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CLOSURE REPORT
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Submitted to:

Centra Gas (Manitoba) Inc.
c/o Agassiz North Consultants Inc.
1214-B Chevrier Blvd.
Winnipeg, Manitoba
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Submitted by:

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WX-04783

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APPENDIX A

SUMMARY OF PREVIOUS INVESTIGATIONS AND SITE HISTORY

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A1.0 INTRODUCTION

As part of developing the closure report for the Centra site, AMEC Earth & Environmental Limited (AMEC; formerly AGRA Earth & Environmental Limited) conducted a detailed review and compilation of the available site data. The available data included assessment reports by CH2M Hill Engineering Inc (CH2M) and AMEC, completed between 1993 and 1999. This section summarizes the available site data including;

- A historical summary of the site operations
- A discussion of the site setting
- A summary of the work plans completed by CH2M and AMEC prior to the current contract works;
- A summary of the key subsurface site characteristics; and
- A summary of the previous field and lab data.

The information contained within this section will be utilized as a basis to assess the potential impacts of the site contamination, develop remedial options and costs for the site and to develop a risk based approach to long term management of the environmental liabilities

A2.0 DESCRIPTION OF CURRENT SITE SETTING

The Centra site is located in the North End district of the City of Winnipeg in the ward of North Point Douglas. The major portion of the site is bounded by Rover Avenue to the North, Annabella Street to the east, Gladstone Street to the west and Sutherland Avenue to the south. The bridge supports for the Disraeli Bridge are located along the west side of the site. A smaller portion of the Centra site is located on the south side of Sutherland Avenue, however, this area has not been impacted by the historical operation of the Manufactured Gas Plant (MGP). The Red River is located approximately 45 metres north of the property boundary, across Rover Avenue.

The area surrounding the site is generally developed with light industry however, a significant number of residential properties are also located in the area. Winnipeg Hydro operates a power substation immediately east of the site across Annabella Street. Residences are located to the south and east of the Winnipeg Hydro property. Additional residences are located west of the site, beyond the Disraeli Bridge. Land along the river bank is owned by the City of Winnipeg and is considered parkland. To the southwest of the site is a mattress manufacturing company. The location of the site within the City of Winnipeg is shown in Figure A1.

The present facility consists of an Operations Building, a Transportation Building, a Stores Building and a Training Complex Building. The Operations Building is used for engineering, planning, customer service, construction, meter provisioning, environment health & safety and maintenance activities. The layout of the existing site facilities are shown in Figure A2.

A3.0 HISTORY OF SITE

Historical information, documented by CH2M (1994) and AMEC (1999), indicates that a retort gas plant operated at the site between 1885 and 1924, after which a water gas and a coke oven plant operated at the site until about 1958. The coal gasification plant serviced an area within an approximately 25 kilometre radius of the site and provided fuel primarily for the Fort Rouge area of the City. During its operation, the MGP operated under several names including the Winnipeg Gas Company, the Manitoba Electric and Gas Light Company, the Winnipeg Electric Street Railway Company and the Winnipeg Electric Company. The MGP ceased production of manufactured gas in about 1958. After this time, many of the original buildings were demolished. However, some of the original building foundations and utility lines may remain buried at the site. Construction of the Disraeli Bridge to the west of the site began in about 1958. The Disraeli Bridge is located across the northwest corner of the former MGP property, as shown on the site plan, Figure A2.

The type of plant that operated at the site after 1924 was a Koppers Company By-Product Coke Plant which consisted of a coke and coal handling facility, a coke oven gas plant, a water gas plant, and a purification plant. Historical plans obtained from Centra and aerial photographs obtained from the Ministry of Natural Resources indicate that the north and northeast portions of the site were primarily used for the storage of coal and coke (carbonized coal) and the coke oven plant was located at the south end of the site. The former water gas plant was located at the northwest portion of the site.

In general, water gas (also known as blue gas) was produced by reacting coal or coke with steam to yield a gas rich in hydrogen and carbon monoxide. The water gas was usually further enriched in heating value by adding petroleum oils (usually Bunker 'C' or gas oil) to the hot gas. Oil was then thermally cracked to gaseous constituents in a practice known as carburetion with the resulting product called carburetted water gas (AES, 1996). The major by-product of water gas production was the uncracked portion of the liquid hydrocarbons fed to the carburettor. The uncracked portions consisted of tar sludges, polymers and petroleum sludges or emulsions and liquors (AES, 1996). Tar sludges were produced from the residual heavy hydrocarbons in the coke or the injected oil; they tended to be heavy and relatively stable. Polymers and petroleum sludges were formed in relatively small quantities while emulsions and contaminated liquors were formed in relatively high quantities. Emulsions and liquors were formed when the water gas was cooled resulting in the condensation of water and oil.

Coal gas (also known as coke oven gas) was produced by the carbonization (coking) of bituminous coal in the absence of air. By-products and wastes of this operation included coke, coal tar, sludges, tar liquors, and ammonia liquor (AES, 1996). Coke was marketed for domestic heating and coal tar was recovered for distillation into valuable products or was sold for use as fuel.

The by-products from the purification and distillation processes of the coke oven plant included pitch, tar acids (phenols), ammonia and various aromatic polycyclic hydrocarbons such as naphthalene. Some of these by-products were sold or recovered for use as fuel. The sale of tar and coke at the Winnipeg Electric Street Railway Company was documented in Brown's Directory of North American and International Gas Companies between 1910 and 1948 (AES, 1996).

In addition to the by-products mentioned above, waste streams associated with the former plant operation would have included tar sludge, clinkers, ash, fixed cyanide, ammonia, sulphur, oil sludge, gas condensates, and contaminated liquors.

A plan of the site dated 1924 indicated that several active and abandoned sewer, water, tar liquor, tar, gas, overflow and steam pipes were located throughout the site. Some sewer lines appeared to discharge to mains located beneath Gladstone Street and comments on the plan indicate that some of the sewer lines may have discharged directly to the Red River. The 1924 plan produced by the Winnipeg Electric Company showed sewer lines connecting most site buildings to exterior manholes and sewer lines that discharged to the Red River. The location of this discharge point was approximately 27 m west of the river water pumping station. Two abandoned sewer lines leading from the water gas plant are shown to run down the west side of Gladstone Street and discharge to the Red River. It is not known what materials were discharged into the various sewer lines, however, they are shown to be connected to overflows at the various facilities and therefore there is a potential that tar and/or some of the other process by-products were discharged into these sewer systems.

The MGP facility was flooded by the Red River in 1950. Rover Avenue was subsequently raised in order to provide a dyke for flood protection. It is not known what impact the flood may have had on the operation of the facility. As well, there are no records to determine if any of the product storage areas may have been flooded; thereby causing possible product releases.

In 1959 demolition of some of the site facilities was initiated. Demolition in 1959 included the coke oven building, boiler and scrubber room building, chimney stack, oil and tar by-product storage wells, removal of railroad tracks, and the purification building. In 1969, a second phase of demolition occurred in order to construct the existing Operations Building and support facilities. Removal of foundation structures associated with the gas holders, office, and meter house, and removal of tanks and miscellaneous subsurface structures was completed before construction. Prior to construction of the operations facility in 1969, the site was reportedly covered by 2 to 4 m of heterogeneous fill consisting of clay, sand, gravel, brick and concrete. According to CH2M's report, the geotechnical consultant (Ripley, Klohn and Leonoff) that

conducted the 1967 subsurface investigation recommended that the Operations Building be constructed with a vapour barrier under the basement floor slab and that detached sumps be used to minimize the potential for vapours entering the basement of the new facility. It has been assumed that this approach was used during construction procedures, although there is no information available to confirm this assumption.

A4.0 REGIONAL GEOLOGY

Based on available geological maps, the subsurface stratigraphy in the Winnipeg area normally consists of topsoil and fill materials underlain by glacio-lacustrine silt and clay to a depth of about 15 to 18 meters from grade. A deposit of silty till, typically a few meters or more in thickness, occurs between the clay and the underlying bedrock. The bedrock in this area is of the Lower Fort Garry Member and largely consists of Palaeozoic limestone and dolomite bedrock. Bedrock is estimated to occur at about 25 to 27 meters below grade.

Adjacent to the river system, alluvial deposits can be present and a more complex subsurface stratigraphy often exists. The alluvial deposits can typically consist of silts, sands and clays, generally present in thin interbedded layers. The presence of these alluvial soils can result in a zone of much higher soil permeability.

A5.0 REGIONAL HYDROGEOLOGY

Primarily low permeability tills and glaciolacustrine silt and clay deposits dominate the area with the exception of locations along the floodplains of the rivers where permeabilities may be higher. Fractures in the glacio lacustrine silts and clays, as wells as in the till deposit, can be a source of greater permeabilities.

The major underlying aquifer in the Winnipeg area is the upper 15 to 30 m fractured zone of the Upper Carbonate Aquifer. The aquifer is somewhat confined by the overburden and underlying lower permeability carbonate bedrock.

Prior to the development of the aqueduct system which supplies the City of Winnipeg with drinking water, the Upper Carbonate Aquifer was an important source of water for both municipal and industrial use. The Upper Carbonate Aquifer remains a potable water source in areas bordering the city (east of the Red River) and for some industrial use within Winnipeg. It is known that the Red River supplied process water to the former MGP.

The Lower Carbonate Aquifer occurs in the bottom 7.5 to 15 m of the Red River formation, along the interface of the upper shale unit of the Winnipeg formation. This aquifer is of limited use for potable water supply. The Winnipeg Formation contains an upper sandstone aquifer which ranges in thickness from 6 to 12 m and a lower sandstone aquifer approximately 3 metres thick. Both sandstone aquifers contain non potable saline waters.

The alluvial deposits which are present often contain a shallow aquifer which is directly connected to the Red River. These isolated aquifers represents a limited area of permeability and would therefore have no use as a water supply.

A6.0 SUMMARY OF PREVIOUS INVESTIGATIONS (1993 – 1998)

During the period between 1993 and 1999, several environmental investigation and assessment reports were prepared for the Centra site. A listing of these reports is included below along with a brief synopsis.

- *Environmental, Health, and Safety Assessment of the Sutherland Avenue Operations Facility in Winnipeg, Manitoba. Phase I: Preliminary Site Investigation. CH2M Hill Engineering Limited. April 1994.*

  Centra identified the former coal gasification plant located at the Sutherland Avenue Operations Facility in Winnipeg, Manitoba as requiring environmental investigation due to the historic use of the property as a Manufactured Gas Plant. Centra Gas initiated an assessment of this property as part of its proactive environmental management plan. In September 1993 CH2M Hill Engineering Limited (CH2M Hill) initiated Phase I (Preliminary Site Characterization) of a proposed four phase Environmental Health and Safety Assessment (EHSA). The Phase I study included a review of historical operations and processes, a geophysical survey, drilling test holes across the site and installing monitoring wells, conducting air monitoring, and excavating test pits. The intrusive investigation identified gas plant residues, such as coal tar, and industrial debris at the site.

- *Volume I: Environmental, Health and Safety Assessment of the Sutherland Avenue Operation Facility in Winnipeg, Manitoba. Phase II: Detailed Site Characterization. CH2M Hill Engineering Limited. January 1995.*

  Based on the findings of Phase I, investigation of sediment and water quality in the Red River was conducted by CH2M Hill in 1994 as part of Phase II (Detailed Site Characterization) of the EHSA. Sewer piping inspections and water sampling were also conducted as part of the Phase II study.

- *Surficial Sediment Plume Study – 1996. Phase II B Biological Impact Assessment – Red River, Manitoba. Agassiz North Associates Limited under contract with CH2M Hill Engineering Inc. viii + 69 pp. 1996.*

  Surficial Sediment Plume Study – 1997 – Red River, Manitoba. Agassiz North Associates Limited. 1997.

  Surficial Sediment Plume Study – 1998. Agassiz North Associates Limited. February 1999.

Between 1995 and 1998, inclusive, Agassiz North Associates Limited (Agassiz) conducted sediment sampling to monitor the plume size of coal tar residues within the Red River. Agassiz also completed an assessment of the physical features of the riverbank, including the location of any existing outfalls, pipes, *etc.* The results of these studies is presented in detail by Agassiz, however can be summarized as showing that a plume of coal tar residues was identified in the river bottom sediments. The results between 1995 and 1998 indicated a large variation in the plume size from year to year.

- *Elevator Construction, Centra Operations Building. AGRA Earth & Environmental Limited. 1995/1996.*

  In Fall of 1995, during construction of an elevator addition to the Operations Building, coal tar residues were identified in the soil and groundwater beneath the footprint of the addition. In order to mitigate impacts to the construction workers, to manage proper handling and disposal of all impacted soil and groundwater and to ensure that long term migrations pathways into the building were not generated, AMEC Earth & Environmental Limited (AMEC) provided environmental consulting services over about a one year period. The work plan included soil and groundwater sampling and testing, bio-remediation of PAH impacted soils excavated from the site and supervision of the installation of a hydrocarbon resistant liner below the addition.

- *Biotreatability Study Analyses and Results, Centra Gas Sutherland Avenue Plant Site, Winnipeg, Manitoba. AGRA Earth & Environmental Limited. November 1997.*

  In accordance with direction from Manitoba Conservation, contaminated groundwater entering the Red River from the Centra site was considered to be of concern to water quality of the River. As such, the purpose of the biotreatability study was to determine the feasibility of bioremediation technology for in-situ treatment of PAH and hydrocarbon contaminated groundwater. The aim of the study was to test the ability of Oxygen Releasing Compounds (ORC's) to stimulate biological activity which would result in the reduction of dissolved contaminants in the groundwater. Although not conclusive, the study determined that bioremediation utilizing ORC as an oxygen source could be an effective method of removing volatile hydrocarbons and several PAH parameters found in the groundwater at the Centra property.

- *Air Quality Monitoring. AGRA Earth & Environmental Limited. April 1996 through April 1999.*

  In April 1996 (sampled from Feb 29 to March 4, 1996), May 1996 (sampled from April 26 to May 1, 1996), September 1996 (sampled on August 24, 1996) and in April 1999, air sampling was conducted at several locations in the Centra operations building. The samples were collected from areas considered to have the highest likelihood of impact, due to the relative proximity to the contaminated soil and groundwater which is believed to underlie the building.

- *Summary of Activities and Findings, Investigation of the Source of Coal Tar Residues, Centra Gas Sutherland Avenue Operations Site, Winnipeg, Manitoba. AGRA Earth & Environmental Limited. February 1999.*

The purpose of this report was to investigate potential sources of the coal tar residues which had been documented at the site and off-site to the north, in particular in the river bottom sediments. The primary goal of this non-intrusive study was to evaluate the potential that on-going subsurface migration of coal tar residues from the site to the river sediment was occurring.

A7.0 SUMMARY OF MAJOR FINDINGS

A7.1 Site Geology

The main native overburden stratigraphic units identified at this site by CH2M during the 1993 subsurface investigation and AMEC's subsequent investigations included:

- Fill materials;
- Weathered glaciolacustrine silty clay;
- Unweathered glaciolacustrine silty clay;
- Stratified alluvial; and
- Silty glacial till.

The depth of fill ranged from 1.5 to 4.0 m and was generally thicker in areas close to the existing buildings. The fill was generally thinner at the northern portion of the property. The fill materials encountered at the site were categorized into four main groups: topsoil, granular fill, fill with industrial debris, and fill without industrial debris. The granular fill consisted of the asphalt surface base and sub-base. Fill material typically consisted of sandy silt, silty clay, silty sand and clayey silt. Industrial debris encountered within the fill materials included bricks, coke, concrete, and wood chips. Coke debris and tar pockets were observed in the vicinity of BH09 and BH10 (CH2M) at the southern portion of the site. Coke debris and a white deposit with a strong sulphur odour was encountered in BH04 and TP02 (CH2M). Coke was observed in both TP01 and TP03 (CH2M).

Weathered glaciolacustrine silty clay was encountered in the southern portion of the site beneath the surficial fill materials. The deposit ranged in thickness from 2.0 to 4.0 m and was encountered at depths ranging from 1.5 to 4.0 m and extended to 4.9 to 6.9 m below ground surface. The silty clay was high plastic, stiff, mottled grey-brown or olive-brown, and moist. The unweathered glaciolacustrine silty clay deposit was also encountered in the southern portion of the site, beneath the weathered zone discussed above. This deposit was encountered at depths ranging from 4.9 to 7.7 m. The deposit was characterized by high plasticity, little or no oxidation, higher moisture contents, darker grey in colour, trace coarse sand and gravel, stiff consistency, and occasional organic remnants.

A stratified alluvial deposit was encountered at the north end of the site; on the west side extending from BH07 (CH2M) towards the Red River and on the east side extending from the area of BH09 and BH13 (CH2M) to the Red River. The alluvial deposit was characterized by interbeds of fine-grained, low permeability materials (silts and clays) and coarser-grained, high permeability materials (generally sand). The deposit was generally found to underlie the fill material and extended to depths of about 13 to 16 m below grade. The alluvial soils were generally saturated throughout the depth of the deposit. Generally, the alluvial deposit comprised the following discontinuous primary soil zones:

- Fine sand with silt and clay interbeds
- Clayey silt with fine sand interbeds
- Fine sand

- Silty clay with sand and silt interbeds
- Clayey silt/sandy silt

A silt till deposit was encountered close to the Red River at MW22 (CH2M) at a depth of 13.4 m below grade. The silt till was characterized by some coarse-grained sand and gravel within a predominantly silt matrix, very dense/hard, grey and moist. A geotechnical investigation conducted by Ripley, Klohn and Leonoff Limited in 1967 reported that the till deposit was encountered at 16.1 m below grade in the southern portion of the site.

Within the south portion of the site, the highly plastic clay is known to have very low permeabilities, generally in the order of 1×10^{-7} to 1×10^{-9} cm/sec, and would therefore impede the migration of contaminants in this area of the site. In this regard, the upper fissured, weathered clay would have a permeability in the order of 1×10^{-7} cm/sec, while the lower, unweathered clay would have a permeability in the order of 1×10^{-9} cm/sec. At the north portion of the site, the alluvial soils, in particular the sand and silt zones, have much higher permeability (likely 1×10^{-3} to 1×10^{-5} cm/sec) and are therefore more conducive to the migration of contaminants both vertically and laterally. With depth, the zone of dense silty till is inferred to have a lower permeability (1×10^{-6} cm/sec) which will generally act to impede migration of by-product wastes to greater depths. However, the till can contain fissures which could allow migration through selective pathways.

Test hole drilling was also completed in the River for construction of the Disraeli Bridge. These test holes indicate that the soil profile underlying the Red River consists of alluvial deposits of sand, silt and clay to depths of about 3 m below river bottom, underlain by coarse sand, gravel and limestone fragments. Generally , the particle size increased with depth and large diameter boulders were encountered approximately 10 m below the river bottom. Fine sand and clay interbeds were occasionally found within the gravel zone.

Test hole logs as recorded by CH2M Hill at the time of drilling have been included as Figures A3 to A31. The test hole locations are shown on Figure A32.

A7.2 Site Hydrogeology

Shallow groundwater was measured at elevations ranging from 227.6 m at the south end of the site to 226.1 m at the north end of the site.

The groundwater encountered at the south end of the site was encountered in the fill materials and represents a zone of perched groundwater, which lies above the low permeability clay zone. At the north end of the site, a groundwater table was encountered in the stratified alluvial deposits and test hole drilling indicates that this groundwater zone is hydraulically connected with the Red River and the water levels are correspondingly impacted by the River levels.

A7.3 Distribution of Waste By-products in the Fill and Native Deposits

In the 1994 Phase I: Preliminary Site Investigation report completed by CH2M Hill, a system of identifying the distribution of physical contamination was determined from inspection of each soil sample. Characteristics such as odour, discoloration, and total organic vapour (TOV) were used to classify the materials into the following groups:

> NC (No contamination): The NC designation was used where the TOV reading was low, little or no odour was present, and there was no visual evidence of coal tar remnants.
>
> TC (Trace contamination): TC was used where there was no visual evidence of contamination however, a faint odour and low to moderate TOV measurements were present.
>
> VC (Visual Contamination): VC was used where a black discoloration of the soil material was observed or the presence of coal tar, coke or white-coloured residue was observed. Generally, the odour was strong and a high TOV reading resulted (50 to 215 ppm).
>
> C(no VC) (Contamination but no visual evidence): C (no VC) was used where no visual evidence existed, but a strong odour was present. TOV readings were generally high.

The VC and C (no VC) classifications represent materials where the greatest impact has occurred from the former gasification plant.

At the north end of the site, VC and/or C (no VC) classifications were identified at MW22, MW12, BH04, BH06, BH07, MW03, TP02 and TP03. VC and C (no VC) were present down to the till at 14 m below grade at MW22. At BH04, BH07 and MW12, the VC classification terminated at approximately 8 m below grade. However, in BH06 and MW03, the VC classification extended to the termination depth of 9.1 m. A reddish oily liquid was observed in BH06 and a black tar liquid was observed in TP03.

A7.4 Results of Air Monitoring – Operations Building

As part of the Phase I: Preliminary Site Investigation, CH2M (1994) conducted air monitoring and sampling at four locations within the operations building. The three areas tested within the basement were the south mechanical room sump, the north mechanical room sump, and the men's change room; a fourth sample was obtained at the west side of the building on the second floor. None of the parameters analyzed were detected on the tube or filter. The detection limit in air was calculated for each chemical to show that it was below the available air quality criteria. It was concluded that there was no evidence of air quality impacts attributable to manufactured gas plant residues based on the four samples collected in areas most likely to be affected in the Operations building.

AMEC subsequently completed air monitoring within the Operations Building in 1996 and again in 1999. The concentrations of PAH and BTEX parameters were below laboratory detection limits in April and May of 1996. The results of the September 1996 and April 1999 monitoring indicated a slightly elevated naphthalene concentration; the remaining parameters in the September testing were below method detection limits. The results of the August 1999 testing indicated that BTEX and PAH parameters were again below method detection limits.

A7.5 Results of Sewer Inspection

Sewer inspection and sampling was completed by CH2M in 1995 to verify that contaminant migration through the sewer system was not occurring. The inspection was completed as 1) the sewer elevations are close to that of the water table in some areas of the site, 2) sewer and/or sewer backfill have been found at other properties to act as pathways for contaminant migration, 3) sewers have been modified with time and sewers which at one time contained residues may or may not be in use or exist today, and 4) interviews with persons familiar with the historical operation of the facility indicated some evidence of gas plant residues had been observed in the sewers beyond the property.

Four sewer manholes were chosen to determine the composition of the sewer gas and water. The manholes chosen were selected based on their location relative to tributaries from the site, proximity to the water table, and results of the preliminary screening measurements. Gas and water samples were taken for laboratory analysis.

Of the gas analysis performed for PAHs and BTEX compounds, only one compound, xylene, was found to be above method detection limits; however, the concentration was below the acceptable exposure criteria for xylene established by ACGIH.

Background sewer water quality contained several PAH and BTEX constituents at relatively low levels. These results indicated that low levels of chemicals characteristic of gas plant residues are present in the sewer system. A comparison of the background concentrations indicated that concentrations did not increase across the site by a significant margin. Most concentrations remained stable or did not vary significantly. This indicated that there was no measurable

impact on sewer water quality due to infiltration of groundwater exposed to residues in the subsurface of the Centra site.

It was concluded that no significant impacts were apparent on either the sewer water or gas quality in the sewers immediately surrounding the former gas plant property. This suggests that there is little potential for migration along the sewers to off-site receptors and that no further attention need be directed at investigating this potential pathway.

A7.6 Summary of Health & Safety Assessment by CH2M Hill

In summary, the Health & Safety Assessment completed by CH2M Hill concluded that the PAH impacted soil and groundwater at the site, and beyond the site boundaries, did not pose a significant threat to Health & Safety of staff working at the Centra site, or those persons living in residences located adjacent to the site. As well, the assessment concluded that there were no significant issues related to water quality within the Red River.

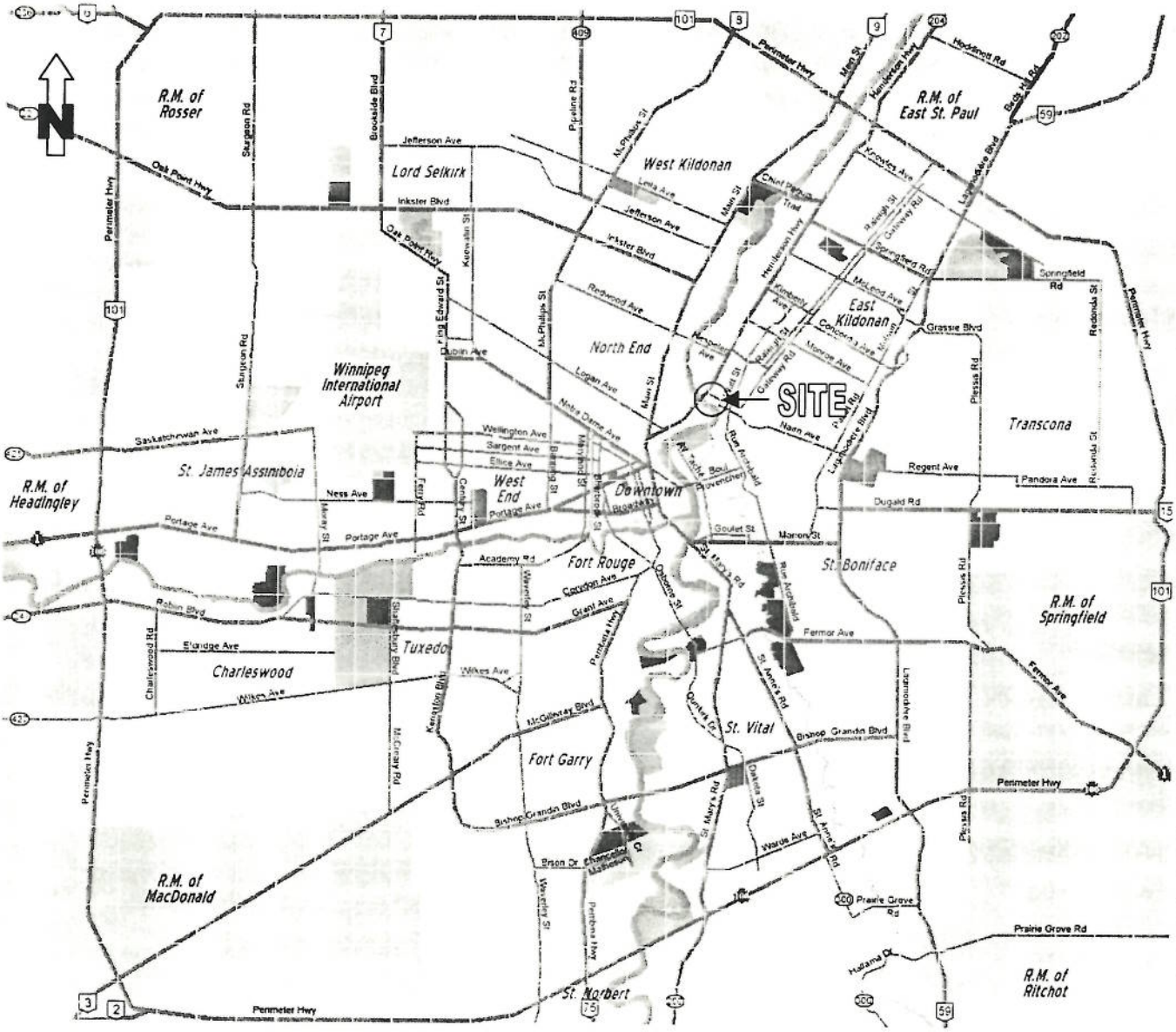
A8.0 SUMMARY

In summary, the investigations completed by CH2M, Agassiz and AMEC between 1993 and 1999 identified significant and widespread PAH and BTEX contamination throughout a majority of the Centra site, with the north end of the site being the most highly impacted area. Impacts were noted within both soil and water, with some evidence of free product also being present. Studies completed off site to the north and within the Red River indicated that the impacts had extended off of property and that a plume of coal tar residues was present in the river bottom sediments. A comprehensive Health and Safety assessment was completed by CH2M in 1995 and this study identified that there was limited health risk to users of the property due to the contaminants identified.

Based on the results of these studies, a meeting with Manitoba Conservation was undertaken in 1999. Based on this meeting, it was determined that the primary concern of the Department was the potential that on-going migration of coal tar residues to the Red River was occurring. This was based on an increase in the plume size within the Red River. However, if it could be shown that on-going migration was not occurring (i.e. the plume is a result of historic occurrences), the site could be removed from the Manitoba Conservation Contaminated Sites List.

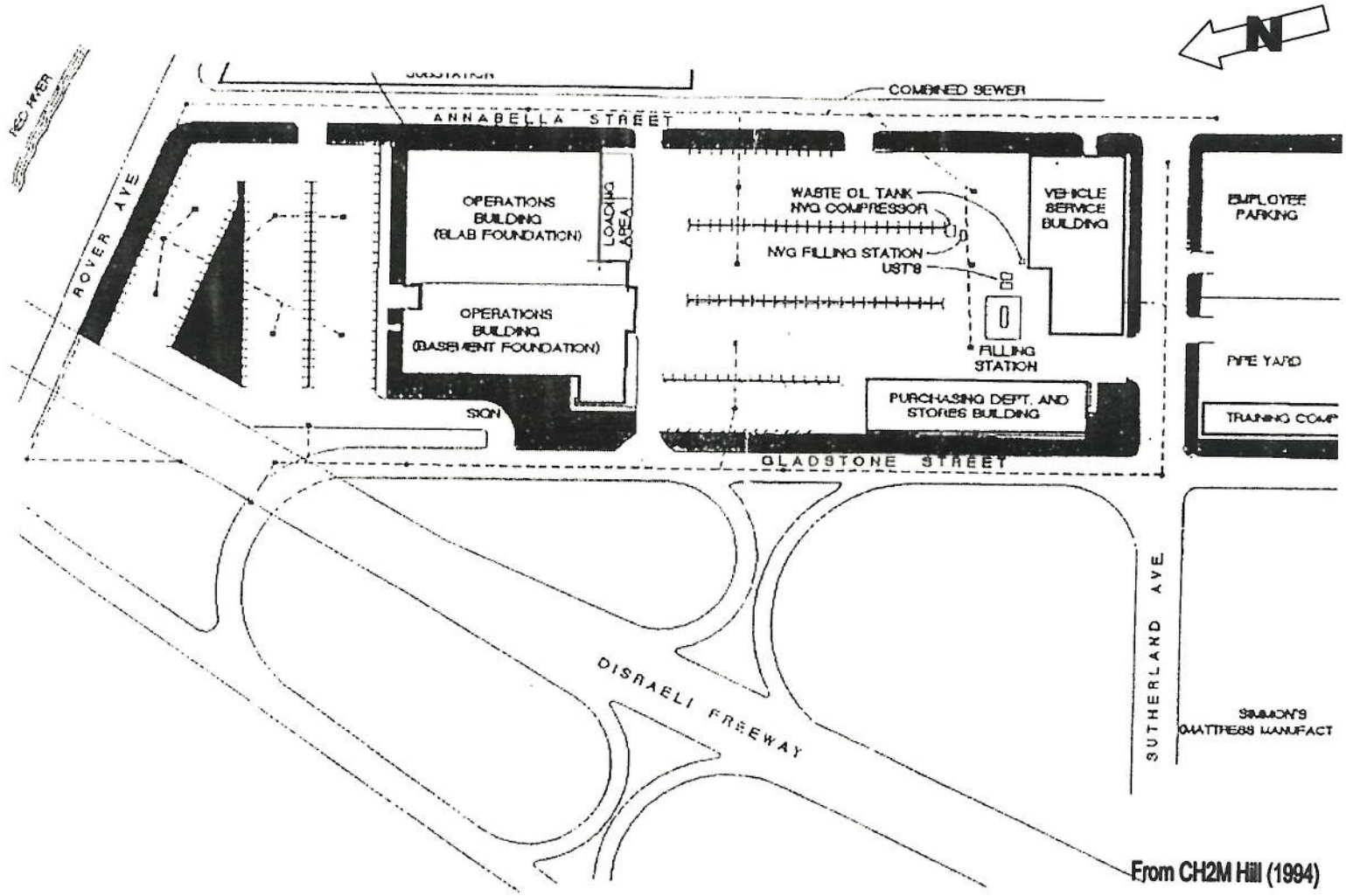
ATTACHMENT A1

FIGURES



CITY OF WINNIPEG

AGRA *Earth & Environmental Limited*		**SITE LOCATION** **CENTRA OPERATIONS BUILDING SITE** **35 SUTHERLAND AVENUE** **WINNIPEG, MANITOBA**		
CENTRA GAS MANITOBA INC.				
Drawn: N/A	Scale: ~1:150 000	Date: JUN/00	Project No.: WX-04783	Figure: A1



From CH2M Hill (1994)

AGRA *Earth & Environmental Ltd* *An AMEC Company*		**LAYOUT OF SITE FACILITIES CENTRA SUTHERLAND AVENUE SITE WINNIPEG, MANITOBA**		
CENTRA GAS (MANITOBA) INC.				
Drawn: N/A	Scale: NTS	Date: JUN/00	Project No.: WX-04783	Figure: A2

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-01 | PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 24, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.940
(metres) Well Pipe Elevation: 229.772
TOTAL DEPTH (m): 9.91
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	INU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION VC - VISUAL CONTAMINATION C/noVC - CONTAM/NO VISUAL EVIDENCE SS - SPLIT-SPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST
	CS1	NA	NC		**ASPHALT** (15 cm)
					GRANULAR FILL (0.15 m to 0.76 m) -tan brown, dry sand and gravel, no odour or staining
1	CS2	<2	VC		**SILT FILL** (0.76 m to 1.37 m) -black, trace fine sand, moist, strong napthalene odour and black staining
2	CS3	NA	NC		**SILTY CLAY FILL** (1.37 m to 3.96 m) -mottled grey and brown, moist, some grey silt, no odour or staining
	CS4	NA	NC		-as above
3	CS5	<2	NC		-as above
4	CS6	NA	NC		**SILTY CLAY** (3.96 m to 9.91 m) -grey-brown, native material, moist, oxidized.
5	CS7	NA	NC		-as above
	CS8	NA	NC		-as above
6	CS9	0	NC		-as above
7	CS10	NA	NC		-grey, moist, no oxidation, high plasticity, high clay content, some shells from 7.0 m to 7.6 m
8	CS11	NA	NC		-as above, silty clay
	CS12	0	NC		-as above, silty clay
	CS13	0	NC		-as above, silty clay
10					**BOREHOLE TERMINATED AT 9.91 m**

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL

FLUSH-MOUNT CASING

-cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 m to 4.88 m)
-hydrated bentonite holeplug

FILTER PACK
(4.88 m to 8.84 m)
-#65 grain clean Silica Sand

WELL SCREEN
(5.64 m to 8.69 m)
-Schedule 40 P.V.C., #10 slot 5 cm I.D.

WELL SEAL
(8.84 m to 9.75 m)
-hydrated bentonite holeplug

BOREHOLE DIAMETER = 0.20 m

A3

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-02 | PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 20, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.450 (metres) Well Pipe Elevation: 229.336
TOTAL DEPTH (m): 8.99
EASTING: 144.780
NORTHING: 231.860

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
					ASPHALT (15 cm)
	SS1	NA	NC		GRANULAR FILL (0.15 m to 1.07 m) –grey, dry, crushed stone, compact, black staining at 0.6 m, faint petroleum odour (SS1) S.P.T. results = 10,10,13,11
1	SS2	62	C (noVC)		
	SS3	40	VC		SILTY CLAY FILL (1.07 m to 3.35 m) –black, moist, soft, high organics content, some rootlets, faint tar odour, silty clay (SS2) S.P.T. results = 4,5,8,12
2	SS4	104	VC		–black, moist, silty clay, some white silt pockets, strong petroleum odour (SS3) S.P.T. results = 2,4,5,7
	SS5	104	VC		–black, moist silty clay, strong petroleum odour, trace fine sand (SS4) S.P.T. results = 3,4,5,8
3	SS6	3	TC		–black, moist, some white silt pockets and infilling, trace fine sand (SS5) S.P.T. results = 3,5,6,8
	SS7	5	TC		SILTY CLAY (3.35 m to 5.33 m) –mottled brown and grey, moist, cohesive, highly plastic, slightly fractured, trace fine sand, some white silt pockets (SS6 & SS7) SS6 S.P.T. results = 6,8,9,11 SS7 S.P.T. results = 4,5,9,12
4	SS8	62.5	C (noVC)		–as above, fracture surfaces are oxidized, higher moisture content, some fine sand, faint odour (SS8) S.P.T. results = 4,5,6,8
	SS9	49	C (noVC)		CLAYEY SILT (5.33 m to 8.23 m) –dark grey, saturated, some organic fibres, faint odour (SS9) S.P.T results = 4,4,5,5
5	SS10	13.3	TC		–grey with some brown mottling, saturated, some shells and organic fibres, occasional medium sand grain (SS10) S.P.T. results = 4,5,6,8
6	SS11	22	TC		–grey, saturated, some silt laminations, some shells (SS11) S.P.T. results = 2,3,4,5
7	SS12	0.2	NC		–as above with some organic fibres, shells and silt laminations, higher plasticity (SS12) S.P.T. results = 3,4,4,5
8	SS13	1.8	NC		SILTY CLAY (8.23 m to 8.99 m) –grey, moist, high plasticity, cohesive, some organic fibres (SS13) S.P.T. results = 3,3,3,4
9					BOREHOLE TERMINATED AT at 8.99 m
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL

FLUSH-MOUNT PROTECTIVE CASING –cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL (0.3 m to 5.03 m) –hydrated bentonoite holeplug

FILTER PACK (5.03 m to 8.99 m) –65 grain clean Silica Sand

WELL SCREEN (5.64 m to 8.69 m) # 10 slot, Schedule 40 P.V.C., 5 cm I.D.

BOREHOLE DIAMETER = 0.20 m

A4

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-03

PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE DRILLED: September 24, 1993

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers

ELEVATION: Surface Elevation: 229.810

(metres) Well Pipe Elevation: 229.729

TOTAL DEPTH (m): 9.14

EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE NA – NOT ANALYZED G – GRAB SAMPLE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
	SS1	16.8	TC		**TOPSOIL** (0.91 m) -grass surface -dry, brown, sandy, organic silt, faint napthalene odour
1	SS2	16.5	TC		**MIXED FILL** (0.91 m to 3.66 m) -brown, concrete, bricks and other debris, highly weathered silty clay , sand and gravel, some coal pieces, some black staining, faint napthalene odour (SS2/SS3)
2	SS3	4	TC		-low recovery for SS2 & SS3
3	SS4	22	VC		-black, wet, sandy silt with some brick fragments and wood chips, strong napthalene odour, some cohesion, medium plasticity
4					**SANDY SILT WITH FINE SAND INTERBEDS** (3.66 m to 8.23 m)
5	SS5	145	VC		-grey, saturated, fine sandy silt, some cohesion, moderate plasticity, some sheen on water surface, strong napthalene odour present
6	SS6	83.3	VC		-grey, moist, stratified, silt and fine sand beds, saturated, dark purple irridescent sheen, and strong napthalene odour present
7					
8	SS7	104	VC		-as above
9	SS8	101	VC		**SILTY CLAY WITH FINE SANDY SILT INTERBEDS** (8.23 m to 9.14 m) -grey silty clay and fine sandy silt, stratified, bedded, strong napthalene odour, silty clay beds are cohesive and high plasticity, sheen present
10					**BOREHOLE TERMINATED AT 9.14 m**

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL

FLUSH-MOUNT PROTECTIVE CASING
-cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 m to 2.13 m)
-hydrated bentonoite holeplug

FILTER PACK
(2.13 m to 5.95 m)
-65 grain clean Silica Sand

WELL SCREEN
(2.74 m to 5.79 m)
10 slot, Schedule 40 P.V.C., 5 cm I.D.

WELL SEAL
(5.95 m to 9.14 m)
-hydrated bentonite holeplug

BOREHOLE DIAMETER = 0.20 m

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-04 | PROJECT NO. : ONT29776.A0

CLIENT NAME : CENTRA GAS Manitoba Inc. | DRILLING METHOD : CT250, Hollow-stem Augers

LOCATION : 35 Sutherland Ave. Winnipeg, Man. | SURFACE ELEVATION (M) : 229.95

DATE DRILLED : September 24, 1993 | TOTAL DEPTH (M): 9.14

LOGGER : R. Stacey | EASTING : NA

DRILL COMPANY : Paddock Drilling Ltd. | NORTHING : NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION C (noVC) – CONTAM/NO VISUAL EVIDENCE VC – VISUAL CONTAMINATION NA – NOT ANALYSED G – GRAB SAMPLE SS – SPLITSPOON SAMPLE CS – CONTINUOUS SAMPLE
0	CS1	5.1	TC		TOPSOIL (15 cm) -grass surface, dark brown, moist, sandy
0.5					SILTY CLAY FILL (0.15 m to 0.76 m) -grey, silty clay, fill, some black staining, no odour
1	CS2	24	VC		MIXED FILL (0.76 m to 1.83 m) -black, dry, crumbly, granular, faint odour, suspected waste coke
1.5	CS3	52.5	VC		-white, wet, sandy texture, sulphur odour, suspected purifier waste
2					FINE SANDY SILT WITH SAND INTERBEDS (1.83 m to 5.33 m) -black staining, moist, loose, strong napthalene odour
3	CS4	NA	VC		-black, moist, low plasticity, non-cohesive, some fine sand seams, strong napthalene odour
3.5	CS5	92.5	VC		-as above, some rootlets and organics
4					
5	CS6	111	VC		-as above
5.5	CS7	NA	VC		FINE SAND WITH SILT INTERBEDS (5.33 m to 6.86 m) -black staining, saturated, non cohesive, bedded, fine sand with thin fine sandy silt seams
6	CS8	92	TC		-grey, wet, fine sand, occasional fine sandy silt seam, strong napthalene odour
7	CS9	NA	TC		FINE SAND (6.86 m to 9.14 m) -dark grey, wet, fine sand, faint odour
8	CS10	NA	NC		-dark grey, wet, fine sand, no odour or staining
9	CS11	NA	NC		-as above no odour or staining
9.14					BOREHOLE TERMINATED AT 9.14 m
10					

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-05 | PROJECT NUMBER: ONT29776 .0

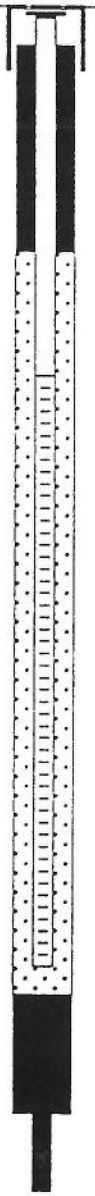
CLIENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 22, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.600
(metres) Well Pipe Elevation: 229.454
TOTAL DEPTH (m): 9.14
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
					ASPHALT (15cm)
1	SS1	1.6	VC		**GRANULAR FILL** (0.15 m to 1.25 m) -brown, dry, compact sand and gravel, 15 cm sample recovery, low blows due to auger disturbance to 0.46 m S.P.T. results = 1,1,1,3.
	SS2	<3	NC		FINE SAND WITH SOME GRAVEL (0.46 m to 1.25 m) dry, compact, napthalene odour near 0.9 m
2	SS3	0.4	NC		**SILT WITH SOME FINE SAND** (1.25 m to 2.29 m) -brown, moist to dry, oxidized, silt, trace fine sand, compact (SS2) -sample recovery = 23 cm, S.P.T. results = 12,15,13,15
	SS4	0.4	NC		-less compact, brown, silt trace fine sand, no odour, higher moisture content near 2.3 m (SS3) -sample recovery = 15 cm, S.P.T. results = 4,4,8,7
3	SS5	0.6	NC		**SAND** (2.29 m to 3.96 m) -loose, dark brown, wet, no odour (SS4) -S.P.T. results = 2,2,2,2
					-wet, fine to medium grained sand, dark brown, loose, no odour (SS5) -S.P.T. results = 2,3,3,1
4	SS6	26	TC		**FINE SAND WITH SILT INTERBEDS** (3.96 m to 7.47 m) -dark brown, wet, fine sand, some black staining, some fine sandy silt seams, napthalene odour, loose (SS6) -S.P.T. results = 1,1,2,2
5	SS7	55	VC		-as above (SS7) -S.P.T. results = 1,1,1,1
	SS8	42	VC		-grey, wet, fine sand, some silt, some black staining and napthalene odour, minor organics, S.P.T. not performed (SS8)
6	SS9	44	VC		-grey, wet, fine sand with some silt seams, napthalene odour, and less black staining than above (SS9) -S.P.T results = 1,1,3,4
7	SS10	32	VC		-as above to 7.47 m (SS10)
	SS10	35	VC		
8	SS11	53	VC		**SILTY CLAY WITH FINE SAND INTERBEDS** (7.47 m to 8.53 m) -grey, black stained, moist, cohesive, firm, silty clay, napthalene odour, high plasticity (SS10) -S.P.T. results = 3,5,5,8
9	SS12	47	C (noVC)		-grey, moist, high plasticity, cohesive, some fine sand seams, silty clay, soft, strong napthalene odour and some black staining (SS11) -S.P.T. results = 2,3,4,5
					SILTY FINE SAND (8.53 m to 9.14 m) -grey, saturated, no plasticity, some cohesion, silty fine sand, loose strong napthalene odour S.P.T. results = 1,2,3,3
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL



FLUSH-MOUNT PROTECTIVE CASING
-cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 m to 1.9 m)
-hydrated bentonite holeplug

FILTER PACK
(1.9 m to 7.62 m)
-65 grain clean Silica Sand

WELL SCREEN
(2.85 m to 7.4 m)
-# 10 slot, Schedule 40 P.V.C., 5 cm I.D.

WELL SEAL
(7.62 m to 9.14 m)
-hydrated bentonite holeplug

BOREHOLE DIAMETER = 0.20 m

BOREHOLE TERMINATED AT 9.14 m

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-06 | PROJECT NO. : ONT29776.A0

LIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Augers
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.62
DATE DRILLED : September 22, 1993	TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey	EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					ASPHALT (15 cm)
	CS1	1.2	NC		GRANULAR FILL (0.15 m to 2.13 m) Sand and Gravel -tan-brown, dry, compact
1	CS2	<2	NC		MIXED FILL (0.76 m to 2.13 m) Construction debris -yellow bricks, sand, gravel, dry, slight odour
2	G1 2.13 m	NA	TC		-grab sample taken from augers contained wood chips with wood preservative odour, fill/native interface at 2.13 m
					FINE SAND (2.13 m to 5.18 m)
3	CS3	70	VC		-black, saturated, non-plastic, fine sand, strong napthalene odour, black staining
4	CS4	108	VC		-black, saturated, fine sand, strong odour and staining
5	CS5	54	VC		-as above, silt content increases at 5.2 m
6	CS6	<100	VC		FINE SANDY SILT WITH FINE SAND INTERBEDS (5.18 m to 6.10 m) -black, saturated, fine sandy silt strong odour and staining, silt content increased at at 5.2 m
	CS7	132	VC		-dark grey, saturated, fine sandy silt, black staining and strong napthalene odour, sheen on water in sampler (CS6)
7	CS8	177	VC		FINE SAND WITH FINE SANDY SILT INTERBEDS (6.10 m to 8.38 m) -dark grey, saturated, fine sand, some fine sandy silt seams , reddish oily liquid accummulating in coarser grained beds, strong napthalene odour (CS7)
8	CS9	166	VC		-dark grey, saturated fine sandy silt increased number of fine sand beds, strong napthalene odour and reddish liquid present (CS8)
	CS10	100	VC		-as above (CS9)
9	CS10	53	VC		FINE SANDY SILT WITH FINE SAND INTERBEDS (8.38 m to 9.14 m) -predominantly fine sandy silt with 15 cm thick fine sand seam from 8.5 m to 8.8 m, accumulation of red-brown oily liquid in fine sand seam
10					BOREHOLE TERMINATED AT 9.14 m

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 0.91 m from surface

Hydrated bentonite chips placed from 0.91 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-07 | PROJECT NO. : ONT29776.A^

CLIENT NAME : CENTRA GAS Manitoba Inc.
DRILLING METHOD : CT250, Hollow-stem Augers
LOCATION : 35 Sutherland Ave. Winnipeg, Man.
SURFACE ELEVATION (M) : 229.52
DATE DRILLED : September 23, 1993
TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey
EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.
NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM./NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION	BACKFILL DETAILS
0					**TOPSOIL** (0.46 m) -brown, dry, sandy, organic	
	CS1	1.0	NC			
1	CS2	200	VC		**SILTY CLAY FILL** (0.46 m to 3.05 m) -dark brown, moist, cohesive, oxidized, some sand and gravel, some coal and black mottling -dark grey, moist, clayey silt, some fine sand and gravel, strong napthalene odour and black staining (CS2)	Borehole was terminated at a depth of 2.0 m and resumed 8.0 m west of original location on asphalt surface. Original borehole was terminated at 2.0 m due to auger refusal on concrete structure. Sampling resumed at 3.05 m at relocated borehole location.
	CS3	195	VC		-as above to 1.83 m (CS3) -black saturated, strong napthalene odour (CS3)	
2	G1	NA	VC		**FINE SILTY SAND FILL** (1.80 m to 3.05 m) -some gravel, strong napthalene odour, some black staining, saturated	
3	CS4	96	VC		**SANDY SILT** (3.05 m to 4.57 m) -grey, saturated, some gravel, strong napthalene odour and black staining, homogenous	
4						Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface Hydrated bentonite chips placed from 1.2 m to 0.8 m Concrete placed from 0.8 m to surface.
5	CS5	83	VC		**SANDY SILT WITH SAND INTERBEDS** (4.57 to 6.55 m) -fine sandy silt, horizontal bedding, grey, saturated, some fine sand seams, yellow/brown liquid accumulates in fine sand seams, strong napthalene odour	
6	CS6	84	VC		-as above to 6.55 m	
7					**SILTY CLAY WITH THIN SAND AND SILT INTERBEDS** (6.55 m to 9.14 m) -grey, moist, vertical and horizontally fractured, fractures contain liquid with irridescent sheen and strong napthalene odour (interbeds are thin)	
8	CS7	36	VC		-as above with fine sand bed from 8 m to 8.25 m -fine sand is stained and has strong napthalene odour	
9	CS8	13.8	TC		-dark grey, moist, high clay content, trace fine sand, thin stratified silty seams, faint napthalene odour, no visible contamination	
10					**BOREHOLE TERMINATED AT 9.14 m**	

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-08 | PROJECT NO. : ONT29776.A0

IENT NAME : CENTRA GAS Manitoba Inc. | DRILLING METHOD : CT250, Hollow-stem Augers

LOCATION : 35 Sutherland Ave. Winnipeg, Man. | SURFACE ELEVATION (M) : 229.85

DATE DRILLED : September 21, 1993 | TOTAL DEPTH (M): 9.14

LOGGER : R. Stacey | EASTING : NA

DRILL COMPANY : Paddock Drilling Ltd. | NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					ASPHALT (10 cm)
	CS1	<18	NC		GRANULAR FILL (0.1 m to 1.52 m) Sand and Gravel -tan-brown, moist, compact, faint petroleum odour
1	CS2	20	TC		-as above, faint odour (low recovery)
	CS3	<10	VC		SILTY CLAY FILL (1.52 m to 2.29 m) -olive-brown, moist, high plasticity, cohesive, some gravel, faint odour, some black discoloration (CS3)
2					
	CS4	<10	TC		SILTY CLAY (2.29 m to 9.14 m)
3	CS5	117	C (no VC)		-mottled olive-brown silty clay, some white silt pockets, cohesive, higher density than above
	CS6	112	C (no VC)		-olive-grey, moist, moderate plasticity, cohesive, some white silt pockets and organiics throughout, wet with water in hole at 3.8 m ,strong diesel odour. -dark olive-grey silty clay, moist, higher clay content, high plasticity and cohesivness, strong hydrocarbon odour at 3.8 m to 4.1 m
4					
	CS7	41.0	C (no VC)		-brown, moist, high plasticity, cohesive, high clay content, some white silt pockets, trace fine sand, petroleum and/or diesel fuel odour
5					
	CS8	1.0	NC		-brown, some grey silt laminations, moist, organics and rootlets throughout, oxidized, no odour or staining
6					
	CS9	1.5	NC		-grey-brown, higher moisture content than above, dense, moderate plasticity, cohesive, slight increase in silt content
7					
	CS10	1.0	NC		-grey-brown, moist, high plasticity and clay content, organics throughout, no odour
8	CS11	0.8	NC		-olive grey-brown, moist, high plasticity and clay content, less organics than above
	CS12	1.5	NC		-as above, high plasticity and cohesiveness, moist, no odour
9					
					BOREHOLE TERMINATED AT 9.14 m
10					

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.8 m

Concrete placed from 0.8 m to surface.

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-09 | PROJECT NO. : ONT29776.A

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Augers
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.87
DATE DRILLED : September 21, 1993	TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey	EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION	BACKFILL DETAILS
0	CS1	0.2	NC		ASPHALT (10 cm)	FILL MATERIAL HOLE SEAL SURFACE REPAIR
	CS1	0.2	TC		GRANULAR FILL (0.1 m to 0.6[illegible]) Sand and Gravel -tan-brown, moist, compact, no odour or staining (CS1)	
1	CS2	186	VC		MIXED FILL (0.61 m to 1.22 m) -black, dry, granular, some sand sized grains, no odour, suspected waste coke (CS2)	
	CS2	72	VC		-black, moist, very dense, pockets of sticky tar, more sand sized grains napthalene odour. (CS2)	
2	CS3	48	VC		FINE SANDY AND SILT FILL (1.22 m to 3.05 m) -light grey, moist, loose, some gravel, black staining and strong napthalene odour, no visible tar (CS2&CS3) - CS3 (POOR RECOVERY)	
	CS4	3.5	TC		-dark grey, moist, soft, silt with trace fine sand and silt, faint odour, no visible tar (CS4)	
3	CS5	1.0	TC		FINE SAND WITH CLAYEY SILT INTERBEDS (3.05 m to 6.10 m) -fine sand, some silt, light grey, wet, bedding evident, faint napthalene odour, some black staining (CS5)	
4	CS6	6.8	TC		-fine sand with increased variation in bedding material, some coarser grained fine sand beds, coarse grained beds are stained black, wet (CS6)	Borehole sealed with bentonite grout installed from base of borehole to 1.2 m from surface Bentonite chips placed and hydrated from 1.2 m to 0.8 m from surface and completed to surface with concrete.
5	CS7	4.2	VC		-as above, napthalene odour, black staining in beds (CS7)	
	CS8	3.0	VC		-black staining in sand seams, napthalene odour, staining is more pronounced (CS8)	
6	CS9	1.0	TC		CLAYEY SILT WITH FINE SAND INTERBEDS (6.10 m to 7.67 m) -fine sand seams are less frequent (three per metre) and are 5 cm thick, black staining has decreased -predominantly bedded clayey silt with some fine sand, cohesive, saturated, and soft (CS9)	
7	CS10	0.2	NC		-predominating clayey silt seams, infrequent silty clay seams, some organics, some sand seams, no odour (CS10)	
8	CS11	0.2	NC		SILTY CLAY WITH FINE SAND INTERBEDS (7.67 m to 8.38 m) -silty clay beds predominate, grey, saturated, soft, high plasticity, some fine sand seams, root in sample at 8.0 m, no odour or staining, interbeds are infrequent (CS12)	
	CS12	0.2	NC		SILTY CLAY (8.38 m to 9.14 m) -medium grey, moist, soft, high plasticity, cohesive, rootlets and organics throughout, trace fine sand, high clay content, no fine sand seams (CS12)	
9					BOREHOLE TERMINATED AT 9.14 m	
10						

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-10 | PROJECT NO. : ONT29776.A0

.IENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.490
DATE DRILLED : September 20, 1993	TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey	EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					**ASPHALT** (10 cm)
	CS1	26	TC		**GRANULAR FILL** (0.1 m to 0.76 m) Sand and Gravel -tan-brown, dry, compact, no odour or staining to 0.46 m
1	CS2	0.2	TC		-some black staining below 0.46 m, dry no odour
	CS3	0.2	VC		**MIXED FILL** (0.76 m to 3.05 m) -black, moist, cohesive, plastic, some white siltstone particles and tar paper throughout, black staining, no odour
2	CS4	120	VC		-black, moist, soft, cohesive, faint tar odour, black staining
					-black, wet, water in borehole, soft, silty clay, some construction debris, visible pockets of tar, strong napthalene odour.
3	CS5	120	VC		-perched water table encountered at 2.9 m
					SILT WITH SOME CLAY (3.05 m to 4.57 m) -grey, moist, cohesive, moderate plasticity, low clay content, some white silt pockets and seams, strong napthalene odour and visible tar in rootholes and fractures.
4	CS6	58	VC		-lower clay contant than above, strong napthalene odour and visible black tar in rootholes and fractures
5	CS7	25	VC		**SILTY CLAY** (4.57 m to 9.14 m) -increasing clay content, some white silt pockets, less visible tar than above
	SS1	60	TC		-mottled grey and brown, moist, cohesve, no tar visually observed, strong napthalene odour
6	CS8	26	TC		-grey and brown, oxidized, moist, some organics and trace fine sand, less mottling than above, strong napthalene odour
7	CS9	2.2	TC		-grey, moist, saturated, some shells, faint napthalene odour
8	CS10	<5	TC		-mottled, moist, less organics than above, cohesive, some silt pockets , no odour detected
	CS11	1.2	NC		-grey and brown mottled, moist, high plasticity, some silt pockets, no odour detected
9					BOREHOLE TERMINATED AT 9.14 m
10					

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-11 | PROJECT NO. : ONT29776.A0

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Auge
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 230.030
DATE DRILLED : September 22, 1993	TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey	EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : NA

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM./NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					ASPHALT (10 cm)
	CS1	<2	NC		GRANULAR FILL (0.1 m to 0.76 m) Sand and Gravel -tan/brown, moist, compact, faint petroleum odour -white crushed stone from 0.46 m to 0.6 m, no odour
1	CS2	0.4	TC		CLAYEY SILT FILL (0.76 m to 2.29 m) -red-brown, moist, silt, some clay, black staining and faint napthalene odour from 1.0 m to 1.83 m
	CS3	107	VC		-olive brown, moist, high plasticity, cohesive, some gravel, strong odour, some black discoloration
2					
	CS4	32	C (noVC)		SILTY CLAY WITH SILT POCKETS AND INTERBEDS (2.29 m to 4.88 m) -olive-grey silty clay, some white silt pockets, cohesive, soft, napthalene odour (CS4)
3	CS5	97	C (noVC)		-olive grey, moist to wet, some white silt, strong napthalene odour
4	CS6	21	C (noVC)		-as above, trace subrounded pebbles, water in hole
	CS7	4.6	TC		SILTY CLAY (4.88 m to 9.14 m) -dark grey, moist, high plasticity, cohesive, high clay content, trace gravel, faint odour, oxidized
5	CS8	0.9	NC		-dark grey, silty clay, high clay content, moist, trace gravel, no odour or staining, some shells
6	CS9	0.7	NC		-dark grey, stiff, some shells moderate plasticity, cohesive, high shell quantity
7	CS10	0.5	NC		-dark-grey, moist, high plasticity and clay content, organic fibres throughout, no odour evident, some coarse sand
8	CS11	0.9	NC		-grey, moist, high plasticity and clay content, some organic fibres, no odour, trace to some gravel
	CS12	0.6	NC		-as above, high plasticity and cohesiveness, moist, no odour, some organic fibres
9					BOREHOLE TERMINATED AT 9.14 m
10					

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-12 | PROJECT NUMBER: ONT29776.A0

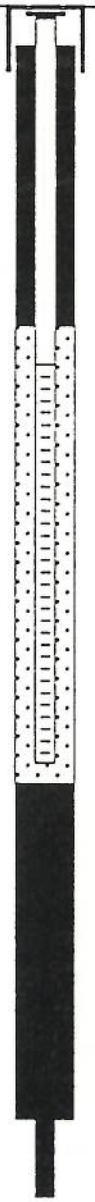
IENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 29, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.440
(metres) Well Pipe Elevation: 229.256
TOTAL DEPTH (m): 9.14
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
	SS1	0.1	TC		**TOPSOIL** (0 to 0.6m) –highly organic, fill, some slag and coal fragments, dry, no odour
1	SS2	1.1	TC		**SANDY SILT FILL** (0.61 m to 1.52 m) –black, dry sandy silt fill, no odour, some slag and silty clay, highly oxidized
2	SS3	<0.4	NC		**CLAYEY SILT** (1.52 m to 3.3m) dark brown, moist, dense, low cohesion, low plasticity
	SS4	NA	NC		–brown, moist, dense, oxidized, trace fine sand, clayey silt
3	SS5	<6.2	VC		**FINE SILTY SAND** (3.3 m to 9.14 m) –brown, fine silty sand, some black staining, strong napthalene odour
4					
5	SS6	<84	VC		–black staining, silty fine sand, some cohesion, no plasticity, strong napthalene odour
6					
7	SS7	<20	VC		–high silt content, saturated, some clay, napthalene odour, black staining
8	SS8	NA	VC		–wet, fine silty sand, high silt content, some clay, black staining and strong napthalene odour
9	SS9	<3	TC		–grey, fine silty sand, wet, less black staining and less napthalene odour than above
10					BOREHOLE TERMINATED AT 9.14 m

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL



FLUSH-MOUNT PROTECTIVE CASING
–cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 m to 2.44 m)
–hydrated bentonite holeplug

FILTER PACK
(2.44 m to 5.94 m)
–65 grain clean Silica Sand

WELL SCREEN
(2.74 m to 5.79 m)
–# 10 slot, Schedule 40 P.V.C., 5 cm I.D.

WELL SEAL
(5.94 m to 9.14 m)
–hydrated bentonite holeplug

BOREHOLE DIAMETER = 0.20 m

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-13 | PROJECT NO. : ONT29776.A0

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Auger
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.53
DATE DRILLED : September 28, 1993	TOTAL DEPTH (M): 9.14
LOGGER : R. Stacey	EASTING : NA
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : NA

SOIL SAMPLE DATA

SOIL DESCRIPTION

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					TOPSOIL (0.76 m) -grass surface, stressed vegetation in area and black staining at surface
1	CS1	<1	NC		-orange-brown, dry, non cohesive, sandy silt, high organics content
2	CS2	0.2	NC		MIXED FILL (0.76 m to 1.52 m) -orange-brown sandy silt, dry, some clay, highly oxidized, some brick fragments, gravel and sand, some black staining near 1.5 m, no odour
3	CS3	0.1	NC		SANDY SILT FILL (1.52 m to 3.81 m) -brown, moist, soft sandy silt fill, no gravel, no odour or staining, oxidized (CS3)
4	CS4	<2	VC		-dark grey, some black staining, moist, loose sandy silt fill, strong napthalene odour, low plasticity (CS4)
	CS5	<4	VC		-as above with some oxidation (CS5) -water table encountered at 3.8 m
	CS6	NA	VC		SILTY FINE SAND WITH SILT AND CLAY INTERBEDS (3.81 m to 8.38 m) -grey, wet, black staining and strong napthalene odour, clay and silt seams are infrequent
5	CS7	<20	VC		-grey, saturated, silty clay, soft, some fine sand seams, black staining and strong napthalene odour throughout
6	CS8	<13	VC		-silty fine sand, wet, black staining, bedded, napthalene odour
7					
8	CS9	<1.4	TC		-as above, some sandy silt with silty sand seams
9	CS10	<0.4	NC		SILTY CLAY (8.38 m to 9.14 m) -grey, moist, stiff, cohesive, plastic, very faint napthalene odour, no staining
10					BOREHOLE TERMINATED AT 9.14 m

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.8 m

Concrete placed from 0.8 m to surface.

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-14 | PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE DRILLED: September 23, 1993

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers

ELEVATION: Surface Elevation: 229.670 (metres) Well Pipe Elevation: 229.492

TOTAL DEPTH (m): 9.14

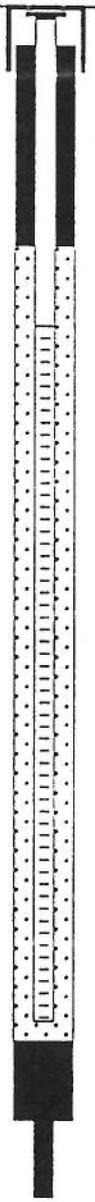
EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION VC - VISUAL CONTAMINATION C/noVC - CONTAM/NO VISUAL EVIDENCE SS - SPLIT-SPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST
					ASPHALT (15cm)
1	SS1	0.3	NC		SAND AND SILT FILL (0.15 m to 1.68 m) -sandy silt, dry, some black staining, highly oxidized, some gravel, faint napthalene odour
	SS2	0.1	NC		-fine sandy silt fill, loose, moist, tan-brown
2	SS3	0.1	NC		FINE SANDY SILT (1.68 m to 2.44 m) -higher density and silt content, trace fine sand, fine sandy silt
	SS4	0	NC		CLAYEY SILT (2.44 m to 3.05 m) -tan-brown, higher moisture content, some cohesion, some clay, trace fine sand, no odour or staining
3	SS5	0.3	NC		FINE SAND (3.05 m to 3.96 m) -wet, trace silt, no odour or staining
4	SS6	215	VC		FINE SAND AND SILT (3.96 m to 4.72 m) -wet, fine sand and silt, trace clay, oxidized, black staining and strong napthalene odour, becomes less oxidized with depth
5	SS7	41	VC		FINE SAND (4.72 m to 5.33 m) -grey, saturated, fine sand, strong napthalene odour, purple sheen on water
6	SS8	150	VC		FINE SANDY SILT WITH FINE SAND INTERBEDS (5.33 m to 8.53 m) -grey silt, some fine sand beds, saturated, purple sheen and strong napthalene odour
	SS9	160	VC		-fine sandy silt, saturated, low sample recovery, strong odour and sheen
7					
8	SS10	275	VC		-fine sand and silt, dark grey, purple sheen and strong napthalene odour, thin fine sand seams throughout, trace clay, saturated.
9	SS11	121	C (noVC)		CLAYEY SILT (8.53 m to 9.14 m) -grey clayey silt, trace fine sand, cohesive, moderate plasticity, strong napthalene odour
					BOREHOLE TERMINATED AT 9.14 m
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL



FLUSH-MOUNT PROTECTIVE CASING
-cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL (0.3 m to 1.83 m)
-hydrated bentonoite holeplug

FILTER PACK (1.83 m to 7.92 m)
-65 grain clean Silica Sand

WELL SCREEN (2.44 m to 7.77 m)
-# 10 slot, Schedule 40 P.V.C., 5 cm I.D.

WELL SEAL (7.92 m to 9.14 m)
-hydrated bentonite holeplug

BOREHOLE DIAMETER = 0.20 m

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-15 | PROJECT NO. : ONT29793.A0

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Auge.
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.59
DATE DRILLED : September 29, 1993	TOTAL DEPTH (M): 6.10
LOGGER : R. Stacey	EASTING : 133.880
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : 230.310

SOIL SAMPLE DATA

SOIL DESCRIPTION

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM./NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

BACKFILL DETAILS
FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					**ASPHALT** (15 cm)
	CS1	71	TC		**GRANULAR FILL** (0.15 m to 0.76 m) -tan brown, dry, compact, sand and gravel, old gasoline odour
1	CS2	29.5	TC		**MIXED FILL** (0.76 m to 1.52 m) -low sample recovery, construction debris, concrete chips, old gasoline odour
2	CS3	12.9	VC		**CLAYEY SILT FILL** (1.52 m to 3.05 m) -clayey silt, loose, black staining, old petroleum odour, moist
	CS4	<5	TC		-grey and brown, mottled, some oxidation, clayey silt, faint old fuel odour
3	CS5	0.1	TC		**CLAYEY SILT** (3.05 m to 3.81 m) -grey-brown, less mottling, some plasticity and cohesion, faint fuel odour
4	CS6	0.1	TC		**SILTY CLAY** (3.81 m to 6.10 m) -silty clay, moist, some oxidation, faint old fuel odour
5	CS7	0.1	TC		-olive-grey, silty clay, faint old fuel odour, moist, less oxidation
	CS8	0.1	NC		-grey, moist, cohesive, high plasticity, no odour
6					**BOREHOLE TERMINATED AT 6.10 m**
7					
8					
9					
10					

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-16 | PROJECT NO. : ONT29793.A0

CLIENT NAME : CENTRA GAS Manitoba Inc. | DRILLING METHOD : CT250, Hollow-stem Augers

LOCATION : 35 Sutherland Ave. Winnipeg, Man. | SURFACE ELEVATION (M) : 229.68

DATE DRILLED : September 30, 1993 | TOTAL DEPTH (M): 5.18

LOGGER : R. Stacey | EASTING : 120.720

DRILL COMPANY : Paddock Drilling Ltd. | NORTHING : 238.420

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION	BACKFILL DETAILS
0					ASPHALT (15 cm)	
	CS1	<1.6	NC		GRANULAR FILL (0.15 m to 0.76 m) -tan brown, dry, sand and gravel, oxidized, compact, no odour	
1	CS2	<58	VC		MIXED FILL (0.76 m to 1.22 m) -grey-brown and black, moist, construction debris and wood chips, very coarse grained, cobbles etc., old oil odour, some black staining	Borehole was relocated 1.22 m south of original location due to auger refusal at 1.5 m on construction debris.
	SS1	<15.7	VC			
2	SS2	<67	VC		SILTY CLAY FILL (1.22 m to 1.52 m) -dark-grey, moist, soft, cohesive high plasticity, silty clay fill, old gasoline odour at 1.52 m	
	SS3	<117	VC		SILTY CLAY (1.52 m to 5.18 m) -light-grey, moist, cohesive, highly plastic silty clay, old fuel odour and some black staining in seams, some coarse sand grains throughout, some white silt pockets at 1.52 m (SS1 & SS2)	
3	SS4	NA	TC		-as above (SS3)	
	SS5	NA	TC		-as above (SS4)	
4					-as above, less odour and staining (SS5)	Borehole sealed with hydrated bentonite chips from borehole termination depth to surface. Concrete placed from 0.6 m to surface.
	SS6	<3	NC		-mottled grey and brown, moist, cohesive, high plasticity, no odour or staining (SS6)	
5					BOREHOLE TERMINATED AT 5.18 m	
6						
7						
8						
9						
10						

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-17 | PROJECT NO. : ONT29793.A0

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Augers
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.65
DATE DRILLED : September 29, 1993	TOTAL DEPTH (M): 6.10
LOGGER : R. Stacey	EASTING : 147.460
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : 259.580

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION
0					**ASPHALT** (15 cm)
	CS1	0	NC		**GRANULAR FILL** (0.15 m to 0.76 m) -tan brown, moist, compact sand and gravel
	CS1	23	VC		
1	CS2	23	VC		-at 0.6 m sand and gravel is stained black and has napthalene odour
					SANDY SILT FILL (0.76 m to 1.52 m) -black, moist, loose, non-cohesive sandy silt, faint napthalene odour
2	CS3	94	VC		**CLAYEY SILT** (1.52 m to 5.49 m) -olive-grey, moist, fractured clayey silt, moderate stiffness, some white silt pockets, visual tar in voids and fractures, strong napthalene odour
	CS4	89	VC		-olive-grey, moist, dense, fractured, oxidation on fracture surfaces, strong napthalene odour, some white silt pockets, tar in fractures and voids (less than above)
3	CS5	82	VC		-light grey-brown, moist, stiff, fractured, oxidation in fractures, tarry substance in fractures and roothole, strong napthalene odour
4	CS6	16.5	TC		-grey-brown, moist, stiff, oxidation in fractures, clayey silt, some shells throughout, no visual contamination, faint napthalene odour
5					
	CS7	<1	NC		**SILTY CLAY** (5.49 m to 6.10 m) -grey, oxidized silty clay, moist, some natural organics, very faint napthalene odour
6					**BOREHOLE TERMINATED AT 6.10 m**
7					
8					
9					
10					

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole sealed with bentonite grout installed through tremie pipe from borehole termination depth to 1.2 m from surface

Hydrated bentonite chips placed from 1.2 m to 0.6 m

Concrete placed from 0.6 m to surface.

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW18

PROJECT NUMBER: ONT29793.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE DRILLED: September 29, 1993

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers

ELEVATION: Surface Elevation: 229.430 (metres) Well Pipe Elevation: 229.245

TOTAL DEPTH (m): 6.10

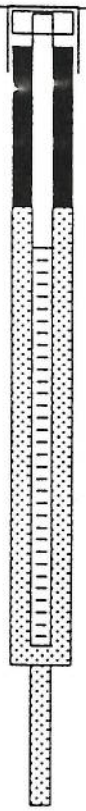
EASTING: 160.730

NORTHING: 239.880

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
					ASPHALT SURFACE (10 cm)
	CS1	<1.75	NC		GRANULAR FILL (0.1 m to 0.76 m) –tan brown, dry, compact, sand and gravel, no odour
1	CS2	58	TC		SANDY SILT FILL (0.76 m to 1.52 m) –sandy silt, tan brown, loose, moist, sandy silt, highly organic, fuel odour
2	CS3	54	C (noVC)		CLAY SILT FILL (1.52 m to 3.05 m) –tan brown, moist, loose, clayey silt, some white silt pockets, strong gasoline odour
	CS4	156	C (noVC)		–as above, strong odour
3	CS5	3.6	TC		CLAYEY SILT (3.05 m to 6.10 m) –brown, weathered, oxidized, moist fractured, faint petroleum odour
4	CS6	0.1	NC		–as above, no odour
5	CS7	0.1	NC		–grey–brown, moist, less oxidation, fractured with silt in fractures, some organics near 5.2 m
	CS8	0.1	NC		–grey, moist, clayey silt, no oxidation, unfractured, some shells, no odour
6					BOREHOLE TERMINATION AT 6.10 m
7					
8					
9					
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL



FLUSH-CASING
–cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 m to 1.52 m)
–bentonite holeplug

FILTER PACK
(1.52 m to 6.10 m)
–#65 grain clean silica sand

WELL SCREEN
(1.83 m to 4.88 m)
–Schedule 40 P.V.C. #10 slot, 5 cm I.D.

BOREHOLE DIAMETER = 0.20 m

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-20 | PROJECT NO. : ONT29793.A0

CLIENT NAME : CENTRA GAS Manitoba Inc.	DRILLING METHOD : CT250, Hollow-stem Aug
LOCATION : 35 Sutherland Ave. Winnipeg, Man.	SURFACE ELEVATION (M) : 229.51
DATE DRILLED : September 30, 1993	TOTAL DEPTH (M): 3.05
LOGGER : R. Stacey	EASTING : 143.910
DRILL COMPANY : Paddock Drilling Ltd.	NORTHING : 226.060

SOIL SAMPLE DATA

DEPTH BELOW SURFACE (metres)	SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL
0	G1	NA	NC	
1	G2	NA	NC	
	G3	NA	NC	
2	G4	<5.4	TC	
	G5	<0.8	NC	
3				
4				
5				
6				
7				
8				
9				
10				

SOIL DESCRIPTION

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM./NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

ASPHALT (15 cm)

GRANULAR FILL (0.15 m to 1.37m)
-tan brown, dry, silty sand and gravel, no odour
non-cohesive

SANDY SILT FILL/SILTY CLAY FILL (1.37 m to 2.29 m)
-brown, moist, sandy silt fill, oxidized, no odour, non-cohesive
-olive green, moist, silty clay fill, faint old fuel odour

GRANULAR FILL (2.29 m to 2.44 m)
-brown, moist, non-cohesive, faint old fuel odour

SILTY CLAY (2.44 m to 3.05 m)
-olive green, silty clay, moist, faint old fuel odour

BOREHOLE TERMINATED AT 3.05 m

BACKFILL DETAILS

FILL MATERIAL
HOLE SEAL
SURFACE REPAIR

Borehole backfilled with auger cuttings from borehole termination depth to 1.52 m from surface
Hydrated bentonite chips placed from 1.52 m below surface to 0.6 m
bentonite hydrated with distilled water.
Concrete placed from 0.[illegible] to surface.

CH2M HILL ENGINEERING LTD.

SUBSURFACE BOREHOLE LOG

BOREHOLE NO. : BH-19 | PROJECT NO. : ONT29793.A0

CLIENT NAME : CENTRA GAS Manitoba Inc. | DRILLING METHOD : CT250, Hollow-stem Augers

LOCATION : 35 Sutherland Ave. Winnipeg, Man. | SURFACE ELEVATION (M) : 229.380

DATE DRILLED : September 30, 1993 | TOTAL DEPTH (M): 3.05

LOGGER : R. Stacey | EASTING : 166.910

DRILL COMPANY : Paddock Drilling Ltd. | NORTHING : 235.370

LEGEND
NC - NO CONTAMINATION
TC - TRACE CONTAMINATION
C (noVC) - CONTAM/NO VISUAL EVIDENCE
VC - VISUAL CONTAMINATION
NA - NOT ANALYSED
G - GRAB SAMPLE
SS - SPLITSPOON SAMPLE
CS - CONTINUOUS SAMPLE

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DATA: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESSMENT	SAMPLE INTERVAL	SOIL DESCRIPTION	BACKFILL DETAILS
0					ASPHALT (15 cm)	FILL MATERIAL HOLE SEAL SURFACE REPAIR
	G1	NA	NC		GRANULAR FILL (0.15 m to 0.76m) -tan brown, dry, sand and gravel, no odour	
1	G2	NA	VC		SILTY CLAY FILL (0.76 m to 2.29 m) -olive green, moist, silty clay, faint fuel odour, some black staining	Borehole backfilled with auger cuttings from borehole termination depth to 1.52 m from surface Hydrated bentonite chips placed from 1.52 m below surface to 0.8 m Bentonite hydrated with distilled water. Concrete placed from 0.8 m to surface.
	G3	0.4	VC		-as above	
2	G4	<12.2	VC		-black, moist, cohesive, plastic, soft, strong napthalene odour	
	G5	<16.2	TC		SILTY CLAY (2.29 m to 3.05 m) -brown, moist, high plasticity, stiff, faint napthalene odour, oxidized (G5)	
3					BOREHOLE TERMINATED AT 3.05 m	
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CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-21

PROJECT NUMBER: ONT29793.A0

IENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE DRILLED: September 30, 1993

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers

ELEVATION: Surface Elevation: 229.600 (metres)

Well Pipe Elevation: 229.498

TOTAL DEPTH (m): 6.10

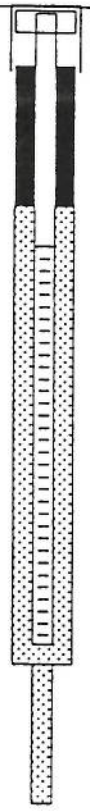
EASTING: 146.570

NORTHING: 251.780

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST
	CS1	1.4	NC		ASPHALT (15 cm) GRANULAR FILL (0.15 m to 0.76 m) –sand and gravel, tan–brown, dry, compact, no odour
1	CS2	NA	VC		MIXED FILL (0.76 m to 1.52 m) –low sample recovery, stone blocks sampler, some black staining and odour
2	CS3	127	VC		SANDY SILT FILL (1.52 m to 2.44 m) –black, sandy silt, moist, loose, strong napthalene odour –as above to 2.44 m
3	CS4	NA	VC		CLAYEY SILT (2.44 m to 5.33 m) –olive–grey, faint napthalene odour, trace to some black staining
	CS5	56	TC		–as above, faint napthalene odour, moist
4	CS6	NA	TC		–some shells and organic fibres, faint napthalene odour, (1) large shell observed
5	CS7	NA	NC		–light grey–brown, no odour, some white silt infilling, increasing clay content, mottled
	CS8	2	NC		SILTY CLAY (5.33 m to 6.10 m) –grey silty clay, less mottling, moist, no odour
6					BOREHOLE TERMINATED AT 6.10 m
7					
8					
9					
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL



FLUSH–CASING
–cemented around well casing

LOCKABLE J–PLUG CAP

WELL SEAL (0.46 m to 1.52 m)
–bentonite holeplug

FILTER PACK (1.52 m to 6.10 m)
–#65 grain clean silica sand

WELL SCREEN (1.83 m to 4.88 m)
–Schedule 40 P.V.C. #10 slot, 5 cm I.D.

BOREHOLE DIAMETER = 0.20 m

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-22

PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE DRILLED: September 28, 1993

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Auge

ELEVATION: Surface Elevation: 229.790

(metres) Well Pipe Elevation: 229.679

TOTAL DEPTH (m): 14.63

EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION VC - VISUAL CONTAMINATION C/noVC - CONTAM/NO VISUAL EVIDENCE SS - SPLIT-SPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST
					ASPHALT (15cm)
	SS1	0.3	NC		SAND AND SILT FILL (0.15 m to 1.68 m) -sandy silt, dry, some black staining, highly oxidized, some gravel, faint napthalene odour
1	SS2	0.1	NC		-fine sandy silt fill, loose, moist, tan-brown
2	SS3	0.1	NC		FINE SANDY SILT (1.68 m to 2.44 m) -higher density and silt content, trace fine sand, fine sandy silt
	SS4	0	NC		CLAYEY SILT (2.44 m to 3.05 m) -tan-brown, higher moisture content, some cohesion, some clay, trace fine sand, no odour or staining
3	SS5	0.3	NC		FINE SAND (3.05 m to 3.96 m) -wet, trace silt, no odour or staining
4	SS6	215	VC		FINE SAND AND SILT (3.96 m to 4.72 m) -wet, fine sand and silt, trace clay, oxidized, black staining and strong napthalene odour, becomes less oxidized with depth
5	SS7	41	VC		FINE SAND (4.72 m to 5.33 m) -grey, saturated, fine sand, strong napthalene odour, purple sheen on water
	SS8	150	VC		FINE SANDY SILT WITH FINE SAND INTERBEDS (5.33 m to 8.53 m) -grey silt, some fine sand beds, saturated, purple sheen and strong napthalene odour
6	SS9	160	VC		-fine sandy silt, saturated, low sample recovery, strong odour and sheen
7					
8	SS10	275	VC		-fine sand and silt, dark grey, purple sheen and strong napthalene odour, thin fine sand seams throughout, trace clay, saturated.
	SS11	121	C (noVC)		CLAYEY SILT (8.53 m to 10.1 m) -grey clayey silt, trace fine sand, cohesive, moderate plasticity, strong napthalene odour
9					
10					

WELL CONSTRUCTION

CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL

FLUSH-CASING
-cemented around well casing

LOCKABLE J-PLUG CAP

WELL SEAL
(0.3 mto 0.5 m)
-bentonite holeplug

GROUT SEAL
(0.3 m to 9.75 m)
-water, bentonite and catalyst

STEEL CASING
(0.15 m to 11.89 m)
-0.25 m diameter, 0.095 m wall thickness, 11.74 m length
-casing installed, through grout mixture, into 0.3 m diameter hole to 9.75 m, then pushed through native soil to 11.89 m

-grout removed from inside of casing with augers retraction and water flushing methods

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-22 | PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 28, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.790
(metres) Well Pipe Elevation: 229.679
TOTAL DEPTH (m): 14.63
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (metres)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION C/noVC – CONTAM/NO VISUAL EVIDENCE SS – SPLIT-SPOON SAMPLE CS – CONTINUOUS SAMPLE S.P.T. – STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, FILTER PACK, WELL SEAL
11	CS1	<68	C (noVC)		SILTY FINE SAND (10.1 m to 11.3 m) -grey, wet, silty fine sand, strong napthalene odour	
12	SS12	<22	C (noVC)		SILTY CLAY (11.3 m to 13.1 m) -very plastic, very cohesive, organic odour, moist, soft -moist, grey, stiff, cohesive, silty clay	
13	SS13	65	C (noVC)		SAND (13.1 m to 13.41 m) -fine and medium grained, trace silt, strong napthalene odour, sheen on water, saturated	
	SS14	28	VC		SILTY CLAY TILL (13.41 m to 14.63 m) -very coarse, sand and gravel with some silt and clay, reworked to 13.9 m, strong napthalene odour, grey, saturated, hetergeneous	
14	SS15	5.1	TC		-coarse, glacial till, coarse sand and gravel, not reworked as above, very dense, silty clay matrix, grey, tight, moist, very faint napthalene odour	FILTER PACK (12.5 m to 14.63 m) –#65 grain clean silica sand WELL SCREEN (12.8 m to 14.3 m) –#10 slot P.V.C., Schedule 40, 5 cm I.D. CAVE MATERIAL (14.30 m to 14.63 m)
15					BOREHOLE TERMINATED AT 14.63 m	
16						BOREHOLE DIAMETER = 0.2 m IN SCREENED INTERVAL
17					Sample details and geologic interpretation from surface to 9.14 m was used from BH/MW-14. BH/MW-14 is 12.2 m west of BH/MW-22. Sampling began at a depth of 10.9 m at this location.	
18						
19						
20						

A24 (CON'T)

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: BH/MW-23A | PROJECT NUMBER: ONT29776.CO

CLIENT NAME: CENTRA GAS MANITOBA INC.

LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN.

DRILLING METHOD: CT-250, Hollow-stem Augers

ELEVATION: -SURFACE ELEV.: 229.753

(metres) -TOP RISER PIPE: 229.715

DATE DRILLED: June 8, 1994

TOTAL DEPTH: 15.24

LOGGER: R. Stacey

EASTING: NA

DRILL COMPANY: Paddock Drilling Ltd.

NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/noVC - CONTAMINATION / NO VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC.
						Flush-mount Protective Casing cemented over well
	SS1	1.5	NC		**SILTY CLAY FILL** (surface to 4.42 m) -dry silty clay, brown, loose, occasional gravel	J-Plug Lockable cap covers well pipe
1	SS2	1.6	NC		-as above with traces of ash, cinder and coal near 1.5 m -some sand, medium plasticity	
2	SS3	10	TC		-as above with traces of cinder and ash throughout	Well Seal (0.5 m to 3.05 m) -hydrated bentonite holeplug
	SS4	10	TC		-as above, moist	
3	SS5	32	NC		-as above, moist, some oxidation throughout, soft, high plasticity, occasional gravel -auger anulus T.O.V. = 0 ppm	
4	SS6	2.5	VC		-moisture content increases to saturated at 4.6 m	Well Seal (3.05 m to 3.8 m) -bentonite grout
5	SS7	85	VC		**FINE SANDY SILT WITH SILTY CLAY AND FINE SAND INTERBEDS** (4.42 m to 7.62 m) -naphtalene odour and black staining at 4.8 m, fine sandy silt -auger anulus T.O.V. = 60 ppm	
6	SS8	60	VC		-laminated fine sandy silt, brown/grey, wet, strong naphtalene odour, black staining and sheen throughout, soft, low plasticity	
	SS9	380	VC		-fine sand and silt, saturated, black staining and strong napthalene odour	
7	SS10	154	VC		-alternating silty sand and silty clay beds, darker staining and stronger odour in coarser grained beds	
8	SS11	27	VC		-brown silt clay with some fine sand laminations, cohesive, strong napthalene odour, some black staining -auger anulus T.O.V. = 30 ppm	
	SS12	65	VC		**SILTY CLAY** (7.62 m to 9.91 m) -light grey silty clay, napthalene odour, stiff to soft, some black staining and sheen noted	
9	SS13	13.4	VC		-as above, high plasticity	
10					-as above with some fine to medium sand seams, grey, napthalene odour	

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: BH/MW-23A | PROJECT NUMBER: ONT29776.CO

CLIENT NAME: CENTRA GAS MANITOBA INC.

LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN.

DATE DRILLED: June 8, 1994

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT-250, Hollow-stem Augers

ELEVATION: -SURFACE ELEV.: 229.753

(metres) -TOP RISER PIPE: 229.715

TOTAL DEPTH : 15.24

EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/noVC - CONTAMINAION / NO VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC
11	SS14	22	C (NO VC)		[illegible] (10.91 m to 11.43 m) -medium grained sand, dark grey, wet, strong napthalene odour, clam shell at 10.4 m below surface	
	SS15	15	C (NO VC)		-as above faint napthalene odour	
12	SS16	7	TC		SILTY CLAY (11.43 m to 14.48 m) -darg grey clay, some organic fibres throughout, stiff, moist, faint napthalene odour, occasional sand grain	
	SS17	0.4	NC		-reworked light grey till and dark grey varved clay, dense, stiff, blocky	
13	SS18	0.2	NC			
	SS19	0.3	NC		-dark grey varved clay, 5cm diameter dropstone at 13.1 m, some light grey till at 13.7 m	
14					-lighter grey to 14.48 m, high plasticity, occasional large sand grain	
15	SS20	0	NC		SILTY CLAY TILL (14.48 m to 15.24 m) -light grey till, very angular limestone gravel, some sand and clay, very coarse grained till, clay is highly plastic	
					Borehole terminated at 15.24 m	
16						
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Well Screen (13.72 m to 15.24 m)
φ 10 slot, schedule 40 P.V.C., 5 cm I.D.

Filter Pack (13.11 m to 15.24 m)
-#5 grain clean silica sand

A25 (CON'T)

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: BH/MW-238 PROJECT NUMBER: ONT29776.C0

CLIENT NAME: CENTRA GAS MANITOBA INC.
LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN.
DATE DRILLED: June 8, 1994
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: C[illegible]-250, Hollow-stem Augers
ELEVATION: -SURFACE ELEV.: 229.753
(metres) -TOP RISER PIPE: 229.67
TOTAL DEPTH : 6.71
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/noVC - CONTAMINAION / NC VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC.
						Flush-mount Protective Casing cemented over well
0	SS1	1.5	NC		SILTY CLAY FILL (surface to 4.42 m) -dry silty clay, brown, loose, occasional gravel	J-Plug Lockable cap covers well pipe
1	SS2	1.5	NC		-as above with traces of ash, cinder and coal near 1.5 m -some sand, medium plasticity	Backfill (surface to 2.13 m) -clean auger cuttings
2	SS3	10	TC		-as above with traces of cinder and ash throughout	
	SS4	10	TC		-as above, moist	Well Seal (2.13 m to 3.05 m) -hydrated bentonite holeplug chips
3	SS5	32	NC		-as above, moist, some oxidation throughout, soft, high plasticity, occasional gravel -auger anulus T.O.V. = 0 ppm	
4	SS6	2.5	VC		-moisture content increases to saturated at 4.8 m	Well Screen (3.66 m to 6.71 m) # 10 slot, schedule 40 P.V.C., 5 cm I.D.
5	SS7	85	VC		FINE SANDY SILT WITH SILTY CLAY AND FINE SAND INTERBEDS (4.42 m to 6.71 m) -naphthalene odour and black staining at 4.8 m, fine sandy silt -auger anulus T.O.V = 50 ppm	
6	SS8	80	VC		-laminated fine sandy silt, brown/grey, wet, strong naphthalene odour, black staining and sheen throughout, soft, low plasticity	Filter Pack (3.05 m to 6.1 m) -#5 grain clean silica sand
	SS9	380	VC		-fine sand and silt, saturated, black staining and strong naphthalene odour	
7					-alternating silty sand and silty clay beds, darker staining and stronger odour in coarser grained beds	
8					Borehole terminated at 6.71 m Sample details and descriptions have been interpolated from BH/MW 23A	
9						
10						

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-24A&B | PROJECT NUMBER: ONT29776.CO

CLIENT NAME: CENTRA GAS MANITOBA INC.
LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN.
DATE DRILLED: June 10, 1994
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT-250, Hollow-stem Augers
ELEVATION: -SURFACE ELEV.: 229.865
(metres) -TOP RISER PIPE: 229.795 & 229.765
TOTAL DEPTH: 14.9
EASTING: NA
NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/noVC - CONTAMINAION / NO VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC.
						Flush-mount Protective Casing cemented over well
0	SS1	0	NC		SILTY CLAY FILL (surface to 3.66 m) -fill, loose, silty clay, grey/brown, plastic, moist	J-Plug Lockable cap covers well pipe
1	SS2	0	NC		-brown clayey silt, moist, low plasticity, loose	Backfill (surface to 2.13 m) -clean auger cuttings
2	SS3	0	NC		-as above	
	SS4	0	NC		-as above	Grout Seal (2.13 m to 10.52 m) -liquid bentonite grout
3	SS5	0	NC		-as above, moist, some brown fine sand at 3.66 m	
4	SS6	0	NC		FINE SANDY SILT WITH SILTY CLAY AND FINE SAND INTERBEDS (3.66 m to 10.21 m) -brown clayey silt with some fine sand and silty clay seams, cohesive and plastic clays, wet	
5	SS7	0.2	VC		-brown fine sandy silt to 5.03 m -grey fine to medium sand to 5.34 m, highly oxidized at 5.03 m, strong napthalene odour, sheen	
6	SS8	4.4	VC		-dark grey fine to medium sand, strong napthalene odour, sheen	
	SS9	122	VC		-as above to 6.5 m, becomes fine sandy silt, some oxidation, tar in fractures, some vertical fractures, strong napthalene odour and staining	
7	SS10	112	VC		-dark grey fine sandy silt, some fine to medium silty sand seams, bedded, strong napthalene odour, some tar in fractures, sheen in saturated sand	
8	SS11	80	C (NO VC)		-as above sand seams are thin laminations with napthalene odour and producing a sheen, no tar observed	
	SS12	52	C (NO VC)		-as above, no tar observed, medium sand beds throughout	
9	SS13	40	C (NO VC)		-fine sandy silt with some silty clay and medium sand seams, dark grey no tar observed, napthalene odour observed	
10						

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: MW-24A&B | PROJECT NUMBER: ONT29776.CO

CLIENT NAME: CENTRA GAS MANITOBA INC. | DRILLING METHOD: CT-250, Hollow-stem Augers

LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN. | ELEVATION: -SURFACE ELEV.: 229.865

DATE DRILLED: June 10, 1994 | (metres) -TOP RISER PIPE: 229.795 & 229.765

LOGGER: R. Stacey | TOTAL DEPTH : 14.9

DRILL COMPANY: Paddock Drilling Ltd. | EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/ncVC - CONTAMINATION / NO VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC.
	SS14	24	C (NO VC)		**MEDIUM TO COARSE GRAINED SAND WITH SOME SILTY CLAY SEAMS** (10.21 m to 12.35 m) -medium grained grey sand, strong naphthalene odour -as above to 11.3 m, some shells throughout -grey clay seam from 11.3 m to 11.45 m, no tar observed	Filter Pack (10.52 m to 12.35 m) -#5 grain clean silica sand Well Screen (MW-24B) (10.82 m to 12.35 m) -schedule 40 P.V.C., 2.5cm I.D., manually slotted screen Well Seal (12.35 m to 13.12 m) -bentonite holeplug chips Filter Pack (13.12 m to 14.9 m) -#5 grain clean silica sand Well Screen (MW-24A) (13.41 m to 14.9 m) # 10 slot, schedule 40 P.V.C., 5 cm I.D.
11	SS15	0.8	TC			
12	SS16	1.2	TC		-medium sand with some silty clay seams throughout, reworked Note: water was added to augers at this depth to equilize pressures and control "sand heave"	
	SS17	0	TC		-medium to coarse grained sand to 12.35 m, fluvial origin, naphthalene odour, no staining or tar observed.	
13	SS18	0	NC		**GREY SILTY CLAY** (12.35 m to 14.02 m) -dark grey silty clay, cohesive, moist, high plasticity, mixed with light grey clay till, some sand and gravel throughout	
14	SS19	0	NC		-as above to 14.02 m, large cobble encountered at 13.8 m	
	SS20	NA	NC		**COARSE SILTY CLAY TILL** (14.02 m to 14.94 m) -light grey fine sandy silt till with many angular gravel and sand fragments -light grey till, coarse grained angular gravel with occasional sand grain, moist, no odour, clay matrix is highly plastic	
15						
16					Borehole terminated at 14.94 m	
17						
18						
19						
20						

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

WELL NUMBER: BH/MW-24C | PROJECT NUMBER: ONT29778.CO

CLIENT NAME: CENTRA GAS MANITOBA INC.

LOCATION: 35 SUTHERLAND AVE. WINNIPEG, MAN.

DATE DRILLED: June 10, 1994

LOGGER: R. Stacey

DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT-250, Hollow-stem Augers

ELEVATION: -SURFACE ELEV.: 229.865

(metres) -TOP RISER PIPE: 229.81

TOTAL DEPTH : 6.86

EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	WELL CONSTRUCTION: CASING, SCREEN INTERVAL, SAND PACK, SEAL, ETC.
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION C/noVC - CONTAMINAION / NO VISUAL VC - VISUAL CONTAMINATION NA - NOT ANALYSED G - GRAB SAMPLE SS - SPLITSPOON SAMPLE CS - CONTINUOUS SAMPLE S.P.T. - STANDARD PENETRATION TEST	Flush-mount Protective Casing cemented over well
0	SS1	0	NC		SILTY CLAY FILL (surface to 3.66 m) -fill, loose, silty clay, grey/brown, plastic, moist	J-Plug Lockable cap on well pipe
1	SS2	0	NC		-brown clayey silt, moist, low plasticity, loose	
2	SS3	0	NC		-as above	Well Seal (0.81 m to 2.74 m) -bentonite holeplug chips
3	SS4	0	NC		-as above	
	SS5	0	NC		-as above, moist, some brown fine sand at 3.66 m	Filter Pack (2.74 m to 5.95 m) -#5 grain clean silica sand
4	SS6	0	NC		FINE SANDY SILT WITH SILTY CLAY AND FINE SAND INTERBEDS (3.66 m to 6.86 m) -brown clayey silt with some fine sand and silty clay seams, cohesive and plastic clays, wet	
5	SS7	0.2	VC		-brown fine sandy silt to 5.03 m -grey fine to medium sand to 5.34 m, highly oxidized at 5.03 m, strong napthalene odour, sheen	Well Screen (3.51 m to 6.55 m) # 10 slot, schedule 40 P.V.C., 5 cm I.D.
6	SS8	4.4	VC		-dark grey fine to medium sand, strong napthalene odour, sheen	
	SS9	122	VC		-as above to 6.5 m, becomes fine sandy silt, some oxidation, tar in fractures, some vertical fractures, strong napthalene odour and staining	
7					Borehole terminated at 6.86 m	
8						
9						
10						

CH2M HILL ENGINEERING

TEST PIT LOG

TEST PIT NO.: TP-01

PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE EXCAVATED: October 5, 1993

EXCAVATOR: Operated by CENTRA GAS

LOGGER: R. Stacey

SURFACE ELEVATION: 229.815 (AVE.) (metres)

TOTAL DEPTH : 2.13

EASTING: NA

NORTHING: NA

DEPTH BELOW SURF-CE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	ADDITIONAL COMMENTS
					LEGEND NC – NO CONTAMINATION TC – TRACE CONTAMINATION VC – VISUAL CONTAMINATION G – GRAB SAMPLE	EVIDENCE OF CONTAMINATION, BACKFILL DETAILS, DEPTH TO WATER TABLE.
	G1	NA	NC		TOPSOIL (0 to 0.3 m) -grey silty clay, some pebbles, moist, some sandy pockets	
	G2	NA	VC		MIXED FILL (0.3 m to 1.52 m) -black suspected coke, dry, granular, very coarse grained, no coal tar	
1	G3	NA	TC		-construction debris, some bricks, limestone slabs (0.6 m x 0.9 m), 0.5 cm diameter x 1.5 m long metal pipe -some wood chips, some highly oxidized sandy silt with trace clay, moist, some bricks	Testpit backfilled to surface with original material and compacted with backhoe. Topsoil was replaced at surface.
	G4	NA	NC		FINE SANDY SILT (1.52 m to 2.13 m) -grey, oxidized fine sandy silt, some clay, moist, cohesive, no odour	
2					TEST PIT TERMINATED AT 2.13 m	
3						
4						
5						

CH2M HILL ENGINEERING

TEST PIT LOG

TEST PIT NO.: TP-02

PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE EXCAVATED: October 5, 1993

EXCAVATOR: Operated by CENTRA GAS

LOGGER: R. Stacey

SURFACE ELEVATION: 229.845 (AVG.) (metres)

TOTAL DEPTH : 2.13

EASTING: NA

NORTHING: NA

DEPTH BELOW SURFACE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	ADDITIONAL COMMENTS
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION VC - VISUAL CONTAMINATION G - GRAB SAMPLE	EVIDENCE OF CONTAMINATION, BACKFILL DETAILS, DEPTH TO WATER TABLE.
0	G1	NA	NC		MIXED FILL (1.83 m) - mixed sandy fill with construction debris, some wood chips, no odour dry to moist, some oxidation	Testpit backfilled to surface with original material and compacted with backhoe. Topsoil was replaced at surface.
1					-10 cm seam of black, dry, granular material, suspected coke, no odour	
	G2	NA	VC		-white sand sized grains, faint sulphur odour, suspected purifier waste, dry	
2	G3	NA	NC		SAND FILL (1.83 m to 1.9) -brown sand, moist to dry, sand fill	
					SILTY CLAY (1.9 m to 2.13 m) -grey, wet, dense, no odour, native silty clay	
3					TEST PIT TERMINATED AT 2.13 m	
4						
5						

CH2M HILL ENGINEERING

TEST PIT LOG

TEST PIT NO.: TP-03

PROJECT NUMBER: ONT29776.A0

CLIENT NAME: CENTRA GAS Manitoba Inc.

LOCATION: 35 Sutherland Ave. Winnipeg, Man.

DATE EXCAVATED: October 5, 1993

EXCAVATOR: Operated by CENTRA GAS

LOGGER: R. Stacey

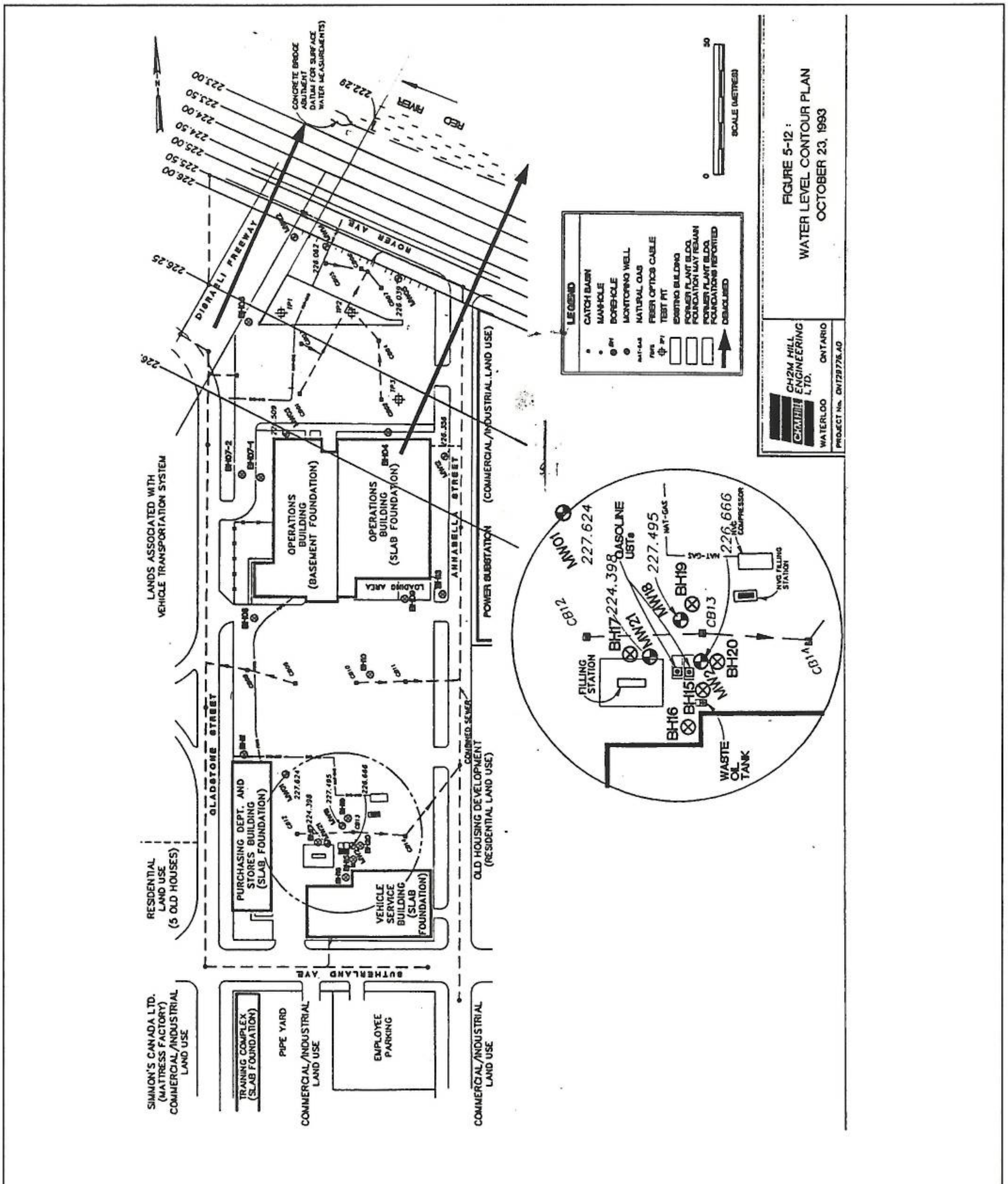
SURFACE ELEVATION: 229.425 (AVG.) (metres)

TOTAL DEPTH : 0.91

EASTING: NA

NORTHING: NA

DEPTH BELOW SURF-CE (METRES)	SOIL SAMPLE DETAILS: SAMPLE TYPE AND NUMBER	HNU ORGANIC VAPOUR CONC. (PPM)	VISUAL AND OLFACTORY ASSESS.	SAMPLE INTERVAL	SOIL DESCRIPTION	ADDITIONAL COMMENTS
					LEGEND NC - NO CONTAMINATION TC - TRACE CONTAMINATION VC - VISUAL CONTAMINATION G - GRAB SAMPLE	EVIDENCE OF CONTAMINATION, BACKFILL DETAILS, DEPTH TO WATER TABLE.
	G1	NA	NC	●	ASPHALT (10 cm)	
					GRANULAR FILL (0.1 m to 0.3 m) -sand and gravel, compact, tan-brown, moist, no odour	
	G2	NA	VC	●	MIXED FILL (0.3 m to 0.91 m) -black coke, strong napthalene odour, metal strapping found at 0.6 m, granular, some black tarry liquid at 0.9 m	
1						
					TEST PIT TERMINATED AT 0.91 m (CONTAMINATION OBSERVED)	Testpit backfilled to surface with original material and compacted with backhoe. Asphalt was replaced by CENTRA GAS MANITOBA INC.
2						
3						
4						
5						



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CENTRA GAS MANITOBA INC

CH2M TEST HOLE LOCATION PLAN
SUTHERLAND OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: N/A	Scale: NTS	Date: NOV/00	Project No.: WX-04783	Figure: A32

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APPENDIX B

ASSESMENT CRITERIA

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B1.0 INTRODUCTION

In order to develop possible remedial options and to evaluate the severity of the contaminants identified, a review of available regulatory criteria was undertaken. At this time, AMEC has adopted the use of available criteria; however, has not developed risk based values based on the current conditions, pathways and receptors which are unique to the Centra site. However, given the proximity of the site to the River, and given the current land use and soil conditions, it is considered unlikely that large deviations from the available generic criteria will be possible.

B2.0 SOIL GUIDELINE CRITERIA

Based on the current commercial land use, the Canadian Council of Ministers of the Environment (CCME) 1999 *Canadian Environmental Quality Guidelines* (EQG) for a commercial land use situation have been used as the applicable soil criteria for the site. The EQG has established criteria for benzene, toluene, ethylbenzene and xylene (BTEX) and some PAH (polycyclic aromatic hydrocarbons) parameters. Guideline criteria for additional PAH parameters have been obtained from CCME *Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites* (1991) and Ministry of Ontario Environment and Energy (MOE) 1997 *Guideline for Use at Contaminated Sites in Ontario*. The EQG (CCME, 1999) are considered to be the Tier 1 guideline criteria and alternative guidelines have only been used where criteria have not been established within the EQG.

The criteria for the BTEX and PAH parameters are shown in Table B1.

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TABLE B1: BTEX, PAH GUIDELINE CRITERIA - SOIL			
Parameter	**CCME Criteria**		**MOE Criteria**
	1999 EQG COMMERCIAL	**1991 Interim COMMERCIAL/ INDUSTRIAL**	**INDUSTRIAL (NON-POTABLE)[1]**
Benzene	5	--	--
Toluene	0.8 (10) [2]	--	--
Ethylbenzene	20	--	--
Xylenes	17	--	--
Acenaphthene	--	50	1300
Acenaphthylene	--	--	840
Anthracene	--	--	28
Benzo(a)anthracene	--	10	40
Benzo(a)pyrene	0.7	10	1.9
Benzo(b)fluoranthene	--	10	19
Benzo(g,h,i)perylene	--	--	40
Benzo(k)flouranthene	--	10	19
Chrysene	--	--	19
Dibenzo(a,h)anthracene	--	10	1.9
Fluoranthene	--	--	40
Fluorene	--	--	350
Indeno(1,2,3-cd)pyrene	--	10	19
2-Methylnaphthalene	--	--	280
1-Methylnaphthalene	--	--	280
Naphthalene	22	50	40
Phenanthrene	--	--	40
Pyrene	--	100	250

Notes: All values in parts per million (ppm-µg/g)
[1] – Soil in a non-potable groundwater situation.
[2] – (10) used in a non potable groundwater situation

B3.0 WATER GUIDELINE CRITERIA

Presently there is no use of the groundwater at the site, although the carbonate aquifer must be considered as a potable groundwater source and is a potential receptor. Although, at this point, none of the monitoring wells at the site are tied into the upper carbonate aquifer and therefore potable groundwater criteria are not applicable for the present study.

The more likely pathway to be considered at the site is expected to be seepage towards the Red River, and as such, the CCME EQG for Freshwater Aquatic Life have been selected as the Tier I guideline criteria for both ground and surface water. The EQG has established criteria for benzene, toluene, ethylbenzene and some PAH parameters. Guideline criteria for additional PAH parameters have been obtained from CCME *Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites* and MOE 1997 *Guideline for Use at Contaminated Sites in Ontario.* Alternative guidelines have only been used where criteria have not been established within the EQG.

The various criteria for the BTEX and PAH parameters are shown in Table B2.

TABLE B2: BTEX, PAH GUIDELINE CRITERIA – WATER			
Parameter	**CCME Criteria**		**MOE**
	1999 EQG FAL[1]	**Interim Coal Gas. Sites[2]**	**Industrial (Non-potable)[3]**
Benzene	370	--	1900
Toluene	2.0	--	5900
Ethylbenzene	90	--	28000
Xylenes (Total)	--	--	5600
Total Semi-Volatile Hydrocarbons (C1-C32)	--	--	--
Total Volatile Hydrocarbons	--	--	--
Phenols	4.0	--	26000
Acenaphthene	5.8	--	1700
Acenaphthylene	--	--	2000
Anthracene	0.012	--	12
Benzo(a)anthracene	0.018	1	5.0
Benzo(a)pyrene	--	1	1.9
Benzo(b)fluoranthene	--	1	7.0
Benzo(g,h,i)perylene	--	--	0.2
Benzo(k)fluoranthene	--	1	0.4
Chrysene	--	--	3.0
Dibenzo(a,h)anthracene	--	1	0.25
Fluoranthene	0.04	--	130
Fluorene	3.0	--	290
Indeno(1,2,3-cd)pyrene	--	1	0.27
2-Methylnaphthalene	--	--	13000
1-Methylnaphthalene	--	--	13000
Naphthalene	1.1	20	5900
Phenanthrene	0.4	20	63
Pyrene	0.025	20	40

Notes:All values in parts per billion (ppb-µg/L)

1 Canadian Environmental Quality Guidelines. 1999. Canadian Council of Ministers of the Environment (CCME) for FAL.

2 Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites. Canadian Council of Ministers of the Environment (CCME). 'C' classification (contamination is significant).

3 Ministry of Ontario Environment and Energy. Guideline for use at Contaminated Sites in Ontario. 1997. Table B Soil Guidelines, non-potable water, commercial/industrial site.

B4.0 RIVER AND SEDIMENT CRITERIA

Manitoba has not developed guidelines for sediment quality, relying instead upon federal guidelines. Environment Canada has developed a set of interim guidelines for PAHs in freshwater sediments, although these are still in draft form (Environment Canada, 1995). The Environment Canada sediment quality guidelines employ two assessment values:

- Threshold Effect Level (TEL) – the concentration below which adverse effects are expected to occur rarely.

- Probable Effect Level (PEL) – the concentration above which adverse effects are expected to occur frequently.

Concentrations between the TEL and PEL are occasionally expected to be associated with adverse biological effects.

Although the policy in Manitoba is to rely upon federal guidelines in the absence of provincial guidelines, sole reliance on federal guidelines is somewhat limiting in this case because the federal guidelines cover only a few PAH compounds (Table B3). Consequently, it is necessary to consider other guidelines in the data evaluation in addition to the federal values. Those considered as secondary guidelines in this assessment include the Ontario Sediment Quality Guidelines (Persaud et al 1993) and the interim Quebec sediment guidelines for the St. Lawrence River (Environment Canada/Ministere de L'Environnement du Quebec, 1992).

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TABLE B3:
FEDERAL AND PROVINCIAL SEDIMENT QUALITY CRITERIA FOR PAHS.

Parameter	CCME Criteria		Federal		Ontario[3]		Quebec[4]		
			1995 Environment Canada[2]						
	ISQG	PEL	TEL	PEL	LEL	SEL	NET	MET	TET
Acenaphthene	6.71	88.9	--	--	--	--	10	--	--
Acenaphthylene	5.87	128	--	--	--	--	10	--	--
Anthracene	46.9	245	--	--	220	10,500	20	--	--
Benzo(a)anthracene	31.7	385	32	385	320	42,200	50	400	475
Benzo(a)pyrene	31.9	782	32	782	370	41,000	55	500	665
Benzo(b)fluoranthene	--	--	--	--	--	--	300	--	--
Benzo(g,h,i)perylene	--	--	--	--	170	9,120	100	--	--
Benzo(k)fluoranthene	--	--	--	--	240	38,200	300	--	--
Chrysene	57.1	862	57	862	340	13,100	100	600	760
Dibenzo(a,h)anthracene	6.22	135	--	--	60	3,710	5	--	--
Fluoranthene	111	2,355	111	2355	750	29,100	110	600	1900
Fluorene	21.2	144	--	--	190	4,560	10	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	200	9,120	70	--	--
2-Methylnaphthalene	20.2	201	--	--	--	--	--	--	--
1-Methylnaphthalene	--	--	--	--	--	--	--	--	--
Naphthalene	34.6	391	--	--	--	--	20	400	570
Phenanthrene	41.9	515	42	515	560	27,100	50	400	760
Pyrene	53.0	875	53	875	490	24,200	60	700	950
Total PAH	--	--	--	--	4000	285,000	--	--	--
TOC[5]	n/a	n/a	n/a	n/a	n/a	2.85	n/a	n/a	n/a

Units µg/kg

n/a Not applicable
1 Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines. Sediment, Freshwater
2 Environment Canada 1995
3 Persaud et al. 1993
4 Environment Canada/ Ministere de L'Environment du Quebec 1992
5 Total organic carbon value used to calculate criteria

TEL Threshold Effects Level
LEL Lowest Effect Level
NET No Effect Threshold
TET Toxic Effect Level
PEL Probable Effects Level
SEL Severe Effect Level
MET Minimum Effect Threshold
Blank No criteria has bee n developed for that parameter

The Ontario and Quebec guidelines employ three assessment values:

- No Effect Level (NEL)/No Effect Threshold (NET) – the concentration below which no adverse effect on water quality, fish or benthic organisms can be detected.

- Lowest Effect Level (LEL)/Minimum Effect Threshold (MET) – the concentration above which some adverse effect can be detected. No effects on the majority of benthic organisms are expected. Effects are typically marginal although further investigation may be required.

- Severe Effect Level (SEL)/Toxic Effect Threshold (TET) – the concentration indicating heavily polluted sediment that is likely to affect the health of sediment dwelling organisms. A management plan may be required at this level of contamination.

In the data evaluation, the Environment Canada guidelines were considered as the primary criteria. In the absence of a federal guideline for any compound, the Ontario or Quebec guidelines were used as follows. In the case of a missing TEL, the lower of the applicable Ontario LEL or Quebec MET was used. A missing PEL was replaced by the lower of the Ontario SEL or Quebec TET. The Ontario SEL values are determined in part by the total organic carbon (TOC) concentration in the sediment. The SEL values listed in Table B3 were based on a TOC concentration of 2.85%, which represents the mean TOC concentration in the ten sediment samples that were analyzed in 1998.

B5.0 AIR QUALITY GUIDELINE CRITERIA

Manitoba has not published provincial air quality criteria for acceptable concentrations of PAH or BTEX therefore, the air quality standards from the Alberta Occupational health and Safety Act have been used. The values are consistent with those listed by the American Council of Government Industrial Hygienist, which are referenced by the Province of Manitoba Workplace Health and Safety and the Health Canada document entitled *"Indoor Air Quality in Office Buildings: A Technical Guide"*. The applicable air quality criteria are shown in Table B4.

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TABLE B4: OCCUPATIONAL EXPOSURE VALUES – 1999		
Parameters	Air Quality Standards American Conference of Governmental Industrial Hygienists Concentration (mg/m^3)	
	TWA	STEL
naphthalene	52	79
acenaphthylene	--	--
acenaphthene	--	--
fluorene	--	--
phenanthrene	--	--
anthracene	--	--
fluoranthene	--	--
pyrene	--	--
benzo(a)anthracene	--	--
chrysene	A2	--
Benzo(b)fluoranthene	A2	--
Benzo(k)fluoranthene	--	--
benzo(a)pyrene	A2	--
indeno(123cd)pyrene	--	--
dibenzo(ah)anthracene	--	--
benzo(ghi)perlyene	--	--
benzene	1.6	8.0
toluene	188	--
ethylbenzene	434	543
xylenes	434	651

TWA Time weighted average exposure concentration for a conventional 8 hour (TLV, PEL) or up to a 10-hour (REL) workday and a 40-hour workweek.

STEL Short term exposure limit. Usually a 15-minute time weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA, PEL-TWA or REL-TWA. Threshold Limit Value (TLV), Permissible Exposure Limit (PEL), Recommended Exposure Limit (REL).

A2 Suspected human Carcinogen: Human data are accepted as adequate in quality but are conflicting or insufficient to classify the agent as a confirmed human carcinogen; Or the agent is carcinogenic in experimental animals at dose(s), by route(s) of exposure, at site(s), of histologic types(s), or by mechanism(s) considered relevant to worker exposure. The A2 is used primarily when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals with relevance to humans.

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APPENDIX C

SITE INVESTIGATIONS

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C1.0 INTRODUCTION

In 1998/1999, AMEC Earth & Environmental Limited (AMEC) and Agassiz North Associates Limited (Agassiz) completed a review of available information to assess if on-going migration of coal tar from the Centra site to the sediments underlying the Red River was occurring. The results of this assessment were presented to Manitoba Conservation (then Manitoba Environment) in a meeting of April 1999. Subsequent to this meeting, and in keeping with the discussions of the meeting, a number of specific site investigations were initiated to confirm the site conditions and the conclusions of the previous report. Based on the meeting, the specific tasks which were completed at the site included:

- Evaluation of subsurface conditions at the location of a riverbank seep;
- Evaluation of potential migration pathways at the rivers edge through a comprehensive test hole drilling program;
- Monitoring of existing and new monitoring wells on the site to determine a) groundwater levels and flow direction, b) presence/absence of free product, c) subsurface vapour concentrations and d) concentrations of dissolved hydrocarbons; and
- Air quality testing within the Operations Building

The subsequent sections detail the various investigations completed at the site between June 1999 and June 2000.

C2.0 SUBSURFACE INVESTIGATION OF RIVERBANK SEEP

During the 1998 assessment completed by AMEC and Agassiz, a zone of seepage, with a visible hydrocarbon sheen, was identified along the river bank west of the site and the Disraeli Bridge. The location of the seep was approximately half way up the river bank and was assumed to be emanating from a buried pipe. As no substantial ground staining was observed adjacent to the seep, and as the quantity of water escaping the bank was relatively small, it was considered unlikely that this seepage zone was a source of on-going migration of contaminants to the river. However, evaluation of the area was deemed to be of value as the seepage point generally corresponded to the primary contaminant plume found in the river sediment and therefore it was considered a possible historical conduit. The scope of work was to complete a small excavation at the seepage source to identify if there was indeed a pipe below the ground surface and to determine the soil conditions and contaminant levels around the seepage point.

Subsequent to initiation of the original work plan, field reconnaissance by AMEC and Agassiz identified a significant amount of debris at and to the east of the bridge piers (i.e. directly north of the Centra site). The debris included a hardened asphalt like substance which was present at the rivers edge in large quantities. Considering that coal tar is a known by-product of manufactured gas plants and that weathered tar can resemble asphalt, it was decided that a test pit located along the river bank east of the bridge would be beneficial to determine if there was evidence of coal tar migrating through the subsurface and exiting along the river bank. As such, a test pit in this area of the site was added to the work program.

C2.1 INVESTIGATIVE METHODOLOGY

Prior to initiating any excavations, AMEC obtained the necessary utility clearances and permits from the City of Winnipeg. AMEC engaged Ken Palsen Enterprises to conduct the excavation work, which was completed using a small tracked backhoe which had a reach of approximately 3.0 m. Manitoba Conservation was notified in a letter dated October 29, 1999 of the proposed scope of work and schedule. The utilities are shown on Figure C1A.

On November 4, 1999 AMEC's Field Engineer supervised and directed the excavation of two test pits along the river bank, north of the Centra site. Mr. Randy Webber and Mr. Thomas Rae of Manitoba Conservation were also present during excavating. The excavated materials were placed onto a tarp and were then returned to the excavation upon completion. A provision to transport any impacted material to an off-site location for treatment had been made, however, upon seeing the soil conditions within the excavations, Mr. Webber provided on site approval for use of the excavated material as backfill.

C2.2 FIELD RESULTS

The locations of the test pits (TP99-1 and TP99-2) are shown in Figure C1. TP99-1 was located east of the Disraeli Bridge, adjacent and up slope from where the potential solid coal tar deposits were noted along the river bank. The location of the test pit was limited by the stability of the backhoe and the presence of debris including large concrete slabs which could not be moved by the backhoe. At the first test pit location, concrete rubble was encountered at 0.2 m below grade and therefore the test pit was relocated approximately 1.0 m further up slope where no obstructions were encountered. The test pit was excavated to a depth of about 3.0 m from grade.

The soil conditions encountered in the test pit consisted of clay fill to the full 3.0 m depth of the excavation. Sand, gravel, stones and concrete rubble were encountered in the upper 0.9 m of the excavation. Occasional pieces of hard black coal and/or coke were noted at depths between 1.2 and 2.7 m below grade. As well, a trace of a light green material was encountered at approximately 1.2 m below grade. Based on the historical review conducted by AMEC, the material was believed to be either degraded brick mortar or possibly ferri/ferro-cyanides (a by-product of the purification process). No zones or layers of coal tar were observed within the excavated depths. As well, no odours or visual hydrocarbon or PAH contamination was noted.

Test pit TP99-2 was located west of the Disraeli Bridge, at the seep location. Initially, the test pit was manually excavated to determine if any pipes were present below the ground surface. Hand excavation revealed the presence of a 200 mm diameter steel pipe just below ground surface. When the end of the pipe was cleared of soil, water (with a slight hydrocarbon sheen) flowed from the pipe down the bank towards the Red River. An estimated quantity of 75 to 100 L of water was released to the Red River, after which the flow reduced to a trickle. After the seepage stopped, a shallow trench was excavated with the backhoe on the east side of the pipe. The trenching revealed that the surficial fill materials were stained to a depth of approximately 0.3 m; and were underlain by a highly plastic, silty brown clay with no significant odour or visual evidence of hydrocarbon or PAH contamination. There was no evidence of coal tar or coal tar residues in the soil surrounding or underlying the pipe.

Pictures from the excavation can be seen as Figures C2 and C3. Soil logs for the two test pits are shown as Figures C4 and C5.

C3.0 RIVER BANK TESTHOLE DRILLING

The 1998/1999 study completed by AMEC identified potential migration pathways which could result in the deposition of coal tar in the river bottom sediments. Pathways which were identified included natural permeable soil zones such as gravel or coarse sand layers or man made conduits such as former discharge pipes and the existing natural gas line. Based on the data available, the study concluded that on-going migration of coal tar and subsequent deposition of tar in the river bottom sediments through these conduits was unlikely. As such, the observed expansion of the river sediment plume was not attributed to subsurface migration of coal tar residues, but rather a historical deposition and subsequent relocation along the river channel. However, confirmation of soil stratigraphy and contaminant levels between the site and the River was required to confirm AMEC's conclusions and to satisfy the requirements of MC.

Based on the location of the river sediment plume relative to the site, the investigated area extended along an approximately 80 m long portion of the river bank, from a former pump house structure (east of the bridge) to a point 30 m west of the bridge. The extent of the investigation can be seen on Figure C1.

Based on the findings of the initial test hole drilling program along the river's edge, it was determined that additional test hole drilling near the top of bank would be beneficial in assessing the potential that natural soil zones were acting as a pathway for product migration. Subsequent to approval from Centra Gas, six additional test holes were drilled up slope from the initial test holes, between the bridge piers and the abutment.

C3.1 INVESTIGATIVE METHODOLOGY

C3.1.1 January 2000

Prior to drilling, clearances from the City of Winnipeg (Water and Waste, Parks Department, Public Works), Manitoba Conservation, Manitoba Telecom Services, Winnipeg Hydro, Videon and Centra Gas were obtained.

The test hole drilling program conducted during the week of January 10, 2000 consisted of sixteen (16) test holes (TH2K-1 to TH2K-16). The test holes were drilled to depths between 4.9 and 7.9 m below grade at the locations shown on Figure C1. Test hole drilling was conducted with the aid of a track mounted drill rig supplied by Paddock Drilling Limited.

The test holes were advanced using 200 mm diameter hollow stem augers. Soil samples were recovered on a continuous basis during drilling, using a 75 mm diameter split spoon sampler and wire line equipment. In the upper 1.0 m or so, disturbed samples were often collected from the auger flights due to the large amount of debris in the fill materials which interfered with split spoon sample recovery. All disturbed soils which were present on the outside of the samples were removed to minimize potential cross contamination between sample intervals, in particular from below the water table. As well, the sampling equipment was washed and rinsed between sampling locations. Soil samples were classified according to the Modified Unified Soil Classification system and observed for visual evidence of hydrocarbon contamination, coal tar and/or coal tar residues. To maintain consistency with previous investigations, the NC, TC, VC,

C(no VC), methodology developed by CH2M was used for reporting results of the visual evaluation. Select soil samples were field screened for volatile hydrocarbon vapours using ambient temperature headspace (ATH) techniques and a Gastech vapour analyzer. The ATH technique involved half filling and sealing a 3.0 litre plastic bag with soil and allowing the sample to reach ambient temperature prior to analyzing the headspace. Accumulated vapours were measured in parts per million (ppm). Test hole logs for each of the test holes were developed and are shown as Figures C6 to C21. The test hole logs document the soil stratigraphy, sample locations and type, summary of the visual classification system and the results of the ATH vapour testing.

A number of soil samples were retained in laboratory prepared jars for possible laboratory analysis. In particular, soil samples exhibiting coal tar residues (product), staining and/or elevated ATH soil vapour levels were retained. All of the soil samples were stored in an insulated cooler while on site and during shipping to the laboratory.

Three of the test holes were completed with 50 mm diameter monitoring wells. The groundwater monitoring wells (TH2K-5, TH2K-9 and TH2K-14) were constructed with No. 10 (0.01 inch thick) slots and Schedule 40 PVC pipe. The slotted section of the pipe varied from 1.5 to 3.0 m in length depending on the conditions in which it was installed. Silica sand was placed in the annular space between the PVC pipe and the borehole wall, to approximately 0.3 m above the top of the screen, to filter out fine materials and prevent them from clogging the screen. A minimum of 0.3 m of granular bentonite was placed above the sand and then the test hole was backfilled with auger cuttings to within 300 mm of ground surface. The monitoring well was then finished to grade with granular bentonite. Each monitoring well was completed with a locked, above ground protective cover. The monitoring well construction details are shown on the applicable test hole logs.

The test holes and monitoring wells were horizontally located in relation to the fixed points on site and were then referenced to Agassiz Station 0+00, which has been used for the River sediment plume monitoring. Ground surface elevations were referenced to the top of the pipe in MW23A (installed by CH2M Hill in 1993 and located east of Pier Number 5 of the Disraeli Bridge) which is referenced to a geodetic datum located south of the site and designated as datum 26-008 by the City of Winnipeg.

C3.1.2 March 2000

Subsequent to the initial drilling program, it was determined that additional test holes between the site and river were required to confirm the subsurface conditions within this area. Six additional test holes (TH2K-17 to TH2K-22) were drilled the week of March 20, 2000. The test holes were drilled to depths between 6.7 and 10.9 m below grade. Test hole drilling was conducted with the aid of a track mounted drill rig supplied by Paddock Drilling Limited. Drilling, sampling and field testing procedures were as discussed in Section C3.1.1 for the January 2000 site investigation. Test hole logs for each of the test holes were developed and are shown as Figures C22 to C27.

Two of the test holes (TH2K-17 and TH2K-18) were completed with 50 mm diameter monitoring wells, which were constructed as outlined in Section C3.1.1.

C3.2 FIELD RESULTS

C3.2.1 Soil Stratigraphy

In general, the stratigraphy encountered within the test holes along the bank consisted of clay fill underlain by a stratified alluvial deposit followed by a dense glacial silt till. The clay fill was generally medium to highly plastic, silty, with some gravel. Bricks, stones, concrete rubble, wood, slag, coal/coke, pieces of metal and a whitish-green substance were occasionally observed within the fill materials. The whitish green material was considered to possibly be a ferro/ferri cyanide created in the purification process at the former MGP. The clay fill was damp, brown to black in colour and extended to between 0.6 and 4.6 m below grade at the test hole locations.

The underlying stratified alluvial deposit was characterized by interbeds of low permeability fine grained soil and higher permeability coarse grained soil. The higher permeability material was present in relatively thin zones approximately 100 mm or less in thickness and typically consisted of fine grained sand. The sand zones were discontinuous and occurred at varying depths. Small mollusc shells and pieces of tree root were occasionally encountered. This deposit extended to the depth of the test hole except where glacial till was encountered. There were no gravel or coarse sand zones encountered in any of the test holes.

A glacial silt till was generally encountered at an elevation of between 215.4 to 216.9 m (5.8 m to 10.4 m below grade). The dense glacial silt till was characterized by a light beige colour, with varying quantities of coarser materials such as sand and gravel. The investigation extended a maximum of about 0.6 m into the glacial silt till.

C.3.2.2 Soil Vapour Levels and Olfactory Indicators

The soil vapour levels measured during the drilling program are shown on the test hole logs and are summarized in Table C1. Zones in which visual evidence of contamination was identified are also noted in the Table.

TABLE C1: SOIL VAPOUR LEVELS

Test Hole No.	Test Hole Depth (m)	Zone of Visual Contamination	Soil Vapour Levels > 500 ppm (m)	Maximum Soil Vapour Level	
				Level (ppm)	Depth (m)
2K-1	4.9	None	None	65	2.4-3.0
2K-2	6.1	None	None	140	3.0-3.6
2K-3	6.4	4.1 – 4.3	None	15	1.8-2.4
2K-4	6.4	None	None	10	1.8-3.0
2K-5	7.3	2.4 – 3.7	2.4 – 4.3	850	3.0-3.6
2K-6	6.7	2.3 - 3.2, 3.4 – 3.5, 4.4 - 4.6	None	240	1.8-2.4
2K-7	7.9	1.8 – 2.9	None	200	2.4-3.0
2K-8	7.5	1.8-2.4	None	160	2.4-3.0
2K-9	7.3	2.4-2.9	None	210	1.2-1.8
2K-10	7.9	2.4-3.0	None	340	1.8-2.4
2K-11	7.3	1.7, 2.1	None	250	1.2-1.8
2K-12	4.3	1.5-1.7	None	180	1.5-1.7
2K-13	4.3	1.5	None	330	1.2-1.8
2K-14	4.3	1.2-1.5, 1.7-1.8	None	240	1.2-1.5
2K-15	3.6	1.1, 1.5, 2.1	None	280	1.5-1.8
2K-16	3.1	1.1, 1.2-1.7	1.2-1.5	520	1.2-1.5
2K-17	9.1	0.5 – 1.7, 4.3-6.4	6.1-6.4	540	6.1-6.4
2K-18	9.1	0.6 – 1.2, 1.7 – 2.4, 4.1 – 4.6, 4.8 – 5.2, 6.4 - 6.7	None	220	5.5-6.1
2K-19	10.9	1.8, 3.5 – 4.3, 4.6	None	96	3.6-4.3
2K-20	9.8	1.5	None	280	7.3-7.9
2K-21	9.1	0.3 – 1.5, 4.6, 4.9, 5.6 – 5.8	None	180	4.9-5.5
2K-22	6.7	0.6 – 1.2, 2.1, 2.4 – 4.8 4.7 – 5.7 2.1 – 4.9	N/A	N/A	N/A

Note: N/A Soil vapour concentrations were not determined at any of the sampling locations for this test hole because the samples were collected within transparent liners for examination in AMEC's soil laboratory.

Visual contamination (VC) as defined by the CH2M report was identified in all but TH2K-1 to TH2K-4. Coal tar residues were not identified within TH2K-1 to TK-4, located upstream of the bridge (VC at TH2K-3 not coal tar). However, trace amounts of coal/coke and wood were identified in the upper 4 m of these test holes. Coal tar residues were observed in TH2K-5 through TH2K-18, TH2K-21 and TH2K-22.

In general, the greatest degree of visual coal tar contamination was observed at the test holes which were located immediately adjacent to and downstream (northwest) of Disraeli Bridge Pier Number 5, with the relative degree of visible coal tar decreasing to the northeast. A small amount of staining and hydrocarbon odour was encountered in TH2K-19 however, no sheen or naphthalene odour were found. Except for a few small pieces of coal/coke at 1.5 m below grade, there was no visual or olfactory evidence of contamination at TH2K-20. The impacts from coal tar residue in TH2K-21 and TH2K-22 was limited to trace amounts of coal tar in thin zones 4.6, 4.9 and 5.8 m below grade and coal, metal, brick and a light green material between 0.3 and 1.5 m below grade.

Generally, the soils from about 2.0 to 3.5 m below grade at the Bridge Pier test holes were found to be saturated and contained significant quantities of coal tar residues (see Figures C28 and C29). While some of the test holes near the top of bank also contained visual evidence of coal tar contamination, the nature of the contamination in the two areas was quite distinct. In this regard, the upper test holes generally contained small nodules of coal tar within primarily non permeable soil zones, while the lower test holes contained soil layers saturated with water and coal tar and liquid hydrocarbons. None of the upper test holes contained permeable zones saturated with coal tar residues.

C3.2.3 LABORATORY RESULTS

The laboratory program was developed to include the analyses of PAH parameters. A total of nine soil samples were submitted for confirmatory laboratory analysis at Phillip Analytical Services Corporation in Mississauga, Ontario. The laboratory is certified with the Canadian Association of Environmental Analytical Laboratories (CAEAL). The Certificate of Laboratory Proficiency and Laboratory QA/QC is attached along with the Certificates of Analysis.

The soil samples submitted to the laboratory were considered to be representative of worst case conditions and/or were chosen to assist in the definition of the PAH contaminant plume. The results of the laboratory analysis are summarized in Tables C2 and C3. Also included in the Table are the results of the previous lab testing completed at the site by CH2M in 1993 and 1994. Table C3 shows the PAH concentrations in terms of percentage of total PAH's, for each of the individual parameters, from select sample locations.

TABLE C2 - Polycyclic Aromatic Hydrocarbons - Soil

Parameter	Test Hole/Depth																				CCME Criteria		MOE
	BH6 6.86-8.23	BH7 8.38-9.14	BH9 7.62-8.38	BH10 2.29-3.05	MW22 14.32-14.63	TP1 1.52	TP2 1.83	TP3 0.3-0.91	MW23A 6.1-6.9	MW23A 11.4 – 12.2	MW23A 14.5-15.2	MW24A 13-13.7	TH2K-4 1.22-1.83	TH2K-6 4.42-4.57	TH2K-7 1.83-2.44	TH2K-11 1.22-1.83	TH2K-14 1.22-1.52	TH2K-17 5.18-5.49	TH2K-17 6.1-6.4	TH2K-18 4.88-5.18	TH2K-19 3.51-3.66	1999 EQG COMM [1]	1991 Interim COMM/IND [2]	Industrial (Non-potable) [3]
Year Tested	1993	1993	1993	1993	1993	1993	1993	1993	1994	1994	1994	1994	2000	2000	2000	2000	2000	2000	2000	2000	2000			
Acenaphthene	38.1	ND	ND	ND	0.0142	ND	ND	6.370	29.4	ND	ND	ND	0.81	87.4	58.9	274	1110	1.26	5.99	2.67	1.20		50	1300
Acenaphthylene	383	0.0139	0.00108	74.8	0.0415	0.0176	12.8	90.5	348	0.00414	ND	0.00321	0.08	194	401	12.7	75.7	6.16	25.2	2.84	2.83			840
Anthracene	160	0.00874	0.00396	123	0.0421	0.00553	1.580	542	142	ND	ND	ND	0.27	97.6	312	184	738	3.37	12.4	3.80	8.65			28
Benzo(a)anthracene	97.3	0.0102	0.00608	172	0.0441	0.0112	17.9	381	154	ND	ND	0.013	0.17	64.6	282	79.4	311	2.06	8.85	3.29	8.33		10	40
Benzo(a)pyrene	96.6	0.0112	0.00421	134	0.0517	0.0159	22.8	479	173	ND	ND	ND**	0.18	68.3	286	71.0	303	2.32	9.86	4.01	10.5	0.7	10	1.9
Benzo(b)fluoranthene	41.8	0.0182*	0.001	118	0.0653*	0.0378*	34.8	390	81.7	ND	ND	ND	0.09	36.5	214	15.8	225	1.42	5.37	2.70	6.24		10	19
Benzo(g,h,i)perylene	52.3	0.0057	0.0024	64.5	0.0265	0.0267	69.1	257	95.3	ND	ND	0.00702	0.11	37.5	151	30.3	134	0.99	4.02	1.82	4.49			40
Benzo(k)fluoranthene	54.7	*	*	118	*	*	35.7	283	71.2	ND	ND	ND	0.12	40.4	146	40.3	120	1.64	6.46	2.38	6.63		10	19
Chrysene	95.7	0.00851	0.00508	131	0.0445	0.0165	42	292	106	ND	ND	ND	0.17	64.0	224	79.3	307	1.98	8.69	3.21	8.25			19
Dibenzo(a,h)anthracene	6.2	ND	ND	17.7	0.00296	0.00455	ND	53.4	18.9	ND	ND	ND	ND	6.01	23.8	6.71	25.1	0.20	0.30	0.40	0.90		10	1.9
Fluoranthene	262	0.0245	0.0148	385	0.109	0.0171	198	762	285	0.00638	ND	0.0636	0.47	171	1110	242	959	5.03	20.8	9.33	17.6			40
Fluorene	170	0.00996	0.00244	166	0.0278	ND	0.753	159	143	ND	ND	ND	0.33	92.5	406	130	585	2.88	10.4	2.77	1.72			350
Indeno(1,2,3-cd)pyrene	43.8	0.00437	0.00346	98.3	0.0306	0.0255	70	342	102	ND	ND	ND	0.09	35.1	148	30.2	133	1.06	4.36	1.92	4.64		10	19
2-Methylnaphthalene	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	0.56	279	281	125	452	5.97	21.4	5.14	1.63			280
1-Methylnaphthalene	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	0.47	175	216	83.2	327	6.35	22.7	5.47	1.73			280
Naphthalene	1560	0.353	0.00512	774	0.0156	0.00665	0.354	87.3	1460	0.167	0.0137	0.0271	3.48	1220	489	271	1300	46.5	154	47.1	5.80	22	50	40
Phenanthrene	627	0.0378	0.0129	623	0.165	0.00874	1.560	73.2	522	0.00698	0.00695	0.00532	1.15	329	2140	544	2250	14.3	45.6	16.2	25.4			40
Pyrene	20.2	0.054	0.0121	280	0.138	0.0201	40.4	629	344	0.00742	ND	0.00719	0.60	210	1360	294	1230	7.78	26.6	12.3	22.7		100	250

Notes: All values in parts per million (ppm-µg/g)
Original Certificates of Analysis should be referred to for the laboratory method detection limits
Shading indicates concentration exceeds CCME EQG (1999).
Cross-hatching indicates concentration exceeds CCME Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites.
ND Less than the method detection limit which is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
NM No analysis performed for this parameter
COMM Commercial
IND Industrial
1 Canadian Environmental Quality Guidelines. 1999. Canadian Council of Ministers of the Environment (CCME).
2 Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites. Canadian Council of Ministers of the Environment (CCME). 'C' classification (contamination is significant).
3 Ministry of Ontario Environment and Energy. Guideline for use at Contaminated Sites in Ontario, 1997. Table B Soil Guidelines. non-potable water, commercial/industrial site.
* Benzo (b) and (k) fluoranthene coeluted, therefore, the results are reported as a total.
** Benzo(a) pyrene was not detected, however, a similar compound possibly an isomer, was present at 297 ng/g quantitated against benzo(a)pyrene.

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TABLE C3 - Polycyclic Aromatic Hydrocarbons – Soil
PERCENTAGE DISTRIBUTION

Parameter	Test Hole/Depth													
	BH6 6.86-8.23	BH10 2.29-3.05	TP2 1.83	TP3 0.3-0.91	MW23A 6.1- 6.9	TH2K-4 1.22-1.83	TH2K-6 4.42-4.57	TH2K-7 1.83-2.44	TH2K-11 1.22-1.83	TH2K-14 1.22-1.52	TH2K-17 5.18-5.49	TH2K-17 6.10-6.40	TH2K-18 4.88-5.18	TH2K-19 3.51-3.66
Year Tested	1993	1993	1993	1993	1994	2000	2000	2000	2000	2000	2000	2000	2000	2000
Acenaphthene	1.03	ND	ND	0.1	0.7	8.9	2.7	0.7	10.9	10.5	1.1	1.5	2.1	0.9
Acenaphthylene	10.33	2.3	2.3	1.9	8.5	0.9	6.1	4.9	0.5	0.7	5.5	6.4	2.2	2.0
Anthracene	4.31	3.8	0.2	11.2	3.5	3.0	3.0	3.8	7.3	7.0	3.0	3.1	3.0	6.2
Benzo(a)anthracene	2.62	5.2	3.3	7.9	3.8	1.9	2.0	3.4	3.2	2.9	1.9	2.2	2.6	6.0
Benzo(a)pyrene	2.60	4.1	4.2	9.9	4.2	2.0	2.1	3.5	2.8	2.9	2.1	2.5	3.1	7.5
Benzo(b)fluoranthene	1.13	3.6	6.4	8.1	2.0	1.0	1.4	2.6	0.6	2.1	1.3	1.6	2.1	4.5
Benzo(g,h,i)perylene	1.41	2.0	12.6	5.3	2.3	1.2	1.2	1.8	1.2	1.3	0.9	1.0	1.4	3.2
Benzo(k)fluoranthene	1.47	3.6	6.5	5.9	1.8	1.3	1.3	1.8	1.6	1.1	1.5	1.6	1.9	4.8
Chrysene	2.58	4.0	7.7	6.0	2.6	1.9	2.0	2.7	3.2	2.9	1.8	2.2	2.5	5.9
Dibenzo(a,h)anthracene	0.17	0.5	ND	1.1	0.5	ND	0.2	2.9	0.3	0.2	0.2	0.1	0.3	0.6
Fluoranthene	7.06	11.7	36.1	15.8	7.0	5.1	5.3	13.5	9.6	9.1	4.5	5.3	7.3	12.6
Fluorene	4.58	5.1	0.1	3.3	3.5	3.6	2.9	4.9	5.2	5.5	2.6	2.7	2.2	1.2
Indeno(1,2,3-cd)pyrene	1.18	3.0	12.8	7.1	2.5	9.8	1.1	1.8	1.2	1.3	0.9	1.1	1.5	3.3
2-Methylnaphthalene	NM	NM	NM	NM	NM	6.1	8.7	3.4	5.0	4.3	5.4	5.4	4.0	1.2
1-Methylnaphthalene	NM	NM	NM	NM	NM	5.1	5.5	2.6	3.3	3.1	5.7	5.8	4.3	1.2
Naphthalene	42.06	23.6	0.0	1.8	35.8	38.0	38.0	0.2	10.8	12.3	41.8	39.1	37.0	4.2
Phenanthrene	16.90	19.0	0.2	1.5	12.8	12.6	10.3	25.9	21.7	21.3	12.9	11.6	12.7	18.2
Pyrene	0.54	8.5	7.4	13.0	8.4	6.6	6.6	16.5	11.7	11.6	7.0	6.8	9.7	16.3
TOTAL PAHS's	3709	3279.3	547.7	4826.8	4075.5	9.15	3207.9	8248.7	2512.9	10584.8	111.3	394.0	127.4	139.2

Notes: All values in percentage (%), except for total PAH's which is in ppm (µg/g)
ND Less than the method detection limit which is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
NM No analysis performed for this parameter
COMM Commercial

Following is a summary of the key findings of the lab analysis conducted in 2000:

- The concentration of benzo(a) pyrene in the soil samples submitted exceeded the CCME EQG for commercial land use, except at TH2K-4 (1.2-1.8 m).
- The naphthalene concentration also exceeded the CCME EQG for commercial land use at all sample locations except from TH2K-19 (3.51-3.66 m depth) and TH2K-4 (1.2-1.8 m).
- TH2K-6, TH2K-7, TH2K-11 and TH2K-14 had exceedances of the CCME Interim guideline criteria (1991) for acenaphthene, benzo(a)anthracene, benzo(b)fluoranthene ,benzo(k)fluoranthene, indeno (1,2,3-cd) pyrene and pyrene. TH2K-7 and TH2K-11 also had exceedances of the Interim guideline criteria (1991) for dibenzo(a,h)anthracene.

Overall, the lab testing program identified substantially elevated PAH constituents at most of the test hole locations, with concentrations well in excess of the 1999 CCME EQG for a commercial land use at TH2K-6, 7, 11, 14, 17 and 18. The CCME (1991) Interim guideline criteria for a commercial/industrial site were also exceeded at most locations. Generally, the PAH concentrations were highest at the test holes immediately adjacent to and downstream of Bridge Pier 5, at the Rivers edge, which corresponded well with the visual evaluation. The test holes near the top of bank (TH2K-17, TH2K-18 and TH2K-19) contained PAH concentrations above guideline values, however the concentrations were substantially less than those at the Bridge Pier.

The make-up of the PAH contamination (see Table C3) indicates the relative distribution of the PAH parameters varied significantly between test holes. However, it is important to note that at the rivers edge (TH2K-7, TH2K-11 and TH2K-14), the PAH contamination appears much different from that at the top of bank (TH2K-17 to TH2K-19), with a much lower percentage of naphthalene and much higher percentages of acenaphthene, phenanthrene and pyrene.

C4.0 GROUNDWATER WELL MONITORING AND SAMPLING

A monitoring program was implemented for the site to determine the following site characteristics:

- Groundwater levels and groundwater flow direction
- Subsurface vapour concentrations
- Groundwater vapour concentrations
- Presence/absence of Free Product
- Hydrochemistry of the groundwater

C4.1 METHODOLOGY

On October 4 and 5, 1999 the initial monitoring and groundwater sampling program was conducted on the historic wells. Subsequent monitoring trips on both the historic wells and newly installed wells (without groundwater sampling) were completed on February 15, March 7, March 22 and April 27, 2000.

The following items limited the monitoring program at some locations and resulted in additional site trips being required:

- MW2 has been covered by asphalt or was removed during the removal of underground storage tanks.
- MW3 was removed during construction of the elevator addition.
- The monitoring wells installed in January, 2000 were frozen at an elevation near grade almost immediately after installation, therefore field measurements could not be obtained from these wells (TH2K-5, TH2K-9 and TH2K-14). TH2K-14 was flooded during all subsequent monitoring trips, while TH2K-9 remained frozen throughout the monitoring period.
- Field measurements were obtained from TH2K-17 and TH2K-18 one day after drilling. Laboratory analysis of groundwater samples from these two wells was not included in the proposed scope of work.
- Due to the presence of stockpiled snow, four of the monitoring wells (MW23A,B and MW24A, B) could not be located during the March monitoring trip. MW22 was not monitored due to the presence of a thick layer of ice which enclosed the j-cap cover.
- The j-cap cover was observed to be missing at MW23A in March 2000, therefore well headspace vapour concentration measurements were likely affected.

The subsurface vapour concentration in the monitoring wells was measured by placing the probe of a GasTech combustible vapour meter into the well piping to a depth of about 1.0 m below grade (or less if the groundwater level was less than 1.0 m below grade) immediately after removing the protective cap. The concentration was recorded in percent lower explosive limit (% LEL) or parts per million total vapour (ppm). All results have been converted to %LEL for reporting.

The presence and thickness of light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) was measured using an electronic interface probe. The groundwater level and depth to bottom of the monitoring well were also measured with the interface probe. Where the possible presence of free product was identified, confirmation with a disposable bailer was conducted.

Once verification of free product thickness was completed, a groundwater sample for measuring groundwater headspace was obtained using a disposable PVC bailer. The sample was placed into a clean sample bag, sealed with a 1L headspace, and allowed to reach an ambient temperature of approximately 15 to 20°C.

As noted, groundwater sampling for laboratory analysis was completed in October 1999. To collect representative groundwater samples from the monitoring wells at the site, approximately three well volumes of water were removed from each monitoring well after taking the above noted field measurements. The water was removed using a dedicated PVC bailer and was placed into 205 L drums located at the site for future treatment or disposal. Groundwater samples were obtained using a dedicated PVC bailer and were immediately placed into laboratory prepared sample bottles. Samples were preserved and/or filtered as required for the laboratory methods. Clean nitrile gloves were used to avoid physical contact with the sample and reduce the possibility of cross-contamination. The headspace in the sample bottles was minimized to reduce potential volatilization. All sample bottles had Teflon lined caps. Groundwater samples were stored and transported within a cool, dark environment at all times. Groundwater samples for laboratory analysis were collected only during the October monitoring trip.

C4.2 FIELD RESULTS

Table C4 summarizes the monitoring data that has been obtained by AMEC since October 1999.

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TABLE C4: MONITORING SUMMARY							
Well #	Date	Well headspace (% LEL)	Water Level (m)	Product thickness (mm)		Groundwater headspace (%LEL)	Depth to bottom
				LNAPL	DNAPL		
MW1	Oct 4/99	<1	2.04	4	0	2	8.68
	Feb 15/00	3	2.80	0	0	1	6.60
MW5	Oct 4/99	2	3.59	0	0	2	7.42
	Feb 15/00	4	3.92	0	0	3	7.36
MW12	Oct 4/99	3	3.12	0	0	19	5.67
	Feb 15/00	3	3.46	0	0	3	5.66
MW14	Oct 4/99	1	3.64	0	0	12	NM
	Feb 15/00	3	4.92	0	0	4	7.62
	Mar 22/00	NM	3.89	0	0	NM	6.62
MW18	Oct 4/99	87	1.91	0	0	1	4.61
	Feb 15/00	80	2.66	0	0	2	4.60
MW21	Oct 4/99	3	1.79	4	0	2	NM
	Feb 15/00	20	2.49	0	0	2	NM
MW22	Oct 4/99	2	4.50	0	375	7	14.17
	Mar 7/00	NM	5.71	0	0	NM	13.4
	Mar 22/00	NM	5.30	0	0	NM	13.12
MW23A	Oct 4/99	<1	5.29	0	0	<1	15.17
	Mar 22/00	NM	5.57	0	0	NM	14.16
MW23B	Oct 4/99	3	4.55	0	0	2	8.66
	Mar 7/00	1	4.26	0	0	NM	NM
	Mar 22/00	NM	4.31	0	0	NM	6.650
MW24A	Oct 4/99	1	5.64	1	0	<1	14.71
	Mar 7/00	<1	5.20	0	0	NM	14.69
MW24B	Oct 4/99	<1	NM	0	0	NM	NM
	Mar 7/00	<1	4.03	NM	NM	NM	12.13
MW24C	Oct 4/99	3	4.26	2	0	2	6.89
	Feb 15/00	4	4.59	0	0	3	6.88

TABLE C4: MONITORING SUMMARY (Cont'd)

Well #	Date	Well headspace (% LEL)	Water Level (m)	Product thickness (mm)		Groundwater headspace (%LEL)	Depth to bottom
				LNAPL	DNAPL		
MW2K-5	Feb 15/00	NM	Frozen at 2.33	NM	NM	NM	NM
	Mar 7/00	NM	Frozen at 2.33	NM	NM	NM	NM
	Apr 27/00	10	1.258	0	0	10	1.589
MW2K-9	Feb 15/00	NM	Frozen at 1.88	NM	NM	NM	NM
	Mar 7/00	NM	Frozen at 1.80	NM	NM	NM	NM
	Apr 27/00	3	Frozen at 1.88	NM	NM	NM	NM
MW2K-14	Feb 15/00	NM	Frozen at 1.03	NM	NM	NM	NM
	Mar 7/00	Flooded					
	Mar 22/00	Flooded					
	Apr 27/00	Flooded					
MW2K-17	Mar 22/00	7	4.89	0	0	6	7.03
	Apr 27/00	4	4.61	0	0	12	7.03
MW2K-18	Mar 22/00	4	3.57	0	0	7	6.41
	Apr 27/00	8	3.49	0	0	13	6.44

The following items were identified during the monitoring program :

- During monitoring in October, 1999, AMEC's field technician noted strong odours (primarily napthalene) emanating from within MW5, MW12, MW14, MW22, MW2K-5, MW2K-9, MW2K-17 and MW2K-18.
- In October 1999, 37.5 cm of dark, oily product was measured in the bottom of MW22. In addition, LNAPL was detected at MW1 and MW21 (4 mm), MW24A (1 mm) and MW24C (2mm). Phase separated product (LNAPL and DNAPL) was not detected during monitoring in February, 2000 by AMEC's field technician, although the bottom of well depth was found to vary, possible indicating a blockage or sedimentation at the bottom of the pipe.

The following comments are made based on a review of the monitoring results and a comparison of the data between events:

- Elevated groundwater and well headspace concentrations were measured at the majority of the wells. These concentrations have been consistent across the monitoring events.
- Fluctuations in the groundwater level have been measured however, there has not been any dramatic changes and the groundwater flow direction has remained consistent (towards the River).

Monitoring in TH2K-5, TH2K-9 and TH2K-14 was limited by the presence of ice at ground level during the winter and subsequent flooding of the wells. It is likely that Fall will be the most appropriate time to monitor these wells, once drawdown of the River has occurred and prior to freeze up.

Figure C30 summarizes the measured groundwater levels in October 1999. As expected groundwater flow direction from the Centra site is towards the northwest, to the Red River.

C4.3 LABORATORY ANALYSIS

Table C5 summarizes the laboratory analysis of groundwater samples recovered from the monitoring wells in October 1999. The Table also shows the results of the laboratory analysis completed from 1993 to 1995 by CH2M.

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TABLE C5- Polycyclic Aromatic Hydrocarbons - Water

Parameter	Monitoring Well Location/ Date of Sampling																				CCME Criteria		MOE
	MW01	MW01	MW01	MW02	MW02	MW03	MW03	MW03	MW05	MW05	MW05	MW05	MW05	MW05	MW05	MW05	MW12	MW12	MW12	MW12	1999 EQG FAL[1]	Interim Coal Gas Sites[2]	Industrial (Non-potable)[3]
Date Tested	Oct. 4/93	Jun. 26/94	Oct. 14/99	Oct. 4/93	Jun. 26/94	Oct. 4/93	Jun. 26/94	Aug. 13/94	Oct. 4/93	Jun. 26/94	Aug. 13/94	Dec/96	Mar/97	May/97	Jun/97	Oct. 14/99	Oct. 4/93	Jun. 26/94	Aug. 13/94	Oct. 14/99			
Benzene	ND	ND	ND	14.3	ND	3710	5140	2930	684	980	1160	47000	2000	1200	1300	609	ND	5.43	ND	159	370		1900
Toluene	ND	ND	ND	ND	ND	740	350	244	ND	ND	ND	4000	27	11	11	13.3	ND	ND	ND	8.0	2.0		5900
Ethylbenzene	ND	ND	ND	ND	ND	300	770	ND	427	30	427	3800	1300	560	3	205	1.4	1.31	ND	27.4	90		28000
Xylenes (Total)	0.47	ND	ND	277	ND	2530	670	2225	447	500	938	3200	1000	610	540	262	40.3	58.8	49	55.6			5600
Total SemiVolatile Hydrocarbons (C1-C32)	NM	NM	ND	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	6380	NM	NM	NM	896			
Total Volatile Hydrocarbons	NM	NM	ND	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	3350	NM	NM	NM	720			
Phenols	3	ND	NM	51	8.4	230	140	65	42	46	NM	NM	NM	NM	NM	NM	10	12	NM	NM	4.0		26000
Acenaphthene	ND	ND	ND	0.086	0.066	18.9	14.6	12.6	36.8	32.9	13.3	27	100	59	32	54	0.868	0.74	0.638	1.9	5.8		1700
Acenaphthylene	0.021	0.024	ND	0.368	0.12	561	428	351	69	97.8	19.4	140	11	130	63	110	0.197	0.079	ND	2.0			2000
Anthracene	0.012	ND	ND	0.042	0.069	60.6	14.5	16.3	1.87	1.34	0.251	5.5	0.4	1.2	0.6	1.3	0.148	0.022	0.03	ND	0.012		12
Benzo(a)anthracene	ND	ND	ND	ND	0.057	20.9	6.38	6.04	0.347	0.111	0.44	1.5	0.1	ND	ND	ND	0.027	ND	ND	ND	0.018	1	5.0
Benzo(a)pyrene	ND	ND	0.018	ND	0.061	25.8	7.88	6.92	0.312	0.063	0.312	1.5	ND	ND	ND	ND	ND	ND	ND	ND		1	1.9
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	36.6*	4.41	3.23	0.173	0.101*	0.243	0.2	ND	ND	ND	ND	ND	ND	ND	ND		1	7.0
Benzo(g,h,i)perylene	ND	ND	ND	ND	0.028	10.6	4.57	5.14	0.175	0.026	0.164	0.8	ND	ND	ND	ND	ND	ND	ND	ND			0.2
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	*	3.21	5.58	0.207	*	0.165	0.5	ND	ND	ND	ND	ND	ND	ND	ND		1	0.4
Chrysene	ND	ND	ND	ND	0.041	16.1	3.97	6.14	0.341	0.082	0.331	0.6	0.1	0.1	ND	ND	0.03	ND	ND	ND			3.0
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	0.908	0.78	ND	ND	0.043	0.1	ND	ND	ND	ND	ND	ND	ND	ND		1	0.25
Fluoranthene	0.014	ND	0.055	0.072	0.135	81.8	10.9	14.7	1.41	0.869	1.11	5.7	0.2	0.6	0.3	0.7	0.169	0.063	0.013	ND	0.04		130
Fluorene	ND	ND	ND	0.251	0.177	80.6	39.1	36	4.49	4.68	0.395	22	1.5	4.4	2.9	3.6	0.871	0.27	ND	1.1	3.0		290
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	0.038	14.8	5.57	4.93	0.209	0.015	0.261	0.7	ND	ND	ND	ND	ND	ND	ND	ND		1	0.27
2-Methylnaphthalene	NM	NM	ND	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	120	NM	NM	NM	4.2			13000
1-Methylnaphthalene	NM	NM	ND	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	270	NM	NM	NM	11.5			13000
Naphthalene	0.044	0.457	0.065	2.63	0.831	3150	13400	6650	1.3	6390	2.43	130	39	3100	2700	3400	7.81	39.4	6.09	95	1.1	20	5900
Phenanthrene	0.031	ND	ND	0.251	0.25	306	48.4	43.2	9.06	6.82	0.297	24	0.4	4.9	2.6	6.7	0.467	0.021	0.027	ND	0.4	20	63
Pyrene	0.018	ND	0.070	0.092	0.159	117	15	20.4	1.65	0.863	1.49	6.4	0.8	1.9	0.6	0.9	0.184	0.089	0.04	ND	0.025	20	40

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TABLE C5 - Polycyclic Aromatic Hydrocarbons – Water (CONT'D)

Parameter	Monitoring Well Location/ Date of Sampling																			CCME Criteria		MOE
	MW14	MW14	MW14	MW14	MW14	MW14	MW14	MW18	MW18	MW18	MW18	MW21	MW21	MW22	MW22	MW22	MW23A	MW23A	MW23A	1999 EQG FAL[1]	Interim Coal Gas. Sites[2]	Industrial (Non-potable)[3]
Date Tested	Oct. 4/93	Jun. 26/94	Dec/96	Mar/97	May/97	Jun/97	Oct. 14/99	Oct. 4/93	Jun. 26/94	Aug. 13/94	Oct.14/99	Jun. 26/94	Oct. 14/99	Oct. 4/93	Jun. 26/94	Oct. 14/99	Jun. 27/94	Aug. 13/94	Oct. 14/99			
Benzene	53300	94930	NM	NM	NM	NM	50700	ND	2080	1363	235	ND	ND	1280	2280	3330	ND	ND	233	370		1900
Toluene	8570	10700	NM	NM	NM	NM	2950	ND	ND	ND	11.3	ND	0.3	ND	380	1770	ND	ND	1.2	2.0		5900
Ethylbenzene	2930	ND	NM	NM	NM	NM	4030	ND	1130	ND	0.7	ND	0.5	ND	490	1530	ND	ND	52.1	90		28000
Xylenes (Total)	4140	5800	NM	NM	NM	NM	3690	136	550	1140	89.5	38.4	5.0	181	335	1440	ND	ND	13.1			5600
Total SemiVolatile Hydrocarbons (C1-C32)	NM	NM	NM	NM	NM	NM	18200	60	NM	NM	433	NM	ND	NM	NM	10700	NM	NM	199			
Total Volatile Hydrocarbons	NM	NM	NM	NM	NM	NM	97100	860	NM	NM	2200	NM	ND	NM	NM	20500	NM	NM	772			
Phenols	1840	1500	NM	NM	NM	NM	NM	5.8	25	23	NM	52	NM	22	16	NM	1.6	3.0	NM	4.0		26000
Acenaphthene	4.48	48.4	17	13	20	25	35	NM	0.066	0.057	0.127	0.174	0.451	45.5	276	87	0.156	0.041	6.23	5.8		1700
Acenaphthylene	92.6	368	100	81	160	230	290	NM	0.07	0.071	0.072	0.032	0.262	91.9	1590	480	1.12	1.21	11.6			2000
Anthracene	5.09	20.3	3.5	2.2	4.4	8.9	3.2	NM	0.045	0.042	0.052	ND	ND	34.5	504	24	0.609	0.299	2.02	0.012		12
Benzo(a)anthracene	0.829	7.07	1.2	1.4	2.8	3.2	ND	NM	ND	0.011	0.064	ND	ND	6.72	167	13	3.42	0.761	0.330	0.018	1	5.0
Benzo(a)pyrene	0.662	20.1	1.3	2.1	3.4	3.7	ND	NM	ND	ND	0.067	ND	ND	7.72	165	ND	3.17	1.42	0.177		1	1.9
Benzo(b)fluoranthene	0.87*	11.5	1.3	1.7	3.0	3.3	ND	NM	ND	ND	0.111	ND	ND	7.29*	218*	ND	1.55	0.632	0.130		1	7.0
Benzo(g,h,i)perylene	0.355	13.8	0.9	1.7	1.2	1.0	ND	NM	ND	ND	0.070	ND	ND	ND	64	ND	1.78	0.758	0.121			0.2
Benzo(k)fluoranthene	*	8.35	0.4	0.7	1.4	2.0	ND	NM	ND	ND	0.118	ND	ND	*	*	ND	1.36	0.798	0.095		1	0.4
Chrysene	0.829	9.55	1.3	1.3	2.5	2.9	ND	NM	ND	ND	0.091	ND	ND	8.88	11.9	15	2.3	0.913	0.301			3.0
Dibenzo(a,h)anthracene	0.032	2.27	0.1	ND	3.4	ND	ND	NM	ND	ND	ND	ND	ND	ND	ND	ND	0.277	0.112	ND		1	0.25
Fluoranthene	4.86	31.4	3.6	2.2	5.7	8.9	0.7	NM	0.068	0.038	0.090	ND	0.073	44.8	850	40	2.25	0.554	1.78	0.04		130
Fluorene	12.7	44.1	14	1.4	18	27	25	NM	0.082	0.06	0.142	0.36	1.04	65.9	486	66	0.414	0.077	6.86	3.0		290
Indeno(1,2,3-cd)pyrene	0.353	14.9	0.7	1.4	1.6	1.2	ND	NM	ND	ND	0.079	ND	ND	ND	60.9	ND	1.91	0.692	0.117		1	0.27
2-Methylnaphthalene	NM	NM	NM	NM	NM	NM	440	NM	NM	NM	4.81	NM	ND	NM	NM	610	NM	NM	0.913			13000
1-Methylnaphthalene	NM	NM	NM	NM	NM	NM	280	NM	NM	NM	5.92	NM	0.110	NM	NM	380	NM	NM	10.2			13000
Naphthalene	3330	15614	200	1200	3200	6300	8200	NM	2.43	5.47	1.48	0.03	ND	11.1	13600	8800	0.436	0.488	0.577	1.1	20	5900
Phenanthrene	26.6	81.9	15	7.8	18	41	20	NM	0.041	0.016	0.082	ND	ND	213	1960	150	0.689	0.401	14.8	0.4	20	63
Pyrene	5.96	42.7	4.3	6.6	9.5	34	0.9	NM	0.039	0.024	0.098	ND	ND	49.8	1110	48	7.75	3.39	1.81	0.025	20	40

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TABLE C5 - Polycyclic Aromatic Hydrocarbons – Water (CONT'D)

Parameter	Monitoring Well Location/ Date of Sampling										CCME Criteria		MOE
	MW23B	MW23B	MW23B	MW24A	MW24A	MW24A	MW24B	MW24C	MW24C	MW24C	1999 EQG FAL[1]	Interim Coal Gas. Sites[2]	Industrial (Non-potable)[3]
Date Tested	Jun.26 /94	Aug.13 /94	Oct.14 /99	Jun.26 /94	Aug. 13 /94	Oct.14 /99	Aug. 13 /94	Jun. 26 /94	Aug.13 /94	Oct.14 /99			
Benzene	10320	7710	1870	ND	ND	4.6	105	6270	5080	3580	370		1900
Toluene	ND	ND	8.9	ND	ND	1.0	ND	70	ND	19.1	2.0		5900
Ethylbenzene	520	ND	11.7	ND	ND	5.2	ND	310	915	720	90		28000
Xylenes (Total)	725	2555	491	ND	ND	4.6	102.5	595	620	236			5600
Total SemiVolatile Hydrocarbons (C1-C32)	NM	NM	1160	NM	NM	ND	NM	NM	NM	2420			
Total Volatile Hydrocarbons	NM	NM	7020	NM	NM	349	NM	NM	NM	6190			
Phenols	87	210	NM	ND	3.6	NM	28	56	350	NM	4.0		26000
Acenaphthene	138	54.3	23	0.14	0.023	1.21	0.888	20.9	26.5	23	5.8		1700
Acenaphthylene	1450	741	320	0.162	0.195	3.06	2.06	47	73.4	32			2000
Anthracene	636	191	38	0.021	0.02	0.161	0.159	2.54	6.68	2.2	0.012		12
Benzo(a)anthracene	509	90.6	27	ND	ND	ND	ND	0.86	0.258	ND	0.018	1	5.0
Benzo(a)pyrene	517	98.4	ND	ND	ND	0.017	ND	0.725	0.116	ND		1	1.9
Benzo(b)fluoranthene	296	83.3	ND	ND	ND	ND	ND	0.331	0.066	ND		1	7.0
Benzo(g,h,i)perylene	277	51.9	ND	ND	ND	ND	ND	0.421	0.042	ND			0.2
Benzo(k)fluoranthene	191	56.4	ND	ND	ND	ND	ND	0.328	0.066	ND		1	0.4
Chrysene	364	101	31	ND	ND	ND	ND	0.612	0.203	ND			3.0
Dibenzo(a,h)anthracene	72.2	7.23	ND	ND	ND	ND	ND	ND	0.011	ND		1	0.25
Fluoranthene	960	242	68	0.069	0.057	0.098	0.148	3.09	2.64	2.3	0.04		130
Fluorene	573	203	68	ND	0.023	1.06	0.555	6.6	11	4.7	3.0		290
Indeno(1,2,3-cd)pyrene	289	45.3	ND	ND	ND	ND	ND	0.403	0.055	ND		1	0.27
2-Methylnaphthalene	NM	NM	650	NM	NM	8.90	NM	NM	NM	36			13000
1-Methylnaphthalene	NM	NM	480	NM	NM	10.5	NM	NM	NM	220			13000
Naphthalene	22800	12400	7100	0.399	0.018	131	0.084	3090	3030	790	1.1	20	5900
Phenanthrene	2200	603	180	0.064	0.036	1.11	0.039	13	18.7	13	0.4	20	63
Pyrene	1170	330	93	0.081	0.077	0.113	0.162	3.65	3.21	2.8	0.025	20	40

The following notes apply to Table C5:

- All values in parts per billion (ppb-μg/L)
- ND Less than the method detection limit which is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
- NM No analysis performed for this parameter
- Shading indicates concentration exceeds CCME EQG (1999) for freshwater aquatic life (FAL).
- [1]Canadian Environmental Quality Guidelines. 1999. Canadian Council of Ministers of the Environment (CCME) for FAL.
- [2]Interim Guidelines for PAH Contamination at Abandoned Coal Tar Sites. Canadian Council of Ministers of the Environment (CCME). 'C' classification (contamination is significant).
- [3]Ministry of Ontario Environment and Energy. Guideline for use at Contaminated Sites in Ontario, 1997. Table B Soil Guidelines, non-potable water, commercial/industrial site.

* Benzo (b) and (k) fluoranthene coeluted, therefore, the results are reported as a total.

The October 1999 monitoring identified the following:

- The concentrations of benzene, ethylbenzene and toluene exceeded the CCME (1999) EQG for freshwater aquatic life at MW05,MW14, MW22 and MW24C. the toluene guideline parameter was also exceeded at MW12, MW23B and MW18. The benzene guideline parameter was also exceeded at MW23B.
- The acenaphthene concentration exceeded the guideline criteria at MW14, MW22, MW23A, MW23B, MW24A, and MW24C.
- Anthracene and fluoranthene MW05, MW14, MW18, MW22, MW23A, MW23B, MW24A, and MW24C. The fluoranthene concentration at MW01 also exceeded the criteria.
- The benzo(a)anthracene concentration exceeded the guideline criteria at MW18, MW22, MW23A and MW23B.
- The fluorene concentration exceeded the guideline criteria at MW05, MW14, MW22, MW23A, MW23B, and MW24C.
- The naphthalene concentration exceeded the guideline criteria at all wells except MW01 and MW23A.
- The phenanthrene exceeded the guideline criteria at all wells except MW01, MW12 and MW18.
- The pyrene concentration in the groundwater exceeded the guideline at all wells except MW12.

Generally, exceedances of the applicable guideline criteria was encountered throughout a majority of the site. Large fluctuations in dissolved BTEX and PAH concentrations were identified between sampling events, most likely a result of seasonal variations. There does not appear to be any reduction in the PAH or BTEX concentrations since monitoring of the site began in 1993.

C5.0 AIR MONITORING

AMEC Earth & Environmental Limited (AMEC) conducted air monitoring in the Centra Gas Operations Building (35 Sutherland Avenue) on August 25 through 27, 1999 and again on April 14 through 18, 2000.

The purpose of the air sampling and testing program was to determine if the air quality within the building had been impacted as a result of the soil and groundwater contamination which is present at the site.

C5.1 INVESTIGATIVE METHODOLOGY

The air sampling locations in August, 1999 and April, 2000 were the same three locations where air samples had previously been obtained by AMEC in September, 1996 (sampled August 24, 1996) and April, 1999. The sample locations are described below.

Sample Location 1 - Basement Level of Elevator Addition

The elevator addition is located at the northwest corner of the Operations Building. The air sample was obtained in the basement level, immediately adjacent to the elevator door.

Sample Location 2 - South Mechanical Room

The South Mechanical Room is located in the basement at the southwest end of the Operations Building. The air sample was obtained from directly above the sump pit located within this room. It was previously identified that the sump pit in the South Mechanical Room was at a lower elevation (and therefore closest to the impacted soil and groundwater) than the sump pit in the North Mechanical Room. The protective steel plate cover was removed from the sump pit during air sampling.

Sample Location 3 - Vapour Collection Pipe below Elevator

The vapour collection pipe was installed below the elevator addition during construction. The piping is located below and adjacent to the elevator pit and was located above the HDPE liner that surrounds the elevator addition basement. The air sampling hose was placed into the vertical riser pipe as far as possible (approximately 0.6 m).

The procedure used to obtain the air samples was consistent with the previous monitoring events and was performed in accordance with NIOSH Methods 5515 and 1501. Following is a summary of the test procedures utilized:

- Two sampling pumps were calibrated to a flow of 2L/min and 1L/min for analysis of PAH and BTEX, respectively.

- Prior to collection of the air sample, a sorbent tube and a 0.8 µm quartz filter were connected to the PAH collection pump via flexible tubing. A sorbent charcoal XAD tube was connected to the BTEX collection pump via flexible tubing.

- The air samples were collected over a time period that ensured the volume of air collected was between 200 and 500 L for PAH and between 80 and 110 L for BTEX.

- Immediately after completion of sampling, the ends of the sampling tubes and cartridges were capped. The tubes and cartridges were then wrapped in aluminium foil to minimize degradation due to ultraviolet light.

- The foil wrapped tubes and filter cartridges were sealed in a plastic bag and stored at 4°C prior to shipping to AMEC's Mississauga laboratory for analyses.

The air samples from each location were tested for PAH and BTEX.

C5.2 LABORATORY RESULTS

The laboratory analysis indicated that the concentrations of the tested parameters at the three sampling locations were below laboratory detection limits. The results of the laboratory analysis are shown on the attached Certificates of Analysis. (Attachment C1)

A comparison of the August, 1999 results with the April 1999 laboratory analysis indicates that all of the results were consistent with the exception of the naphthalene concentrations. The concentrations of naphthalene were marginally elevated during the April 1999 sampling event (at all sampling locations), but were below laboratory detection limits in August, 1999 and April, 2000.

C6.0 SUMMARY

Two cross sections were developed in order to aid in the evaluation of whether on-going migration of coal tar was occurring from the site to the river. Items which were evaluated were the presence of any continuous zones of more permeable soils, or if continuous zones of visible contamination were readily apparent between the site and the River. The cross-section locations are shown on Figure C31 and the cross sections are shown as Figures C32 and C33

Evidence of coal tar contamination was evident from the site to the river's edge and it was apparent that migration of PAHs had followed the groundwater flow direction. However, the relative degree of impact does not support on-going migration of coal tar. This was based on the following:

- There were no continuous sand or gravel layers identified between the site and the river's edge.
- The degree of impact, as determine by visual evaluation and laboratory analysis, was much greater at the River's edge than at the top of bank (up to an order of magnitude higher).
- The make-up of the PAH contamination (see Table C3) indicated that the contamination at the test holes closest to the River was significantly different than at the upper test holes (i.e. much lower percentage of naphthalene and much higher percentages of acenaphthene, phenanthrene and pyrene).
- AMEC could not confirm the presence of any underground pipes and/or conduits which may be providing a migration pathway.

Based on the above, the investigation results indicate that while significant PAH contamination is present at the river's edge and throughout the riverbank, there does not appear to be any evidence that significant on-going migration of coal tar from the site to the River is occurring.

It is possible that migration of coal tars from the site to the River occurred on a historical basis during operation of the plant. This could be due to direct discharge to the river (i.e. through sewer pipes) or through migration within layers of high permeability. Furthermore, it is possible that construction of the bridge abutment and the dyke has changed the subsurface stratigraphy up gradient of the pier and the use of lower permeability clay backfill may have impeded continued migration.

amec

ATTACHMENT C1
CERTIFICATES OF ANALYSIS
AIR MONITORING

AGRA
ENGINEERING GLOBAL SOLUTIONS

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Environmental Limited
160 Traders Blvd.
Unit 4
Mississauga, Ontario
Canada L4Z 3K7
Tel (905) 890-0785
Fax (905) 890-1141

Client : AGRA Earth and Environmental Ltd.
95 Scurfield Blvd.
Winnipeg, Manitoba R3Y 1G4

Date: May 08, 2000

Page: 1 of 1

Project Name : Centra

Sample Type: Air

Project No. : WX 04783

Lab Ref.: F2000-0655

Contact : A. Desgroseilliers

Final

CERTIFICATE OF ANALYSIS

Polyaromatic Hydrocarbons

Lab # Sample ID Date Collected Unit		Lab Blank (µg)	S2000-3539 1 - Elevator (14/04/00) (µg)	S2000-3540 2 - South Sump (17/04/00) (µg)	S2000-3541 3 - Exterior (18/04/00) (µg)
Parameters	MDL * (µg)				
Naphthalene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Fluorene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Anthracene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Chrysene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Benzo(b)fluoranthene	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Indeno(123 cd.)pyrene	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenzo(ah)anthracene	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Surrogate Recovery					
Naphthalene-d8 (%)		74	75	84	84
Anthracene-d10 (%)		75	81	78	84
Perylene-d12 (%)		77	71	82	86

Comments: Method NIOSH 5515
* Method Detection Limit

THE CHEMICAL PROFESSION IN ONTARIO
CHARTERED
Suman Punani
CHEMIST
ASSOCIATION OF

Analyst: Tyron Wyton, B.Sc.

Cynthia Ridge, C. Chem.
Q.A./Q.C. Officer

Suman Punani, C. Chem.
Laboratory Manager

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Client : AGRA Earth and Environmental Ltd.
95 Scurfield Blvd.
Winnipeg, Manitoba R3Y 1G4

Project Name : Centra

Project No. : WX 04783

Contact : A. Desgroseilliers

Date: May 08, 2000

Sample Type: Air

Lab Ref.: F2000-0655

Final

CERTIFICATE OF ANALYSIS

Lab # Sample ID Date Collected Unit		Lab Blank (µg)	S2000-3539 1 - Elevator (14/04/00) (µg)	S2000-3539 1 - Elevator (14/04/00) (µg)	S2000-3540 2 - South Sump (17/04/00) (µg)	S2000-3540 2 - South Sump (17/04/00) (µg)
Parameters	MDL* (µg)		Front	Back	Front	Back
Benzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes	2.0	<2.0	<2.0	<2.0	<2.0	<2.0

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Winnipeg, Manitoba R3Y 1G4

Date: May 08, 2000

Project Name : Centra

Sample Type: Air

Project No. : WX 04783

Lab Ref.: F2000-0655

Contact : A. Desgroseilliers

Final

CERTIFICATE OF ANALYSIS

Lab #		S2000-3541	S2000-3541
Sample ID		3 - Exterior	3 - Exterior
Date Collected		(18/04/00)	(18/04/00)
Unit		(µg)	(µg)
Parameters	MDL* (µg)	Front	Back
Benzene	0.5	<0.5	<0.5
Toluene	0.5	<0.5	<0.5
Ethylbenzene	0.5	<0.5	<0.5
Xylenes	2.0	<2.0	<2.0

Comments: Method NIOSH 1501
Total Hydrocarbons quantified as Toluene
Total Hydrocarbons boiling point 36-126°C includes BTEX
* Method Detection Limit

Analyst: Tyron Wyton, B.Sc.

Cynthia Ridge, C. Chem.
Q.A./Q.C. Officer

Suman Punani, C. Chem.
Laboratory Manager

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Suman Punani
CHEMIST

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Date: September 8, 1999

Page: 1 of 1

Project Name: Centra Gas

Sample Type: Air

Project No. : WX 04783.1 (2000)/WX 04783.2

Lab Ref.: F99-1359/F99-1375

Contact : Allyson D.

Final

CERTIFICATE OF ANALYSIS

Polynuclear Aromatic Hydrocarbons

Lab # / Sample ID / Date Collected / Unit		Lab Blank	S9907376 Loc. 3 Outside (26/08/99)	S9907460 Sample 1B (26/08/99)	S9907461 Sample 3B (27/08/99)
Parameters	MDL * (µg)	(µg)	(µg/m³)	(µg/m³)	(µg/m³)
Naphthalene	0.08	< 0.08	< 0.08	< 0.08	< 0.08
Acenaphthylene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Acenaphthene	0.08	< 0.08	< 0.08	< 0.08	< 0.08
Fluorene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Phenanthrene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Anthracene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Fluoranthene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Pyrene	0.12	< 0.12	< 0.12	< 0.12	< 0.12
Benzo(a)anthracene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Chrysene	0.04	< 0.04	< 0.04	< 0.04	< 0.04
Benzo(b)fluoranthene	0.16	< 0.16	< 0.16	< 0.16	< 0.16
Benzo(k)fluoranthene	0.16	< 0.16	< 0.16	< 0.16	< 0.16
Benzo(a)pyrene	0.12	< 0.12	< 0.12	< 0.12	< 0.12
Indeno(123 cd.)pyrene	0.12	< 0.12	< 0.12	< 0.12	< 0.12
Dibenzo(ah)anthracene	0.16	< 0.16	< 0.16	< 0.16	< 0.16
Benzo(ghi)perylene	0.08	< 0.08	< 0.08	< 0.08	< 0.08
Sample Volume			490L	430L	422L
Surrogate Recoveries					
Naphthalene-d8 (%)		95	103	91	79
Anthracene-d10 (%)		96	94	95	86
Perylene-d12 (%)		86	97	99	86

Comments: Method: NIOSH 5515
* Method Detection Limit

Analyst: T. Wyton, B.Sc.

Cynthia Ridge, C. Chem.
Q.A./Q.C. Officer

Suman Punani, C. Chem.
Laboratory Manager

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Date: September 8, 1999

Page: 1 of 1

Project Name : Centra Gas

Sample Type: Charcoal Filter

Project No. : WX 04783

Lab Ref.: F99-1359

Contact : Allyson D.

Final

CERTIFICATE OF ANALYSIS

Lab # / Sample ID / Date Collected / Unit		Lab Blank	S9907371 Loc. 1 Bsmt. Elev. Door (25/08/99)	S9907373 Loc. 2 South Mech. Rm. (25/08/99)	S9907375 Loc. 3 Outside (25/08/99)	Exposure Limit
Parameters	MDL* (ppm)	(µg)	(ppm)	(ppm)	(ppm)	(ppm)
Benzene	0.01	<0.5	<0.01	<0.01	<0.01	0.5
Toluene	0.01	<0.5	<0.01	<0.01	<0.01	50
Ethylbenzene	0.01	<0.5	<0.01	<0.01	<0.01	100
Xylenes	0.05	<2.0	<0.05	<0.05	<0.05	100
Sample Volume (L)		-	100	106	94	-

Comments: Methods: NIOSH 1500/1501: Solvent Ext/GC/FID
* Method Detection Limit

Analyst: A. Raksit, C. Chem.

Cynthia Ridge, C. Chem.
Q.A./Q.C. Officer

Suman Punani, C. Chem.
Laboratory Manager

DISRAELI STREET

ROVER AVE.

FORMERLY GLADSTONE STREET

DISRAELI BRIDGE

FORMER WATER GAS PLANT

OPERATIONS BUILDING (PRIOR TO ELEVATOR ADDITION)

BLOW-OFF CHAMBER

WOODEN GAS TANK AND TAR IN EXCAVATION FOR PIER NO.4 JUNE 1958

APPROXIMATE SUMMER WATER LEVEL (ELEV. 223.6m)

NATURAL GAS PIPELINE

RED RIVER flow direction

TH2K-16
TH2K-15
TH2K-14
TH2K-13
TH2K-12
TH2K-11
TH2K-10
TH2K-9
TH2K-8
TH2K-7
TH2K-6
TH2K-5
TH2K-4
TH2K-3
TH2K-2
TH2K-1
TH2K-20
TH2K-19
TH2K-18
TH2K-17
TH2K-22
TH2K-21
TP99-2
TP99-1
TH99-2
TH99-1
TH99-3

2
3
4
5
6
7

TH1
BH6
MW22
MW23A
MW23B
MW14
TP1
TP2
MW5
TP3
MW24A,B
MW24C
TH5
TH2 (1955)
TH6D
TH7D
TH11 (1955)
TH12 (1955)
TH3 (1955)
TH6U
TH7U
TH5 (1949)
TH6 (1949)
TH3 (1949)
TH4 (1949)
TH4 (1955)
TH5 (1955)

MONITORING WELL LOCATION
CH2M TEST HOLE LOCATION
TEST HOLE LOCATION
TEST HOLE LOCATION FOR BRIDGE GEOTECHNICAL INVESTIGATION (1949 - 1955)
TEST PIT LOCATION

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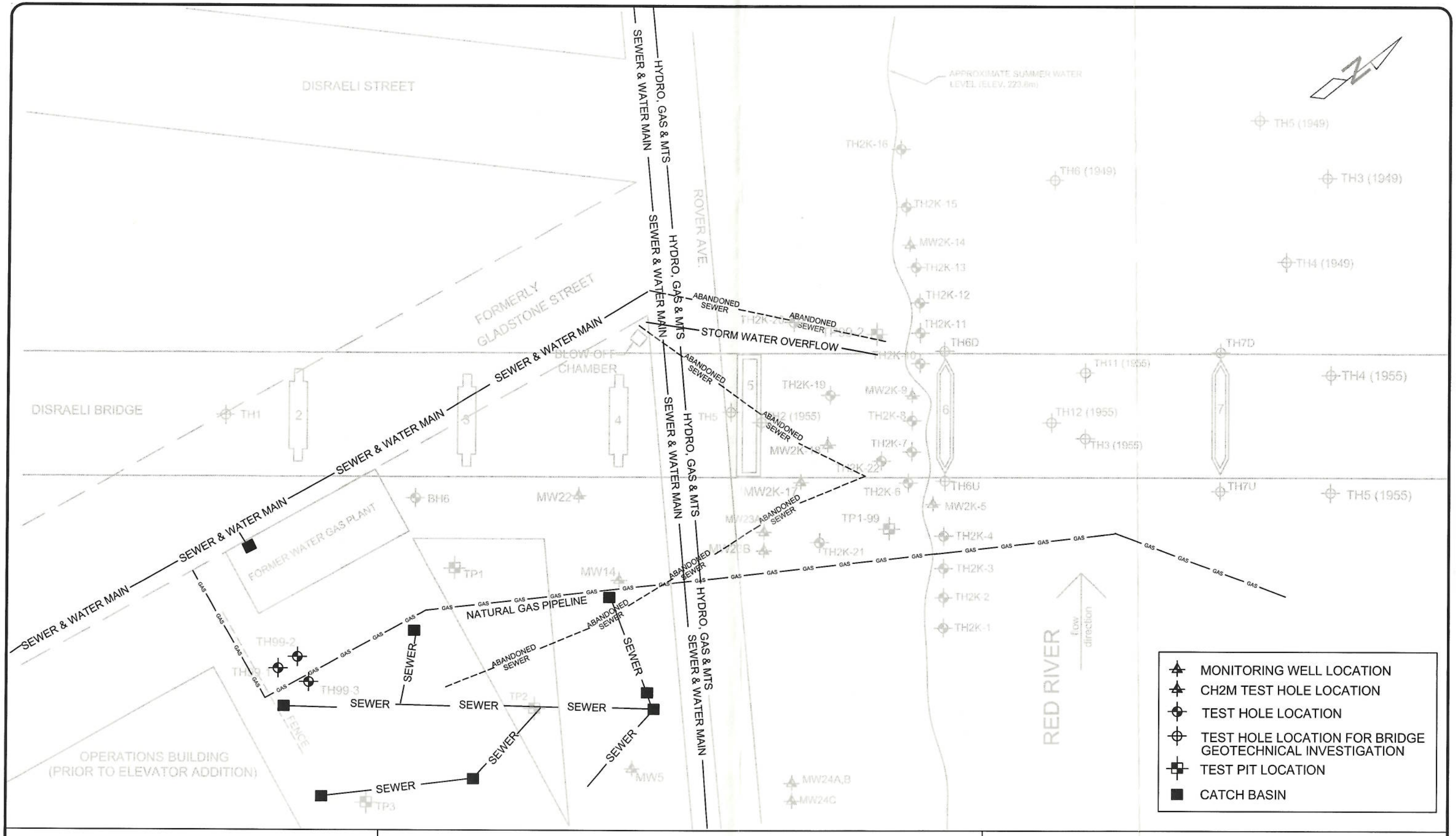
CENTRA GAS

TEST HOLE LOCATION PLAN
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: EET	Scale: 1:600	Date: June/00	Project No. : WX-04783	Figure: C1



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CENTRA GAS

UTILITY LOCATION PLAN
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: EET	Scale: 1:600	Date: June/00	Project No. : WX-04783	Figure: C1a

Asphalt-like substance observed along river bank.

Seepage of water from river bank. Trace sheen observed on water.
Note stormwater outfall to left of seepage.

amec Earth & Environmental Limited **CENTRA GAS (MANITOBA) INC.**		**SITE PHOTOGRAPHS NORTH OF CENTRA GAS OPERATIONS FACILITY 35 SUTHERLAND AVENUE WINNIPEG, MANITOBA**		
Drawn: N/A	Scale: N/A	Date: NOV/00	Project No.: WX-04783	Figure: C2

Test pit (TP1-99) at east side of Disraeli Bridge. Light green and beige material was observed on back wall (south wall) of excavation

Excavation (TP2-99) of seepage point at east side of Disraeli Bridge. A pipe containing some water was encountered

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Earth & Environmental Limited

CENTRA GAS (MANITOBA) INC.

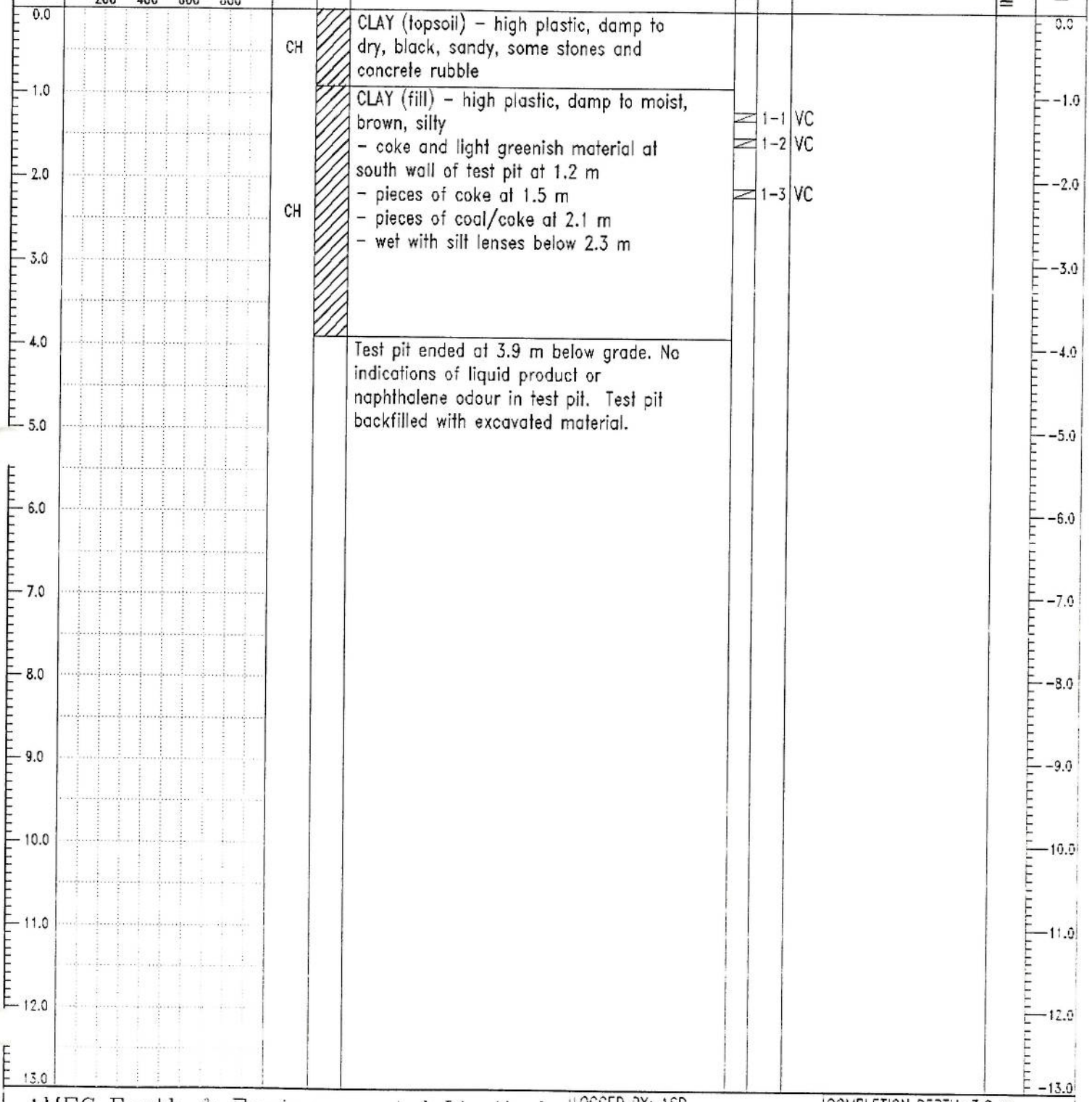
SITE PHOTOGRAPHS
NORTH OF CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: N/A	Scale: N/A	Date: NOV/00	Project No.: WX-04783	Figure: C3

Culvert Evaluation	Contractor: Ken Palsen Enterprises	TEST HOLE NO: TP99-1
Centra Gas	Backhoe	PROJECT NO: WX-04783
		ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



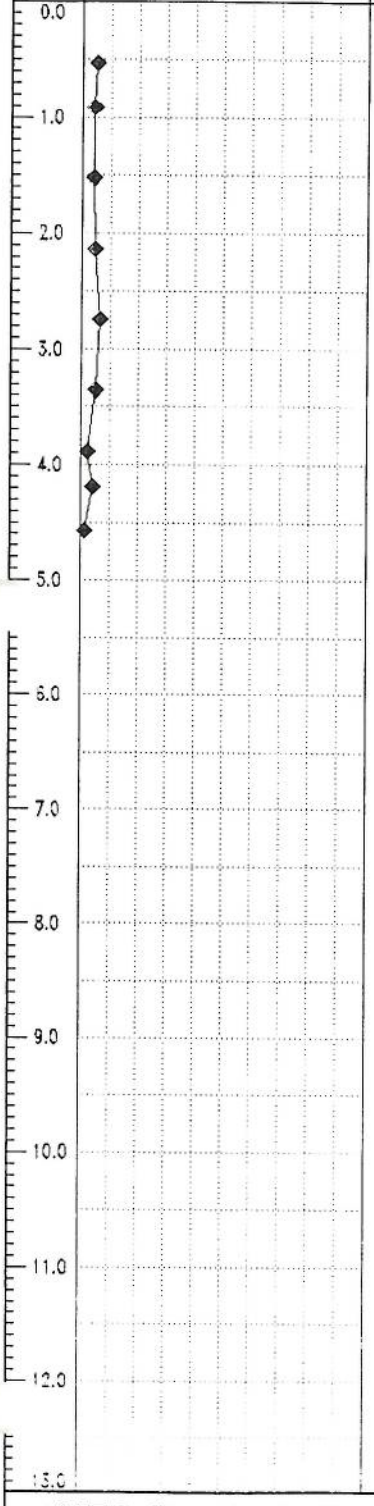
AMEC Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: ASD	COMPLETION DEPTH: 3.9 m
	REVIEWED BY: HDP	COMPLETE: 04/11/99
	Fig. No: C4	Page 1 of 1

00/11/22 09:47AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-1
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 222.48 m

SAMPLE TYPE ■ SHELBY TUBE ▨ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
ML		SILT (fill) – low plastic, moist, loose, dark grey to black, clayey, sand and gravel		1-1	NC		222.0
CI		CLAY – medium plastic, very moist to wet, soft, dark grey to black, silty, sandy		1-2	NC		
		CLAY – low plastic, moist, firm, dark grey, very silty, trace fine grained sand		1-3	NC		221.0
CL		– thin organic lense at 2.36 m		1-4	NC		
		– thin fine grained sand lense		1-5	NC		220.0
CH		– stones at 3.3 m		1-6	NC		219.0
SP		CLAY – highly plastic, moist, firm, dark grey		1-7	NC		
CI		– thin silt lense at 3.6 m		1-8	NC		218.0
		SAND – poorly graded, fine grained, wet, loose, dark grey,		1-9	NC		
		CLAY – medium plastic, moist, firm, grey, silty					217.0
		End test hole at 4.9 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					216.0
							215.0
							214.0
							213.0
							212.0
							211.0
							210.0

AMEC Earth & Environmental Limited
Winnipeg, Manitoba

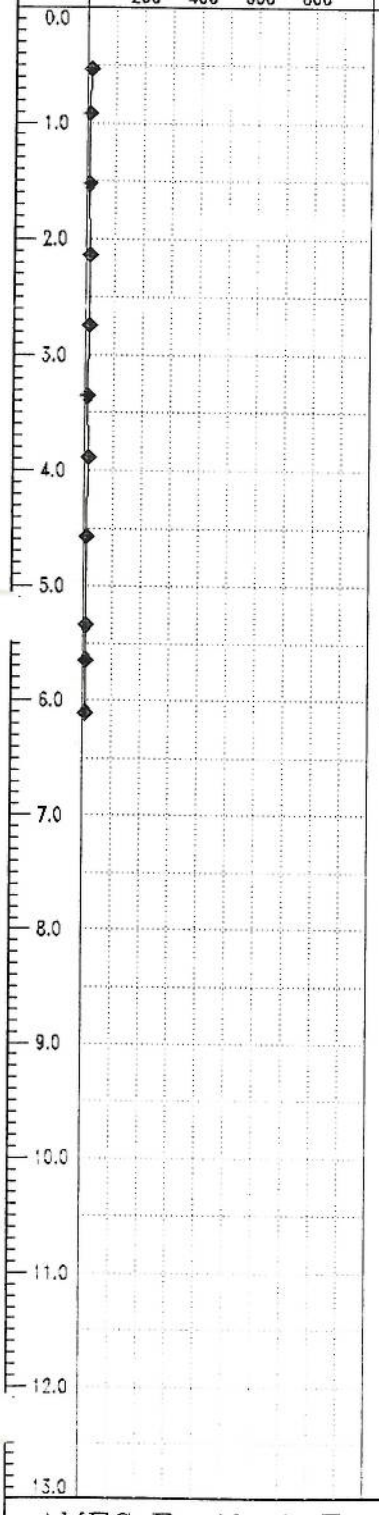
LOGGED BY: ASD	COMPLETION DEPTH: 4.88 m
REVIEWED BY: HDP	COMPLETE: 10/01/00
Fig. No: C6	Page 1 of 1

00/11/22 09:53AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-3
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 222.44 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
CI		CLAY (fill) - dark grey, frozen, silt and gravel		3-1	NC		222.0
				3-2	NC		
CL-CI		CLAY (fill) - low to medium plastic, moist, soft, dark grey and black varves, silty, trace organics		3-3	NC		221.0
CL		CLAY (fill) - low plastic, very moist, soft, dark grey, silty, trace sand and gravel, thin sand lenses throughout, trace fibrous organics throughout (rootlets, wood)		3-4	TC		220.0
		- trace stones and small wood fibres at 2.1 m		3-5	TC		
		- stones at 2.4 m		3-6	VC		219.0
		- pieces of wood at 2.7 m, 3.1 m, 3.4 and 3.5 m (strong odour)		3-7			
SP		- very sandy 3.6 to 4.2 m		3-8	NC		218.0
		- piece of glass and coal at 4.1 m		3-9			
CH		SAND - poorly graded, fine grained, loose, wet, dark grey to black		3-10	NC		217.0
		- faint odour below 4.9 m		3-11	NC		
TILL		CLAY - highly plastic, moist, firm to soft, dark grey		3-12	NC		216.0
		- brown below 5.7 m					
		SILT TILL - soft, wet, clay and gravel					215.0
		End test hole at 6.4 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					214.0
							213.0
							212.0
							211.0
							210.0

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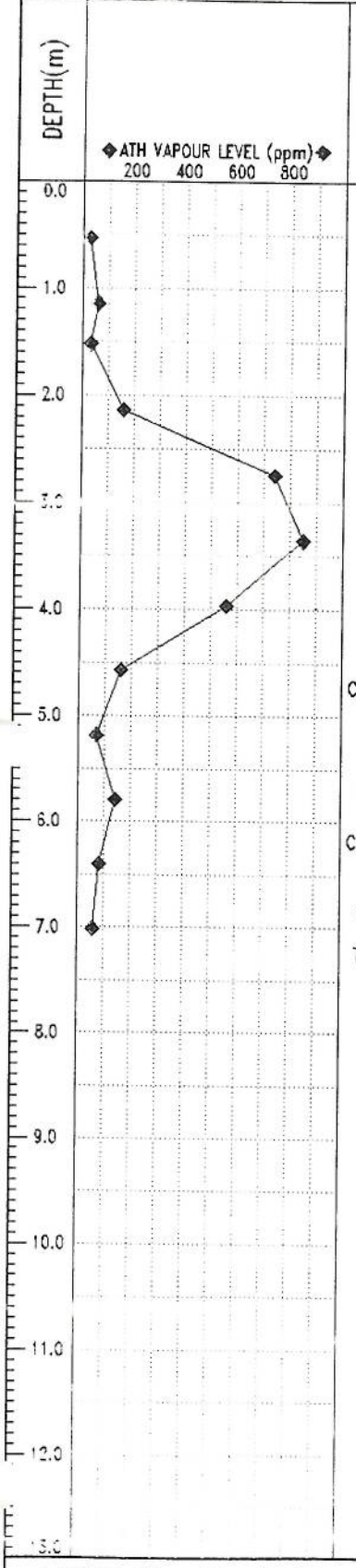
LOGGED BY: ASD	COMPLETION DEPTH: 6.41 m
REVIEWED BY: HDP	COMPLETE: 10/01/00
Fig. No: C8	Page 1 of 1

00/11/22 09:53AM (GEO_EH9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-5
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 223.28 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	ELEVATION(m)
GW		GRANULAR (fill) – well graded, sand and gravel, loose, frozen, silty, stones, piece of coal at 1.8 m		5-1	NC	223.0
				5-2	NC	
				5-3	NC	222.0
				5-4	TC	
CL		CLAY (fill) – low plastic, wet, soft, dark grey, sandy, silty – liquid coal tar residue from 2.4 to 4.0 m – piece of wood at 3.6 m		5-5	VC	221.0
				5-6	VC	220.0
				5-7	TC	
CI-CL		CLAY – medium to low plastic, moist, firm, dark grey, silty		5-8	NC	219.0
				5-9	TC	
		– fine grained sand lense at 5.3 m				218.0
SP		SAND – dark grey, wet, fine grained sand, loose		5-10	NC	
CI-CL		CLAY – medium to low plastic, moist, grey to brown, silty, soft		5-11	NC	217.0
CH		CLAY – highly plastic, moist, stiff, clay with silt till inclusions throughout		5-12		
TILL		SILT TILL – light beige, dense, gravelly				216.0
		End test hole at 7.3 m below grade. Seepage and sloughing occurred. Monitoring well installed.				215.0
						214.0
						213.0
						212.0
						211.0

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LOGGED BY: ASD
REVIEWED BY: -DP
Fig. No: C10

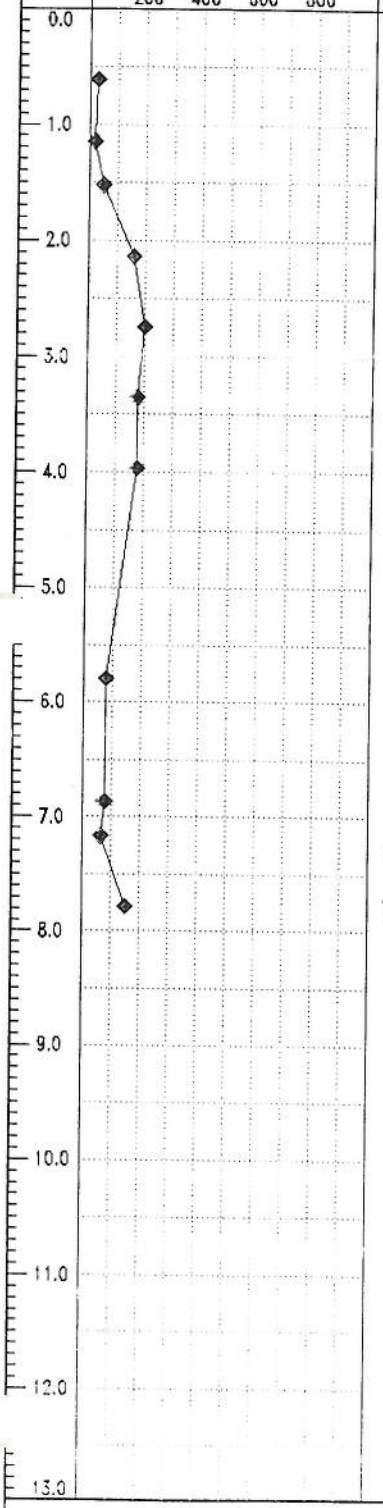
COMPLETION DEPTH: 7.32 m
COMPLETE: 11/01/00

00/11/22 09:54AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-7
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 223.68 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
0.0	OH		CLAY (fill) - black, sand, gravel, glass, rubble, stones		7-1	NC		223.0
1.0					7-2	NC		
						TC		
	ML		SILT (fill)- very moist, dense, light brown, trace stones, faint odour		7-3	VC		222.0
2.0	SP		SAND - poorly graded, fine to medium grained, wet, loose, black, staining and odour		7-4	VC		
3.0	CL		- visible coal tar 2.1 to 2.9 m - wood at 2.6 m		7-5	C (NO VC)		221.0
			CLAY - low plastic, moist, firm, dark grey, silty		7-6	C (NO VC)		
4.0			- very sandy from 3.0 to 3.3 and 3.5 to 3.6 m		7-7	C (NO VC)		220.0
			CLAY - low plastic, soft, wet, dark grey, silty		7-8	NC		
5.0	CL		- moist and firm below 4.6 m - thin organic layer at 5.2 m		7-9	NC		219.0
			- very sandy, wet and soft at 5.5 to 5.9 m and at 6.7 to 7.0 m		7-10	NC		
6.0					7-11	NC		218.0
7.0					7-12	NC		217.0
	CH		CLAY - highly plastic, firm, moist, olive brown, silty		7-13	NC		
					7-14	NC		
8.0	TILL		SILT TILL - light beige, dense, gravelly, damp		7-15			216.0
			End test hole at 7.9 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger					
9.0								215.0
10.0								214.0
11.0								213.0
12.0								212.0
13.0								211.0

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LOGGED BY: ASD
REVIEWED BY: HDP
Fig. No: C12

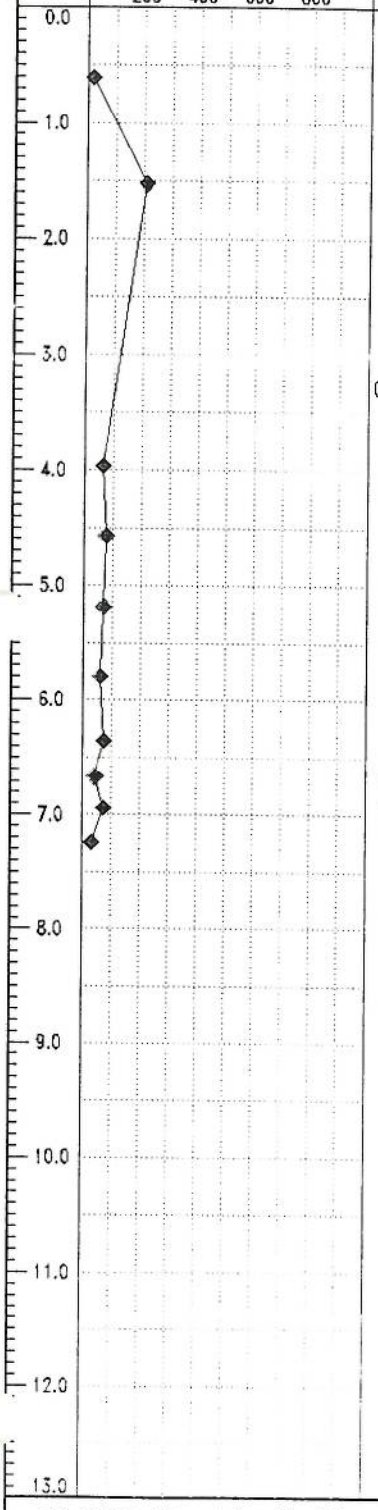
COMPLETION DEPTH: 7.93 m
COMPLETE: 11/01/00

00/11/22 09:54AM (GEO_EW9A)

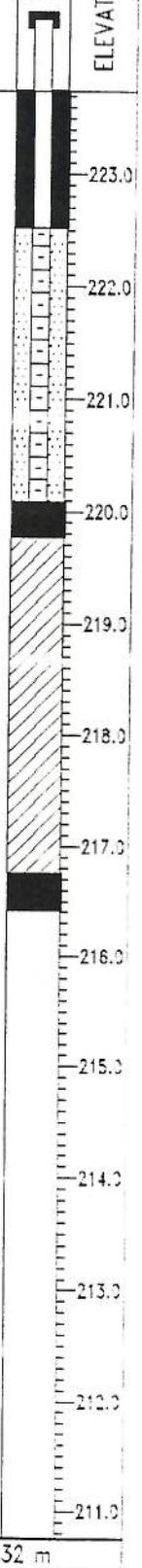
Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-9
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 223.738 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS
OH		CLAY (fill) – black, stones, gravel, rubble and brick, frozen		9-1	nc
				9-2	C (NO VC)
CI		CLAY (fill) – medium plastic, moist to wet, soft, dark grey to black, hydrocarbon odour – fibrous organics at 2.1 m		9-3	TC
				9-4	VC
CI-CH		– black, stained with visible product and viscous coal tar between 2.4 and 2.9 m		9-5	TC
SP		CLAY – medium to highly plastic, moist, soft, dark grey, very silty, trace fine grained sand seams		9-6	NC
		SAND – poorly graded, fine grained, wet, dense, dark grey		9-7	NC
CL		CLAY – low plastic, very moist to wet, firm, grey, very silty – soft, wet sand lense at 5.2, 5.3 and from 5.8 to 5.9 m		9-8	NC
				9-9	NC
				9-10	NC
CH				9-11	NC
CH		CLAY – high plastic, moist, stiff, grey, varved with dense, damp silt lenses		9-12	NC
		CLAY – high plastic, moist, stiff, grey, silt till inclusions		9-13	NC
		SILT TILL – beige, dense, gravelly			
		End test hole at 7.3 m below grade. Seepage and sloughing occurred. Monitoring well installed.			



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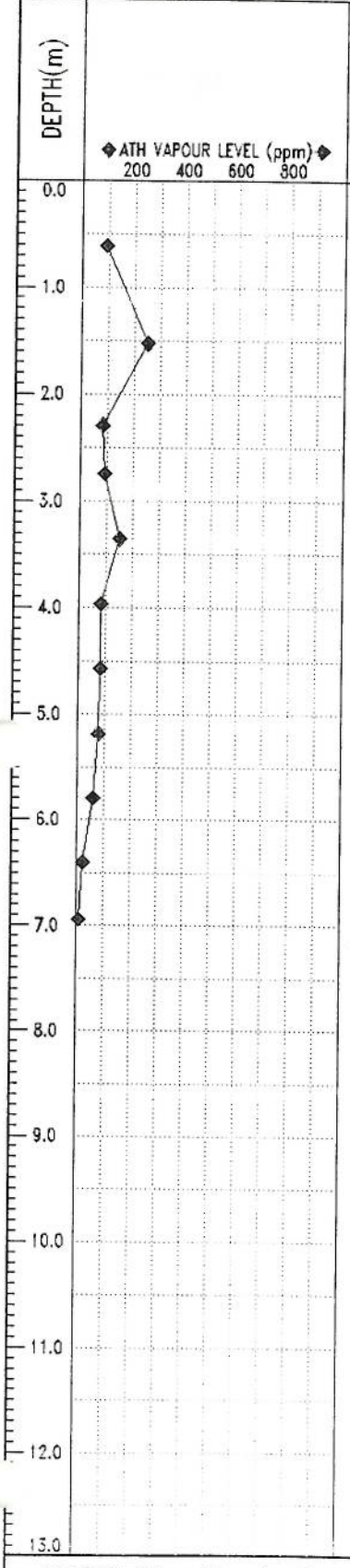
LOGGED BY: ASD	COMPLETION DEPTH: 7.32 m
REVIEWED BY: HDP	COMPLETE: 13/01/00
Fig. No: 014	Page 1 of 1

00/11/22 09:55AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-11
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 222.55 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION (m)
0.0	OH		CLAY (fill) – black, loose, wet, soft, some gravel and sand		11-1	NC		222.0
1.0								
2.0			CLAY – medium plastic, very moist to wet, firm to soft, dark grey, very silty and sandy – very thin pieces of wood – 2 mm lense of liquid coal tar resdidue in a medium to coarse grained sand lense at 1.7 m		11-2	VC		221.0
3.0	CI		– 25 mm of liquid coal tar residue in a medium to coarse grained sand lense at 2.1 m – very sandy, wet, soft from 3.0 to 3.3 m, from 3.6 to 4.1 m and at 4.5 m		11-3	VC C (NO VC)		220.0
4.0					11-4			219.0
5.0					11-5	TC		
6.0	SP		SAND – poorly graded, medium to fine grained, wet, dense, small bivalve shells throughout		11-6	TC		218.0
	CH		CLAY – highly plastic, moist, very stiff, dark grey – brown, trace stones and silt inclusions below 6.4 m		11-7	TC		217.0
7.0	TILL		SILT TILL – wet, light beige, dense, gravelly		11-8	TC		216.0
8.0			End test hole at 7.3 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.		11-9	NC		215.0
9.0					11-10			214.0
10.0					11-11	NC		213.0
11.0								212.0
12.0								211.0
13.0								210.0

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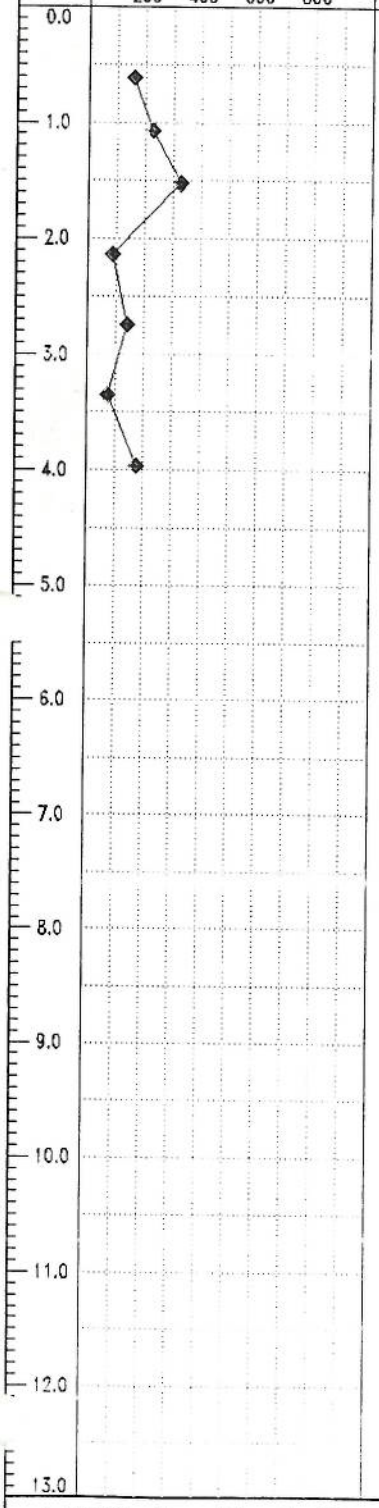
LOGGED BY: ASD	COMPLETION DEPTH: 7.32 m
REVIEWED BY: HDP	COMPLETE: 13/01/00
Fig. No: C16	Page 1 of 1

00/11/22 09:56AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-13
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 222.52 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
CI		CLAY (fill) – highly plastic, soft, dark grey to black, sand and gravel – grass and wood at 1.2 – trace of liquid coal tar at 1.5 m		13-1 13-2 13-3	NC VC C (NO VC)		222.0 221.0
CL		CLAY – low plastic, moist, soft to firm, dark grey, very silty – fibrous organics at 1.8 m – very sandy from 2.4 to 2.6 m and 2.7 to 2.9 m – oxide staining at 2.7 m		13-4 13-5 13-6 13-7	TC C (NO VC) TC C (NO VC)		220.0 219.0
		End test hole at 4.3 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					218.0 217.0 216.0 215.0 214.0 213.0 212.0 211.0 210.0

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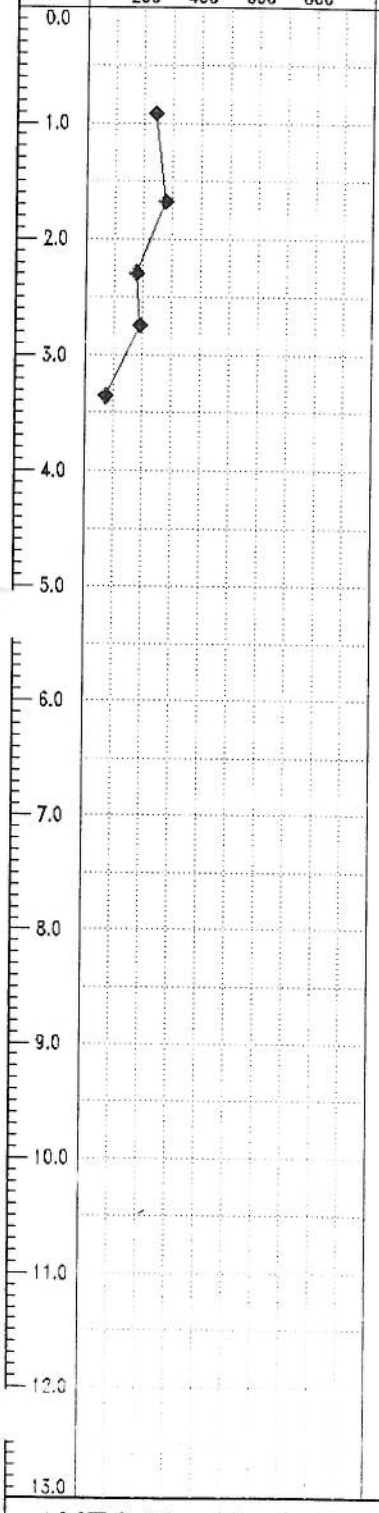
LOGGED BY: ASD	COMPLETION DEPTH: 4.27 m
REVIEWED BY: HDP	COMPLETE: 14/01/00
Fig. No: C18	Page 1 of 1

00/11/22 09:57AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-15
Centra Gas	Drill Rig: Acker SS	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 222.54 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
0.0	CL		CLAY (fill) – low plastic, soft, wet, dark grey, very silty					222.0
1.0			– very moist and firm below 0.8 m – black pieces of wood at 0.8 m – thin lense of liquid coal tar residue at 1.1 m, 25 mm thick in a varved silt lense		15-1	VC		221.0
2.0			– liquid coal tar residue at 1.5 m in a 40 mm coarse sand lense		15-2	VC		220.0
3.0			– faint product sheen in a 1 mm thick fine grained sand lense at 2.1 m – pieces of wood at 3.4 m – very sandy, soft and wet from 3.4 to 3.5 m		15-3 15-4 15-5	VC C (NO VC) TC		219.0
4.0			End test hole at 3.7 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					218.0
5.0								217.0
6.0								216.0
7.0								215.0
8.0								214.0
9.0								213.0
10.0								212.0
11.0								211.0
12.0								210.0
13.0								

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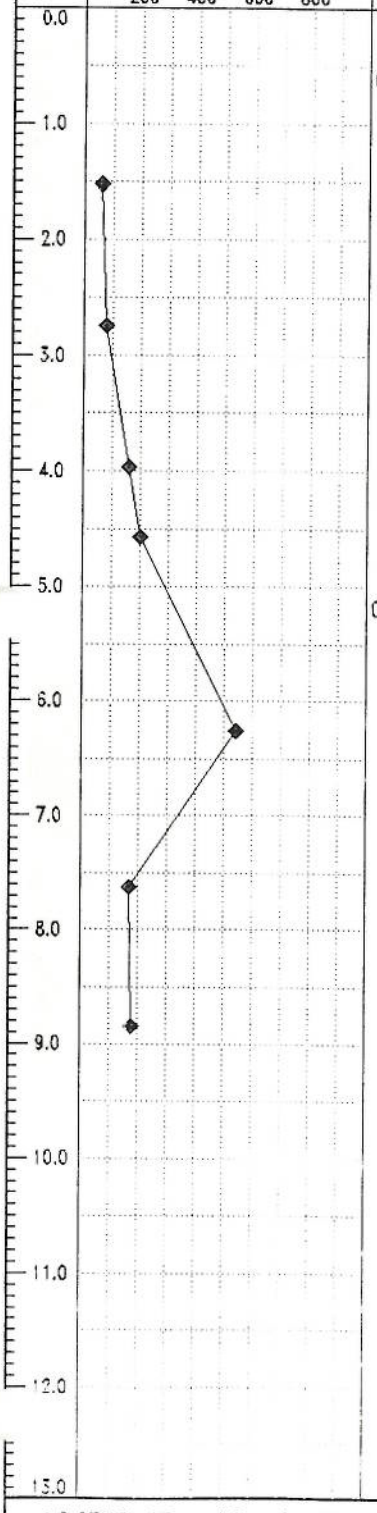
LOGGED BY: ASD	COMPLETION DEPTH: 3.66 m
REVIEWED BY: HDP	COMPLETE: 14/01/00
Fig. No: C20	Page 1 of 1

00/11/22 09:57AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-17
Centra Gas	Drill Rig: RM-30	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 228.04 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	ELEVATION(m)
CI-CH		CLAY (fill) - medium to highly plastic, damp, brown to black, frozen, fibrous organics, some rocks and gravel - beige and light green material at 0.9 to 1.2 m - pieces of coal and metal slag at 1.2 m		17-1	VC	228.0
				17-2	VC	
				17-3	VC	227.0
		CLAY - highly to medium plastic, moist to damp, firm to stiff, brown, silty, trace sand, occassional fine sand lenses (<0.5 mm thick) - small pieces of coal and shells between 1.7 and 2.1 m below grade - firm below 1.8 m - very moist below 3.0 - soft to firm below 3.5 m - grey below 3.7 m - few small shells 4 to 4.3 m - naphthalene odour below 4.3 m - black staining 4.3 to 4.6 m - liquid coal tar residue between 4.9 and 5.6 m - zones of poorly graded, fine grained, wet, grey sand, approximately 75 to 150 mm in thickness at 6.1, 7.8, and 8.4 m below grade		17-4	NC	226.0
				17-5	NC	225.0
				17-6	VC	224.0
				17-7		
CI-CH				17-8	VC	223.0
				17-9	VC	222.0
				17-10	C (NO VC)	221.0
				17-11	C (NO VC)	220.0
				17-12	C (NO VC)	219.0
		End test hole at 9.1 m below grade. Approximately 2.4 m of sand sloughed into bottom of test hole. Monitoring well installed.				218.0
						217.0
						216.0

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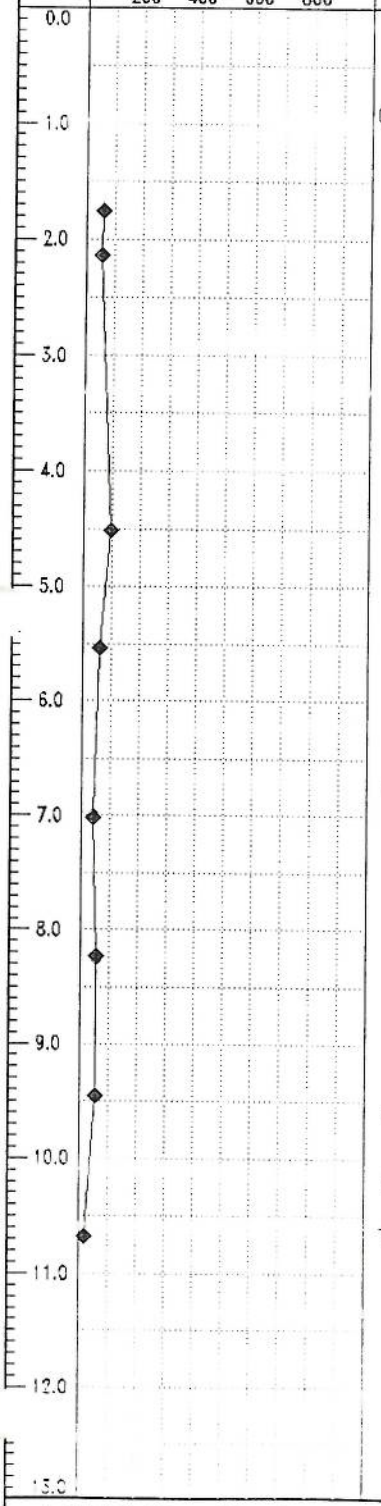
LOGGED BY: ASD	COMPLETION DEPTH: 9.15 m
REVIEWED BY: HDP	COMPLETE: 21/03/00
Fig. No: C22	Page 1 of 1

09/11/22 09:58AM (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-19
Centra Gas	Drill Rig: RM-30	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 226.239 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
0.0	CI-CH	CLAY (fill) - medium to high plasticity, moist, firm, brown, some gravel, some rocks, some red brick - light pink and green material at 1.8 m		19-1	VC		226.0
2.0	CH	CLAY (fill) - highly plastic, moist, soft, silty, brown, trace sand - small piec of blackened wood at 2.7 m - wet, very sandy at 2.6 and 2.9 m - firm below 3.0 m		19-2	NC		225.0 224.0
4.0		- grey and black staining, sheen between 3.5 and 4.3 m - piece of blackened wood at 4.3 m		19-3	VC		223.0
5.0	CH	CLAY - highly plastic, moist, firm to soft, grey, silty - thin (25 mm) zone of black staining, hydrocarbon odour at 4.6 m		19-4	VC		222.0
6.0				19-5	NC		221.0
7.0				19-6	NC		220.0 219.0
8.0		- piece of wood at 7.8 m - very sandy and wet from 7.9 to 8.1 m - firm below 8.2 m - piece of wood at 8.5 m - very sandy, grey,wet from 8.7 to 8.8 m		19-7	NC		218.0
9.0	SP	SAND - poorly graded, fine grained, wet, grey, silty, some clay - root at 9.1 m		19-8	NC		217.0
10.0	CH	CLAY - highly plastic, firm, moist, grey, silty		19-9	NC		216.0
11.0	TILL	SILT TILL - wet, light beige, sandy, gravelly End test hole at 11.0 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					215.0 214.0
12.0							
13.0							

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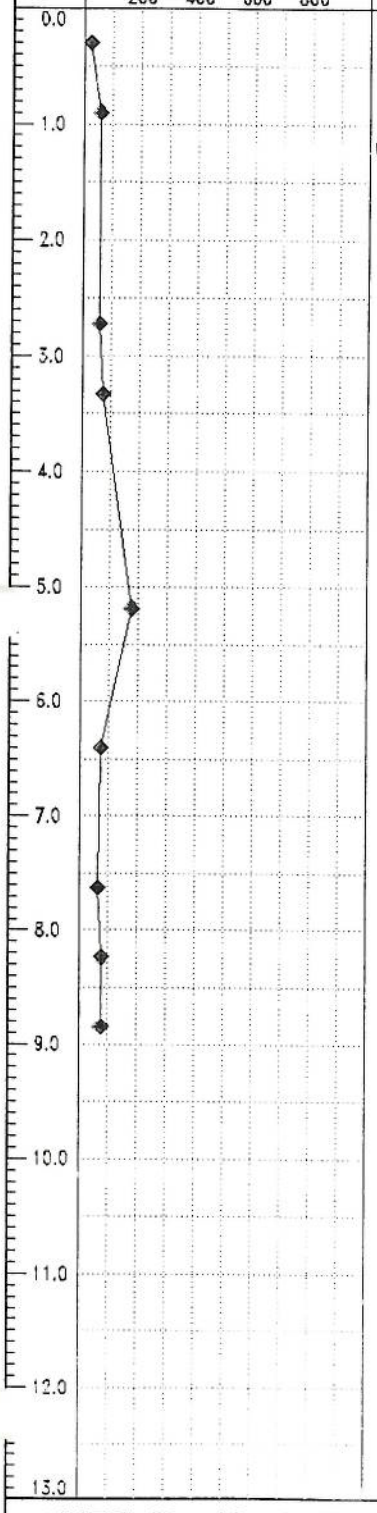
LOGGED BY: ASD	COMPLETION DEPTH: 10.98 m
REVIEWED BY: HDP	COMPLETE: 20/03/00
Fig. No: C24	Page 1 of 1

00/11/22 09:58Au (GEO_EW9A)

Riverbank Evaluation	Contractor: Paddock Drilling	TEST HOLE NO: TH2K-21
Centra Gas	Drill Rig: RM-30	PROJECT NO: WX-04783
	Auger: 200 mm HSA	ELEVATION: 227.149 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	COMMENTS	INSTRUMENTATION DATA	ELEVATION(m)
		CLAY (fill) - medium to highly plastic, moist, brown, stone and gravel, fibrous organics, pieces of coal and metal		21-1	VC		227.0
		- light pink and green material 1.2 to 1.5 m		21-2	VC		
CI-CH							226.0
							225.0
		CLAY - highly plastic, moist, soft, brown, silty		21-3	NC		
				21-4	NC		224.0
		- very moist, grey below 3.5 m					
		- firm below 3.9 m		21-5	NC		
CH							223.0
		very sandy, wet, grey, silty 4.6 to 4.8 m		21-6	VC		
		- sheen below 4.6 m, trace liquid coal tar residue 4.7 to 4.9 m		21-7	C (NO VC)		222.0
		- thin organic layer at 5.2 m					
		- very sandy 5.3 to 5.4 m and 5.6 to 5.8 m		21-8	VC		
		- trace sheen at 5.8 m			NC		221.0
		CLAY - highly plastic, moist, firm, grey, silty		21-9			
		- rootlets at 6.3 m					
		- very silty, below 6.6 m			NC		220.0
CH				21-10			
					NC		219.0
		- fibrous organics at 8.2 m		21-11			
					NC		
				21-12			218.0
		End test hole at 9.2 m below grade. Seepage and sloughing occurred. Test hole backfilled with bentonite and auger cuttings.					
							217.0
							216.0
							215.0

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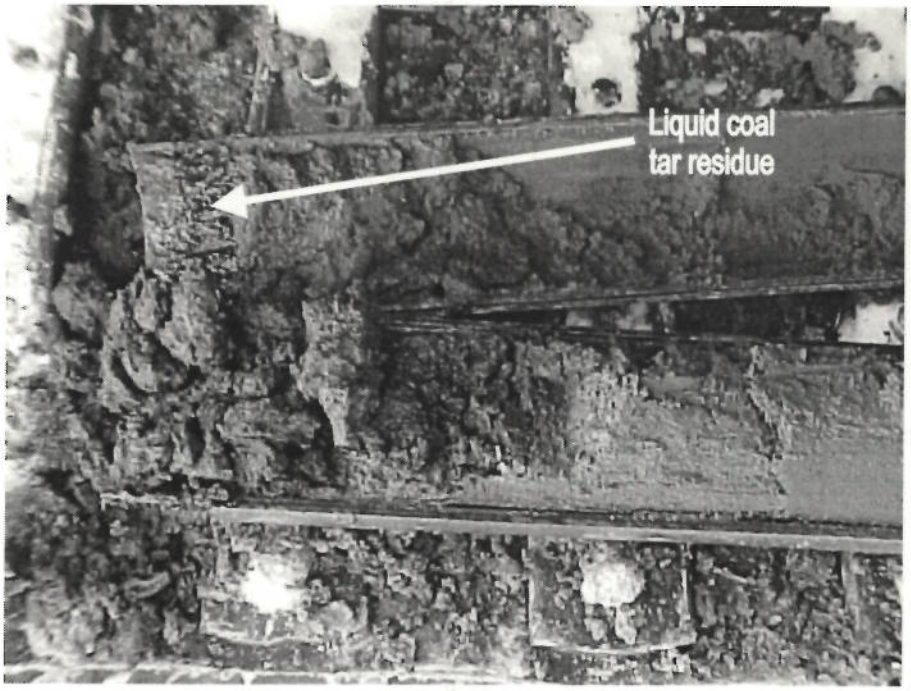
LOGGED BY: ASD	COMPLETION DEPTH: 9.15 m
REVIEWED BY: HDP	COMPLETE: 20/03/00
Fig. No: C26	Page 1 of 1

00/11/22 09:59AM (GEO_EW9A)



Sheen and liquid coal tar encountered in TH8-2K

Liquid coal tar residue observed at end of split spoon sampler.

amec Earth & Environmental Limited **CENTRA GAS (MANITOBA) INC.**		**SITE PHOTOGRAPHS NORTH OF CENTRA GAS OPERATIONS FACILITY 35 SUTHERLAND AVENUE WINNIPEG, MANITOBA**		
Drawn: N/A	Scale: N/A	Date: NOV/00	Project No.: WX-04783	Figure: C28

A sheen was often evident on the outside of contaminated soil samples when the split spoons were opened

Hydrocarbon sheen and liquid coal tar residue as seen on a sample obtained from TH8-2K.

amec Earth & Environmental Limited **CENTRA GAS (MANITOBA) INC.**		**SITE PHOTOGRAPHS NORTH OF CENTRA GAS OPERATIONS FACILITY 35 SUTHERLAND AVENUE WINNIPEG, MANITOBA**		
Drawn: N/A	Scale: N/A	Date: NOV/00	Project No.: WX-04783	Figure: C29

DISRAELI STREET

ROVER AVE.

APPROXIMATE SUMMER WATER LEVEL (ELEV. 223.6m)

FORMERLY GLADSTONE STREET

BLOW-OFF CHAMBER

DISRAELI BRIDGE

2

3

4

5

6

7

MW14
223.6 m

TH2K-9
ICE 222.6 m

TH2K-18
224.1 m

TH2K-17
224.3 m

224.0 m

TH2K-5
223.6

WOODEN GAS TANK AND TAR IN EXCAVATION FOR PIER NO.4 JUNE 1953

224.5 m

MW23B
225.4 m

FORMER WATER GAS PLANT

MW14
225.6 m

NATURAL GAS PIPELINE

225 m

225.5 m

223.6 m

RED RIVER

flow direction

OPERATIONS BUILDING
(PRIOR TO ELEVATOR ADDITION)

MW24C
225.8 m

MONITORING WELL LOCATION

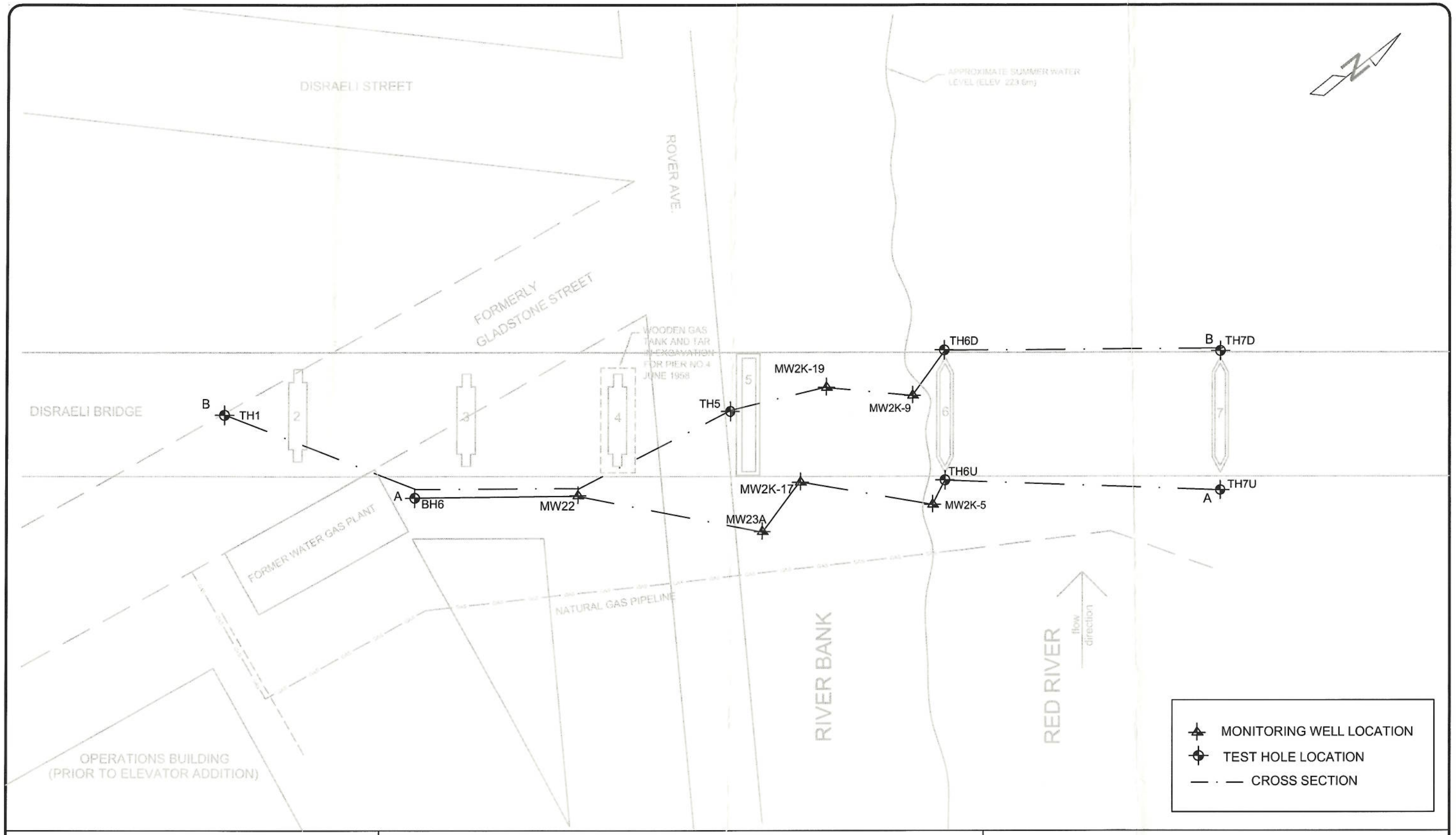
CH2M TEST HOLE LOCATION

amec

CENTRA GAS

GROUNDWATER CONTOUR PLAN
WELLS SCREENED AT APPROXIMATELY 5 m DEPTH
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: EET	Scale: 1:600	Date: June/00	Project No. : WX-04783	Figure: C30



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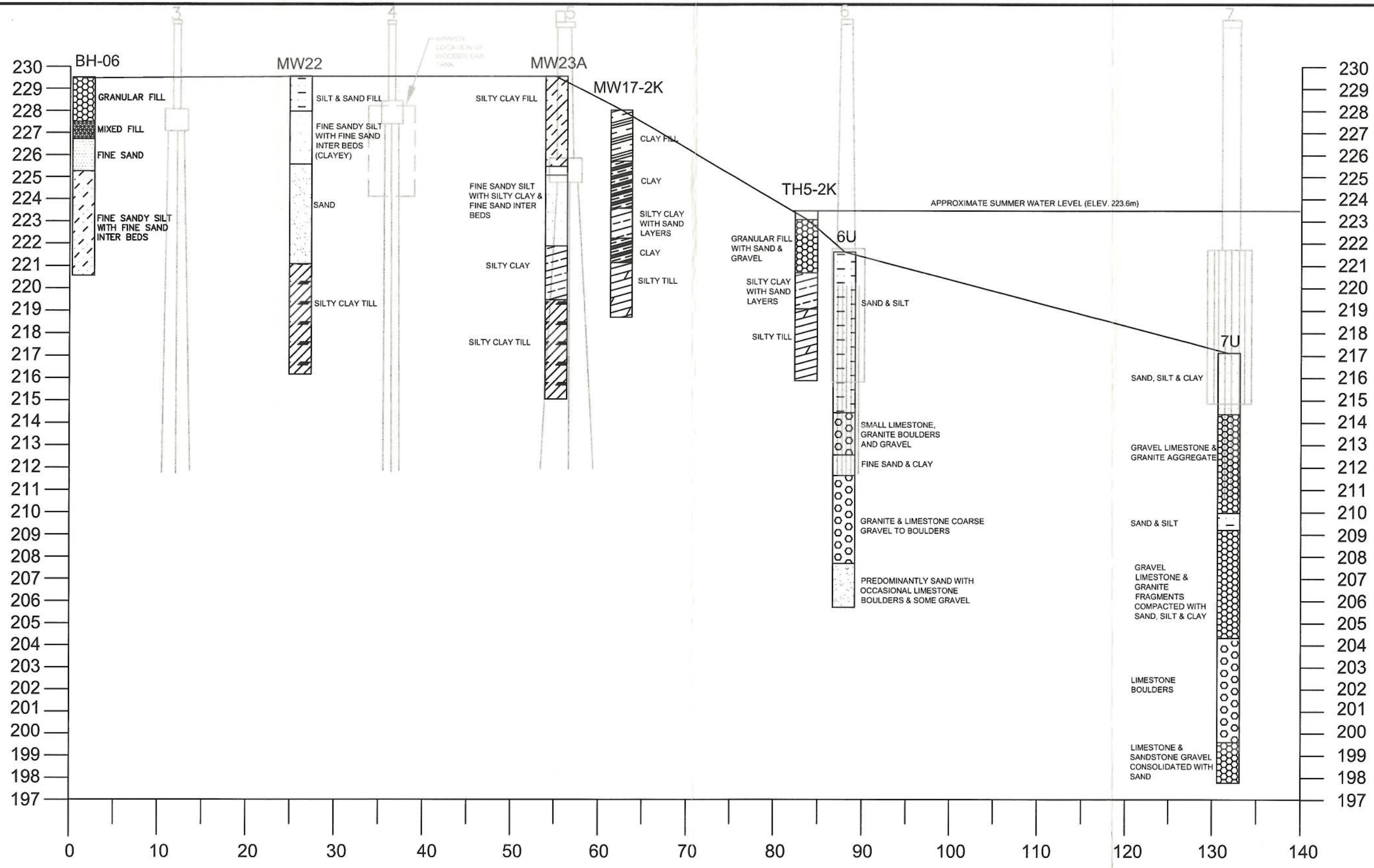
CENTRA GAS

CROSS SECTION LOCATION PLAN CENTRA GAS OPERATIONS FACILITY 35 SUTHERLAND AVENUE WINNIPEG, MANITOBA

Drawn: EET	Scale: 1:600	Date: June/00	Project No. : WX-04783	Figure: 31



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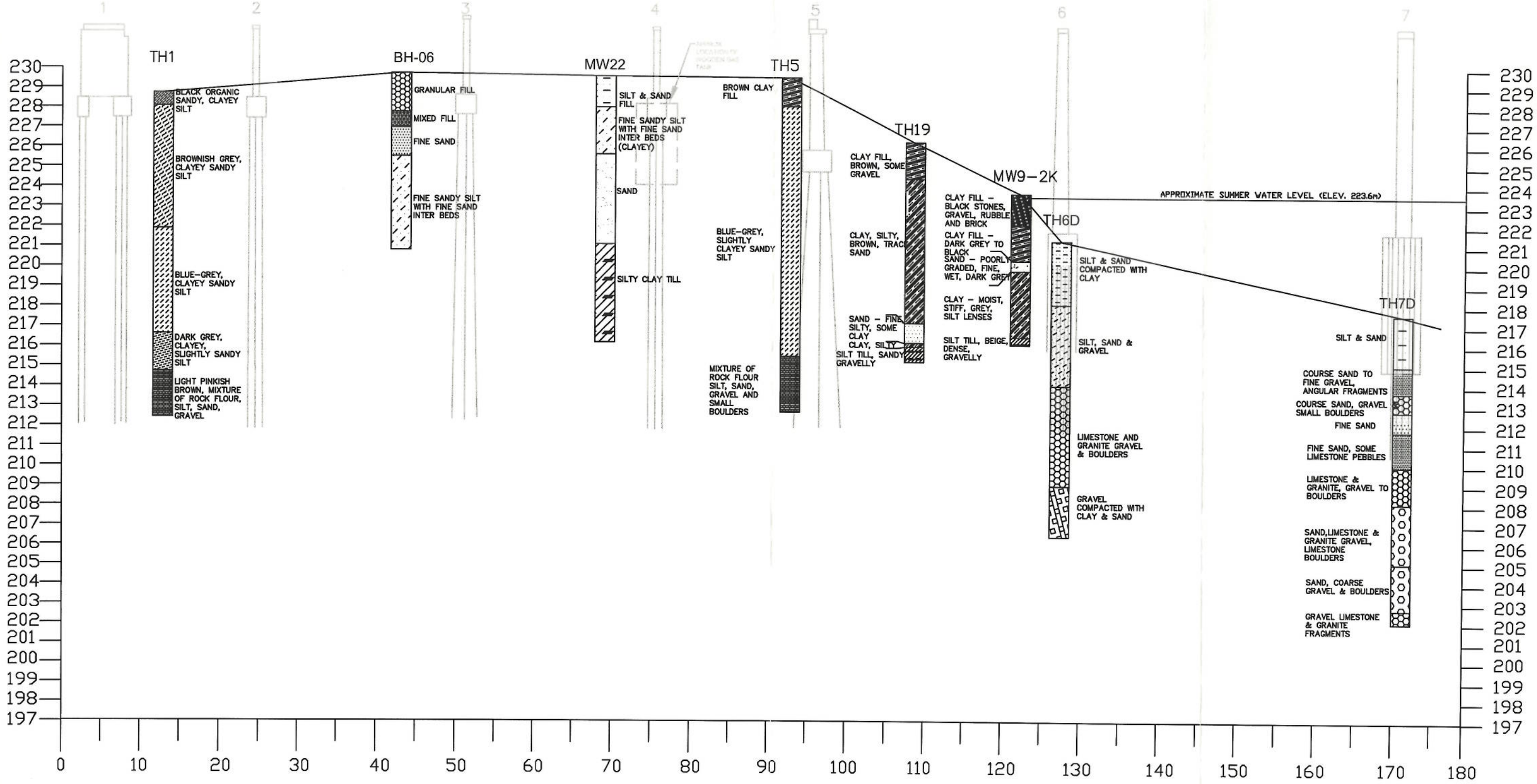
CENTRA GAS

CROSS SECTION A - A
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: EET	Scale: AS SHOWN	Date: JUNE/00	Project No. : WX-04783	Figure: C32



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CENTRA GAS

CROSS SECTION B - B
CENTRA GAS OPERATIONS FACILITY
35 SUTHERLAND AVENUE
WINNIPEG, MANITOBA

Drawn: EET	Scale: AS SHOWN	Date: JUNE/00	Project No. : WX-04783	Figure: C33