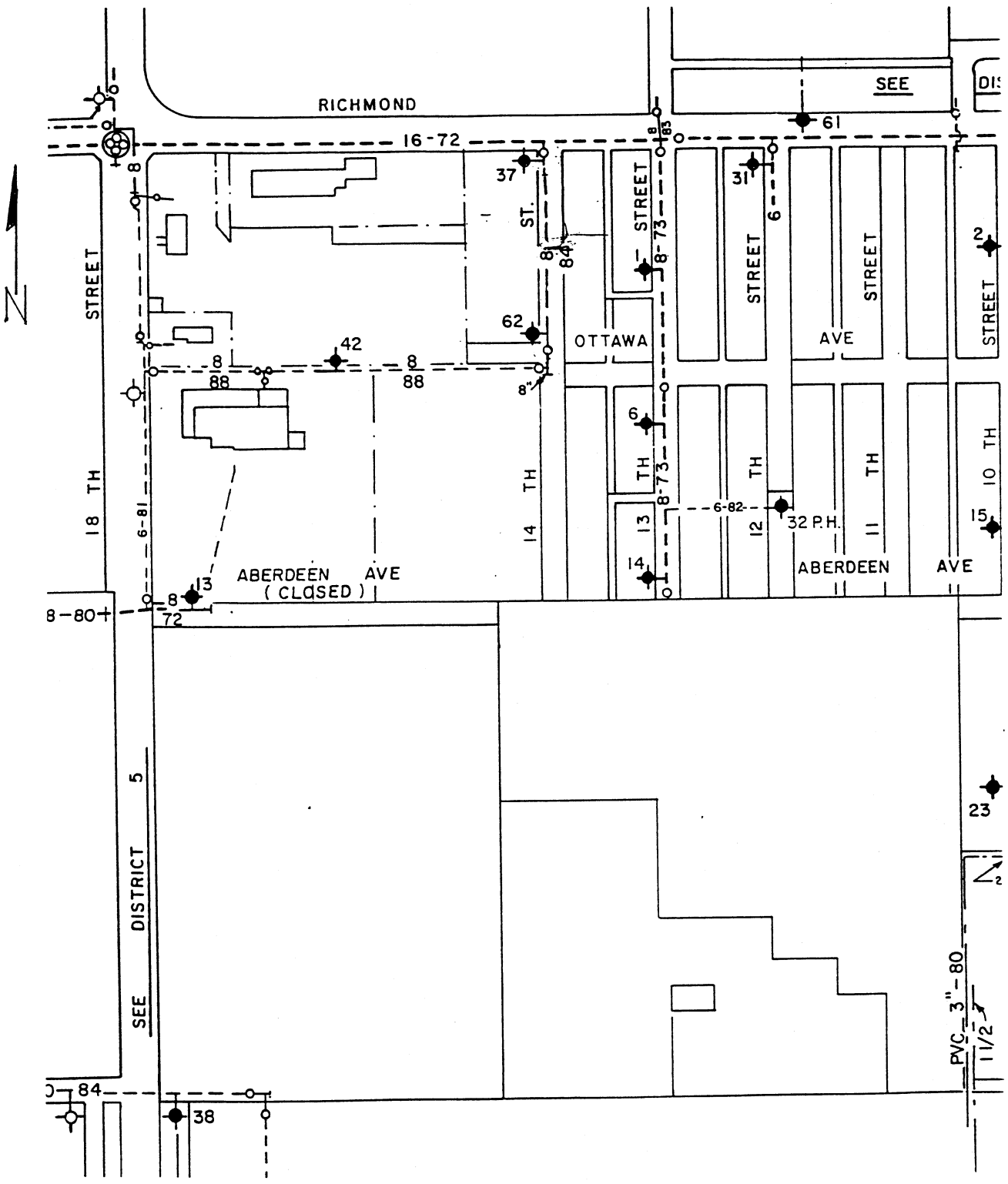
TITLE LAND ZONING
NEAR CANADIAN TIRE CORP.
BRANDON, MANITOBA

SCALE: NA	DATE: 18-12-92	MADE: HP	CHKD.: WK	JOB: E254-5.1	PLATE: 2



Geokwan Environmental Ltd	TITLE	STORM SEWER PLAN BRANDON, MANITOBA

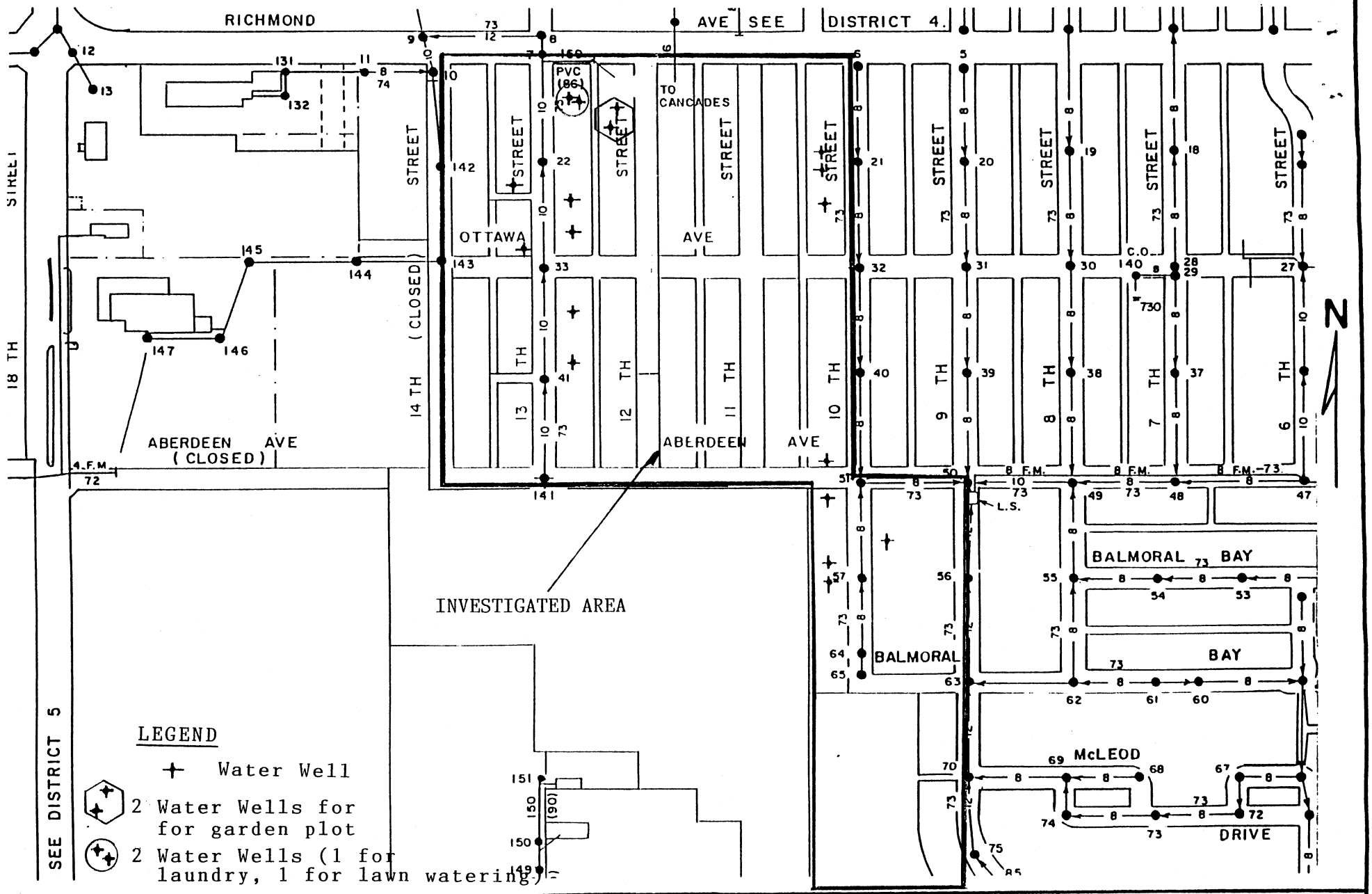
SCALE : NA	DATE : 18/12/92	MADE : HP	CHKD.: WK	JOB : E254-5.1	PLATE : 3



Geokwan Environmental Ltd

TITLE: WATER LINE PLAN
BRANDON, MANITOBA

SCALE: NA	DATE: 18/12/92	MADE: HP	CHKD.: WK	JOB: E254-5.1	PLATE: 4



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ENVIRONMENTAL ENGINEERS

TITLE

Water Well Location Plan
Brandon, Manitoba

SCALE : 1"=40'	DATE : Nov 10/92	MADE : JDT	CHKD. : HP	JOB : E254	PLATE : 5

BOREHOLE LOG

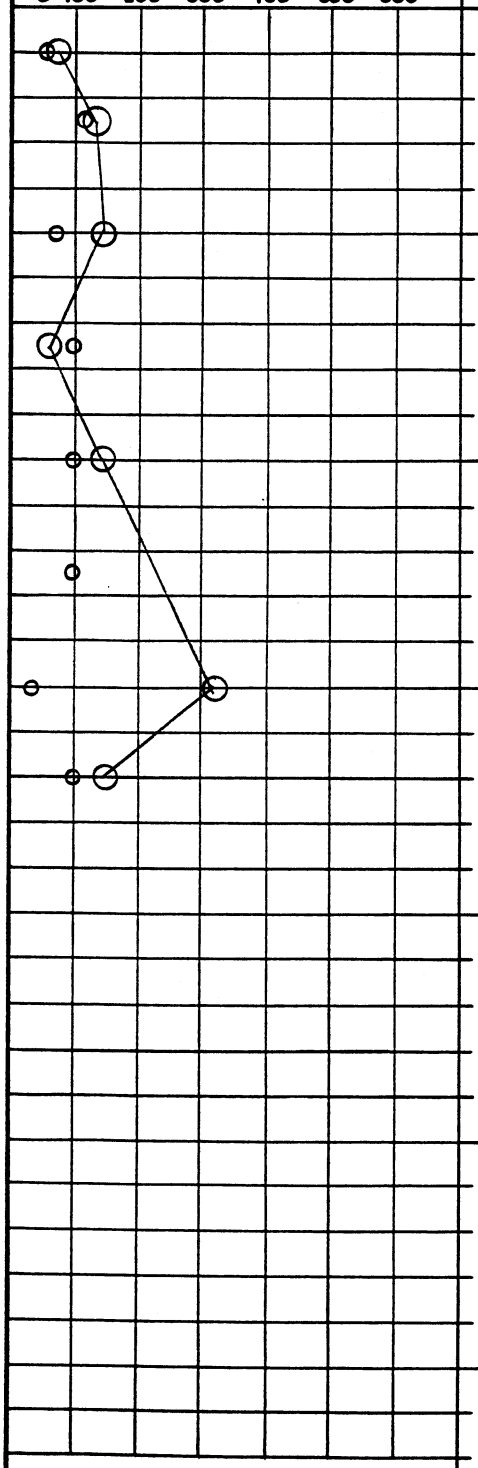
PROJECT
OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3, 1992	JOB: E254-5.1	MW191

SAMPLE TYPE: SHELBY TUBE | SPLIT SPOON | CORE | DISTURBED | NO RECOVERY | OTHER

SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 20 40 60 80 100 120
○ 100 200 300 400 500 600



SOIL SYMBOL	SOIL DESCRIPTION	(m) DEPTH	SAMPLE TYPE	DRILL TYPE / OTHER TESTS
	DATUM SURFACE ELEVATION 1289.62'			DRILL TYPE: 5" Auger OTHER TESTS
	FILL - brown sandy gravel - clayey, slight hydrocarbon - odor at 2' - dark brown sand, wet at 3'	1		
	SAND - black, clayey, trace gravel - brown, medium, wet at 5.25' - trace hydrocarbon odor - reddish brown, oxidized at 6.5' - trace gravel - saturated at 8.5'	2		▽ W.L. 4-12-92
	GRAVEL - fine, some sand - saturated - dark grey, moderate hydrocarbon odor	3 4		
	CLAY - soft, silty, grey - no hydrocarbon odor	5		
	End hole at 17' from grade. Notes: 1) Heavy seepage and caving to 8.5' from grade upon completion of augering. 2) Monitoring well installed to 14'6" from grade.	6 7 8 9 10		

PLATE 6

BOREHOLE LOG

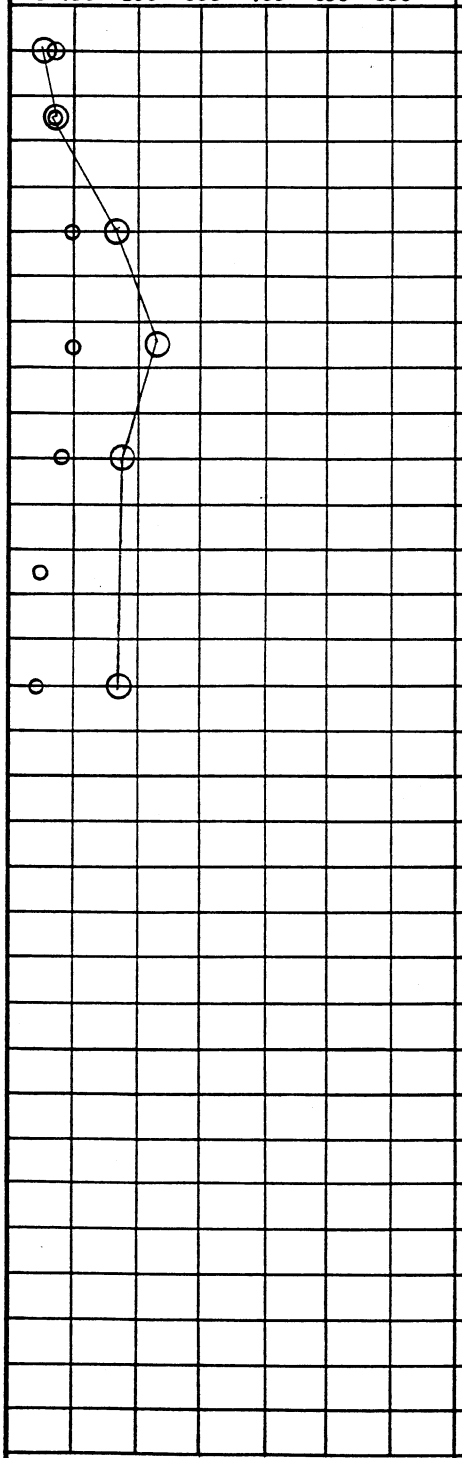
PROJECT
OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3/92	JOB: E254-5.1	MW192

SAMPLE TYPE: ◪ SHELBY TUBE ☒ SPLIT SPOON ▤ CORE ⊠ DISTURBED ☐ NO RECOVERY ◧ OTHER

SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 20 40 60 80 100 120
○ 100 200 300 400 500 600



SOIL SYMBOL

SOIL DESCRIPTION

DATUM

SURFACE ELEVATION 1290.76'

(m) DEPTH

SAMPLE TYPE

DRILL TYPE
5" Auger

OTHER TESTS

FILL - brown, gravelly sand
- dry
- moist at 1.5'

CLAY - dark brown, sandy
- trace organics
- dark grey from 5 to 6'

SAND - brown, trace clay & gravel
- moderate hydrocarbon odor
- black, oily, saturated

CLAY - brown, silty

SAND - fine, black, oily
- trace gravel
- saturated
- gravelly at 13'

CLAY - grey, silty, stiff

End hole at 17' from grade.

Notes:
1) Heavy caving & seepage to 8' from grade upon completion of augering.
2) Monitoring well installed to 14'6" from grade.

1 2 3 4 5 6 7 8 9 10

W.L. 4-12-92

PLATE 7

BOREHOLE LOG

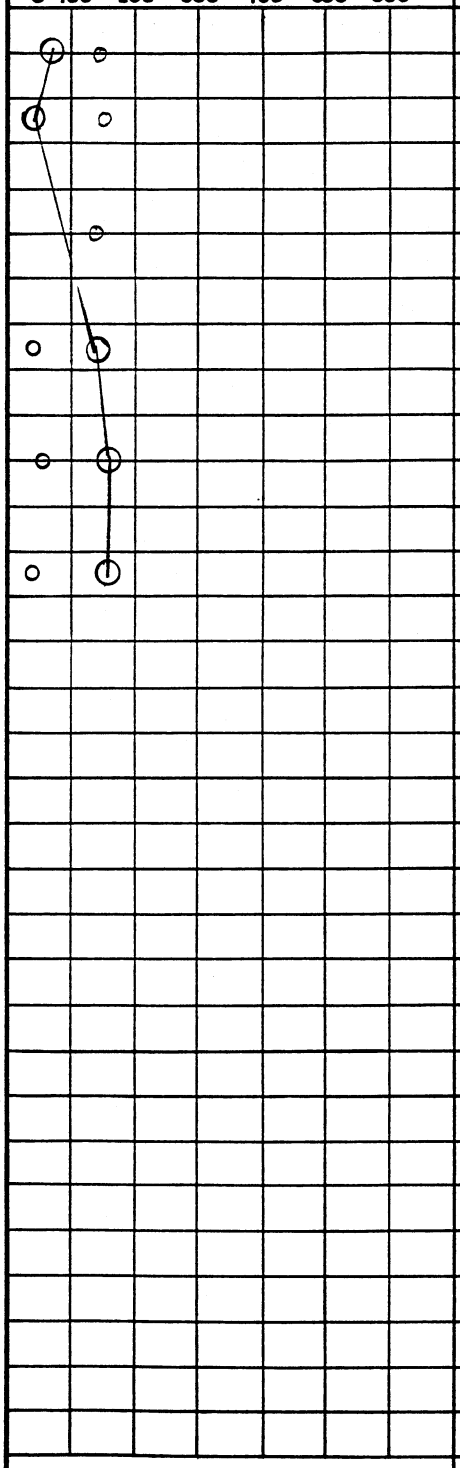
PROJECT: OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3, 1992	JOB: E254-5.1	MW193

SAMPLE TYPE: SHELBY TUBE | SPLIT SPOON | CORE | DISTURBED | NO RECOVERY | OTHER

SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 20 40 60 80 100 120
○ 100 200 300 400 500 600



SOIL SYMBOL

SOIL DESCRIPTION

DATUM

SURFACE ELEVATION 1287.44'

(m) DEPTH

SAMPLE TYPE

DRILL TYPE: 5" Auger

OTHER TESTS

TOPSOIL - dark brown, silty, sandy, fibrous

SAND - brown, gravelly, medium
- trace oxidization
- coarse at 2', some gravel
- reddish brown
- fine, tan sand layers below 6'

GRAVEL - fine, some sand
- saturated
- coarse at 10'

W.L. 4-12-92

CLAY TILL - brown, stiff
- some sand and gravel

End hole at 13' from grade.

Notes:

1) Slight caving and seepage to 8' from grade upon completion of augering.

2) Monitoring well installed to 12'6" from grade.

1 2 3 4 5 6 7 8 9 10

PLATE 8

BOREHOLE LOG

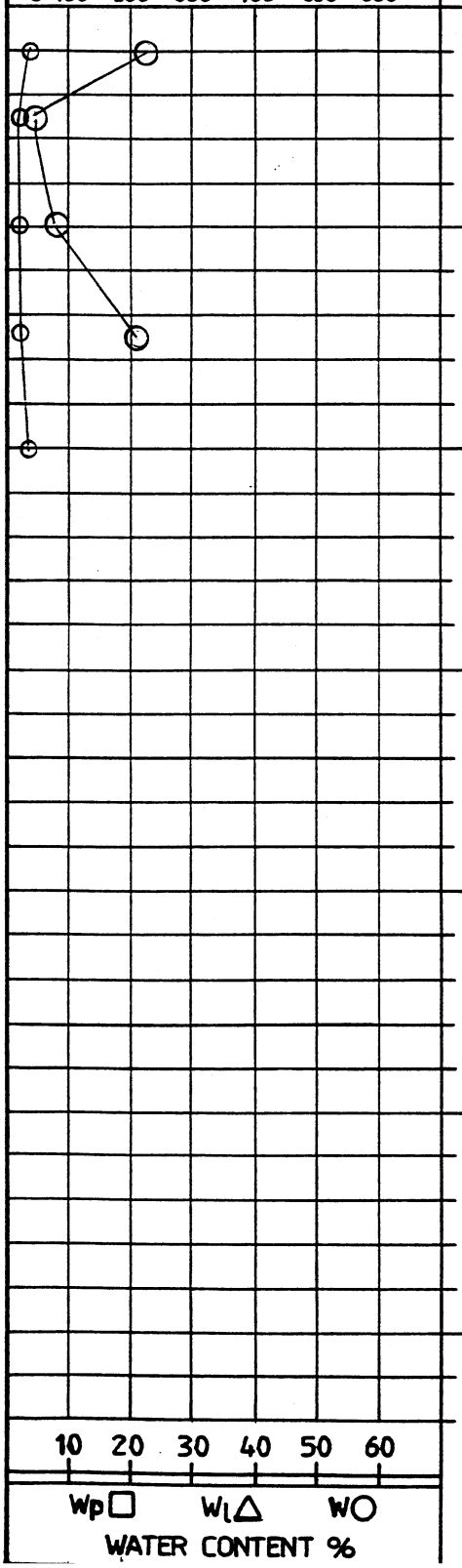
PROJECT: OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3/92	JOB: E254-5.1	MW194

SAMPLE TYPE: ◪ SHELBY TUBE ☒ SPLIT SPOON ▤ CORE ✳ DISTURBED ☐ NO RECOVERY ◧ OTHER

SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 0 | 20 100 | 40 200 | 60 300 | 80 400 | 100 500 | 120 600



SOIL SYMBOL

SOIL DESCRIPTION

DATUM

SURFACE ELEVATION 1284.18'

(m) DEPTH

SAMPLE TYPE

DRILL TYPE: 5" Auger

OTHER TESTS

TOPSOIL - black, sandy, silty, dry
- trace fibrous organics

SAND - fine to medium, light brown
- moist
- tan, silty clay inclusions at 3'
- reddish brown, oxidized at 3.5'
- trace gravel
- saturated, some clay at 5'

CLAY - firm, brown, silty

CLAY TILL - stiff, brown
- some sand and gravel

End hole at 10'6" from grade.

Notes:
1) Very slight caving & seepage upon completion of augering.
2) Monitoring well installed to 10'6" from grade.

▽ W.L. 4-12-92

PLATE 9

BOREHOLE LOG

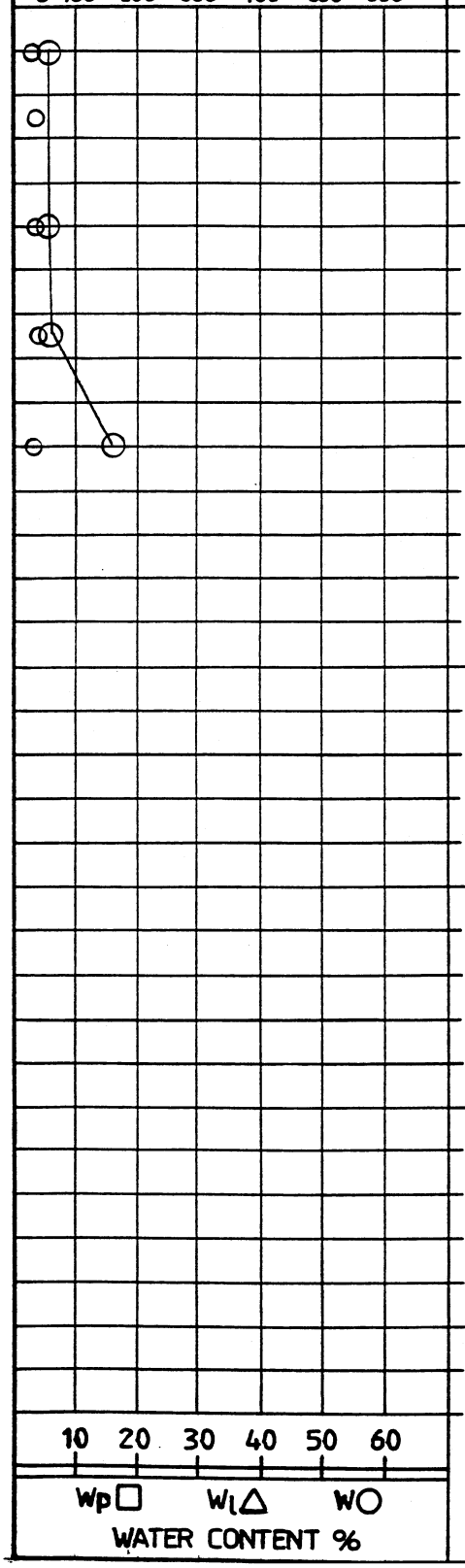
PROJECT
OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3, 1992	JOB: E254-5.1	MW195

SAMPLE TYPE: SHELBY TUBE | SPLIT SPOON | CORE | DISTURBED | NO RECOVERY | OTHER

SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 20 40 60 80 100 120
○ 100 200 300 400 500 600



SOIL SYMBOL	SOIL DESCRIPTION	(m) DEPTH	SAMPLE TYPE
	DATUM SURFACE ELEVATION 1287.49'		
	FILL - dark brown topsoil to 6" - very fine silty sand below 6"		
	TOPSOIL - dark brown, silty, sandy		
	CLAY - grey, silty	1	
	SAND - light brown, medium, moist - coarse at 6', reddish brown - gravelly at 7' - oxidized stains	2	
	CLAY - brown, silty, stiff		
	CLAY TILL - grey, very stiff - some sand and gravel	3	
	End hole at 11' from grade.	4	
	Notes: 1) Testhole dry, no caving upon completion of augering. 2) Monitoring well installed to 10'6" from grade.	5	
		6	
		7	
		8	
		9	
		10	

DRILL TYPE
5" Auger

OTHER TESTS

W.L. 4-12-92

PLATE 10

BOREHOLE LOG

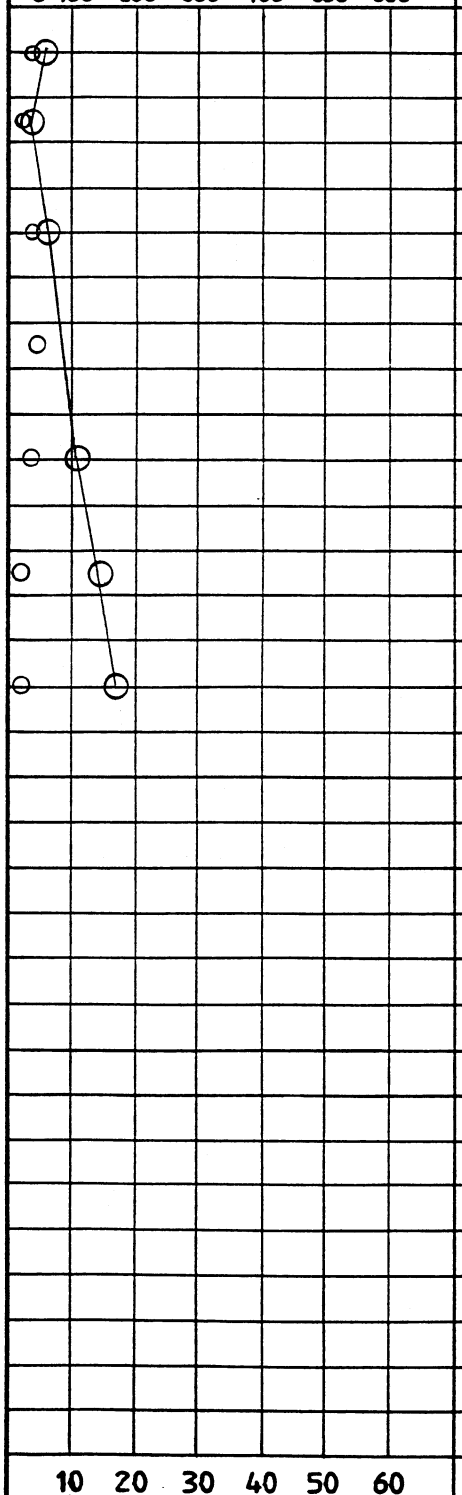
PROJECT
OFF-SITE RISK ASSESSMENT
CANADIAN TIRE PROPERTY, BRANDON

Geokwan Environmental Ltd

LOGGED/DWN: HP	CHKD: WK	DATE OF INV: Dec 3, 1992	JOB: E254-5.1	MW196

SAMPLE TYPE: SHELBY TUBE | SPLIT SPOON | CORE | DISTURBED | NO RECOVERY | OTHER

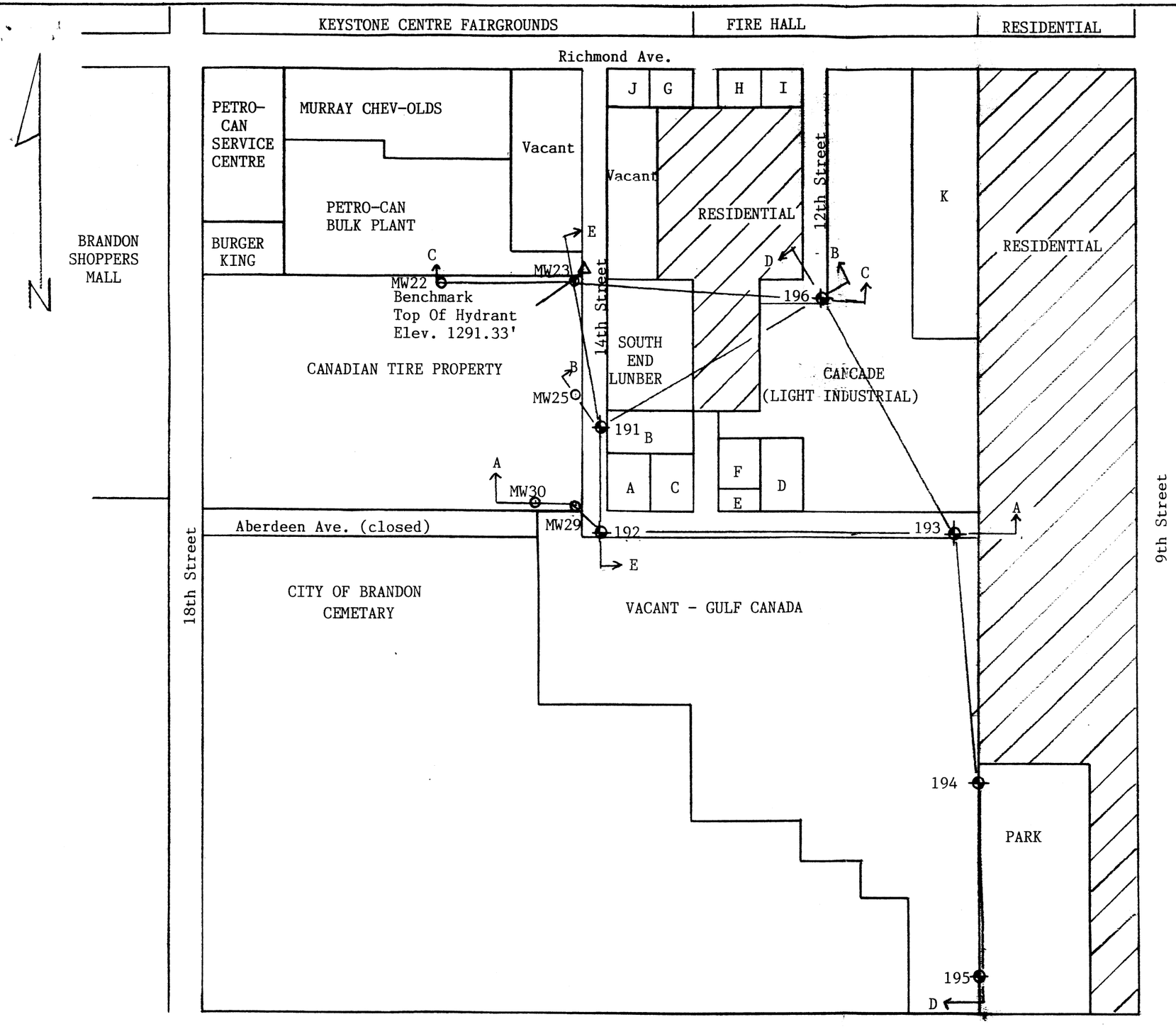
SOIL GAS CONCENTRATION
○ PPM ● %LEL
● 20 40 60 80 100 120
○ 100 200 300 400 500 600



10 20 30 40 50 60
Wp□ WL△ WO○
WATER CONTENT %

(ft) DEPTH	SOIL SYMBOL	SOIL DESCRIPTION	(m) DEPTH	SAMPLE TYPE	DRILL TYPE: 5" Auger / OTHER TESTS
		DATUM SURFACE ELEVATION 1290.18'			
		TOPSOIL - dark brown, sandy, silty			
		SAND - brown, medium, moist - trace gravel - wet, some silt at 6'	1 2		
		CLAY - brown, silty, soft			
		GRAVEL - fine, reddish brown - trace sand, saturated - coarse at 11', some clay	3		▽ W.L. 4-12-92
		CLAY TILL - very stiff, grey - some sand and gravel	4		
		End hole at 15' from grade.	5		
		Notes: 1) Heavy caving & seepage to 7.5' from grade upon completion of augering. 2) Monitoring well installed to 14' from grade.	6 7 8 9 10		

PLATE 11



LEGEND

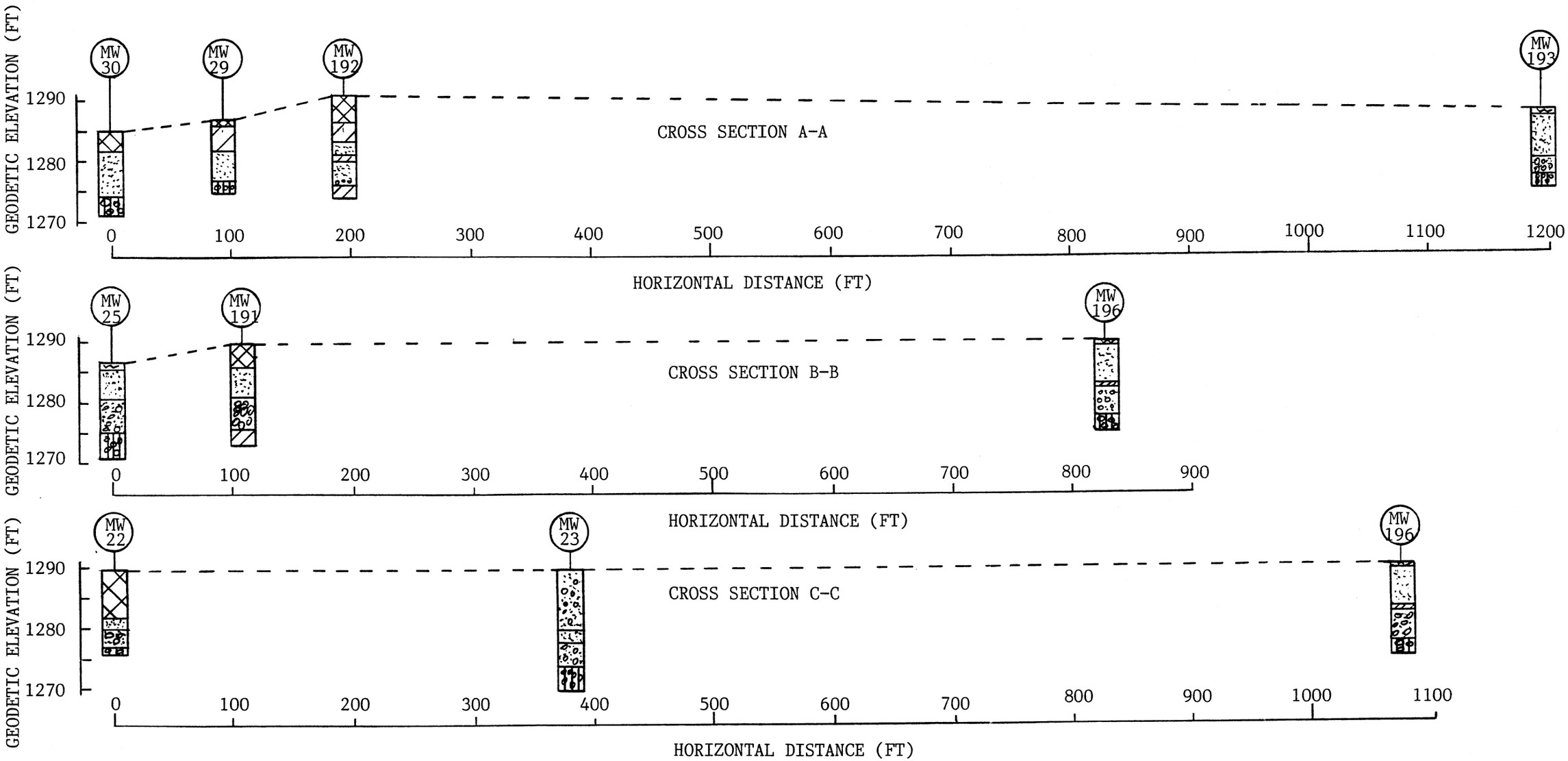
A - A & J Pump Service
B - Westside Plumbing & Heating
  - Assiniboine Fire
C - Manufab
D - Harry's Auto Service
E - Canmark
F - Wheeler's Auto Supply
G - Richmond Cleaners
H - Renatta's Hair Designers
I - Strip Mall
J - Ready Oxygen
K - McMunn & Yates Hardware

Note: All of above are commercial properties.

Geokwan Environmental Ltd
ENVIRONMENTAL ENGINEERS

LAND USE MAP
NEAR CANADIAN TIRE PROPERTY, BRANDON, MB.

SCALE: 1"=300'	DATE: Dec 10/92	MADE: JDT	CHKD: HP	E 254-5.1	PLATE: 1



SAND FILL TOPSOIL

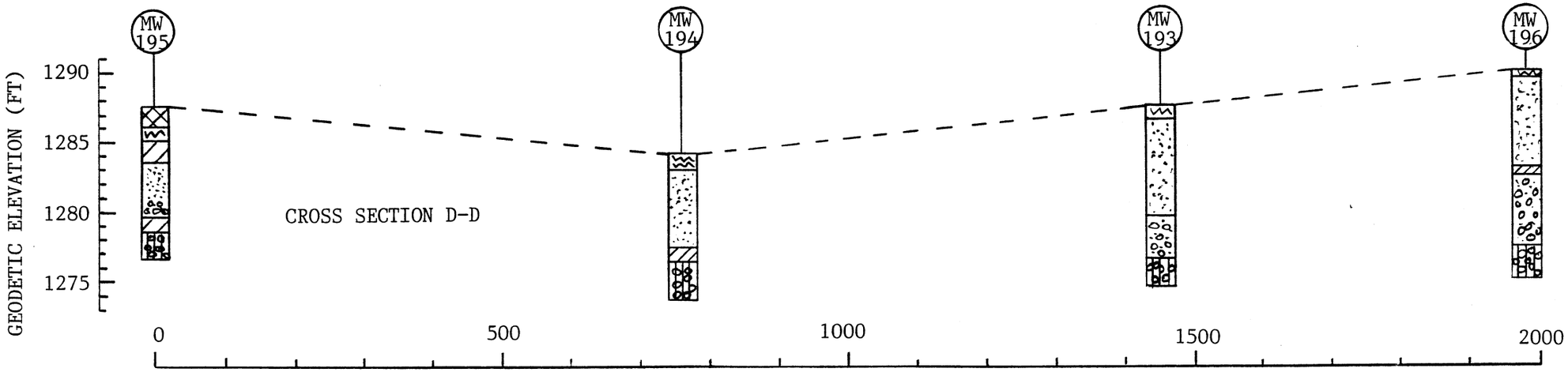
GLACIAL TILL CLAY GRAVEL

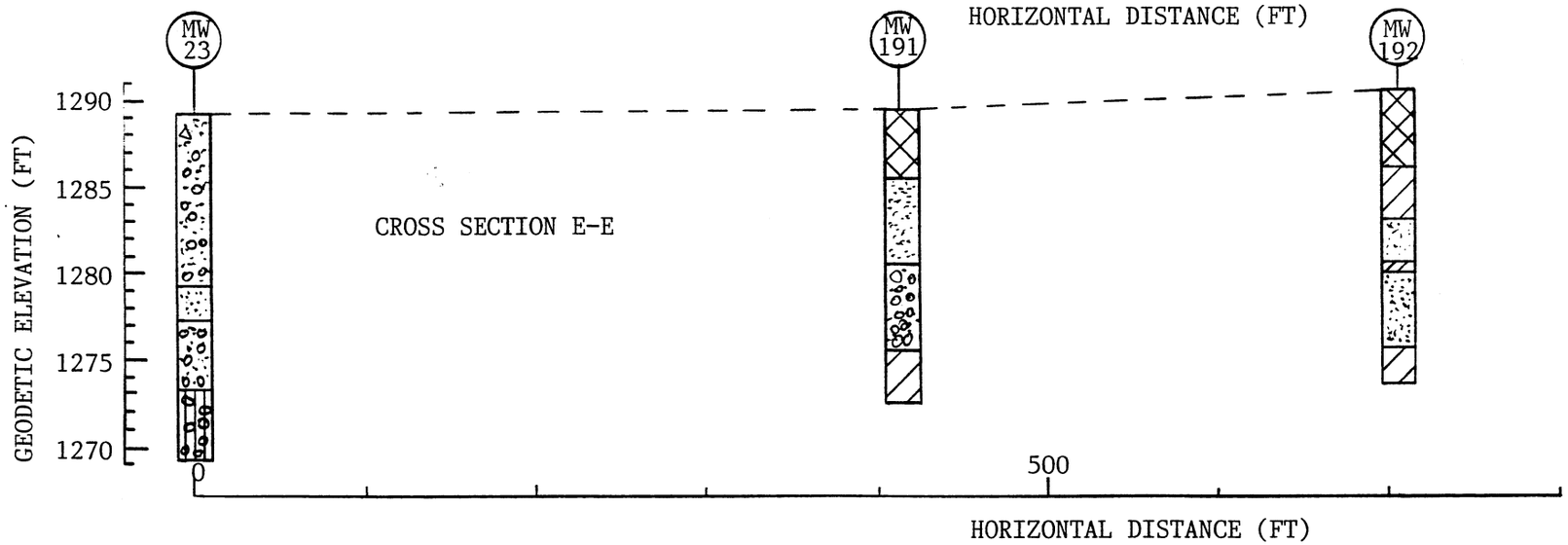
Geokwan Environmental Ltd

ENVIRONMENTAL ENGINEERS

GEOTECHNICAL CROSS SECTIONS A-A TO C-C
CANADIAN TIRE
BRANDON, MANITOBA

SCALE : AS SHOWN	DATE : DEC 16/92	MADE : JDT	CHKD. : HP	JOB : E254-5.1	PLATE : 12





SAND FILL TOPSOIL

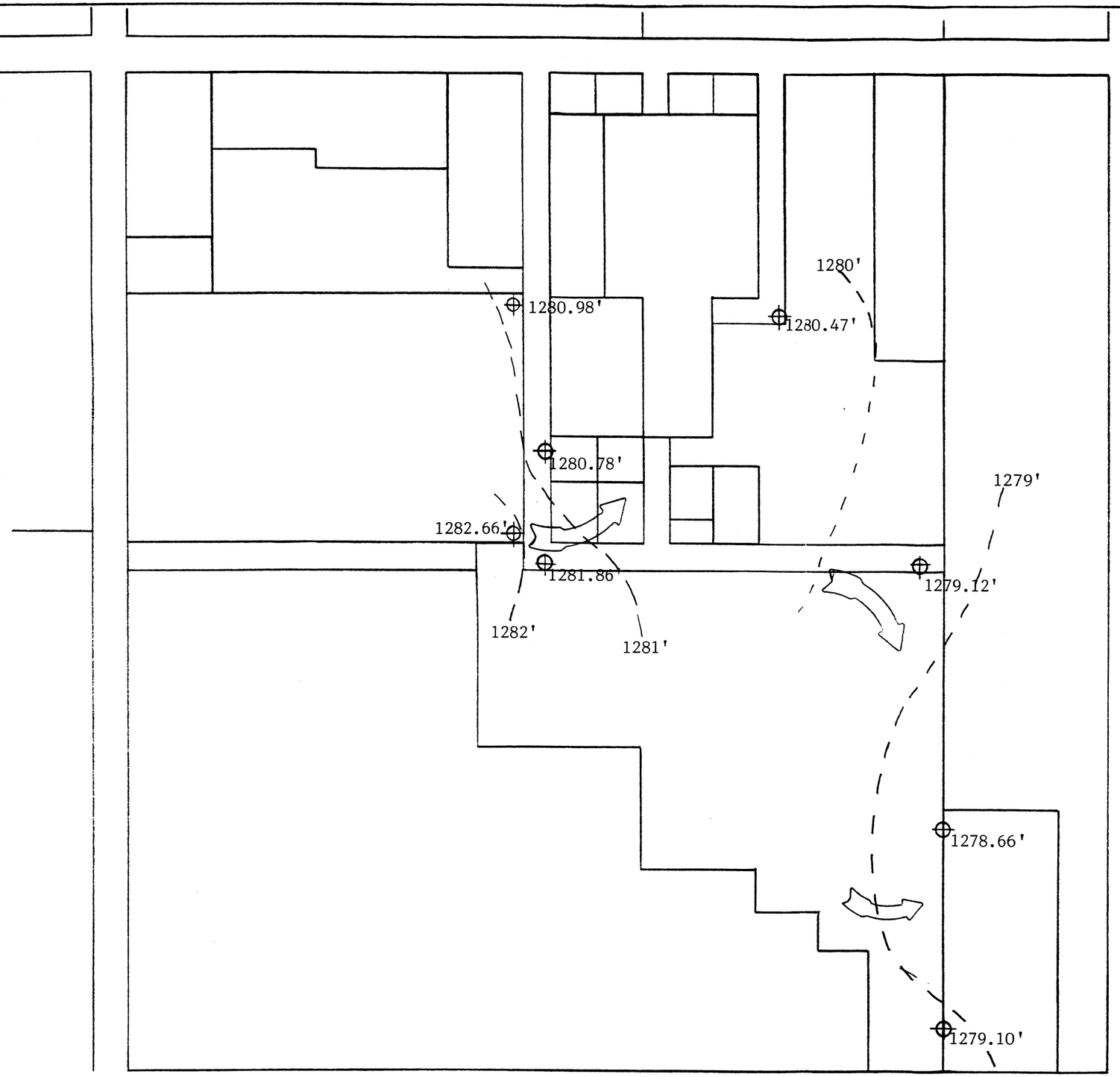
GLACIAL TILL CLAY GRAVEL

Geokwan Environmental Ltd

ENVIRONMENTAL ENGINEERS

CROSS SECTIONS D-D TO E-E
CANADIAN TIRE
BRANDON, MANITOBA

SCALE : AS SHOWN	DATE : Dec 16/92	MADE : JDT	CHKD. : HP	JOB : E254-5.1	PLATE : 13



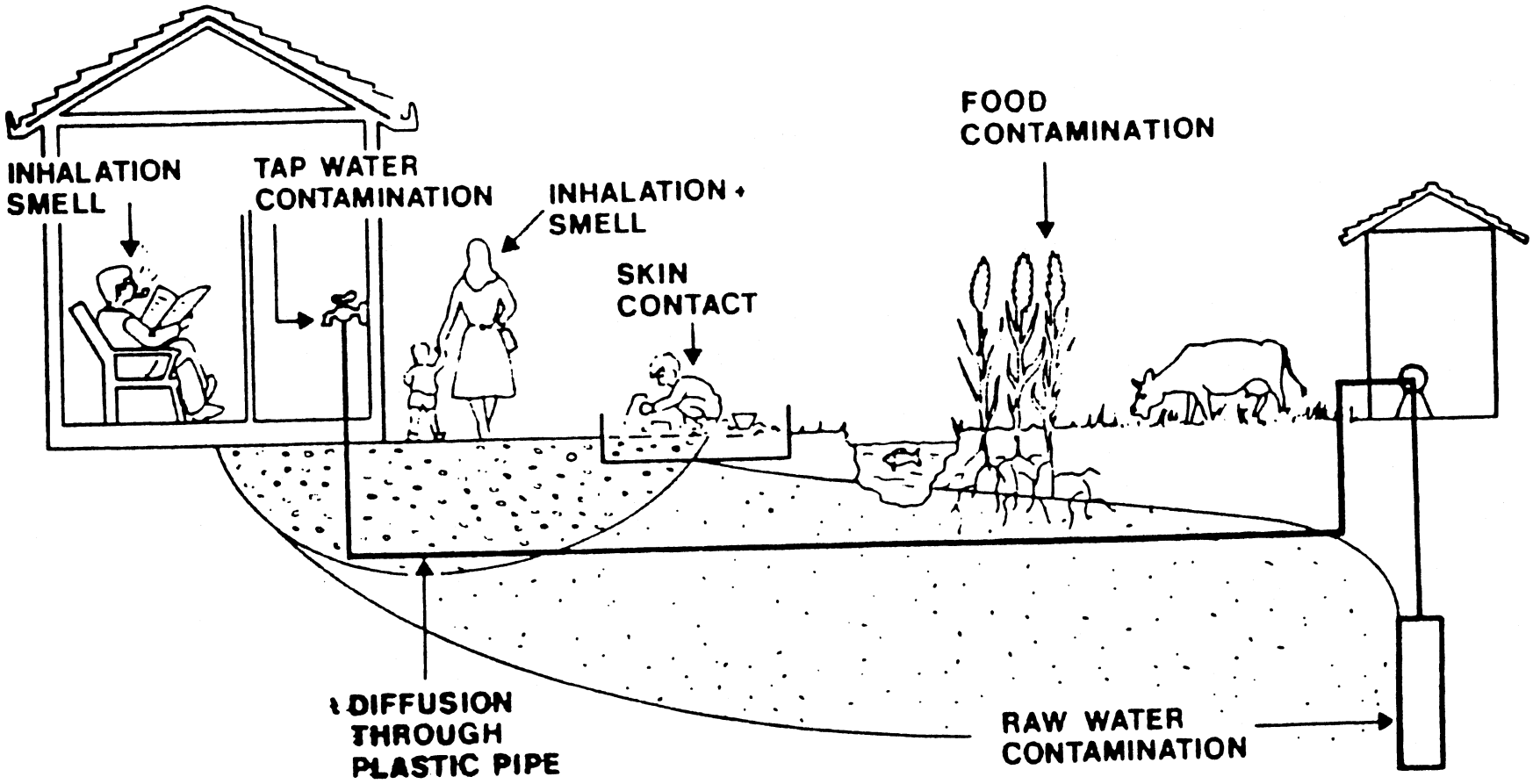
Geokwan Environmental Ltd

ENVIRONMENTAL ENGINEERS

ESTIMATED GROUNDWATER CONTOUR
NEAR CANADIAN TIRE PROPERTY
BRANDON, MANITOBA

Scale 1"=300'	Dec.20/92	Made: HP	Chkd: WK	Job: E254-5.1	Plate 14

EFFECT ON HUMAN HEALTH



Geokwan Environmental Ltd
ENVIRONMENTAL ENGINEERS

TITLE
EFFECTS ON HUMAN HEALTH FROM VARIOUS POTENTIAL EXPOSURE PATHWAYS

SCALE : Nil	DATE : 93/3/18	MADE : WK	CHKD. :	JOB : E254.5.1	PLATE : 15