Manitoba Hydro

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May 7, 2012

Warren Rospad, B.Sc.
District Supervisor
Environmental Operations/Central Region
Manitoba Conservation and Water Stewardship
160-123 Main Street
Winnipeg, Manitoba R3C 1A5

Dear Mr. Rospad:

BURIED 69 KV DISTRIBUTION LINE INSTALLATION – VICINITY OF SUTHERLAND AVENUE FACILITY

For your review, Manitoba Hydro is respectively submitting 2 hard copies and 1 digital copy ← Correct of our Remedial Action Plan for the installation of a 69 kV buried distribution line from the Rover Avenue Station to the intersection of Sutherland Avenue to Gladstone Street in Winnipeg, Manitoba, entitled
"*Remedial Action Plan, 69 kV Buried Distribution Line, Rover Burrows Work Site – Winnipeg, Manitoba*"

EGE Engineering Ltd. (EGE) was retained by Manitoba Hydro, Distribution Engineering and Construction Division, to develop an environmental Remediation Action Plan (RAP) to address residual contaminants that may be encountered during the installation of a 69 kV buried distribution line from the Rover Station to the Burrows Station. The potential to encounter residual contaminants has been identified in association with the section of the route from the Rover Station south along Annabella Street to Sutherland Avenue, and west along Sutherland Avenue to Gladstone Street; in proximity to a Former Manufactured Gas Plan (MGP) site located at 33-38 Sutherland Avenue.

The residual contaminants are associated with the historical operation the former MGP. Environmental investigations undertaken at the former MGP site have identified the presence of polycyclic aromatic hydrocarbons (PAHs), monocyclic aromatic hydrocarbons, including benzene, toluene, ethylbenzene, and xylenes (BTEX), and Petroleum Hydrocarbon Fraction 1 to Fraction 4, at concentrations greater than the relevant Canadian Council of Ministers of the Environment (CCME) guidelines. The 69 kV buried distribution line route passes along the eastern and southern edges of the historic operational area of the former MGP.

This RAP has been prepared to specifically address the portion of the route that may encounter residual contaminants associated with the former Manufactured Gas Plant (MGP)

between Rover Station and Gladestone Street. Site-specific mitigation and monitoring measures have been developed for this area based on the specific contaminants of concern known to be present in this section of the route. The installation tender is scheduled to be issued June 1, 2012 with installation of the 66 kV line to commence August 2012.

We look forward to your comments. Please contact the undersigned at (204) 360-7081 or rphillips@hydro.mb.ca , should you have any questions regarding the RAP.

Rick Phillips
Construction Project Officer
Distribution Contracts
Distribution Design - Winnipeg
Distribution Engineering & Construction - Winnipeg

JRP/ /LTR_RAP_Mb Conservation Warren Rospad.docx

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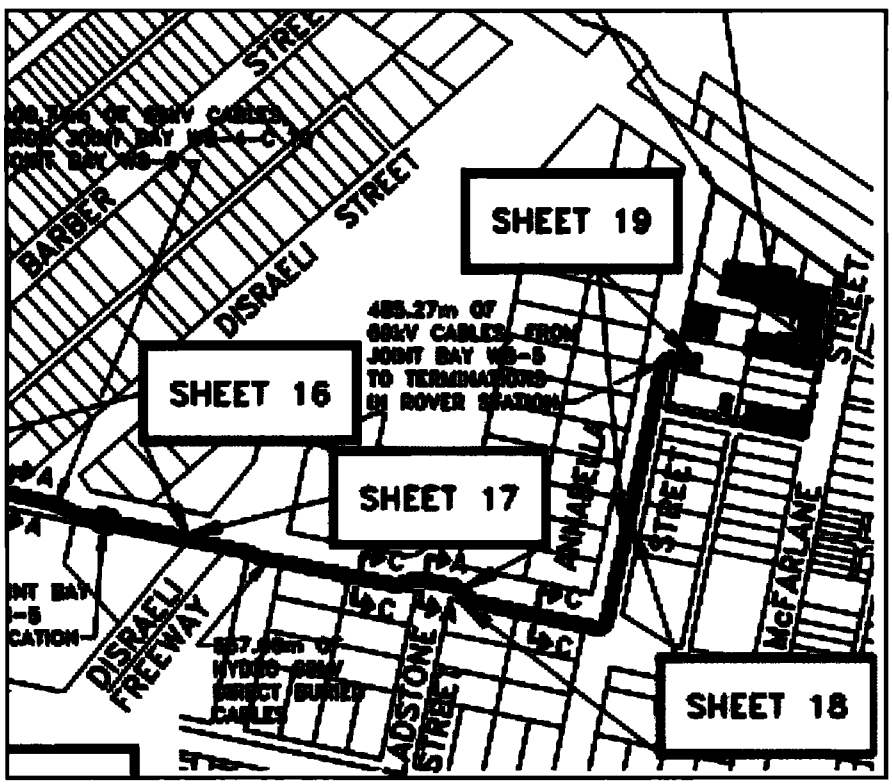
Remedial Action Plan
69 kV Buried Distribution Line
Rover Burrows Work Site - Winnipeg, Manitoba



May 2012

Manitoba Hydro Purchase Order: 4500262209

Prepared for:
Manitoba Hydro
Distribution Engineering & Construction
1315 Notre Dame Avenue
Winnipeg, Manitoba R3E 3G2

Prepared by:
EGE Engineering Ltd.
511 Pepperloaf Cres.
Winnipeg, Manitoba
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EGE Engineering Ltd.
Engineering, **G**eosciences &**E**nvironmental

May 4, 2012 File: 0133-001-01

Manitoba Hydro
Distribution Engineering & Construction
1315 Notre Dame Avenue
Winnipeg, Manitoba
R3E 3G2

Attention: **Mr. Rick Phillips**
Construction Project Officer

RE: Remedial Action Plan
69 kV Buried Distribution Line
Rover Burrows Work Site - Winnipeg, Manitoba

Dear Mr. Phillips:

EGE Engineering Ltd. (EGE) is pleased to submit the following Remedial Action Plan (RAP) for the proposed installation of underground high voltage distribution cables at the Rover Burrows Work Site in Winnipeg, Manitoba. The RAP has been prepared based on the findings from several Environmental Site Assessments completed between 1993 and 2008, as well as environmental monitoring completed between 2009 and 2011 as part of the Long Term Remedial Monitoring Program implemented for portions of the route between the Rover Station south on Annabella Street and west on Sutherland Avenue to Gladstone Street, and recent investigations undertaken by Manitoba Hydro along the initial stages of the proposed route.

Should you have any questions or require any additional information on the report please contact the undersigned at (204) 226-7378 or Mr. David Klassen at (204) 612-0944.

Sincerely,

EGE ENGINEERING LTD.

Larry Bielus, M.Sc., P.Eng.
Senior Geological Engineer
Lpb/lb

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1.0 INTRODUCTION

EGE Engineering Ltd. (EGE) was retained by Manitoba Hydro, Distribution Engineering and Construction Division, to develop an environmental Remedial Action Plan (RAP) to address residual contaminants that may be encountered during the installation of a 69 kV buried distribution line, from the Rover Station at Rover Avenue and Annabella Street, to the Burrows Station at Burrows Avenue and Aikins Street, in Winnipeg, Manitoba. The potential to encounter residual contaminants has been identified in association with the section of the route from the Rover Station south along Annabella Street to Sutherland Avenue, and west along Sutherland Avenue to Gladstone Street.

The residual contaminants are associated with the historical operation of the Former Manufactured Gas Plant (MGP) located at 33-38 Sutherland Avenue in Winnipeg, Manitoba. Environmental investigations, undertaken at the former MGP site by various consultants beginning in 1993, have identified the presence of polycyclic aromatic hydrocarbons (PAHs), monocyclic aromatic hydrocarbons, including benzene, toluene, ethylbenzene and xylenes (the BTEX components), and the petroleum hydrocarbon (PHC) F1 to F4 Fractions, at concentrations greater than the relevant Canadian Council of Ministers of the Environment (CCME) guidelines for soil, groundwater and sediment. The 69 kV buried distribution line route passes along the eastern and southern edges of the historic operational area of the former MGP.

This RAP has been prepared to specifically address the portion of the route that may encounter residual contaminants associated with the former MGP between the Rover Station and Gladstone Street, and site-specific mitigation and monitoring measures have been developed for this area based on the specific contaminants of concern known to be present in this section of the route. The installation activities along the remainder of the route will be covered by existing Manitoba Hydro environmental policies and procedures for construction projects that include prescribed actions should contamination be discovered at a work site.

1.1 BACKGROUND

Manitoba Hydro will be installing a 69 kV buried distribution line extending from the Rover Station to the Burrows Station. Two potential installation methods have been identified by Manitoba Hydro as being suitable for the installation, and either or both methods may be used along the route at the discretion of Manitoba Hydro. The two methods consist of directional bore and direct bury by excavated trench.

The proposed route for the buried distribution line is shown on Sheet 1 of 19 of the design drawings prepared by Manitoba Hydro and included in Appendix A. As noted on the first drawing, the proposed route commences at the Rover Station, located at the southeast corner of Rover Avenue and Annabella Street. The buried distribution line exits the Rover Station through the retaining wall on the west side of the station and commences southward along Annabella Street to Sutherland Avenue. The line travels west on Sutherland Avenue to Aikins Street, where it turns north and travels along Aikins Street to the Burrows Station, located at the northwest corner of Burrows Avenue and Aikins Street.

The portion of the buried distribution line along Annabella Street and Sutherland Avenue west to Gladstone Street will be installed in an area known to have potentially contaminated soil associated with

the former Sutherland Avenue MGP site. The detailed design drawings for this portion of the route, Sheets 17, 18 and 19 of 19, are also included in Appendix A.

The area associated with the former Sutherland Avenue MGP has been designated under Section 7(1) of the Manitoba Contaminated Sites Remediation Act [(1)] as a Contaminated Site. This site is currently under an Order from Manitoba Conservation to undertake a Long Term Remedial Monitoring Program [(2)] in accordance with the Comprehensive Environmental Monitoring Plan (CEMP) developed for the site by AECOM in 2006 [(3)]. The CEMP includes regularly scheduled monitoring of the soil, groundwater and air quality in the Upland Area (non-riparian area south of Rover Avenue) as well as the sediment quality within the Red River down gradient of the site. The installation of the buried distribution line along Annabella Street and Sutherland Avenue to Gladstone Street is located within the designated Upland Area.

Current land use surrounding the proposed route of the 69 kV buried distribution line near the former MGP includes: the Manitoba Hydro Sutherland Facility located west of Annabella Street and north of Sutherland Avenue; single-family residential properties east of Annabella Street south of the Rover Station; single-family residential properties west of Gladstone Street north of Sutherland Avenue; and a Manitoba Hydro Training Facility and storage yard south of Sutherland Avenue between Annabella and Gladstone Streets. A location plan for the area is provided on Figure 01. The current features on the property and adjacent land uses are illustrated on Figure 02. A plan of the site is illustrated on Figure 03.

1.2 PURPOSE OF REMEDIAL ACTION PLAN

The purpose of this RAP is to describe the activities to be undertaken by Manitoba Hydro to manage the residual contaminants that may be encountered during installation of the 69 kV buried distribution line in the vicinity of the former Sutherland Avenue MGP site. This includes actions to mitigate environmental or community health and safety concerns that might arise as a result of the project.

1.3 APPLICABLE GUIDELINES

Manitoba Conservation currently reference the environmental assessment guidelines outlined in the following CCME documents:

- CCME Canadian Environmental Quality Guidelines (CEQG) [(4)];
- CCME Canada Wide Standard (CWS) for Petroleum Hydrocarbons in Soil [(5)].

In the absence of specific provincial environmental guidelines for groundwater, the following documents are referenced:

- CCME CEQG for Aquatic Life [(4)];
- Health Canada Guidelines for Canadian Drinking Water Quality (HC-GCDWQ) [(6)]; and
- Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites [(7)].

Using the above documents, an assessment of the site was completed, including an evaluation of the applicable exposure pathways, land uses, key receptors and an evaluation of the predominant soil texture applicable to the proposed route of the 69 kV buried distribution line. The assessment was conducted in accordance with current CCME guidelines and did not include the modification or recalculation of the formulas used to derive the default guideline values.

The assessment is based on the following rationale:

- Land use - the road right-of-way along which the buried distribution line will be located is considered commercial property and is expected to remain commercial, therefore, the commercial land use criteria have been selected;
- Surface soil (< 1.5 m below ground) - the field classification of the soil during the drilling of test holes in the area indicates that the near surface soil contains both coarse and fine grained material, however, the predominant soil texture is fine grained. Copies of the relevant test hole logs for the area from the Rover Avenue Station to Gladstone Street are provided in Appendix B;
- Subsoil (> 1.5 m below ground) - the field classification of the soil during the drilling of test holes in the area indicates that the subsurface soil is predominantly fine grained;
- Benzene incremental risk factor - the 10^{-6} incremental risk factor has been selected for use at the work site;
- Soil ingestion pathway - the surface soil along the route is covered by asphalt, however, soil will be uncovered during the work and will be accessible to the general public, therefore, soil ingestion is a valid pathway;
- Soil dermal contact pathway - for the same reason as soil ingestion, soil dermal contact is also a valid pathway;
- Soil vapour inhalation pathway - for the same reason as soil ingestion, soil vapour inhalation is also a valid pathway;
- Inhalation of indoor air pathways - there are commercial and residential structures located in close proximity to the proposed route, therefore, the inhalation of indoor air (slab on grade and basement) pathways are considered valid pathways;
- Off-site migration check - the potential exists for off-site migration of contaminants from the site, therefore, the off-site migration check is valid for the work site;
- Potable groundwater (drinking water) pathway - there is no potable groundwater use on the site and the adjacent properties are serviced by municipal treated water from a piped distribution system, therefore, the potable groundwater pathway has been excluded;
- Produce, meat and milk pathway - there are residential areas located adjacent to portions of the route, and these properties may contain gardens that grow produce for consumption, therefore, this pathway is valid for the work site;
- Ecological soil contact - vegetation is present in close proximity to the route, and soil invertebrates are expected to be present, therefore, the ecological soil contact pathway is valid at the work site;
- Soil and food ingestion pathway - as noted above, garden produce may be grown in the residential areas near the proposed route, therefore, this pathway is valid for the work site;

- Nutrient and energy cycling pathway - there is no agricultural development in the area, therefore, this pathway has been excluded;
- Aquatic life (groundwater interaction) pathway - a portion of the route is located within 200 m of the Red River, therefore, the protection of aquatic life is a valid pathway; and
- Management limit pathway - this pathway is used in the absence of other applicable pathways, therefore, it is a valid pathway for the work site.

Based on the above rationale, the following risk management guidelines have been selected for the soil as the lowest numerical value from the list of applicable pathways identified above.

- CCME generic commercial CEQG values for the BTEX parameters for fine grained surface soil, and fine grained subsoil using the 10^{-6} incremental risk factor for benzene. The selected limiting exposure pathways are:
    - Benzene - fine grained surface soil and subsoil - inhalation of indoor air (slab on grade); and
    - Toluene, Ethylbenzene and Xylenes - fine grained surface soil and subsoil - ecological soil contact.
- CCME generic commercial CWS PHC values for the volatile and extractable petroleum hydrocarbons in the F1 to F4 ranges. The selected limiting exposure pathways are:
    - F1 to F4 Fractions - fine grained surface soil - ecological soil contact; and
    - F1 to F4 Fractions - fine grained subsoil - management limits.
- CCME commercial CEQG values for the PAH parameters. The assessment follows the three step process outlined in the 2010 update to ensure that both human health and ecological receptors are protected. For human health protection from the carcinogenic effects of PAHs, the calculated benzo[a]pyrene (B[a]P) total potency equivalent (TPE) was multiplied by a safety factor of three for potential creosote mixtures and is compared with the B[a]P TPE for the incremental lifetime cancer risk (ILCR) of 10^{-6}. For human health protection from the non-carcinogenic effects of PAHs, the Index of Additive Cancer Risk (IACR) was calculated and compared with the guideline for the IACR of 10^{-6} to ensure that potable water resources are protected. For the protection of environmental health from the non-carcinogenic effects of PAHs, the analytical values were compared individually with the appropriate soil quality guidelines (SQG) for commercial land use based on the lowest of the soil contact, soil and food ingestion, protection of freshwater life or interim soil quality guideline (CCME 1991) values.
- CCME generic commercial CEQG values for the metal parameters (there are no distinctions between surface soil and subsoil). Both the human health and environmental exposure pathway check values are cited.

Based on the preceding rationale, the following risk management guidelines have been selected for the groundwater as the lowest numerical value from the list of applicable pathways identified above.

- FCSAP - FIGQG - Generic Guidelines for Commercial and Industrial Land Uses - Tier 2 - Fine Grained Soil for the BTEX parameters, the PHC F1/F2 Fractions, PAHs and metals (Table 3). The limiting exposure pathways are:

    - Benzene - fine grained soil - inhalation;
    - Toluene, Ethylbenzene and Xylenes - fine grained soil - soil organisms direct contact;
    - PHC F1 and F2 Fractions - fine grained soil - soil organisms direct contact;
    - Metals - fine grained soil - freshwater aquatic life; and
    - PAHs - fine grained soil - freshwater aquatic life.

- CCME generic CEQG for Aquatic Life for all parameters.

- HC-GCDWQ for the BTEX, PAH and metal parameters.

In Manitoba, contaminated soil generated by construction activities and/or remediation projects must be managed in a manner that will ensure that further environmental impacts will not occur. Depending on the contaminant levels, this generally involves the off-site transportation of soil to a licensed waste management facility for treatment and/or disposal. Guidance for the management of impacted soil is outlined in the following Manitoba Conservation Guideline:

- Criteria for Acceptance of Contaminated Soil at Licensed Waste Disposal Grounds [(8)].

2.0 SITE INFORMATION

2.1 SITE DESCRIPTION

The proposed route for the 69 kV buried distribution line extends from the west side of the Rover Station to Annabella Street, south to Sutherland Avenue, west to Aikins Street and north to the new Burrows Station. The total length of 69 kV cable to be installed is 8.2 km. The east portion of the route, south on Annabella Street from the Rover Station (145 m) and west on Sutherland Avenue to Gladstone Street (105 m) borders the former MGP site situated at 33-38 Sutherland Avenue.

The former MGP encompassed a rectangular shaped parcel of land bounded by Rover Avenue to the north, Annabella Street to the east, Gladstone Street to the west and Sutherland Avenue to the south. The area at or near this property has been designated under Section 7(1) of the Manitoba Contaminated Sites Remediation Act [(1)] as a Contaminated Site, under certificates of titles 1466297 and 1466300, and legally described as follows:

- Title 1466297 - Firstly: SP Lot I, Plan 31854 WLTO in RL 27 and 28, Parish of St. John; and Secondly: Lots 52, 53 and 54, Block C, Plan 2165 WLTO in RL 28, Parish of St. John; and

- Title 1466300 - Parcel I, Lots 55 to 64, 66 and 67, 71 to 75, and 77 to 87, Block C, Plan 2165 WLTO in RL 28 and 29 Parish of St. John; and Parcel 2, Lots 92 to 96, Block D, Plan 2165 WLTO excluding Street Plans 6775 WLTO and 6825 WLTO in RL 28 and 29, Parish of St. John.

The proposed route for the 69 kV buried distribution line is located in the immediate vicinity of the Upland Area of the above referenced contaminated site, which borders the proposed route to the west along Annabella Street and to the north along Sutherland Avenue up to the intersection of Gladstone Avenue, as shown on Figure 03.

2.2 SITE HISTORY - FORMER MGP

The property located at 33-38 Sutherland Avenue, and currently occupied by Manitoba Hydro, was the location of a former MGP. As documented in the CEMP [(3)], the former MGP was operated under the management of several power companies, from 1883 to 1957. Manitoba Hydro assumed responsibility for the site following the acquisition of Centra Gas Manitoba Inc. (Centra Gas) in 1999. Neither Manitoba Hydro nor Centra Gas operated the former MGP. A location plan illustrating the location and operational layout of the former MGP site is provided on the following page.

The facility began as a retort gas plant in 1883 and distributed manufactured coal gas through 9 km of gas lines laid along the City's major corridors of Higgins, Broadway, Market, Lombard, Portage and James. The plant provided manufactured gas for street lighting, cooking and heating to customers within a 25 km radius. The plant was converted in 1924 to a coke oven plant to meet increasing energy demands. During the winter months, oil was used in the process to produce a gas with a higher BTU heating value. A water gas plant was added in 1929 to provide additional fuel for the coke oven operation. The retort operation closed down in 1924, after which a glass industry operated on the site until 1943.

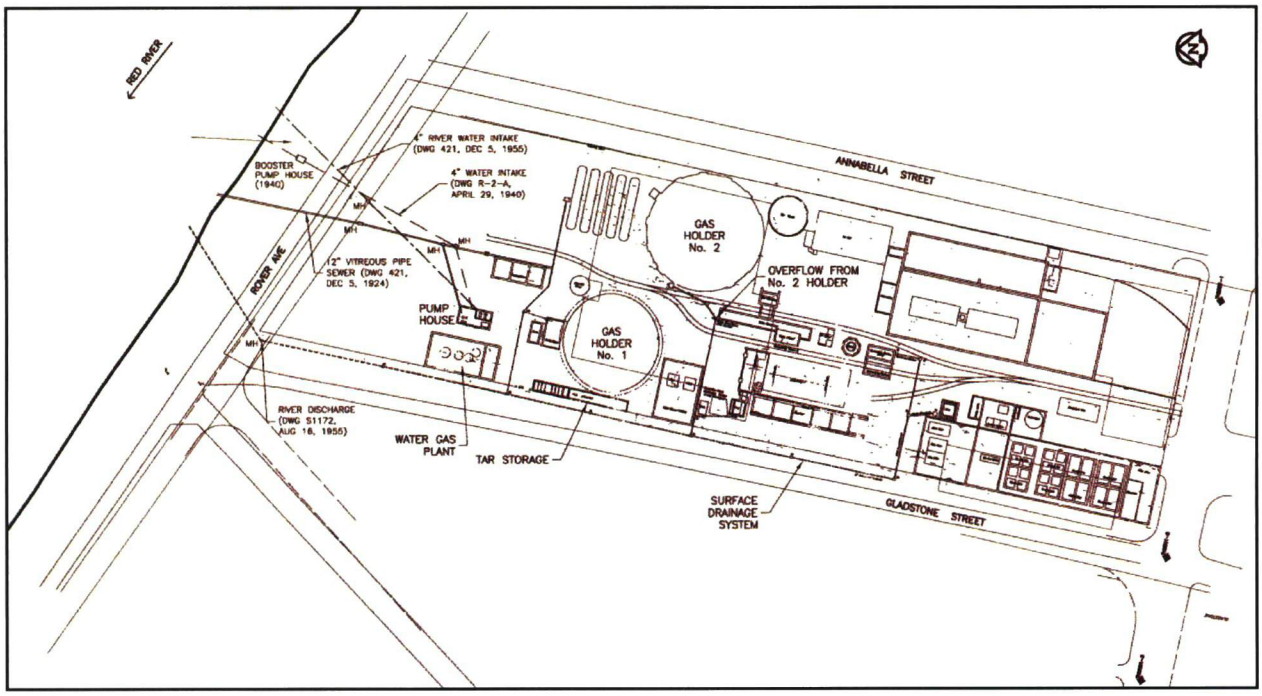

Plate 01 - Historic layout of the former Sutherland Avenue MGP.

Major by-products of the former MGP included coke, tar, sulphur, ammonia, tar liquors, clinkers, ash, fixed cyanide, oil sludge and gas condensates. Those products that had a market value (coke) were sold. A major portion of those products that were produced in insufficient quantities to be sold or had limited or variable market value were disposed of locally.

Water used in the plant operation was obtained from the Red River and from the City of Winnipeg. Surplus cooling water was discharged back to the river. Effluent water from the plant was discharged to the sewer on Gladstone Street, which drained into the Red River. Surface water and associated residues from the site were historically collected in a storm water collection system with a local discharge into the Red River.

Following cessation of the MGP in 1957, the first phase of site decommissioning occurred during 1959 and 1960, including: demolition of the coke oven, boiler and scrubber room buildings and foundations; demolition of the chimney stack and foundation; disposal of the oil and tar from the oil and tar storage wells; removal of the railroad tracks and ties; and demolition of the purification building. In 1969, the final decommissioning phase occurred with demolition of the gasholder foundations, office and meter house, tanks and other various subsurface structures. Although most of the infrastructure was removed, some of the original building foundations and utility lines may still remain on-site. New buildings were erected on the site commencing in 1969 and are currently in use by Manitoba Hydro.

Centra Gas identified the former MGP as a potentially contaminated site in 1993 as the result of an environmental site assessment, noting that MGPs have typically left a legacy of environmental impacts. Manitoba Conservation designated the former Sutherland Avenue MGP as a contaminated site in 1997

under the newly created Manitoba Contaminated Sites Remediation Act. The main reason for designating the site was the potential for the contaminants to impact freshwater aquatic life in the Red River.

2.3 PREVIOUS SITE INVESTIGATIONS AND OTHER REPORTS

Beginning in 1994, extensive investigations of the soil, groundwater, air and riverbed sediments have been undertaken at the site of the former Sutherland Avenue MGP in Winnipeg. The 2003 Supplemental Environmental Site Investigation Report, completed by UMA Engineering Ltd.[9], presents a detailed summary of the site conditions, including the historical and supplemental information collected between 1994 and 2003 for the former Sutherland MGP site. This information is also documented in the CEMP that was developed for the site by AECOM in 2006 [3].

A list of the site investigations completed at the former Sutherland Avenue MGP, as outlined in the 2003 Supplemental Environmental Site Investigation Report and 2006 CEMP is provided below:

1994	Phase I Environmental Site Assessment - CH2M Hill
1994	Preliminary Underground Storage Tank (UST) Investigation at the Sutherland Avenue Facility - CH2M Hill
1995	Phase II Environmental Site Assessment - CH2M Hill
1995	Phase IIB: Off-site Soil Gas Survey - CH2M Hill
1996	Phase IIB: Biological Impact Assessment - Agassiz North Associates Ltd.
1996 - 1999	Surficial Sediment Plume Study - Agassiz North Associates Ltd.
1996 - 2000	Indoor Air Quality Monitoring - Agra Earth and Environmental Ltd.
1997	In-Situ Bioremediation Pilot Study - Agra Earth and Environmental Ltd.
2000	Closure Report - AMEC Earth and Environmental Ltd.
2000	Health Risks at the Sutherland Avenue Site - OHG Consulting Inc.
2001	Occupational Hygiene Survey PAH Exposure Levels at the Sutherland Avenue Site
2001	Occupational Hygiene Survey PAH Exposure Levels at the Sutherland Avenue Site Part 2
2001	ESA: Red River Bank adjacent to former Sutherland Ave. MGP - MECI
2001	ESA: Red River Sediments adjacent to former Sutherland Ave. MGP - MECI
2003	Supplemental Environmental Site Investigation Report, 35 Sutherland Avenue, Winnipeg, Manitoba - UMA Engineering Ltd.
2003	Review of the Ecology of the Red River within the City of Winnipeg: A Context for Potential Impacts of Contamination from the Sutherland Site - North/South Consultants Ltd.
2003	Assessment of Contaminant Risks to Aquatic Life in the Red River Adjacent to the Sutherland Site: Approach and Methods for the Collection and Analysis of Bathymetric Data, Benthic Invertebrates and Sediment - North/South Consultants Ltd.
2004	Assessment of Risks to Aquatic Life in the Red River Adjacent to the Sutherland Site: Implications of Coal Tar Contaminated Sediments on Benthic Community Structure in the Urbanized Red River - UMA Engineering Ltd.

Based on the above environmental investigations, which were completed at the former Sutherland Avenue MGP, the following documents include information relevant to the proposed route for the 69 kV buried distribution line along Annabella Street south to Sutherland Avenue, and along Sutherland Avenue west to Gladstone Street.

1994	Phase I Environmental Site Assessment - CH2M Hill [10]
1995	Phase II Environmental Site Assessment - CH2M Hill [11]
1995	Phase IIB: Off-site Soil Gas Survey - CH2M Hill [12]
2003	Supplemental Environmental Site Investigation Report, 35 Sutherland Avenue, Winnipeg, Manitoba - UMA Engineering Ltd. [9]

In addition to the above, the 2006 CEMP, updated technical information on the CEMP from 2008, environmental monitoring completed between 2009 and 2011 as part of the Long Term Remedial Monitoring Program, and supplemental investigations that were recently completed by Manitoba Hydro, also include information relevant to the proposed route for the 69 kV buried distribution line. These documents are listed below:

2006	Comprehensive Environmental Management Plan (CEMP) for Residuals from Historical Operations at the Sutherland Avenue Former Manufactured Gas Plant - AECOM [3]
2008	Updated Technical Information Prepared for the TAC Comprehensive Environmental Management Plan (CEMP) for Residuals from Historical Operations at the Sutherland Avenue Former Manufactured Gas Plant - AECOM [13]
2009	Site Monitoring Activities Report, Former Sutherland Avenue Manufactured Gas Plant Site - AECOM [14]
2010	Site Monitoring Activities Report, Former Sutherland Avenue Manufactured Gas Plant Site - AECOM [15]
2011	Draft Site Monitoring Activities Report, Former Sutherland Avenue Manufactured Gas Plant Site - AECOM [16]
2011	Summary of Environmental Investigation & Recommendations - 69 kV Line Installation - Rover Station to Burrows Station - Manitoba Hydro [17]

Key findings from the above ten referenced reports are presented below.

Phase I Environmental Site Assessment - CH2M Hill, 1994

In 1994, CH2M Hill Engineering Ltd. (CH2M Hill) completed a Phase I Environmental Site Assessment (ESA) at the former MGP site that included a review of historical operations, a geophysical survey, indoor air quality sampling and subsurface soil and groundwater investigations at strategic locations across the former MGP site [10]. Based on the findings of the investigation, CH2M Hill made the following observations relative to the south portion of the site near Sutherland Avenue:

- Results of the air monitoring and sampling in the operations building found non-detectable levels of chemical compounds associated with the gas plant residues. Results were within the

applicable government standards and little, if any risk, exists to the health and safety of the employees working in the building;

- The fill material in the south portion of the site extending from the south side of the operations building was underlain with weathered and un-weathered silty clay/clayey silt materials of suspected low relative permeability;
- Residues from the gas plant were present in the soil in all areas of the site, however, the concentrations were most significant in the north portion of the site where stratified deposits were identified;
- Although residues or by-products were evident in the soil in the south portion of the site, the depth was generally limited to above 6 to 7 m. The lower permeability silty clay/clayey silt appeared to impede vertical migration to depths below 7 m in the south portion of the site;
- The water table was encountered at a depth of 2 to 3 m across the site. Groundwater flow was directed downwards and to the north towards the Red River and was expected to flow more readily through the stratified deposits than the fine grained silty clay/clayey silt deposit;
- Groundwater quality was degraded beneath the site by chemicals derived from the manufactured gas plant residues; and
- The lateral extent of residues or by-product was likely more significant toward the Red River, however, may also extend to the east and west off-site.

Based on these findings, CH2M Hill recommended that a Phase II ESA be carried out.

Phase II Environmental Site Assessment - CH2M Hill, 1995

A baseline human health risk assessment was completed as part of the Phase II ESA [11] to determine whether an adverse human health risk was expected based on current land uses at the site. The primary exposure pathway considered in the assessment was inhalation of gaseous residues. Risks due to ingestion and dermal contact were considered unlikely due to the site conditions and it was presumed that risk would be mitigated through the use of proper health and safety equipment. The receptors considered in the risk assessment were current and future adult workers on the former MGP site.

An off-site risk assessment was not carried out at the time based on: the results of off-site sewer sampling for residues being negative; the on-site risk assessment suggested risks were within acceptable levels; and there was a lack of data on the factors required to determine off-site risks.

Inhalation risks were estimated for gaseous residues (PAHs) entering the on-site operations building using the concentrations of residues found in the northern portion of the site. This portion of the site contained the highest levels of residues encountered. The estimated risk in this northern area did not exceed the accepted criteria of 10^{-6} (one in one million excess cancer risk for known carcinogens) or a hazard index of one for non-carcinogenic compounds. These results indicated that risks to workers were within accepted limits. These results were also supported by the results of the previous air sampling that was conducted in the buildings.

The risk assessment was not repeated for chemicals found in the central or southern portions of the site, where residues were present at lower levels than the northern area. Based on the assessment of the

northern area, it was concluded that risk to on-site workers from the central and southern areas would be well below acceptable levels.

Phase IIB: Off-site Soil Gas Survey - CH2M Hill, 1995

CH2M Hill completed a Phase IIB: Off-site Soil Gas Survey in December 1995 [12] to determine whether soil gases characteristic of MGP residues were present at and beyond the east and west property boundaries adjacent to areas of residual land use. The study also assessed the significance of off-site soil gas migration by comparison with established guidelines and by applying risk assessment techniques. The study included a shallow soil gas screening survey and discrete sampling of soil gas for chemical analysis just beyond the perimeter of the former MGP, focusing on areas of residential land use adjacent to the site. The locations of the discrete soil gas samples are presented on the plate below.

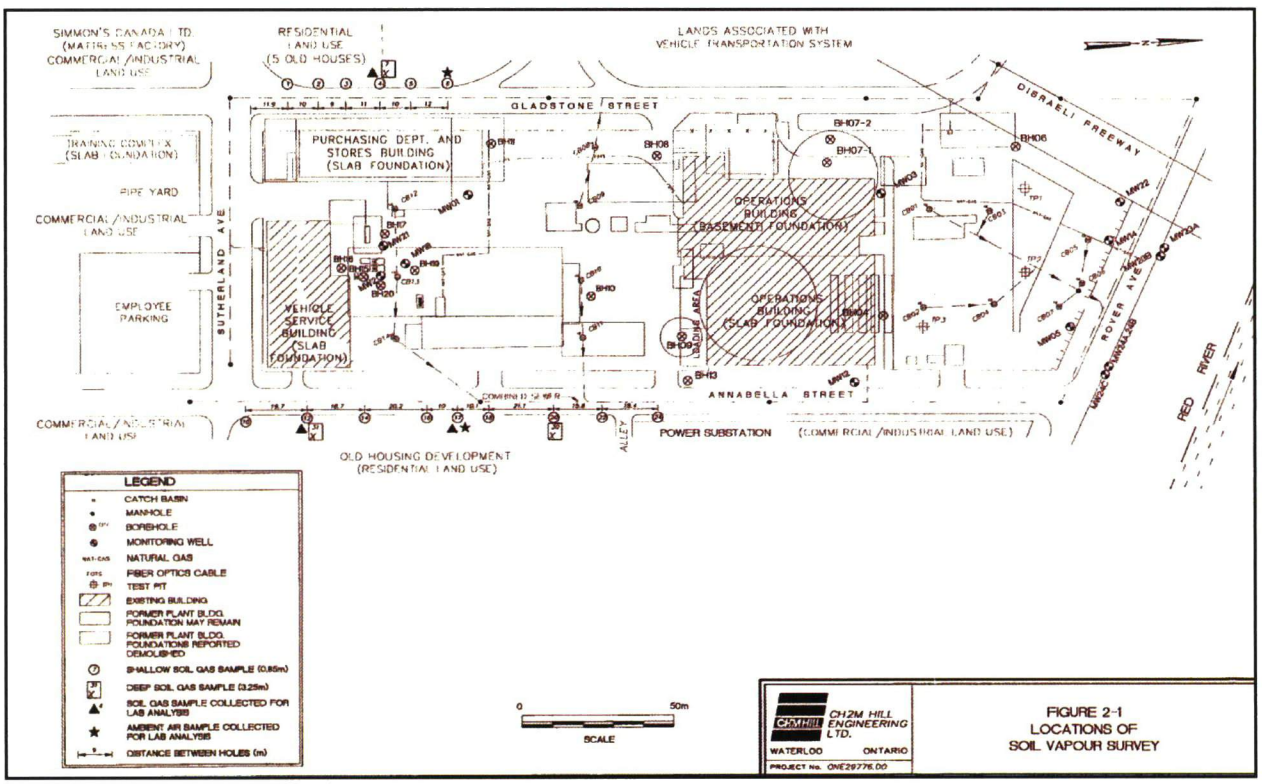

Plate 02 - Location of soil vapour probes.

The analysis considered soil gas migration beyond the property line and included an estimation of exposure concentrations in indoor air due to gas migration into residential basements. A focused off-site risk assessment was then undertaken to estimate potential impacts from soil gas beyond the property boundary. The following conclusions were developed from the study:

- Soil gases in the boulevards on Gladstone Street and Annabella Street adjacent to the former MGP were found at concentrations above the City of Winnipeg ambient air quality guidelines;
- Soil gases were not found at concentrations that pose an explosion hazard;

- Soil gases were found to be below the applicable occupational workplace health and safety air quality criteria;
- Indoor air quality in residential basements was predicted to be 0.003 times the measured soil gas concentrations in the boulevard, which was far below typical indoor air quality in Canadian homes; and
- Health risks due to the calculated soil gas movement into residential buildings was within acceptable levels for both adult and child receptors.

Based on the results of the Phase IIB soil gas investigation it was concluded that there was no reason to further investigate potential soil gas movement into nearby residences nor was there a need to implement any mitigative action to address this pathway.

Supplemental Environmental Site Assessment - UMA Engineering Ltd., 2003

Following a review of the historical environmental and site information, and discussions with Manitoba Hydro personnel, UMA Engineering Ltd. determined that additional site information was required to adequately address specific information gaps with respect to characterization of the areas surrounding the former MGP [(9)].

Supplemental environmental site investigations were completed to assess impacted soil identified at various locations at the site during sewer upgrading works completed by the City of Winnipeg in 2002. Additional test holes were also completed at the former coal storage and distribution facilities located at the Manitoba Hydro Training Facility on Sutherland Avenue, immediately south of the former MGP site. As part of these investigations, the following test holes were installed near the proposed route of the 69 kV buried distribution line:

- TH-30 and TH-31 located within the Manitoba Hydro Training Facility south of Sutherland Avenue; and
- TH-36 and TH-37 located along Annabella Street.

The locations of the above test holes are shown on Figure 03. Soil samples were submitted: from test holes TH-31, TH-36 and TH-37 for analysis of the BTEX components and the PHC F1 to F4 Fractions; from all four of the test hole locations for analysis of PAHs; and from test holes TH-30 and TH-31 for analysis of metals. The previous results of the BTEX/PHC, PAH and metal analyses are presented in Tables 1, 2 and 3, respectively and have been compared with the current CCME CEQG and CCME CWS for PHCs.

As noted on Table 1, the sample from test hole TH-30, located south of Sutherland Avenue and collected at a depth of 4.3 m below ground, exceeded the benzene guideline based on the vapour inhalation limiting pathway. A sample from the same test hole location, at a depth of 7.4 m, did not exceed the guideline. There were no exceedances of the BTEX or PHC guidelines for the samples submitted from test holes TH-36 or TH-37 along Annabella Street, for samples submitted from depths of 3.8 and 6.9 m, respectively.

As shown in Table 2, with the exception of a trace concentration of naphthalene at test hole TH-36, at a depth of 3.8 m, the PAH results were all below the laboratory method detection limits for the two test holes located along Annabella Street, TH-36 and TH-37. Within the Manitoba Hydro training area located south of Sutherland Avenue, elevated PAHs were detected in the 0.8 m deep sample submitted from test hole TH-30, located southeast of the intersection of Gladstone Street and Sutherland Avenue, with exceedances of the naphthalene and phenanthrene guidelines, along with the B[a]P TPE and IACR. The results from test hole TH-31 at a depth of 1.8 m, located to the east of test hole TH-30 on the south side of Sutherland Avenue, were below the laboratory method detection limits for all of the PAH parameters.

As shown in Table 3, the lead concentration at test hole TH-30 exceeded the CCME CEQG. There were no other metal exceedances at test hole TH-30 or at test hole TH-31.

Comprehensive Environmental Management Plan - AECOM, 2006

In 2006, Manitoba Hydro developed a CEMP [3] for managing the residual contaminants associated with the former MGP located at 33-38 Sutherland Avenue. The CEMP included a summary of the analytical data from the historical soil, groundwater, sediment, surface water and soil vapour samples obtained at the site, and in the surrounding areas. The objectives of the management plan were to:

- provide on-going assurance that residual conditions do not pose a threat to human health or the environment;
- detect and measure any potential changes in conditions on or off the site in a time frame to allow appropriate response;
- implement additional remedial actions if warranted; and
- manage the site in an environmentally sound and socially responsible manner.

The risk management approach of the CEMP was based on investigating multiple environmental and human health related parameters at the site over 15 years. In 2006, a Technical Advisory Committee (TAC) was established by Manitoba Conservation for the purpose of obtaining technical input from all levels of government to Manitoba Hydro's proposed CEMP for the site. In response to the TAC comments, additional work was completed at the site to provide supplemental information and/or clarifications on the existing data provided in the 2006 CEMP.

Updated Technical Information - AECOM, 2008

In 2005 and 2006, AECOM completed additional site investigations along the Red River riparian zone and Upland Area, both in areas on and adjacent to the former MGP site [13]. The objective of the supplemental investigations was to provide both lateral and vertical delineation of the contaminant distribution, and concentrations, in both soil and groundwater, in order to develop a comprehensive environmental management plan for the site. As part of the investigations, numerous nested groundwater wells and soil vapour wells were installed along the riparian zone and north side of the former MGP site, in addition to a select number of monitoring wells along the east and west sides of the site, and adjacent properties. The new wells were installed to serve as long-term monitoring points.

A select number of monitoring wells and soil vapour probes, which were installed as part of the 2006 investigation, are located near the proposed route of the 69 kV buried distribution line, including:

- MW-54 (nested well pair and soil vapour probe) and MW-55 (nested well pair and soil vapour probe) located on the west side of Annabella Street on the east side of the former MGP site;
- MW-59 (well and vapour probe), MW-60 and MW-61 (wells only) located on the east side boulevard of Annabella Street; and
- MW-56 (well and soil vapour probe) located on the west side of Gladstone street south of Sutherland Avenue.

The locations of the above monitoring wells and soil vapour probes are shown on Figure 03. The nested wells are designated as "A/B" (deep/shallow wells) and the vapour probe locations are designated with a "V". Soil samples were submitted from each of the test holes for analysis of the BTEX components, the PHC F1 to F4 Fractions and PAHs. The previous results of the BTEX/PHC and PAH analyses are presented in Tables 1 and 2, respectively, and have been compared with the current CCME CEQG and CCME CWS for PHCs.

As noted in Table 1, the sample from test hole MW-55, located on the west side of Annabella Street on the former MGP site and collected at a depth of 4.6 m, exceeded the benzene guideline based on the vapour inhalation limiting pathway and the PHC F2 Fraction guideline based on the soil contact limiting pathway. There were no exceedances of the BTEX or PHC guidelines for the remaining parameters or for the samples submitted from test hole MW-54 at a depth of 1.5 m, test hole MW-59 at a depth of 3.1 m, test hole MW-60 at a depth of 3.8 m, test hole MW-61 at a depth of 1.5 m or test hole MW-56 at depths of 2.3 and 3.8 m.

As noted in Table 2, the sample from test hole MW-55 at a depth of 4.6 m exceeded several PAH guidelines, including: acenaphthene; anthracene; benzo(a)anthracene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene, fluorene; indeno(1,2,3-c,d)pyrene; naphthalene, phenanthrene, pyrene, the B[a]P TPE and IACR. A sample from the same location at a depth of 6.9 m also exceeded the PAH guidelines for: acenaphthene; fluorene, naphthalene, phenanthrene, the B[a]P TPE and IACR. The remaining samples adjacent to Annabella Street, from test holes MW-54, MW-59, MW-60 and MW-61, did not exceed any of the PAH guidelines, with the majority of the parameters at or below the laboratory method detection limits. Two samples were submitted from test hole MW-56 at the corner of Gladstone Street and Sutherland Avenue, one from a depth of 2.3 m and one from a depth of 3.8 m. The results from the shallower sample were at or below the laboratory method detection limits, while the results from the deeper sample showed detectable PAH concentrations for several of the PAH parameters and exceeded the criteria for naphthalene.

Groundwater samples were collected in 2006 from the shallow points at the nested wells MW-54 and MW-55. The samples were analyzed for PAHs and the results are presented in Table 4. As shown, select PAH parameters exceeded the CCME CEQG for Aquatic Life, the HC-GCDWQ and/or the FCSAP FIGQG, however, the concentrations were only slightly above the referenced guidelines.

Starting in 2009, Manitoba Hydro commenced long term CEMP [3] monitoring, including groundwater levels, soil vapours and ambient air quality (on the Manitoba Hydro property and in the vicinity of the residences located along Annabella Street). This involved: quarterly water level and combustible organic vapour readings at wells MW-54, MW-55, MW-56, MW-59, MW-60 and MW-61; annual soil vapour readings at the vapour probes located at MW-55 and MW-59; and annual ambient air quality monitoring at the southwest corner of Gladstone Street and Sutherland Avenue. The results of the CEMP monitoring are documented in the 2009 [14], 2010 [15] and 2011 [16] (draft) annual monitoring reports.

The monitoring results from the four quarterly periods undertaken in 2011 [16] are summarized in Table 5. The reported groundwater elevations reflect typical seasonal fluctuations in the water table, with the lowest readings generally obtained in the fourth quarter (December) and the highest readings in the second quarter (June), after the spring melt. There does not appear to be any definitive pattern in the combustible organic vapour readings in the wells. The majority of the results were below 25 parts per million (ppm), which are considered to be reflective of background conditions. However, elevated levels of 130 to 240 ppm were reported at well MW-55B during three of the four monitoring events, including March 2011, September 2011 and December 2011. During the December 2011 monitoring event elevated readings of 100 and 140 ppm were also reported at wells MW-54A and MW-56, respectively.

Following notification of approval from the TAC in 2010, Manitoba Hydro submitted the final monitoring program for management of the residuals from the historic operations at the former MGP site. The multi-media monitoring program is based on the protection of human health and the physical environment, including monitoring of both the contaminant sources and exposure pathways (groundwater, soil vapour, sediment and indoor air quality of the current Manitoba Hydro Sutherland Avenue Facility buildings).

On January 9, 2012, Manitoba Conservation, under the Contaminated Sites Remediation Act [1], issued an Order to commence the Long Term Remedial Monitoring Program at the Site [2] in accordance with the schedule laid out in the CEMP documents. Manitoba Conservation identified the CEMP to be comprised of five reports, including:

2003	Former Manufactured Gas Plant: 35 Sutherland Avenue, Winnipeg, Manitoba, Supplemental Environmental Site Investigation [9];
2006	Comprehensive Environmental Management Plan for Residuals from Historical Operations at the Sutherland Avenue Former Manufactured Gas Plant [3];
2008	Comprehensive Environmental Management Plan for Residuals from Historical Operations at the Sutherland Avenue Former Manufactured Gas Plant: Updated Technical Information Prepared for the TAC [13];
2011	Long Term Remedial Monitoring Program: Former Sutherland Avenue Manufactured Gas Plant Site, Winnipeg, Manitoba [2]; and
2011	Justification for Long-Term Monitoring Program: Former Sutherland Avenue Manufactured Gas Plant Site, Winnipeg, Manitoba [18].

Summary of Environmental Investigation and Recommendations - 69 kV Line Installation - Rover Station to Burrows Station - Manitoba Hydro, 2011

Subsurface investigations were carried out by Manitoba Hydro in December 2010 along the proposed route for the 69 kV buried distribution line [17] from the Rover Station south along Annabella Street to Sutherland Avenue, and west along Sutherland Avenue to Gladstone Street. The purpose of the investigation was to determine the presence of soil impacts, if any, along the proposed route in the area of the former MGP.

The investigation, which was completed as part of the design phase for the 69 kV buried distribution line, consisted of eight test holes, TH10-01 through TH10-08, including one completed as a monitoring well, TH10-08. The test holes were completed to depths ranging from 3.05 to 7.62 m below grade. Test holes TH10-01 through TH10-04 were located along Annabella Street and test holes TH10-05 through TH10-08 were located along Sutherland Avenue. The locations of the test holes are shown on Figure 03.

Based on the field observations and soil vapour screening, nineteen soil samples were submitted for analysis of the BTEX parameters, the PHC F1 to F4 Fractions, PAHs and metals. This included two to three samples from each of the test hole locations. The results of the BTEX/PHC, PAH and metal analyses are presented in Tables 1, 2 and 3, respectively, and have been compared with the current CCME CEQG and CCME CWS for PHCs.

As noted in Table 1, all of the submitted samples were below the selected guidelines for the BTEX parameters and the PHC F1 to F4 Fractions. Multiple depth samples, ranging from 1.5 to 7.6 m, were submitted from each test hole location on Annabella Street and Sutherland Avenue. All of the samples from Sutherland Avenue, between Annabella and Gladstone Streets, were below the laboratory method detection limits, with the exception of slightly elevated benzene, and PHC F2 and F3 Fraction concentrations at the 0.8 m depth samples from test holes TH10-05 and TH10-06. However, these concentrations were well below the applicable guidelines. All of the samples from Annabella Street, between the Rover Station and Sutherland Avenue, were below the laboratory method detection limits, with the exception of detectable concentrations of benzene at test holes TH10-03 and TH10-04, and the PHC F2 and F3 Fractions at test hole TH10-01. However, these concentrations were also well below the applicable guidelines.

As shown in Table 2, there were no detectable PAH concentrations noted for any of the samples submitted from the test holes drilled along Annabella Street, test holes TH10-01 through TH10-04. However, PAH exceedances were noted in the 0.8 m deep samples submitted from two of the test holes drilled along Sutherland Avenue, TH10-05 and TH10-06. The exceedances at test hole TH10-05 were for fluorene, naphthalene, phenanthrene, the B[a]P TPE and IACR. The exceedances at test hole TH10-06 were for benzo(a)anthracene, benzo(b)fluoranthene, benzo(b+j)fluoranthene, naphthalene, phenanthrene, the B[a]P TPE and IACR. There were no detectable PAH concentrations in the deeper samples submitted from these test hole locations. This included a sample from test hole TH10-05 at a depth of 2.3 m and a sample from test hole TH10-06 at a depth of 3.1 m. There were also no detectable PAH concentrations for the soil samples that were submitted from test holes TH10-07 and TH10-08, also located along Sutherland Avenue.

As shown in Table 3, the arsenic concentration in the 4.6 m deep sample from test hole TH10-02, located at the north end of Annabella Street, the copper concentration in the 1.5 m deep sample from test hole TH10-03, located midway on Annabella Street, and the chromium and nickel concentrations in the 0.8 m deep sample from test hole TH10-05, located at the east end of Sutherland Avenue, exceeded the selected CCME CEQG. The remaining parameters from these samples, and all of the parameters from the other samples submitted for metals analysis did not report any metal concentrations that were above the selected guidelines. This included a 3.1 m deep sample from test hole TH10-03, a 2.3 m deep sample from test hole TH10-05, and shallower samples from a depth of 1.5 and 3.1 m at test hole TH10-02, indicating the identified metal impacts are isolated pockets.

Summary of the Site Conditions

Results from the previous site investigations indicate that there are localized areas of PHC, PAH and metal impacted soil along the proposed route for the 69 kV buried distribution line. This includes:

- PHC impacted soil at test holes MW-55 and TH-30;
- PAH impacted soil at test holes MW-55, MW-56, TH10-05, TH10-06 and TH-30; and
- Metal impacted soil at test holes TH10-02, TH10-03, TH10-05 and TH-30.

Test holes TH10-02 and TH10-03 are located at the north end of Annabella Street. Test holes TH10-05, TH10-06, TH-30 and MW-56 are located east to west along Sutherland Avenue between Annabella and Gladstone Streets. Test hole MW-55 is located near the southeast corner of the existing Manitoba Hydro Facility. The impacted test hole locations and contaminants of concern in the soil at each of these locations are highlighted on Figure 03.

Results from the previous site investigations also indicate that there is PAH impacted groundwater at two wells located on the east side of the former MGP site, MW-54 and MW-55. The historical information indicates that no LNAPL/DNAPL has been encountered in proximity to the proposed route of the 69 kV distribution line.

2.4 GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

2.4.1 Regional Geology

Information on the geology of the Winnipeg area indicates that the region is underlain by the Paleozoic era Ordovician period Red River Formation, which is characterized by dolomite and limestone, with argillaceous dolomite, limestone and shale inter-beds [19]. A mantle of Pleistocene drift overlies the bedrock, with a maximum drift thickness of 60 m and an average thickness of 18 m [20]. The overburden consists of lacustrine silt and clay deposits associated with the former glacial Lake Agassiz, which in turn overlie a glacial silt till.

2.4.2 Local Geology

The general soil stratigraphy beneath the investigated area at Annabella Street and Sutherland Avenue, as described in the 2011 Summary of Environmental Investigation & Recommendations - 69 kV Line

Installation - Rover Station to Burrows Station - Manitoba Hydro report [17], consisted of granular fill directly below the asphalt, followed by a layer of clay fill and then silty clay to the maximum depth of the investigation, 7.6 m below ground surface. A brief discussion of the key stratigraphic units follows. Detailed soil descriptions are also provided on the individual test hole logs presented in Appendix B. The locations of the test holes are shown on Figure 03.

Granular Fill

The granular fill was generally described as sand and gravel, and at the time of the investigation, was dry and frozen. The fill thickness ranged from 0.15 m at test hole TH10-04 on Annabella Street to 0.75 m at test holes TH10-06 and TH10-07 on Sutherland Avenue. Cinder ash and some sand and/or gravel was also noted at the latter two test hole locations, along with a black color and petroleum hydrocarbon odours. The cinder ash/fill was located from 0.1 to 0.75 m below ground.

Silty Clay Fill

Silty clay fill was observed underlying the surficial granular fill at five of the eight test hole locations, including TH10-01 through TH10-04 and TH10-08. The upper boundary of the fill ranged from 0.15 m below ground at test hole TH10-04 to 0.3 m below ground at the remaining test hole locations. The fill thickness ranged from 0.1 m at test hole TH10-03 to 2.75 m at test hole TH10-01. The silty clay fill was described as, containing some sand and/or gravel, dark brown and frozen in the upper part of the unit, and moist below. No hydrocarbon odours were noted in this unit.

Silty Clay

Silty clay was encountered below the granular and/or silty clay fill at all eight test hole locations. The silty clay extended to the maximum depth of investigation, which ranged from 3.05 m at test holes TH10-03 through TH10-07 to 7.62 m at test hole TH10-08. The exceptions were test holes TH10-01 and TH10-02, at the north end of Annabella Street, where a silty sand was encountered below the clay. The silty clay was described as, containing silt inclusions, moist, firm and dark brown. No petroleum hydrocarbon odours were noted in the silty clay soil.

Silty Sand

At test holes TH10-01 and TH10-02, a layer of silty sand was encountered below the silty clay. The silty sand was fine grained, moist to wet, soft and brown, except at test hole TH10-01, where it was grey with trace petroleum hydrocarbon odors. At test hole TH10-02, the unit graded into a moist to wet, soft and grey sand below a depth of 4.2 m.

2.4.3 Topography

The topography of the work site along Annabella Street and Sutherland Avenue is generally flat, with a slight slope to the north (towards the Red River) and to the west. The slope north of the Rover Station becomes steeper closer to the Red River. The elevation at the intersection of Annabella Street and Sutherland Avenue is approximately 230 m above seal level (asl), 229 m asl at the Rover Station, and 229 m asl at the intersection of Sutherland Avenue and Gladstone Street. Surface runoff follows the local

topography, with flow generally directed by sloped grading of the road surfaces to catch basins and the storm water collection system.

2.4.4 Hydrology

The nearest surface water body to the work site is the Red River, which is located approximately 125 m from the closest point of the proposed route of the 69 kV buried distribution line, at the Rover Station. The Red River is also located about 365 m south of the proposed route along Sutherland Avenue. There are no other surface water bodies near the work site.

2.4.5 Hydrogeology

The carbonate bedrock of the Red River Formation is the primary aquifer in the area, however, the majority of the residential, commercial and industrial development is connected to the City of Winnipeg distribution system, which obtains its water from Shoal Lake, located approximately 150 km east of the City at the Manitoba-Ontario border. However, there is some localized industrial use of the aquifer for cooling and process water. The piezometric surface of the carbonate aquifer is situated approximately 8 to 10 m below grade and groundwater flow is primarily horizontal within the upper fractured surface towards the Red and Assiniboine Rivers. The fine grained overburden soils are not used as a potable water source.

Water levels have been monitored in the wells situated along Annabella Street on a quarterly basis from 2009 to 2011, as part of the CEMP Long Term Remedial Monitoring Program [(2)]. During the 2011 monitoring period [(16)], the relative groundwater elevations ranged from 225.68 to 227.32 m (3.38 to 2.17 m below grade), as summarized in Table 5. Based on these groundwater elevations and other monitoring data collected across the former MGP site, the shallow groundwater flow direction is inferred to be north towards the Red River. Based on information presented in the Supplemental Site Investigation Report by UMA in 2003 [(9)], the calculated horizontal gradient across the former MGP site is in the order of 0.006 m/m and the hydraulic conductivity at the south end of the site was estimated at 5.54×10^{-9} m/s.

3.0 CONTAMINANT TYPE, TRANSPORT AND RISKS

3.1 POTENTIAL CONTAMINANTS OF CONCERN

The principal source of contamination at the former MGP site is the historically deposited coal tar comprised mainly of polycyclic aromatic hydrocarbons (PAHs), monocyclic aromatic hydrocarbons such as benzene, toluene, ethylbenzene and xylenes (the BTEX components), and volatile and extractable petroleum hydrocarbons (PHC F1 to F4 Fractions). These coal tar residuals are concentrated within the Red River sediments and in the subsurface soils of the Upland Area, and are considered to be the primary contaminants of concern with respect to human health or the environment in the area of the former MGP.

PAHs are a group of compounds formed during the incomplete burning of organic substances such as coal, oil, gas, or garbage. PAHs are normally associated with such products as crude oil, coal, coal tar, creosote and roofing tar. The majority of the coal tar residues found in the area of the former MGP were directly deposited in the river and upland soils, while the gas plant operated from 1883 to 1957 (such as through the sewer system, overland floods, spills, poor storage practices, etc.). There have been no new sources of contamination generated or introduced to the environment for over 50 years, since the MGP ceased to operate.

In addition to PHCs and PAHs, elevated concentrations of metals have also been noted in the near surface soils on Annabella Street and Sutherland Avenue. The direct source of the metal impacts is unknown, however, they are suspected to be related to historic operations at the former MGP. Therefore, metals are considered to be a secondary contaminant of concern in the area of the former MGP.

3.2 CONTAMINANT TRANSPORT AND EXPOSURE PATHWAYS

A contaminant transport pathway analysis was undertaken at the former MGP site by AECOM in 2006 [(3)]. The analysis was based on the key factors considered to contribute to the current contaminant distribution patterns, as inferred from: an understanding of the physical-chemical properties and expected fate of various components (especially PAHs) within the contaminant mixture; and variations in the composition of the contaminant mixture at various places in the subsurface environment below the site and out into the river sediments. A technical analysis of PAH composition in environmental samples collected from beneath or near the former MGP site is presented in the CEMP [(3)].

After review of the major contaminant transport and exposure pathways from the former MGP site, the following was concluded for the upland area, within which the work site is located.

- Direct exposure to humans or terrestrial life is precluded due to the depth of contaminants. However, excavation activities for construction could lead to direct exposure and require a site specific health and safety plan to mitigate this exposure pathway.

- Studies by others have indicated that subsurface conditions pose no threat to the health of employees working within the buildings on-site or to the adjacent residents.

- There is limited groundwater impact beneath the site and it has not affected the underlying bedrock aquifer. Further, there are no groundwater users close to the site.

Based on measurements collected from the network of groundwater wells in the area of the former MGP, the groundwater table is between 3 to 5 m below grade. There is no surface exposure path for the dissolved contaminants in the groundwater, other than potential discharge to the Red River. Beneath the former MGP site, the contaminants of concern are confined to the alluvial and lacustrine soils and do not extend to the till, or more importantly, to the bedrock aquifer further below. Based on the depth to water and established hydraulic gradient across the site towards the Red River, there is a very low likelihood of transport and release of contaminants along the proposed route of the 69 kV buried distribution line.

Therefore, as noted above, the potential primary route of exposure to the contaminants of concern at the work site is through vapour or particulate inhalation during construction activities, and soil dermal contact and/or soil ingestion of contaminated soils that may be brought to the surface during construction activities.

3.3 POTENTIAL HEALTH CONCERNS

Under some circumstances, PAHs can be detrimental to human health. The United States Environmental Protection Agency (US EPA) has determined that several of the PAH constituents encountered at the site, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(j+k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene are probable human carcinogens. In response to these research findings, the CCME has produced the CEQG [(4)] for soil that address both the carcinogenic and non-carcinogenic properties of PAH compounds. CCME has also set guidelines for the BTEX, PHC F1 to F4 Fractions and metal compounds that are protective of human health and the environment.

The 2006 CEMP [(3)] completed an evaluation of human health risks associated with residual coal tar and related products from the former MGP site. The CEMP evaluated three major exposure pathways, including:

- Direct exposures to PAH-contaminated soil (through dermal contact, incidental soil ingestion, and soil fine particle inhalation);
- Exposure to volatile components of subsurface coal tar contamination in the outdoor environment; and
- Exposure to volatile components of subsurface coal tar contamination via soil vapour intrusion into the indoor environment.

Direct exposure of humans to PAH contaminated soil is precluded at the former MGP site owing to: the lack of contamination at surface; limited access to the impacted soils, which are located at depth; and the ground surface, which is typically hard surface pavement. The recent investigations completed along the proposed route for the 69 kV buried distribution line identified the presence of near surface contamination along Sutherland Avenue immediately west of the intersection with Annabella Street at depths that may be encountered during installation of the distribution line.

The CEMP identified that individuals excavating into potentially contaminated subsurface soils should be aware of the presence of coal tar contamination and avoid unnecessary exposures through: use of protective clothing and respirators; and decontamination and thorough washing after working in or around excavations, and especially prior to eating or smoking.

For exposures via inhalation of volatile, vapour-phase contaminants, the potential risk is likely greater for occupants within the current buildings on the former MGP site than for the outdoor environment. Indoor exposures and human health risks in the indoor environment at the Manitoba Sutherland Avenue Facility have been evaluated by others. It was concluded that there are no unacceptable human health risks at the site associated with soil vapour intrusion into on-site buildings. These findings from these studies are summarized below.

An indoor air quality monitoring program was undertaken on the site by Agra in 1996, 1999 and 2000 [21]. Results from the 1996 monitoring program noted that of the sixteen tested parameters, only naphthalene was detected at the three sample locations. The reported values were well below the available air quality criteria and it was concluded that the air quality within the building had not been substantially impacted. It was also noted that the test locations represented areas having the highest likelihood of impact, due to their relative proximity to the impacted soil and groundwater.

During the 1999 air monitoring program, naphthalene was again detected at the same three sample locations. However, comparison of the 1999 results to the 1996 data showed that the concentrations had decreased and were only marginally above the laboratory method detection limits and well within the available air quality guidelines. During the 2000 monitoring program, non-detectable concentrations were measured for all of the tested parameters at each of the three sample locations. Further assessment by OHG in 2000 [22], with respect to on-site health risks, also concluded that the workers were not exposed to unacceptable carcinogenic or non-carcinogenic effects.

Based on practical experience and monitoring of airborne hydrocarbon levels associated with the remediation of similar situations at other sites, remediation activities pose little or no risk to the public at-large. Off-site soil gas surveys undertaken in 1995 by CH2M Hill [12] and between 2006 and 2011 by AECOM [3, 13, 14, 15, 16] concluded that the on-site impacts did not pose any risk to the nearby residents.

3.4 POTENTIAL ENVIRONMENTAL CONCERNS

For living organisms other than humans, exposure to the contaminants of concern might be possible if the contaminants were located in surface soils, within the depth range of plant or tree root penetration or within foraging, burrowing and disturbance depth of various animals that might make use of the adjacent upland urbanized habitat. Since there is localized evidence of near surface soil contamination, it is concluded that there are viable exposure pathways in the terrestrial environment for vegetation and possibly wildlife species.

After reviewing the major contaminant transport and exposure pathways from the former MGP site, the following was concluded by AECOM [3]: direct exposure to humans or terrestrial life is precluded due to the depth of contaminants, however, excavation activities for construction could lead to direct exposure,

and require a site specific health and safety plan to mitigate this exposure pathway; and historic direct deposition to the Red River has created an exposure pathway to aquatic organisms.

3.5 UNDERGROUND STRUCTURES AND OTHER ENVIRONMENTAL CONDITIONS

Historically, it has been identified that the mechanism for contaminant transport from the former MGP site was largely direct deposition to the Red River via sewer drains and to a lesser degree from overland run-off or flood events. However, these transport mechanisms are no longer relevant today.

A large number of active and abandoned underground utilities have been identified along the proposed route for the 69 kV buried distribution line, including high pressure natural gas mains. In addition, it is possible that the remnants of abandoned gas distribution lines associated with the former MGP are present at various locations along the route. Active and abandoned underground utilities identified along Annabella Street and Sutherland Avenue, up to and including Gladstone Street, are presented in section on the detailed design drawings prepared by Manitoba Hydro, Sheets 17, 18 and 19 of 19, which are provided in Appendix A. These include high pressure natural gas lines and feeders, telecommunication lines, potable water lines, sanitary sewers and land drainage sewers. With the exception of the telecommunication (MTS) lines and residential natural gas lines, the majority of these utilities are located below a depth of 1.5 m, which is generally the base level of any excavation required to install the buried distribution line.

The contaminants of concern that have been identified at locations at or near the work site have the potential to affect the construction materials used on the project. In particular, the outer cable sheath for the 69 kV line is composed of a type of high density polyethylene (HDPE) known as cross linked polyethylene, or XLPE. HDPE/XLPE generally has good chemical resistance to aliphatic hydrocarbons and exhibits little to no damage after 30 days of exposure, but may show some effects when in contact with aromatic hydrocarbons, such as PAHs. Chemical resistance tests have shown that the damage from aromatic hydrocarbons may include cracking, loss of strength, discoloration, deformation, dissolution or permeation loss. Based on this information, additional protective measures are included for the 69 kV buried distribution line to protect the cable from potential damage related to contact with contaminants of concern. This protection will involve the placement of a chemically resistant liner in the excavated trench for the section of the route from the Rover Station to Gladstone Street. Specific details are provided in Section 4.0. A specification sheet for the proposed liner is also provided in Appendix C.

In addition to protecting the installed 69 kV buried distribution line, the creation of a lineal utility corridor through potentially impacted soil will also require the installation of protective measures to avoid the creation of an artificial conduit for migration. This will include the placement of impermeable grout or cement-stabilized fill at strategic points along the route to prevent horizontal migration. Specific details are outlined in Section 4.0.

3.6 SUMMARY

Results from the previous site investigations indicate that there are localized areas of PHC, PAH and metal impacted soil along the proposed route for the 69 kV buried distribution line. A review of the major

contaminant transport and exposure pathways from the former MGP site indicate that the risk associated with exposure to on-site workers, nearby residents and the general public are negligible provided site conditions do not change.

Studies by others have indicated that subsurface conditions pose no threat to the health of employees working within the buildings on-site or to the adjacent residents. It was concluded that there are no unacceptable human health risks at the site associated with soil vapour intrusion into on-site buildings. Consequently, this evaluation should also be valid for the lower contaminated off-site areas, including the road allowance along Annabella Street and Sutherland Avenue.

Construction and installation of the buried distribution line will include shallow open cut and/or directional bore methods within the road allowance on Annabella Street and Sutherland Avenue. Excavation and boring activities may lead to direct exposure of contaminated soil and soil vapours to on-site workers, employees, nearby residents and the general public. Consequently, site specific procedures will be required during construction activities to mitigate these exposure pathways. These site specific procedures are identified in the discussion of the construction activities in Section 4.0, and the environmental monitoring procedures that are outlined in Section 5.0.

4.0 PROPOSED CONSTRUCTION ACTIVITIES

4.1 SCOPE OF WORK

The RAP presented below addresses all aspects of the handling and disposal of potentially impacted soil and/or groundwater that may be encountered during construction and installation of the proposed 69 kV buried distribution line from the Rover Station south along Annabella Street to Sutherland Avenue and west along Sutherland Avenue to Gladstone Street. The installation activities along the remainder of the route will be covered by existing Manitoba Hydro environmental policies and procedures for construction projects that include prescribed actions should contamination be discovered at a work site.

Two potential methods have been identified by Manitoba Hydro as being suitable for installation of the proposed 69 kV buried distribution line and either or both methods may be used along the route at the discretion of Manitoba Hydro. The two methods consist of directional bore and direct bury by excavated trench. To provide Manitoba Hydro with maximum flexibility in undertaking the work, each method is discussed below, and specific mitigation measures are prescribed for both methods that are to be applied to the section of the route between the Rover Station and Gladstone Street. Typical cross sectional details for both installation methods are presented on Figure 04. The selected installation method(s) for the route will depend on the presence and depth of existing underground utilities, physical restrictions at surface, potential to encounter impacted soil and/or groundwater, work space limitations and other factors. The mitigation measures identified in this section are not applicable to the construction activities to be completed along the remainder of the route beyond the area bounded by the Rover Station and Gladstone Street. Construction along that section of the route will follow typical Manitoba Hydro work specifications.

The results from the previous site investigations, which were summarized in Sections 2.0 and 3.0, indicate localized areas of PHC, PAH and metal impacted soil along the proposed route between the Rover Station and Gladstone Street. Based on the findings, it is estimated that up to 150 m^3 (approximately 30%) of the soil excavated as part of the construction activities (assuming the work is completed by open trench excavation and the total excavated soil volume is about 400 m^3) may be impacted above the commercial land use criteria and would require off-site disposal at a licensed waste disposal/treatment facility.

Human receptors at the work site include: construction workers for the project; nearby residents on Annabella and Gladstone Streets; office workers at the Manitoba Hydro Sutherland Avenue Facility and other commercial buildings in the area; and pedestrian traffic. Soil impacted with PHCs, PAHs and metals represents the most important contaminant source at the site, with the primary transport mechanisms being the potential inhalation of soil vapours or dust particles, and contact with impacted soil (dermal contact or ingestion). Given the proximity of the existing buildings to the previously identified impacted area, the subsurface conditions and the proposed installation methods, there exists a likelihood of exposure and sensitivity to impacted soil vapours in the ambient air, within the work area and in the areas surrounding the work site.

Due to the presence of impacted soil and active infrastructure at the site, the following strategy/actions were developed for soil excavation and the protection of human health and the environment proximate to the 69 kV buried distribution line:

- Baseline monitoring of ambient air quality within the work area;
- Continuous monitoring of soil vapour and ambient air quality within the work and surrounding areas;
- Excavation and off-site disposal of all soil removed during construction and installation of the distribution line between the Rover Station and Gladstone Street. This would apply to both shallow open cut trench and directional bore methods. Soil impacted with PHCs, PAHs and/or metals would be transported directly to a licensed facility for disposal/treatment;
- Placement of low permeable fill within the trench/bore to mitigate potential migration of contaminants into or along the distribution line;
- Installation of a protective liner around the distribution line within the open trenches in areas where soil impacts were noted; and
- Immediately backfilling open trenches following cable installation to mitigate exposure to soil vapours.

Specific monitoring activities have been developed for the pre-construction, construction and post-construction periods. These are described in detail in Section 5.0. The following sections discuss the construction activities for the project and include all mitigative measures required to reduce and/or eliminate the potential for adverse impacts to human health and the environment. This plan is subject to acceptance by Manitoba Conservation.

The 69 kV buried distribution line is scheduled for construction starting in August or September of 2012. Installation activities will generally include: site preparation; open trench excavation; directional bore (optional); duct and transition vault installation (joint station); cable installation; backfilling; and site restoration.

4.2 HEALTH AND SAFETY

Mitigation measures will be used to prevent and control the potential release of contaminants to land, water and air, and will include management of visual aesthetics, including noise, solid, gaseous and liquid wastes. These measures are prescribed in the following RAP, and will be included in the Contract Documents and Specifications for the project.

Construction activities will meet or exceed the governing codes, standards and guidelines, and regulations applicable to Work and issued under the authority of the Government of Canada and Manitoba as follows but not limited to:

- National Fire Code of Canada, 2010;
- Canada Labour Code Part 11- Occupational Health and Safety (R.S. 1985, c.L-2);
- Canadian Environmental Protection Act (CEPA), 1999, c.33;

- Transportation of Dangerous Goods Regulation, *SOR/2001-286, Canada Gazette Part II, August 2001;*
- The Workplace Safety and Health Act, Province of Manitoba;
- Guidelines for Excavation Work, Province of Manitoba;
- Operation of Hydro-vac Excavation, Manitoba Conservation;
- Guidelines for Confined Entry Work, Province of Manitoba;
- Motor Vehicle Safety Act (MVSA), 1995;
- A Guideline for the Environmental Investigation and Remediation of Petroleum Storage Sites in Manitoba;
- Manitoba Guideline 96-05 Treatment and Disposal of Petroleum Contaminated Soil; and
- The Manitoba Contaminated Sites Remediation Act.

In addition, work activities will be carried out in strict conformance with the latest version of Manitoba Hydro documents:

- Corporate Safety and Health Rules [(23)];
- Safe Excavation and Safety Watch Guidelines [(24)]; and
- Guidelines for Excavation of Cables by Water Pressure/Vacuum Systems (Hydro-Vac) [(25)].

Work activities may involve the handling of contaminated and potentially hazardous materials, including liquid coal tar residue. The Prime Contractor will implement, maintain, and supervise a comprehensive health and safety program that will meet the standards and requirements of the applicable regulatory agencies, and those specified by Manitoba Hydro. All personnel at the site will be advised on the potential hazards and safe work practices pertaining to PHC, PAH, and metal impacted media (air, soil and water).

The Prime Contractor will designate a qualified Health and Safety Officer, who is authorized to supervise and enforce compliance with the safety program. The Prime Contractor will also designate a Site Safety Officer who will be on-site during the construction activities between the Rover Station and Gladstone Street to monitor implementation of the mitigative and monitoring measures prescribed in this RAP.

Regular safety meetings will be held no less frequent than once per week during periods of soil excavation and/or directional bore. Daily tailgate meetings will also be conducted during the same period.

All activities involving the excavation and handling of PHC, PAH or metal impacted media (soil and groundwater) will be continuously monitored by a qualified environmental consultant (Environmental Monitor).

Minimum personal protective equipment requirements for handling contaminated soil and/or groundwater will apply, and are discussed below.

4.2.1 Personal Protective Equipment

Based on the historical analytical results of the soil samples collected near the work site, and the intrusive nature of the trenching, excavation and drilling activities, the chemical exposure hazards are expected to

be moderate to low. Therefore, personal protective equipment requirements for trenching, excavation and boring activities in the areas of known or suspected contamination will be initiated with the following Level D protection, as described by OSHA [26]:

- CSA Grade 1/Green Triangle/Omega-rated dielectric steel-toed work boots;
- Hard hat, required when heavy equipment is being used; and
- CSA-approved safety glasses (or equivalent).

Personnel working in direct contact with contaminated soil/groundwater will also be required to wear chemical resistant clothing (Tyvek coveralls and gloves). Monitoring of the work area will be conducted to determine if field conditions warrant an upgrade in the health and safety procedures. Levels of PPE will be adjusted upward to Level C in the event an action level is exceeded (refer to Section 5.1.4). Level C protection will consist of the following equipment, in addition to the equipment listed above for Level D:

- Full-face or half-mask air purifying respirator (NIOSH-approved);
- Chemical-resistant clothing (disposable overalls); and
- Organics, dust and pesticides respirator cartridge (MSA cartridges GMA-H, GMC-H, GMC-S, or equivalent).

All personnel who may be required to wear a respirator during any phase of the site activities will require appropriate training in the use of air-purifying respirators and not have a medical condition that prevents the use of a respirator. Each person assigned a respirator will be responsible for maintaining and inspecting the assigned respirator before and after use. Based on the available environmental information for the site it is not expected that respirators will be required.

4.2.2 Communication

As outlined above, the Prime Contractor will designate a Site Safety Officer, and a Health and Safety Officer (may be the same person) for the project. The Prime Contractor will also designate a Site Superintendent who will be responsible for the overall construction of the project. A qualified environmental consultant will be retained and an Environmental Monitor will be designated for the project to conduct the prescribed environmental monitoring described in Section 5.0. A project representative will be designated from Manitoba Hydro with the responsibility to manage the project. These four (or five) personnel will form the basis of the Project Management Team that is responsible for implementation of the RAP.

The Project Management Team will be in regular communication regarding the progress of the RAP implementation, including, but not limited to:

- A pre-construction meeting to discuss the elements of the RAP, roles and responsibilities for implementing the RAP, communication and reporting responsibilities, regulatory requirements, Manitoba Hydro health and safety requirements, and any other issues associated with implementation of the RAP;

- Meetings during construction to discuss the progress in implementing the RAP. These meetings may be by conference call or in person, and are anticipated to be weekly meetings; and
- Daily tailgate meetings between the Site Safety Officer and Environmental Monitor to discuss the work schedule for the day in order to assess the requirements prescribed by the RAP and to determine the specific environmental monitoring procedures that are required based on the daily construction activities.

At any point in the project, if any of the Prime Contractor's staff becomes aware of an environmental or human health concern at the work site, the concern will be immediately reported to the Site Superintendant and Site Safety Officer, who will also report the concern to the Environmental Monitor and Manitoba Hydro. Similarly, the Environmental Monitor will report any environmental or human health concern discovered during monitoring activities immediately to Manitoba Hydro and the Site Safety Officer. When warranted, the work will be stopped until the situation is evaluated by the Project Management Team and adequate mitigation and monitoring measures are put in place to address the concern.

Manitoba Hydro will be responsible for addressing off-site concerns raised by complainants from the general public or adjacent property owners, and will also be responsible for addressing any members of the media who may inquire about the project. Complaints from the general public received by any member of the Prime Contractor's staff or the Environmental Monitor will be immediately reported to Manitoba Hydro and the Project Management Team.

4.3 SITE PREPARATION AND CAPPING OF ABANDONED UTILITY LINES

Prior to construction, all existing underground utilities will be identified and marked along the route. This will include both active public/private utilities and abandoned utilities, where applicable. Abandoned sewer, water and gas lines have been identified along the route, including the possibility of encountering remnants of abandoned gas distribution lines associated with the former MGP at various locations along the route. In the event abandoned utilities are encountered during excavation, standard abandonment methods will be used to cap the utility lines. Abandonment methods should be completed in conformance with City of Winnipeg Standard Construction Specifications (Section 3).

Prior to construction, adequate notice will be given to nearby residents and commercial businesses, as well as employees at the Manitoba Hydro Sutherland Avenue Facility, that the work will be commencing. The notice will provide a phone number and contact name for the project to allow the reporting of any concerns regarding the construction activities.

4.4 INSTALLATION BY OPEN TRENCH EXCAVATION

Open cut trenching using excavators will be carried out along designated sections of the route to allow for installation of the 69 kV buried distribution line, particularly in areas where access is not restricted by major roadways, structures or underground utilities. It is anticipated that this method will be used for the section of the route between the Rover Station and Gladstone Street.

A cross-section illustrating a typical open trench installation is presented on Figure 04. The cross section indicates that the typical width for the excavation is 1.0 m at the top and 0.76 m at the base, with the base of the trench approximately 1.4 m below grade. The cross section details also indicate that the 69 kV buried line will consist of three XLPE duct cables placed at the base of the trench and surrounded on the sides and top by an 80 mm concrete barrier with 10 mm reinforcing steel. Tamped thermal backfill will be used inside the protective concrete barrier. A 50 mm diameter plastic communication line will also be placed inside the protected area.

Figure 04 also shows a cross section for the joint stations (splice bays) that are required to join two lengths of the 69 kV buried distribution line. These joint stations are required at set intervals depending on the length of cable present on one roll. Typically, the joint stations are required every 400 to 600 m of lineal cable length. As noted on Figure 04, the joint station will be excavated to a typical depth of 2.2 m below grade, where a 150 mm concrete pad with reinforcing steel will be poured and the cable ends from the two sections spliced together. The cables will rest on sand bags placed on concrete blocks. The vault will be covered with a 75 mm reinforced concrete precast cover set into an 80 mm concrete protective top and filled with thermal backfill to the mid-section of the joint. The remainder of the space will be filled with either thermal backfill or crushed stone screenings. The nearest joint station to the former MGP site is referred to as Joint Bay W8-5, and will be located on Sutherland Avenue between Gomez Street and the Disraeli Freeway. This location is beyond the boundaries identified by the RAP, where contaminants may be encountered.

Design drawings for the project identify the presence of numerous buried utility lines extending across and in close proximity to the proposed route for the 69 kV buried distribution line, and some of these utilities are located in areas of known or suspected soil and/or groundwater impacted with PHCs, PAHs, and metals. With the exception of telephone and natural gas residential service lines, the majority of the larger utilities are located at depths greater than that proposed for the open trench excavation, which will average about 1.5 m in depth across the entire route length. Manitoba Hydro excavation guidelines [24] require that for open cut excavation, existing underground utilities must be exposed by hand digging or water pressure/vacuum excavation (hydro-vac) methods. Manitoba Information Bulletin 2006-01E [27] provides guidance for the use of hydro-vac equipment in potentially impacted areas, including the requirements for proper slurry testing and disposal. The Bulletin indicates that hydro-vac slurry be disposed of within a bermed area that is designed to encourage evaporation and takes into consideration run-off, which should be controlled.

The results from the previous environmental site investigations indicate that the majority of PHC, PAH and/or metals impacts along Annabella Street and Sutherland Avenue are located within the near surface soils (less than 1.5 m depth). Consequently, impacted soils excavated as part of open cut trenching activities will require off-site disposal. In addition, perched groundwater encountered during shallow excavation may also be impacted above the criteria and will require containment, classification and off-site disposal.

The primary routes of exposure to contaminants during open cut trenching is vapour inhalation and dermal contact, either from excavated soil directly or residual contamination along the margins of the trench excavation. To mitigate exposure during excavation activities, excavated material from the section

of the route between the Rover Station and Gladstone Street will be loaded directly into covered trucks and transported off-site. Under no circumstances will waste materials from this section of the route be stockpiled on-site or placed in temporary stockpiles adjacent to the work site or at other locations used by the Prime Contractor. The exception is the pavement surface, which should be segregated for off-site disposal as general construction waste according to Manitoba Hydro requirements for recycling pavement from construction sites.

The trucks used to transport the excavated material will be properly covered to prevent the release of dust and soil particles. The trucks will also be brushed off or otherwise cleaned (wheels, box sides and end dump gate) to prevent tracking excavated material away from the work site. A designated haul route will be used that avoids all residential streets, with the exception of the required work on Annabella Street. The trucks will transport the excavated soil directly to the Mid Canada Environmental Services Ltd. soil treatment facility in Ile des Chênes, Manitoba for final disposition. As discussed earlier, a total of 400 m^3 of soil is expected to be excavated from the section of the route between the Rover Station and Gladstone Street, with the potential for 150 m^3 of this soil to be impacted above the commercial land use criteria. The monitoring and sampling procedures to be used during these activities are outlined in Section 5.2.

Should visible evidence of free phase hydrocarbon product or liquid coal tar be observed in any soil at the work site, a sample will be collected for analysis and the soil will be segregated from other soil at the site by excavation and placement into a 4 m^3 soil bin that has been sealed with an impermeable liner and is available on-site at all times during the work. Once the soil with liquid product or coal tar has been placed in the soil bin, and a representative sample obtained, it will immediately be picked up by a licensed hazardous waste transportation company and removed from the site for final disposal. The analytical results will be provided to the hazardous waste contractor to determine the final disposition of the soil.

The existing shallow utility lines represent a potential migration pathway between the former Sutherland Avenue MGP site and the surrounding area. Based on the orientation of the open cut excavation and intersection of existing utility lines, the 69 kV buried distribution line has the potential to act as a conduit and cross-link between contaminated and uncontaminated areas. To mitigate the potential for migration from the identified impacted areas to non-impacted areas, a hydrocarbon resistant liner (Layfield Environmental Systems Enviro Liner 4030, or equivalent - see Appendix C for specification sheet) will be placed along the base and sidewalls of the trench prior to installation of the distribution cable and protective concrete barrier. In addition to the liner, a low permeable grout or cement-stabilized fill barrier will be placed at three locations between the Rover Station and Gladstone Street:

- at the eastern limit of the project, where the cable enters Annabella Street at the Rover Station;
- at the intersection of Annabella Street and Sutherland Avenue; and
- at the western limit of the potentially impacted area, at the intersection of Sutherland Avenue and Gladstone Street.

This low permeable grout or cement-stabilized fill barrier will prevent lateral migration of contaminants along the remainder of the 69 kV buried distribution line and effectively isolate the section of the route between the Rover Station and Gladstone Street. The hydrocarbon resistant liner placed along the

margins of any trench constructed between the Rover Station and Gladstone Street will also mitigate exposure to soil vapours and dermal contact with impacted soil during installation of the cable and will protect the outer sheath of the 69 kV cable from potential exposure to PHCs/PAHs.

Based on the potential presence of impacted soil and groundwater, continuous environmental monitoring will be carried out during all stages of the open cut trenching in the section of the route between the Rover Station and Gladstone Street. Monitoring activities will include ambient air quality sampling, soil vapour screening and characterization of potentially impacted waste materials (soil and groundwater), as required. Details on the monitoring requirements are presented in Section 5.0.

4.5 INSTALLATION BY DIRECTIONAL BORE (OPTIONAL)

Directional bore may be carried out along designated sections of the 69 kV buried distribution line, particularly where open cut trench construction is obstructed by railways, major roadways (such as Main Street) or other large facilities or utilities. It is not anticipated that the directional bore method will be used in the section of the route between the Rover Station and Gladstone Street that is the subject of this RAP, however, mitigation measures are prescribed for this installation method to allow Manitoba Hydro the maximum flexibility in planning the work.

Manitoba Hydro excavation guidelines [24] require that the buried depth of all existing underground utilities be visually verified prior to commencing with directional bore activities. This includes utilities that both cross over/under and extend parallel to the directional bore. Verification is generally carried out by exposing the utility by hand digging or water pressure/vacuum excavation (hydro-vac) methods. Manitoba Information Bulletin 2006-01E [27] provides guidance for the use of hydro-vac equipment in potentially impacted areas, including the requirements for proper slurry testing and disposal. The Bulletin indicates that hydro-vac slurry be disposed of within a bermed area that is designed to encourage evaporation and takes into consideration run-off, which should be controlled.

Discussions with Manitoba Hydro and information presented on the design drawings provided in Appendix A indicate that the directional bore will be approximately 450 mm in diameter and installed at a minimum of 4 m below grade. The 69 kV buried distribution line XLPE cables will be installed within three 150 mm HDPE duct pipes. One 50 mm plastic pipe for communications will also be placed in the 450 mm bore section.

Depending on the location and depth, the directional bore may act as a conduit for contaminant migration from the former MGP site. To mitigate the potential for migration, a low permeable grout will be installed within the directional bore annulus where impacts in the surrounding soil and/or groundwater are suspected. This would include the entire section of the route between the Rover Station and Gladstone Street.

Waste materials generated by directional bore methods may include slurries from daylighting activities, drilling mud, soil cuttings and groundwater. Depending on the contaminant levels, these wastes may require containment, characterization and off-site disposal. Similar to open cut trench methods, the primary routes of exposure to contaminants during directional boring activities are vapour inhalation and

dermal contact. To mitigate exposure during directional boring activities, drilling mud, soil cuttings and/or groundwater will be contained and directly hauled off-site. Under no circumstances will waste materials be stockpiled on-site.

Environmental site investigations along Annabella Street and Sutherland Avenue indicate that the majority of PHC, PAH and metal impacts are located within the near surface soils, which would be affected by daylighting activities, and the excavation of bore pits and joint (splicing) stations. In addition, investigations completed along the east side of the former MGP site also indicate slightly elevated PAH concentrations in the groundwater above the applicable criteria. Consequently, daylighting and directional boring activities may also encounter impacted groundwater that will require containment, characterization and potential off-site disposal. For these reasons, and practical requirements to daylight each utility crossing, directional boring is not likely to be implemented along the section of the route between the Rover Station and Gladstone Street..

Based on the potential for impacted soil and groundwater, if directional boring is undertaken in the section of the route between the Rover Station and Gladstone Street, continuous environmental monitoring will be carried out during all stages of the directional boring activities. Monitoring will include ambient air quality sampling, soil vapour screening and characterization of potentially impacted waste materials (slurry, drilling mud, soil and groundwater), as required. Details on the monitoring requirements are presented in Section 5.0.

4.6 LAYDOWN AND STAGING AREAS

The Prime Contractor may choose to utilize areas along the route for temporary equipment storage and material laydown, during the various stages of construction. Laydown and staging areas will be located in areas that will minimize ground disturbance and avoid damage to existing vegetation. Consideration will also be given to dust control, erosion and runoff control. In addition, the following restrictions are applicable to any laydown, staging or storage area associated with the work area from the Rover Station to Gladstone Street:

- No storage of known or suspected contaminated soil, groundwater or waste material;
- No movement of tools or equipment from contaminated work areas until the equipment has been properly decontaminated;
- No storage of hazardous materials, including fuel and lubricants;
- No refuelling of equipment within 100 m of any surface water body or near a catch basin;
- No laydown or storage areas within 100 m of any surface water body or near a catch basin; and
- No excess movement of construction equipment beyond the designated work site areas;

Site clearing for laydown or staging areas will be kept to a minimum and will minimize the disturbance to the ground surface and vegetation, and protect the existing infiltration and runoff characteristics of the work site.

All construction equipment will be properly maintained to prevent leaks and spills of fuels, lubricants, hydraulic fluids or coolants. Spill control equipment will be available on-site to contain unforeseen spills of

contaminants. Spills will be contained, cleaned up immediately, and reported to the Site Safety Officer and Environmental Monitor.

The laydown and staging areas will be kept clean at all times and dust generation will be minimized. Runoff from the laydown and staging areas will also be controlled to prevent excess sedimentation from reaching the storm sewers. Idling of combustion engines will also be minimized.

4.7 WORK SEQUENCING

The Prime Contractor will be required to develop a site-specific sequencing plan that will minimize the potential for soil exposure during excavation and/or directional boring activities in accordance with the approved work schedule. Key considerations will include:

- Developing a work sequence that minimizes the potential for vapours and exposure of potentially impacted soil by reducing the time any excavation remains open;
- For open cut trenching, only excavating as much of the route as required by the installation method and immediately covering or backfilling the excavation as soon as the cable has been properly laid;
- Avoid leaving the entire lineal length of the excavation from the Rover Station to Gladstone Street open, if possible;
- Completing final restoration (paving) as soon as possible, however, as long as the excavation has been backfilled and covered, final paving may be scheduled after all construction activities are completed for this section of the route;
- Avoid construction activities during adverse weather conditions, such as high winds and excessive rain, to minimize the potential for dust migration and runoff;
- Managing the work to ensure that all supplies and services required to complete the section of the route between the Rover Station and Gladstone Street are in place prior to starting the work, to minimize the potential for project delays; and
- Putting in place any environmental control measures such as erosion protection, spill response equipment, monitoring equipment, hazardous soil container, etc. before starting the work.

Work scheduling must also take into account communication requirements, including providing advance notice of work activities to the adjacent property owners and providing at least 24 hours notice prior to commencing with any excavation activities, to both Manitoba Conservation and the Environmental Monitor. Manitoba Hydro will be responsible for preparing and delivering the required project notifications.

Work scheduling may be affected by decisions taken as a result of the environmental monitoring program outlined in Section 5.0. This may include altering the work sequence to mitigate environmental or human health concerns or stopping the work until such time as mitigative measures can be implemented. The decisions taken to alter the work sequence will be made in consultation with the Prime Contractor, Site Safety Office, Environmental Monitor and Manitoba Hydro.

4.8 SOIL MANAGEMENT

As discussed in Section 4.3, all soil excavated from the work site between the Rover Station and Gladstone Street will be placed directly into trucks, covered with a tarp and immediately transported to the Mid Canada soil treatment facility using designated truck routes and avoiding residential areas. No soil or waste materials will be stockpiled at the work site in this section of the 69 kV buried distribution line, with the exception of clean fill brought to the site for placement during site restoration activities.

As discussed earlier, measures will be implemented to prevent the migration of contaminants within the new utility corridor that is being constructed. This will include the placement of an impermeable hydrocarbon resistant liner and low permeable grout or cement-stabilized fill at strategic locations to both protect the new infrastructure and prevent lateral migration of contaminants.

Specific soil testing and monitoring protocols have been developed and are discussed in Section 5.2. Additional mitigative measures designed to address contact with potentially contaminated soil include:

- Avoiding construction activities during adverse weather conditions, such as high winds and excessive rain, to minimize the potential for dust migration and runoff; and
- Cleaning (brushing) construction vehicles and equipment before leaving an area where impacted soil and/or groundwater is present to avoid tracking contaminated soil beyond the impacted area.

4.9 GROUNDWATER AND SURFACE WATER MANAGEMENT

Recent groundwater levels recorded in the vicinity of the former MGP site suggest groundwater is present within the upper 3 to 5 m of the soil profile. Perched groundwater conditions may also be encountered in localized areas of granular fill. Limited groundwater quality information is available for areas along Annabella Street and Sutherland Avenue. Results from the two groundwater wells located on the east side of the former MGP site noted slightly elevated PAH concentrations. There were no groundwater results for PHCs or metals available for review.

The installation of the distribution line may include open trench excavation and/or directional boring. There is a potential that impacted groundwater will be encountered during either of these installation activities, either through direct seepage into deeper excavations or contamination of drilling muds used during the directional boring activities. Consequently, groundwater, drilling muds and any surface water that has come into contact with contaminated soil (contact water) at the site will be managed accordingly. This will include providing adequate containment and characterization prior to off-site disposal by a licensed waste hauler.

Efforts will also be taken to minimize groundwater accumulation within the excavations, to direct surface water runoff away from the open excavations and to cover the open excavations during excessive precipitation events to avoid accumulation. Discharge of excavation/contact water to storm drains or open ground will be prohibited. Groundwater from dewatering activities may be discharged to sanitary drains, with the prior approval of the City of Winnipeg, Industrial Control Branch of the Water and Waste

Department, and based on satisfactory analytical test results that meet acceptable criteria specified by the City of Winnipeg.

The Prime Contractor will not be permitted to use liquids to wash equipment at the work site, thereby avoiding the creation of contaminated runoff and rinse water. Equipment that requires decontamination involving washing, such as an excavator bucket, will be taken off-site and pressure washed, with the resultant rinse water collected and properly disposed.

4.10 SUPPLY OF BACKFILL MATERIAL

As noted earlier, all soil removed during excavation, trenching and/or directional boring in proximity to the former MGP site will be transported immediately off-site for disposal. As such, excavations will be backfilled with clean imported granular fill. In addition, thermal backfill is required for the area immediately surrounding the 69 kV buried distribution line. Material for backfilling the excavation(s) will be obtained from a local supplier, chosen by the Prime Contractor. All backfill material supplied to the project site will be clean and free of chemical contaminants. The Prime Contractor will be required to source the fill materials from appropriate suppliers, who may be required to provide analytical testing to certify that the fill materials are free of contamination. Alternatively, composite samples of each backfill material will be obtained by the Environmental Monitor and submitted to a CALA accredited laboratory for analysis of PHCs, PAHs and metals to ensure that it is not contaminated.

4.11 SITE RESTORATION

Site restoration activities will consist of paving the work site to grade after the placement of clean fill and the appropriate road base materials. Site restoration work will also include restoring any damage to the boulevards, including re-seeding or sodding damaged grass, repairing curb cuts and a general clean-up of the work site. It is likely that site restoration activities will be the final work task completed for the project, however, for the portion of the route from Rover Station to Gladstone Street, site restoration activities may take place immediately after the cable has been placed, to minimize the potential for exposure to potentially contaminated soil particles and soil vapours. For this section of the route, it will be important to sweep the work area as part of the restoration activities to remove any residual soil particles from the area. Mechanical sweeping may be used if water is applied to minimize dust generation prior to using the mechanical sweepers.

5.0 PROPOSED ENVIRONMENTAL MONITORING ACTIVITIES

The objectives of the proposed environmental monitoring activities are to:

- Provide on-going assurance that contamination associated with the former MGP site do not pose a threat to human health or the environment during installation of the 69 kV buried distribution line;
- Detect and measure any potential changes in conditions on or off the work site in a time frame to allow an appropriate response;
- Implement additional remedial actions if warranted; and
- Manage the site in an environmentally sound and socially responsible manner.

The specific environmental monitoring requirements for the various media that will be encountered during the work (air, soil and water) are provided below. These activities will be undertaken by the Environmental Monitor, who will be a trained and experienced environmental consultant retained by Manitoba Hydro to oversee this aspect of the RAP. A summary of the environmental sampling frequency for the various monitoring components is presented in Table 6.

5.1 AIR QUALITY MONITORING

5.1.1 Ambient Air Quality Sampling

The ambient air quality sampling program is designed to monitor the air quality surrounding the work site from the Rover Station to the intersection of Gladstone Street and Sutherland Avenue. The potential receptors that have been considered for the ambient air sampling program include: the Manitoba Hydro Sutherland Avenue Facility (generally west and north of the work site); residential buildings on Annabella Street (east of the work site), residential buildings on Gladstone Street (northwest of the work site) and the Manitoba Hydro building on the south side Sutherland Avenue between Annabella Street and Gladstone Street (south of the work site).

As discussed earlier, the potential contaminants of concern at the work site include PHCs, PAHs and metals and the ambient air quality sampling program will include analysis of these contaminants. Ambient air sampling for these contaminants of concern will be conducted using the following methods:

- PHCs will be collected in six-litre Summa passivated stainless steel canisters and the samples collected at a flow rate of approximately 9 mL/minute for a period of eight hours;
- PAHs will be collected using a PUF (polyurethane foam) cartridge and glass fibre or quartz filter attached to a high-volume air sampler and the samples collected over a twenty four hour period at an optimum flow rate of 220 L/minute; and
- Metals will be collected as particulates from a glass fibre or quartz filter attached to a high-volume air sampler.

The sampling schedule will be based on the specific operations occurring within the work site. Sampling will be conducted on days when activities at the work site have the potential to impact public health and

will generally be focussed on days when excavation or boring activities have the potential to expose contaminated soil to the atmosphere.

Instantaneous (grab) sampling using smaller 400 mL Summa canisters will be conducted only as necessary when continuous monitoring of the work site or perimeter locations, as discussed in Section 5.1.2, exceeds the prescribed action levels or at the discretion of the Site Safety Officer or Environmental Monitor.

Based on the assessment of potential receptors, ambient air quality samples will be obtained at the following four locations:

- Manitoba Hydro Sutherland Avenue Facility office building northwest of the work site (Sutherland facility);
- Annabella Street at the residential area east of the work site;
- Gladstone Street at the residential area north/northwest of the work site; and
- Manitoba Hydro property on the south side of Sutherland Street, south of the work site.

These four sampling locations are shown on Figure 03.

One pre-construction sample will be obtained at each location identified above (four samples total). The pre-construction samples will be obtained at least one week prior to starting any construction activities at the site. The purpose of the pre-construction sampling is to establish a typical background concentration for the contaminants of concern at the sampling locations that can be used to compare with ambient air quality results obtained during and after construction activities.

Three sets of air quality samples will be obtained from the four ambient air quality sampling locations during the course of the construction activities at the work site, for a total of twelve samples. One post-construction sample will also be taken at each location (four samples total) once the site has been restored and all potential exposure to the contaminated soil has been removed. The total number of ambient air samples to be collected for laboratory analysis is twenty (four pre-construction, twelve during construction and four post-construction).

In addition to the ambient air quality perimeter monitoring, one ambient sample will be obtained per week from within the active excavation area or trench to assess conditions as near the potential source as possible. Given the anticipated construction period of one to two weeks, this activity will likely consist of two samples.

The Summa canisters, PUF cartridges and filters will be analyzed for the BTEX components, the PHC F1 to F4 Fractions, PAHs and metals. A Canadian Association for Laboratory Accreditation Inc. (CALA) certified laboratory will be utilized for the analyses. All analyses will be requested on a 48 hour turnaround period. The results of each sampling event will be provided to the Site Safety Officer and Manitoba Hydro. A shorter sample turnaround will be requested, if concerns are raised respecting the air quality in the work area.

To properly assess the ambient air quality results, continuous monitoring of the wind speed and direction will be required during the work activities. A temporary meteorological station will be set-up to collect and retain continuous wind speed and direction measurements for the duration of the project activities.

In addition to the ambient air quality assessment outlined above, worker exposure samples will be collected during the first week of construction activities and/or when impacts are encountered. Samples will be collected with personal sampling pumps worn by workers over an eight hour period. The sample is collected in a small tube, which will be submitted for laboratory analysis of the same parameters as the ambient air quality monitoring program. The samples will be requested with 24 hour turnaround to quickly build up the database that will be needed to set the work procedures and level of PPE needed at the site, as discussed in Section 4.2. Additional worker exposure samples will then be collected at the discretion of the Site Safety Officer or Environmental Monitor.

The information provided by this ambient air quality sampling program will be used identify potential airborne risks to the on-site workers, and the surrounding residential and commercial areas. The information this program provides will be used to modify work procedures and keep risks at an acceptable level. The air monitoring program will be conducted during the time period involving excavation of potentially impacted soil. The action levels presented below will be used to monitor the activities around the work site and to ensure that there is no overexposure to workers or off-site locations. These action levels are based on OSHA [28], NIOSH [29] and ACGIH [30] recommended exposure limits using a time weighted average for threshold limit values (TLVs).

In Manitoba, the current ACGIH TLVs are the legislated allowable exposure limits for workers and the action levels have been developed to ensure that exposures are less than the recommended TLV at least 95% of the time (ie: 19 days out of 20). Statistically, for a first sample that is 50% of the allowable exposure limit, there is a 95% probability that the average of multiple samples will be less than the allowable exposure limit. Therefore, an action level that is 50% of the recommended TLV is considered an appropriate early warning level and has been adopted for this RAP.

Naphthalene

Naphthalene will be one of the key target parameters as it represents one of the highest observed concentrations at the work site, based on historical information. If naphthalene is detected above the prescribed action level, it is likely that other parameters will also be present above acceptable levels. Naphthalene has an 8-hour (time weighted average) allowable exposure limit (TLV-TWA) of 10 ppm, or approximately 50 mg/m^3. In setting the action level at 50% of the TLV, the following is recommended:

- Recommended Action Level: 25 mg/m^3

A short term exposure limit (STEL) for naphthalene, based on a 15-minute time weighted average has been established at 15 ppm or approximately 80 mg/m^3. This value should not be exceeded at any time during the work period, even if the 8-hour value is within the TLV-TWA. Exposures up to the STEL should also not occur no more than four times per day and there should be at least one hour between the exposures.

PAH Mixtures

The mixture of PAH compounds that may be present at the site are best assessed against the allowable exposure limit established for coal tar pitch volatiles, representing the benzene soluble fraction. This includes PAH parameters such as beno(a)pyrene, anthracene, phenanthrene, chrysene, pyrene and others. Coal tar pitch volatiles have an 8-hour (time weighted average) allowable exposure limit (TLV-TWA) of 0.2 mg/m^3 as total aerosols. In setting the action level at 50% of the TLV, the following is recommended:

- Recommended Action Level: 0.1 mg/m^3

5.1.2 Continuous Air Quality Sampling (Gases and Vapours)

Air monitoring will be conducted continuously during installation of the buried distribution line from the Rover Station to Gladstone Street. The continuous air monitoring is designed to assess and mitigate threats to public health or the environment due to potential off-site migration of contaminants, and to protect workers at the work site. Air monitoring instruments draw in ambient air to determine the presence of a non-specific contaminant and its concentration. If an air monitoring device records the presence of a contaminant that exceeds the perimeter action levels identified for the site, or exceeds the workplace action levels for the project, procedures will be taken for further assessment and potential sampling for specific contamination at the identified location. Specific mitigation measures may also be triggered by the continuous air sampling results, such as implementing odour suppression techniques.

A photoionization detector (PID) will be deployed at the work site where construction crews will be conducting the installation of the buried distribution line. The PID is a wireless organic vapour monitor that delivers real time readings on a continuous basis to the operator. The unit is calibrated based on a hexane standard and delivers readings in the ppm and % lower explosive limit (LEL) range for organic vapours, which would be generated by the PHC and PAH impacted soil, if present.

For perimeter monitoring, the PID will be deployed along the edges of the work site, and near potential off-site receptors, such as the Manitoba Hydro office buildings, residential homes along Annabella Street and Gladstone Street, and properties along Sutherland Avenue. The purpose of the air monitoring along the perimeter of the work site is to detect potential off-site migration of contaminants during work activities. An action level of 25 ppm above background for an instantaneous reading, sustained over 10 minutes, has been selected for the perimeter monitoring. Prior to the start of installation activities, exhaust from mobile sources within the area will be assessed and measures taken to prevent interference of readings on the PID.

If an instantaneous reading of 25 ppm over the background is obtained at any perimeter location at any time during the work activities, the following actions will be triggered:

- Quickly assess the possibility of interferences from mobile or other sources;
- If no interferences can be identified, immediately conduct air monitoring in residential or other public areas downwind of the area producing the elevated reading using a hand held vapour detector (PID);

- If the PID produces an instantaneous reading of 25 ppm or greater above background, quickly conduct an evaluation for potential interferences. If no interferences can be identified, collect an air grab sample using the 400 mL Summa canister for analysis at the analytical laboratory;
- Report the incident immediately to the Site Safety Officer and Manitoba Hydro, for consideration of additional safety measures for workers and the public;
- Immediately deliver the sample to the analytical laboratory and request a rush analysis (24 hour turnaround time); and
- Provide the sample results to the Site Safety Officer and Manitoba Hydro as soon as they are received from the laboratory.

To ensure the safety of the residents located near the work site and employees of Manitoba Hydro who work in nearby buildings, immediate response to reports of odours by providing air monitoring at the location of the complaint will be undertaken using the following procedures:

- A hand held PID will be taken to the location of the complaint of an odour;
- If the reading is greater than 25 ppm above the background reading, conduct an evaluation for potential interferences;
- If no interferences can be identified, a grab sample will be taken immediately using the 400 mL Summa canister for analysis at the analytical laboratory;
- Report the incident immediately to the Site Safety Officer and Manitoba Hydro, for consideration of additional safety measures for workers and the public;
- Immediately deliver the sample to the analytical laboratory and request a rush analysis (24 hour turnaround time); and
- Provide the sample results to the Site Safety Officer and Manitoba Hydro as soon as they are received from the laboratory.

It should be noted that most odour thresholds are below the health assessment thresholds and the Site Safety Officer, Environmental Monitor and Manitoba Hydro should work with the complainants to address any concerns.

5.1.3 Indoor Air Quality Monitoring

Manitoba Hydro conducts regular indoor air quality monitoring at the Sutherland Avenue Facility near the work site. One indoor air quality sample will be obtained from this sampling location during the installation activities to compare the results with the historic database from this location and provide a record of air quality inside the building while the construction work is being undertaken. The indoor air quality sample will be obtained using the same methods and procedures as used for the indoor air quality monitoring program to keep the data consistent with the previous results. The sample will be analyzed for PHCs, PAHs and metals.

5.1.4 Personal Protective Equipment Required Based on Air Sampling Results

Based on the historical analytical results of the soil samples collected near the work site, and the intrusive nature of the trenching, excavation and boring activities, the chemical exposure hazards are expected to

be moderate to low. Therefore, personal protective equipment requirements for trenching, excavation and boring activities in areas of known or suspected contamination will be initiated with the following Level D protection, as described by OSHA [26]:

- CSA Grade 1/Green Triangle/Omega-rated dielectric steel-toed work boots;
- Hard hat, required when heavy equipment is being used; and
- CSA-approved safety glasses (or equivalent).

Personnel working in direct contact with contaminated soil/groundwater will also be required to wear chemical resistant clothing (Tyvek coveralls and gloves).

Monitoring of the work area will be conducted to determine if field conditions warrant an upgrade in health and safety procedures. Levels of PPE will be adjusted upward to Level C in the event that an action level specified above is exceeded. Level C protection will consist of the following equipment, in addition to the equipment listed above for Level D:

- Full-face or half-mask air purifying respirator (NIOSH-approved);
- Chemical-resistant clothing (disposable overalls); and
- Organics, dust and pesticides respirator cartridge (MSA cartridges GMA-H, GMC-H, GMC-S, or equivalent).

All personnel who may be required to wear a respirator during any phase of the site activities will require appropriate training in the use of air-purifying respirators and not have a medical condition that precludes the use of a respirator. Each person assigned a respirator will be responsible for maintaining and inspecting the assigned respirator before and after use. Based on the available environmental information for the site it is not expected that respirators will be required

5.1.5 Odour Suppression Activities Triggered by Air Quality Monitoring

The recommended action levels discussed above have been chosen to prevent over-exposure to workers or off-site receptors. When triggered, these action levels require an assessment of the PPE for workers, and an assessment of additional safety measures designed to prevent on-site and off-site exposure. These additional safety measures will include odour suppression techniques designed to mitigate vapour liberation from exposed contaminated soil at the work site.

Effective odour suppression techniques are available to mitigate vapour liberation. As noted in Section 4.3, construction activities will consist of placing excavated soil for the buried distribution line directly into trucks, covering the box with a tarp and immediately transporting the soil to an off-site treatment facility for segregation and eventual disposal. However, if soil vapours from the excavated trench and/or directional bore access pits are identified as an issue by continuous vapour monitoring or through reports of odours from adjacent properties, an odour suppressant will be utilized along with tarps to cover the active areas. BioSolve Pinkwater is a liquid vapour suppressant, which has been shown to be effective on PAH vapours. This product is a water based blend of non-ionic and anionic surfactants that encapsulate the soil to reduce or eliminate vapours and odours. Product information is provided in Appendix D.

The decision to apply a liquid vapour suppression product will be made after consultation with the Site Safety Officer, Environmental Monitor and Manitoba Hydro.

5.2 SOIL SAMPLING FOR OFF-SITE DISPOSAL

Excavated soil from the work site will be placed directly into trucks and immediately removed from the work area. All soil loaded into trucks will be transported to the Mid Canada Environmental Services (Mid Canada) soil treatment facility located in Ile des Chênes, Manitoba, to await the results of analytical testing before final disposition. During excavation activities, representative soil samples from each truck load will be collected and field screened for combustible organic vapours.

Soil samples will be collected as grab samples from the excavation directly from the excavator bucket before placement in the truck. The samples will be pared and placed in plastic bags for field screening of combustible organic vapours, using the headspace method. A portion of the sample will also be placed into a clean glass container, with minimum headspace, and retained for compositing and laboratory analysis. Disposable nitrile gloves will be used during the sample handling.

The combustible organic vapour survey will be carried out using a PID. The vapour survey will be completed as a guide to identifying zones of petroleum hydrocarbon and PAH impacted soil, and in selecting samples for laboratory analysis. Measurement will be obtained by allowing the samples to volatilize for approximately 20 minutes at a temperature of approximately 20 degrees Celsius. The sample bag will be gently agitated for several seconds, punctured and the probe from the PID inserted into the bag to measure the soil headspace vapour. Combustible organic vapour concentrations, in ppm and/or % LEL, as measured by the headspace method, will be recorded for each truck load and the information provided to the soil treatment facility.

Samples retained for possible laboratory analysis will be stored on ice packs in a cooler until drop-off at the receiving laboratory. A detailed chain of custody record, as supplied by the receiving laboratory, will be completed prior to leaving the project site, placed with the samples and accompany the shipment to the receiving laboratory. The collected samples will be submitted to a CALA accredited laboratory for analysis of the BTEX components, the PHC F1 to F4 Fractions, PAHs and metals.

Initially, soil samples will be selected from a range of combustible organic vapour readings and submitted for rush analysis (24 hour turnaround) as early as possible in the excavation process to quickly build up a database of results that will allow the use of the combustible vapour readings to guide the determination of impacted versus clean soil in real time as it is placed in the trucks for transport to the Mid Canada facility.

One composite sample will also be prepared from the individual soil samples collected from every three truck loads. Assuming each truck load is 8 m^3, this provides one composite sample per 24 m^3 of soil. This composite sampling frequency is conservative, and is more rigorous than the frequency required by Manitoba Conservation in Guideline 96-05 [31], which specifies each subsample should represent 20 m^3, and one composite sample should be submitted for every 100 m^3 of soil. The analytical results from the composite samples will be used as the final decision-maker in determining the eventual treatment and

disposal option. The analytical laboratory will be instructed to composite the submitted field samples to avoid excessive exposure of the samples to volatilization in the field.

Operationally, each truck will off-load the soil at Mid Canada into separate piles, with soil from the three trucks that were composited placed together in one pile, and so on, until the soil analytical results are available. Once the laboratory results are provided, the soil will either be classified as impacted, in which case it will be placed directly into the soil treatment facility, or classified as clean, in which case it may be used as cover material, fill, or blended with other soil at the site. For operational reasons, Mid Canada may choose to blend clean and impacted soil once it has been received at their site, prior to placement into the soil treatment facility. Mid Canada is licensed to receive and treat PHC and PAH impacted soil up to specific acceptance criteria. If the composite sample exceeds these criteria, the soil will not be accepted at the Mid Canada facility and will require shipment as a hazardous waste to an alternate facility. Shipment of soil from Mid Canada as a hazardous waste will follow the process outlined below for soil from the excavation that shows visible evidence of coal tar liquids or hydrocarbon product.

Should visible evidence of free phase hydrocarbon product or liquid coal tar be observed in any soil at the work site, a sample will be collected for analysis and the soil will be segregated from other soil at the site by excavation and placement into a 4 m^3 soil bin that has been sealed with an impermeable liner and is available on-site at all times during the work. Once the soil with liquid product or coal tar has been placed in the soil bin, and a representative sample obtained, it will be picked up by a licensed hazardous waste transportation company and removed from the site for final disposal. The analytical results will be provided to the hazardous waste contractor to determine the final disposition of the soil.

5.3 ENVIRONMENTAL MONITORING NETWORK

A long term environmental monitoring network has been put in place to address the environmental and human health concerns associated with the former MGP site. It is recommended that this environmental monitoring network be utilized during the installation of the 69 kV buried distribution line to provide pre-construction, construction and post-construction environmental data. Specifically, it is recommended that soil vapour levels be measured during these three periods from the probes and monitoring wells located near the work site, including: MW-54, MW-55, MW-56, MW-59, MW-60 and TH10-08. In addition to collecting soil vapour readings, groundwater samples will also be collected from each of the monitoring wells pre and post-construction, and analyzed for the contaminants of concern, including PHCs, PAHs and metals.

The results of the monitoring will be used to determine if the construction activities have caused any short term impacts on the local soil and groundwater quality. The pre-construction water samples will also be used to establish the local water quality in the area in the event that groundwater is encountered during the site work.

5.4 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

In cases where samples are collected for laboratory analysis, a blind duplicate sample will be submitted for every 10 samples analyzed. This will include air samples, soil samples and groundwater samples.

When undertaking water sampling, a field blank sample and a travel blank sample will also be prepared and submitted to the laboratory during each discrete sampling event.

To ensure the most representative composite samples are obtained from the excavated soil sent for off-site disposal, the receiving laboratory will be requested to sub-sample and composite the soil from the individual soil jars collected from each truck load.

All sampling equipment, such as the high-volume air samplers and the PID, require proper calibration prior to use and periodically during use. The monitoring equipment will be calibrated according to the manufacturer's instructions, using appropriate calibration gases and instruments.

5.5 RAP CLOSURE REPORT

At the conclusion of the construction and environmental monitoring activities associated with the Rover Station to Gladstone Street section of the route, and once all analytical results have been received from the laboratory, a RAP Closure Report will be prepared that will include: a summary of the site investigation data and history of the site; methodologies employed during the environmental monitoring and supervision; analytical results for all soil, water and air testing; excavated soil volumes; and the destination and quantities of all material shipped off-site for disposal and/or treatment. The report will include site plans to scale, illustrating the locations of the construction works and all sampling locations. Spreadsheets will be prepared to summarize the analytical data and to compare the results with the appropriate federal and provincial environmental quality guidelines. Project photographs, taken while completing the work, will also be included within the report and/or appended. The report will meet the requirements for RAP Closure Reports as identified in Manitoba Information Bulletin 96-02E [32].

6.0 CLOSURE

This RAP has been prepared by EGE for the exclusive use of Manitoba Hydro (the Client) and their submission of the RAP to Manitoba Conservation for the specific application described in Section 1.0. Any use of this report by a third party, or any reliance on decisions made based on it, are the responsibility of such third parties. EGE does not accept any responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The work has been conducted in accordance with generally accepted environmental engineering practices. Although every effort has been made to confirm that the information and data presented, is factual, complete and accurate, EGE makes no guarantees or warranties whatsoever, whether expressed or implied, with respect to such information or data.

The findings presented in this report are based on the conditions which existed on site at the time of the work and in respect of the environmental media which were assessed. The Client, and any other parties using this report, should acknowledge that conditions affecting the site can vary with time and that other media other than those described herein could be present on site. EGE cannot warrant against undiscovered environmental liabilities.

Should additional information become available, EGE requests that this information be brought to our attention so that we may re-evaluate the findings and conclusions of this report.

Respectively Submitted,

EGE ENGINEERING LTD.

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Environmental Geoscientist

PROVINCE OF MANITOBA
2012-05-04
P. D. KLASSEN
PDK
REGISTERED PROFESSIONAL GEOSCIENTIST

APEGM
Certificate of Authorization
EGE Engineering Ltd.
No. 4232 Date: 2012/05/04

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TABLES

Table 1 - Summary of Petroleum Hydrocarbon Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

Sample Location	Date (yyyy/mm/dd)	Sample Depth (m)	Parameter							
			Benzene	Toluene	Ethylbenzene	Xylenes	F1	F2	F3	F4
Fine Grained Surface Soils (< 1.5 m depth) - Commercial Land Use										
CCME CEQG [3] and CWS for PHC [4]			0.28 (INH)	330 (SC)	430 (SC)	230 (SC)	320 (SC)	260 (SC)	2,500 (SC)	6,600 (SC)
TH10-05	2010/12/21	0.8	0.0081	< 0.050	< 0.015	< 0.010	< 10	28	533	372
TH10-06	2010/12/21	0.8	0.0107	< 0.050	< 0.015	< 0.010	< 10	< 10	190	< 50
Fine Grained Subsoil (> 1.5 m depth) - Commercial Land Use										
CCME CEQG [3] and CWS for PHC [4]			0.29 (INH)	660 (SC)	860 (SC)	460 (SC)	800 (ML)	1,000 (ML)	5,000 (ML)	10,000 (ML)
Sutherland Avenue (Annabella Street to Gladstone Street)										
TH-30	2001/05/02	4.3	**0.52**	0.3	5.21	3.07	213	395	2,390	79.8
		7.4	< 0.04	< 0.04	< 0.04	< 0.12	< 10	< 10	< 10	< 10
MW-56	2006/08/14	2.3	< 0.005	< 0.01	< 0.01	< 0.03	< 5	7	31	14
	2006/08/14	3.8	0.17	0.27	0.26	0.37	37	14	86	10
TH10-05	2010/12/21	2.3	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
TH10-06	2010/12/21	3.1	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
TH10-07	2010/12/21	1.5	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		2.3	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
TH10-08	2010/12/21	1.5	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		6.1	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		7.6	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
Annabella Street (Rover Avenue Station to Annabella Street)										
TH-36	2002/10/23	3.8	< 0.04	< 0.04	< 0.04	< 0.12	< 10	< 10	< 10	< 10
TH-37	2002/10/23	6.9	< 0.04	< 0.04	< 0.04	< 0.12	< 10	< 10	< 10	< 10
MW-54	2006/08/14	1.5	< 0.005	< 0.01	< 0.01	< 0.03	< 5	< 5	36	26
MW-55	2006/08/14	4.6	**17**	14	0.6	16	< 5	**1900**	3,200	390
MW-59	2006/08/14	3.1	< 0.005	< 0.01	< 0.01	< 0.03	< 5	< 5	20	9
MW-60	2006/08/15	3.8	< 0.005	< 0.01	< 0.01	< 0.03	< 5	< 5	15	7
MW-61	2006/08/15	1.5	< 0.005	< 0.01	< 0.01	< 0.03	< 5	5	38	18
TH10-01	2010/12/20	3.1	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		3.8	< 0.050	< 0.050	< 0.015	< 0.010	< 10	349	102	< 50
		4.6	< 0.050	< 0.050	< 0.015	< 0.010	< 10	55	< 50	< 50
TH10-02	2010/12/20	1.5	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		3.1	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		4.6	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
TH10-03	2010/12/20	1.5	0.0063	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		3.1	0.155	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
TH10-04	2010/12/20	1.5	< 0.050	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50
		2.3	0.0061	< 0.050	< 0.015	< 0.010	< 10	< 10	< 50	< 50

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcge.ccme.ca. 10^{-6} risk criteria used for benzene.
   Surface and subsoil limiting pathways for fine grained soil: INH = inhalation (slab on grade); SC = soil contact.
4. CCME CWS for PHC = Canada Wide Standard for Petroleum Hydrocarbons in Soil, January 2008.
   Surface and subsoil limiting pathways for fine grained soil: SC = soil contact; ML = management limit.
5. A shaded cell with bold white text indicates concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-36, TH-37);
   AECOM, 2008 (MW-54, MW-55, MW-56, MW-59, MW-60, MW-61); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 2 - Summary of PAH Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

		Sample Location, Date Sampled and Sample Depth								
		Test Holes Adjacent to Annabella Street (Rover Avenue Station to Sutherland Avenue)								
Parameter	CCME CEQG [4] Commercial	TH-36 2002/10/23 (3.8 m)	TH-37 2002/10/23 (6.86 m)	MW-54 2006/08/14 (1.5 m)	MW-54 2006/08/14 (8.4 m)	MW-55 2006/08/14 (4.6 m)	MW-55 2006/08/14 (6.9 m)	MW-59 2006/08/14 (3.1 m)	MW-60 2006/08/15 (3.8 m)	MW-61 2006/08/15 (1.5 m)
Benzo[a]pyrene equivalency	*0.6*	*0.189*	*0.189*	*0.073*	*0.038*	***177***	***13.5***	*0.039*	*0.039*	*0.039*
IACR (calculated)	*1.0*	*0.746*	*0.746*	*0.236*	*0.149*	***652***	***49.2***	*0.164*	*0.164*	*0.167*
Acenaphthene	0.28 (FL)	<0.05	<0.05	<0.01	<0.01	**7.1**	**0.49**	<0.01	<0.01	<0.01
Acenaphthylene	320 (FL)	<0.05	<0.05	<0.01	<0.01	41	1.7	<0.01	<0.01	<0.01
Acridine	NG	--	--	--	--	--	--	--	--	--
Anthracene	32 (SC)	<0.05	<0.05	<0.01	<0.01	**53**	2.1	<0.01	<0.01	<0.01
Benzo(a)anthracene	10 (I)	<0.05	<0.05	0.01	<0.01	**48**	3.3	0.01	0.01	0.01
Benzo(a)pyrene	72 (SC)	<0.05	<0.05	0.01	<0.01	39	3.0	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	10 (I)	<0.05	<0.05	0.01	<0.01	**24**	3.2	<0.01	<0.01	0.01
Benzo(b+j)fluoranthene	10 (I)	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	NG	<0.05	<0.05	0.01	<0.01	17	1.5	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	10 (I)	<0.05	<0.05	0.01	<0.01	**30**	1.1	<0.01	<0.01	<0.01
Chrysene	NG	<0.05	<0.05	0.01	<0.01	**46**	2.2	<0.01	<0.01	0.01
Dibenz(a,h)anthracene	10 (I)	<0.05	<0.05	0.01	<0.01	7.4	0.52	<0.01	<0.01	<0.01
Fluoranthene	180 (SC)	<0.05	<0.05	0.01	<0.01	140	8.2	<0.01	<0.01	0.01
Fluorene	0.25 (FL)	<0.05	<0.05	<0.01	<0.01	**76**	**2.3**	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	10 (I)	<0.05	<0.05	0.01	<0.01	**19**	1.8	<0.01	<0.01	<0.01
1-Methylnaphthalene	NG	<0.05	<0.05	0.02	<0.01	48	0.94	<0.01	<0.01	<0.01
2-Methylnaphthalene	NG	<0.05	<0.05	0.01	<0.01	100	1.2	<0.01	<0.01	<0.01
Naphthalene	0.013 (FL)	0.06	<0.05	0.5	<0.01	**550**	**8.2**	<0.01	<0.01	<0.01
Phenanthrene	0.046 (FL)	<0.05	<0.05	0.02	<0.01	**230**	**9.5**	<0.01	<0.01	0.01
Pyrene	100 (I)	<0.05	<0.05	0.01	<0.01	**186**	6.2	<0.01	<0.01	0.01

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
   Guideline value for BaP equivalency is for protection of human health from contact with contaminated soil. 10^{-6} incremental lifetime cancer risk (ILCR) selected.
   Guideline value for IACR is for protection of human health for potable water resources.
   Individual parameter guidelines are for protection of environmental health. The lowest applicable pathways are: SC = soil contact; FL= freshwater life; I = interim soil quality guideline, 1991.
5. A shaded cell with bold white text indicates the concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-31, TH-36, TH-37);
   AECOM, 2008 (MW-54, MW-55, MW-56, MW-59, MW-60, MW-61); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 2 - Summary of PAH Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

		Sample Location, Date Sampled and Sample Depth									
		Test Holes Adjacent to Annabella Street (Rover Avenue Station to Sutherland Avenue)									
Parameter	CCME CEQG [4] Commercial	TH10-01 2010/12/20 (3.1 m)	TH10-01 2010/12/20 (3.8 m)	TH10-01 2010/12/20 (4.6 m)	TH10-02 2010/12/20 (1.5 m)	TH10-02 2010/12/20 (3.1 m)	TH10-02 2010/12/20 (4.6 m)	TH10-03 2010/12/20 (1.5 m)	TH10-03 2010/12/20 (3.1 m)	TH10-04 2010/12/20 (1.5 m)	TH10-04 2010/12/20 (3.1 m)
Benzo[a]pyrene equivalency	*0.6*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*	*0.038*
IACR (calculated)	*1.0*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*	*0.149*
Acenaphthene	0.28 (FL)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	320 (FL)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acridine	NG	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	32 (SC)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)anthracene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	72 (SC)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j)fluoranthene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluoranthene	180 (SC)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.25 (FL)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-cd)pyrene	10 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.013 (FL)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.046 (FL)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	100 (I)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
   Guideline value for BaP equivalency is for protection of human health from contact with contaminated soil. 10^{-6} incremental lifetime cancer risk (ILCR) selected.
   Guideline value for IACR is for protection of human health for potable water resources.
   Individual parameter guidelines are for protection of environmental health. The lowest applicable pathways are: SC = soil contact; FL= freshwater life; I = interim soil quality guideline, 1991.
5. A shaded cell with bold white text indicates the concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-31, TH-36, TH-37);
   AECOM, 2008 (MW-54, MW-55, MW-56, MW-59, MW-60, MW-61); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 2 - Summary of PAH Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

		Sample Location, Date Sampled and Sample Depth												
		Test Holes Adjacent to Sutherland Avenue (Annabella Street to Gladstone Street)												
Parameter	CCME CEQG [4] Commercial	TH-30 2002/05/01 (0.80 m)	TH-31 2002/05/01 (1.80 m)	MW-56 2006/08/14 (2.3 m)	MW-56 2006/08/14 (3.8 m)	TH10-05 2010/12/21 (0.8 m)	TH10-05 2010/12/21 (2.3 m)	TH10-06 2010/12/21 (0.8 m)	TH10-06 2010/12/21 (3.1 m)	TH10-07 2010/12/21 (1.5 m)	TH10-07 2010/12/21 (2.3 m)	TH10-08 2010/12/21 (1.5 m)	TH10-08 2010/12/21 (6.1 m)	TH10-08 2010/12/21 (7.6 m)
Benzo[a]pyrene equivalency	*0.6*	***11.7***	*0.177*	*0.039*	*0.217*	***35.8***	*0.036*	***25.4***	*0.036*	*0.036*	*0.036*	*0.036*	*0.036*	*0.036*
IACR (calculated)	*1.0*	***26.9***	*0.496*	*0.164*	*0.639*	***119***	*0.118*	***145***	*0.118*	*0.118*	*0.118*	*0.118*	*0.118*	*0.118*
Acenaphthene	0.28 (FL)	<0.2	<0.05	<0.01	<0.01	0.220	<0.010	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	320 (FL)	0.26	<0.05	<0.01	0.03	0.207	<0.010	0.8	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acridine	NG	--	--	--	--	<0.050	<0.050	< 0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	32 (SC)	0.75	<0.05	<0.01	0.01	1.06	<0.010	0.476	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)anthracene	10 (I)	2.3	<0.05	0.01	0.04	6.07	<0.010	**10.0**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	72 (SC)	2.8	<0.05	<0.01	0.05	8.34	<0.010	3.74	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	10 (I)	3.1	<0.05	<0.01	0.03	8.00	<0.010	**10.1**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j)fluoranthene	10 (I)	--	--	--	--	7.99	<0.010	**10.2**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	NG	2	<0.05	<0.01	0.01	5.89	<0.010	5.36	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	10 (I)	1.3	<0.05	<0.01	0.04	2.89	<0.010	4.39	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	NG	2.3	<0.05	<0.01	0.03	3.42	<0.010	7.51	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	10 (I)	0.45	<0.05	<0.01	0.01	1.03	<0.010	1.18	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluoranthene	180 (SC)	4.3	<0.05	<0.01	0.01	5.75	<0.010	5.91	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.25 (FL)	0.2	<0.05	<0.01	<0.01	**2.4**	<0.010	0.045	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-cd)pyrene	10 (I)	2.3	<0.05	<0.01	0.03	7.67	<0.010	9.56	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	NG	0.19	<0.05	<0.01	<0.01	0.382	<0.010	0.175	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	NG	0.21	<0.05	<0.01	<0.01	0.336	<0.010	0.162	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.013 (FL)	**0.6**	<0.05	0.01	**0.05**	**0.4**	<0.010	**1.5**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.046 (FL)	**2.6**	<0.05	<0.01	0.03	**3.8**	<0.010	**1.2**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	100 (I)	3.8	<0.05	<0.01	0.01	5.65	<0.010	5.89	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
   Guideline value for BaP equivalency is for protection of human health from contact with contaminated soil. 10^{-5} incremental lifetime cancer risk (ILCR) selected.
   Guideline value for IACR is for protection of human health for potable water resources.
   Individual parameter guidelines are for protection of environmental health. The lowest applicable pathways are: SC = soil contact; FL= freshwater life; I = interim soil quality guideline, 1991.
5. A shaded cell with bold white text indicates the concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-31, TH-36, TH-37);
   AECOM, 2008 (MW-54, MW-55, MW-56, MW-59, MW-60, MW-61); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 3 - Summary of Metal Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

		Sample Location, Date Sampled and Sample Depth									
		Test Holes Adjacent to Annabella Street (Rover Avenue Station to Sutherland Avenue)									
Parameter	CCME CEQG [4] Commercial HH / Env	TH10-01 2010/12/20 (3.1 m)	TH10-01 2010/12/20 (3.8 m)	TH10-01 2010/12/20 (4.6 m)	TH10-02 2010/12/20 (1.5 m)	TH10-02 2010/12/20 (3.1 m)	TH10-02 2010/12/20 (4.6 m)	TH10-03 2010/12/20 (1.5 m)	TH10-03 2010/12/20 (3.1 m)	TH10-04 2010/12/20 (1.5 m)	TH10-04 2010/12/20 (3.1 m)
Antimony	40	0.25	0.24	0.26	0.33	0.23	0.24	0.28	0.34	0.32	0.33
Arsenic	12 / 26	5.48	4.4	5.7	6.73	5.43	**14.4**	7.47	6.19	5.85	7.18
Barium	2,000	111	111	108	156	105	132	169	168	234	190
Beryllium	8	0.48	0.42	0.46	0.8	0.3	0.41	0.99	0.75	0.92	0.91
Cadmium	49 / 22	0.283	0.255	0.246	0.399	0.242	0.263	0.25	0.535	0.552	0.523
Chromium	630 / 87	15.3	15.3	14.8	27.9	14.8	17.8	30.9	26.7	28.1	29.3
Cobalt	300	7.61	7.4	7.4	10.1	7.54	7.63	9.85	10.6	10.5	11.4
Copper	4,000 / 91	11.9	11.5	11.7	17.9	10	11.9	**91.9**	22.1	21.3	20
Lead	260 / 600	7.32	7.61	7.33	11	6.93	7.68	11.1	11	10.6	11.8
Mercury	24 / 50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.051
Molybdenum	40	0.602	0.487	0.525	0.586	0.556	0.544	0.446	1.09	0.721	0.436
Nickel	NG / 50	18.5	18.2	18	27.8	17.9	16.5	26.6	29.5	32	30.3
Selenium	125 / 2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver	40	<0.10	<0.10	<0.10	0.42	<0.10	<0.10	0.1	0.16	0.14	0.15
Thallium	1 / 3.6	0.15	0.16	0.16	0.27	0.15	0.16	0.28	0.27	0.3	0.28
Tin	300	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Uranium	33 / 2,000	0.86	0.867	0.892	1.09	0.848	0.91	1.03	1.16	1.09	1.07
Vanadium	NG / 130	30.4	30.4	30	60.8	30.8	33.6	54	55.6	59.8	61.4
Zinc	NG / 360	39	40	39	75	38	42	78	68	70	87

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
   Both human health and environmental protection guidelines values shown where available.
5. A shaded cell with bold white text indicates the concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-31); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 3 - Summary of Metal Results in Soil

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

		Sample Location, Date Sampled and Sample Depth										
		Test Holes Adjacent to Sutherland Avenue (Annabella Street to Gladstone Street)										
Parameter	CCME CEQG [4] Commercial HH / Env	TH-30 2002/05/01 (0.80 m)	TH-31 2002/05/01 (1.80 m)	TH10-05 2010/12/21 (0.8 m)	TH10-05 2010/12/21 (2.3 m)	TH10-06 2010/12/21 (0.8 m)	TH10-06 2010/12/21 (3.1 m)	TH10-07 2010/12/21 (1.5 m)	TH10-07 2010/12/21 (2.3 m)	TH10-08 2010/12/21 (1.5 m)	TH10-08 2010/12/21 (6.1 m)	TH10-08 2010/12/21 (7.6 m)
Antimony	40	--	--	0.52	0.27	0.68	0.42	0.33	0.31	0.26	0.6	0.64
Arsenic	12 / 26	--	--	3.2	5.69	10.2	6.91	5.63	5.34	6.98	7.93	9.48
Barium	2,000	420	198	99.3	191	44.3	162	179	177	178	149	182
Beryllium	8	0.6	1	0.48	0.98	<0.10	0.92	0.97	0.96	0.73	0.76	0.74
Cadmium	49 / 22	0.8	<0.5	0.131	0.453	0.054	0.393	0.579	0.564	0.413	0.734	0.715
Chromium	630 / 87	26	32	**142**	33.8	3.7	34.5	35.1	32.6	28.8	28.2	25.7
Cobalt	300	8	11.0	5.47	11.9	0.129	10.1	10.8	10.7	9.49	9.4	10.2
Copper	4,000 / 91	61	23	21.5	22.4	1.3	26.9	23.2	22.5	20.5	24.6	26.8
Lead	260 / 600	**767**	15	38.3	12.7	109	11.9	12	11.8	14.4	11	11.2
Mercury	24 / 50	--	--	<0.050	<0.050	1.63	0.051	<0.050	<0.050	0.051	<0.050	<0.050
Molybdenum	40	<3	<3	2.92	0.447	1.41	0.513	0.445	0.428	0.373	1.35	1.95
Nickel	NG / 50	22	31	**62.9**	33.7	<0.50	33.2	31.6	31.8	26.8	29.8	31.8
Selenium	125 / 2.9	--	--	0.53	<0.50	1.2	<0.50	0.79	<0.50	<0.50	1.79	1.7
Silver	40	<1	<1	<0.10	0.15	<0.10	0.16	0.18	0.18	0.13	0.19	0.2
Thallium	1 / 3.6	--	--	<0.10	0.31	0.1	0.32	0.31	0.31	0.24	0.3	0.3
Tin	300	--	--	<5.0	<5.0	5.9	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Uranium	33 / 2,000	--	--	0.408	0.907	0.154	1.24	0.975	0.975	0.988	1.61	2.33
Vanadium	NG / 130	32	59	14.2	69.6	8.26	73.7	77.6	70.7	51	66.4	62.9
Zinc	NG / 360	295	93	51	88	18	76	89	87	72	72	70

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
   Both human health and environmental protection guidelines values shown where available.
5. A shaded cell with bold white text indicates the concentration exceeds the referenced guideline value.
6. Test Holes/Monitoring Wells completed by: UMA, 2003 (TH-30, TH-31); and Manitoba Hydro, 2011 (TH10-01 through TH10-08).

Table 4 - Summary of PAH Results in Groundwater

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

Parameter	FCSAP FIGQG [5]	CCME CEQG Aquatic Life [6]	HC-GCDWQ [7]	Sample Location and Date Sampled	
				MW-54B 13/11/2006	MW-55B 13/06/2006
Acenaphthene	0.0058 (FL)	0.0058	NG	–	–
Acenaphthylene	0.046 (FL)	NG	NG	–	–
Acridine	NG	0.0044	NG	< 0.00001	0.00028
Anthracene	0.000012 (FL)	0.000012	NG	–	–
Benzo(a)anthracene	0.000018 (FL)	0.000018	NG	0.00002	0.00003
Benzo(a)pyrene	0.000017 (FL)	0.000015	0.00001 (MAC)	0.00002	< 0.00001
Benzo(b)fluoranthene	NG	NG	NG	0.00003	0.00001
Benzo(b+j)fluoranthene	0.00048 (FL)	NG	NG	–	–
Benzo(g,h,i)perylene	0.00021 (FL)	NG	NG	–	–
Benzo(k)fluoranthene	0.00048 (FL)	NG	NG	< 0.00001	< 0.00001
Chrysene	0.0014 (FL)	NG	NG	–	–
Dibenz(a,h)anthracene	0.00028 (FL)	NG	NG	–	–
Fluoranthene	0.00004 (FL)	0.00004	NG	0.00004	0.0022
Fluorene	0.003 (FL)	0.003	NG	–	–
Indeno(1,2,3-cd)pyrene	0.00023 (FL)	NG	NG	0.00002	< 0.00001
1-Methylnaphthalene	1.5 (FL)	NG	NG	–	–
2-Methylnaphthalene	1.5 (FL)	NG	NG	–	–
Naphthalene	0.0011 (FL)	0.0011	NG	0.00023	0.97
Phenanthrene	0.0004 (FL)	0.0004	NG	–	–
Pyrene	0.000025 (FL)	0.000025	NG	0.00003	0.002
Quinoline	0.0034 (FL)	0.0034	NG	< 0.00001	0.02

Notes:

1. All concentrations expressed in milligrams per litre (mg/L).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. "–" indicates parameter not analyzed.
5. FCSAP FIGQG = Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, May 2010.
   Limiting pathway for fine grained soil: FL = freshwater aquatic life.
6. CCME CEQG = Canadian Environmental Quality Guidelines, Protection of Aquatic Life. Guidelines obtained April 2012 from web page: http://ceqg-rcqe.ccme.ca.
7. HC-GCDWQ = Health Canada Guidelines for Canadian Drinking Water Quality, Summary Table, May 2008. Provided for reference only.
   MAC = Maximum Acceptable Concentration.
8. A shaded cell with bold white text indicates value exceeds the referenced guideline value.
9. Test Holes/Monitoring Wells completed by: AECOM, 2008 (MW-54, MW-55)

Table 5- Summary of Groundwater Monitoring Results

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

Parameter	Date (yyyy/mm/dd)	Well Location							
		MW-54A	MW-54B	MW-55A	MW-55B	MW-56	MW-59	MW-60	MW-61*
Installation Date (yy/mm/dd)		2005/12/13	2005/12/13	2005/12/13	2005/12/13	2005/12/13	2006/08/15	2006/08/15	2006/08/15
Ground Elevation (m)		229.361	229.361	229.556	229.556	229.901	229.140	229.189	229.364
Stick-Up PVC Well Casing (m)		-0.117	-0.077	-0.096	-0.061	-0.062	-0.087	-0.050	0.001
PVC Well Collar Elevation (m)		229.244	229.284	229.460	229.495	229.839	229.053	229.139	229.365
Water Level (m below PVC Well Collar)	2011/03/07	3.055	2.955	3.275	3.050	3.591	--	2.935	--
	2011/06/17	2.243	2.282	2.877	2.172	3.045	2.492	2.302	--
	2011/09/14	3.023	2.964	3.302	2.407	3.342	3.375	3.077	--
	2011/12/14	3.112	3.023	3.284	2.458	3.622	3.306	3.252	--
Groundwater Elevation (m)	2011/03/07	226.189	226.329	226.185	226.445	226.248	--	226.204	--
	2011/06/17	227.001	227.002	226.583	227.323	226.794	226.561	226.837	--
	2011/09/14	226.221	226.320	226.158	227.088	226.497	225.678	226.062	--
	2011/12/14	226.132	226.261	226.176	227.037	226.217	225.747	225.887	--
Combustible Organic Vapour (ppm)	2011/03/07	15	< 5	< 5	130	< 5	--	< 5	--
	2011/06/17	< 5	< 5	< 5	5	< 5	< 5	< 5	--
	2011/09/14	5	< 5	< 5	190	< 5	35	20	--
	2011/12/14	100	15	20	240	140	5	25	--

Notes:

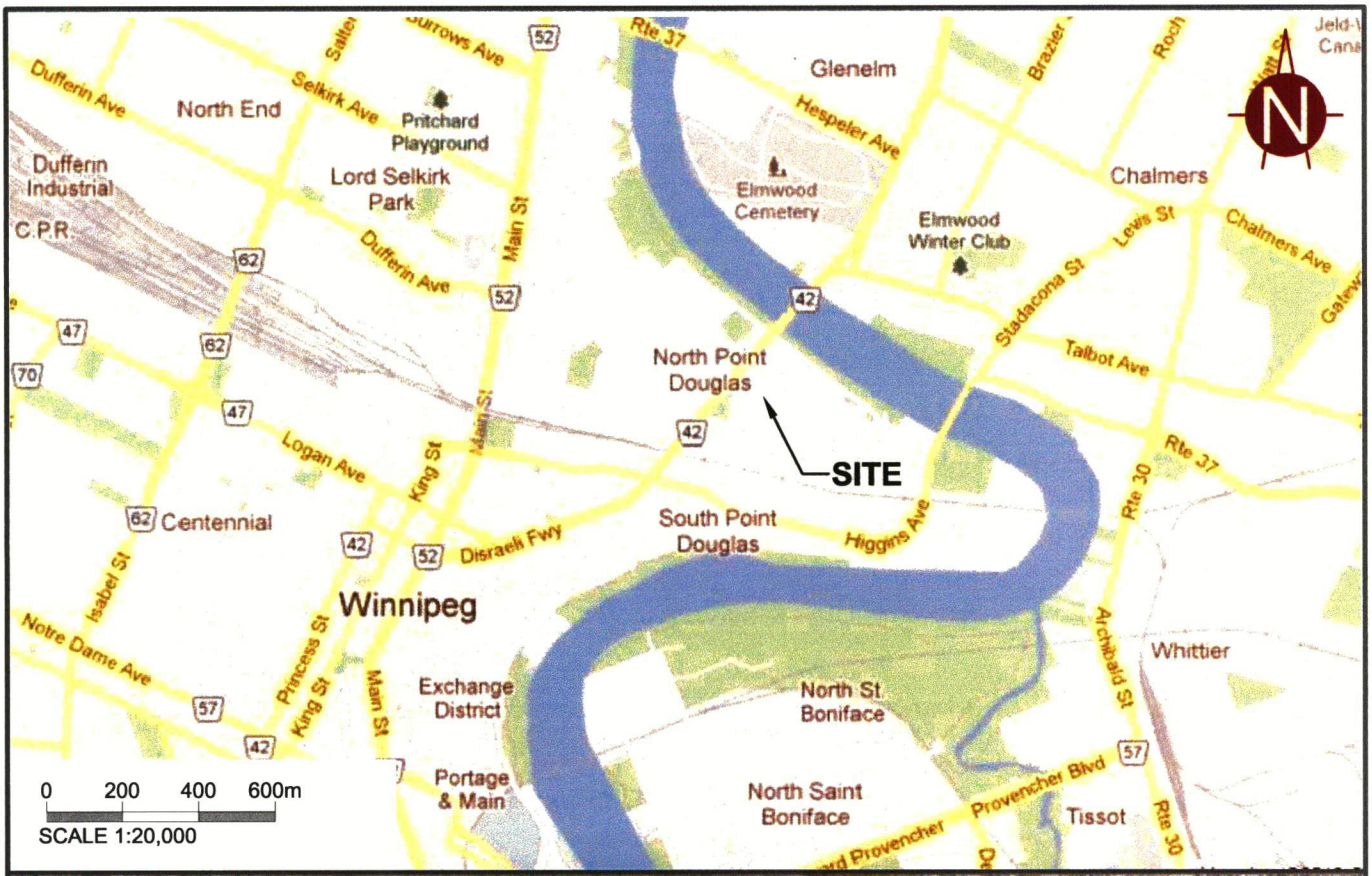
1. Vapour concentrations measured with RKI Eagle set to methane elimination.
2. "--" indicates not measured.
3. Water level measured from below the top of the PVC well collar.
4. Ground elevations calculated based on level surveys and are provided in metres above sea level (m asl).
5. "*" Indicates monitoring well reportedly destroyed and no data collected during the monitoring period.
6. Test Holes/Monitoring Wells completed by: AECOM, 2008 (MW-54, MW-55, MW-56, MW-59, MW-60, MW-61).

Table 6 - Summary of Environmental Sampling Frequency

Remedial Action Plan - 69 kV Buried Distribution Line - Rover Burrows Work Site - Winnipeg, Manitoba

Sampling/Monitoring	Frequency	Quantity	Analyses	Turnaround
Air				
Ambient Air Quality (Four Sites, 6 L Summa Canister/PUF cartridge and filter)				
Pre-Construction	Once	4	PHCs, PAHs, metals	Normal
Construction	Three events	12	PHCs, PAHs, metals	48 hour
Post-Construction	Once	4	PHCs, PAHs, metals	Normal
Ambient Air in Trench Areas (400 mL Summa Canister)	One per week	2	PHCs, PAHs, metals	48 hour
Ambient Air - Instantaneous (400 mL Summa Canister)	As required	As required	PHCs, PAHs, metals	24 hour
Worker Exposure (Personal Sample Pump)	Daily	5	PHCs, PAHs, metals	24 hour
Continuous Perimeter Air Monitoring (PID)	Daily	Continuous	N/A	Instantaneous
Indoor Air Quality (Manitoba Hydro Sutherland Facility)	Once	1	PHCs, PAHs, metals	Normal
Soil				
Excavation/Trench Sampling to Calibrate Vapour Screening	Three per day	9	PHCs, PAHs, metals	24 hour
Combustible Organic Vapour Screening - Excavation	As required	As required	N/A	Instantaneous
Composite Samples of Excavated Material for Disposal	One per truck	51 / 3 = 17	PHCs, PAHs, metals	48 hour
Combustible Organic Vapour Screening - Composites	One per truck	51	N/A	Instantaneous
Liquid Coal Tar/Free Product	As required	As required	PHCs, PAHs, metals	24 hour
Groundwater / Soil Vapour				
Soil Vapour Assessment (6 probe locations)				
Pre-Construction (PID)	Once	6	N/A	Instantaneous
Construction (PID)	Once	6	N/A	Instantaneous
Post-Construction (PID)	Once	6	N/A	Instantaneous
Groundwater Sampling				
Pre-Construction	Once	6	PHCs, PAHs, metals	Normal
Post-Construction	Once	6	PHCs, PAHs, metals	Normal
Dewatering/Surface Water/Runoff				
Excavation dewatering	As required	As required	PHCs, PAHs, metals	24 hour
Site Runoff/Site Discharge	As required	As required	PHCs, PAHs, metals	24 hour

FIGURES



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EGE

Manitoba Hydro

Remedial Action Plan

69 kV Buried Distribution Line

Rover Burrows Work Site, Winnipeg, MB

Location Plan

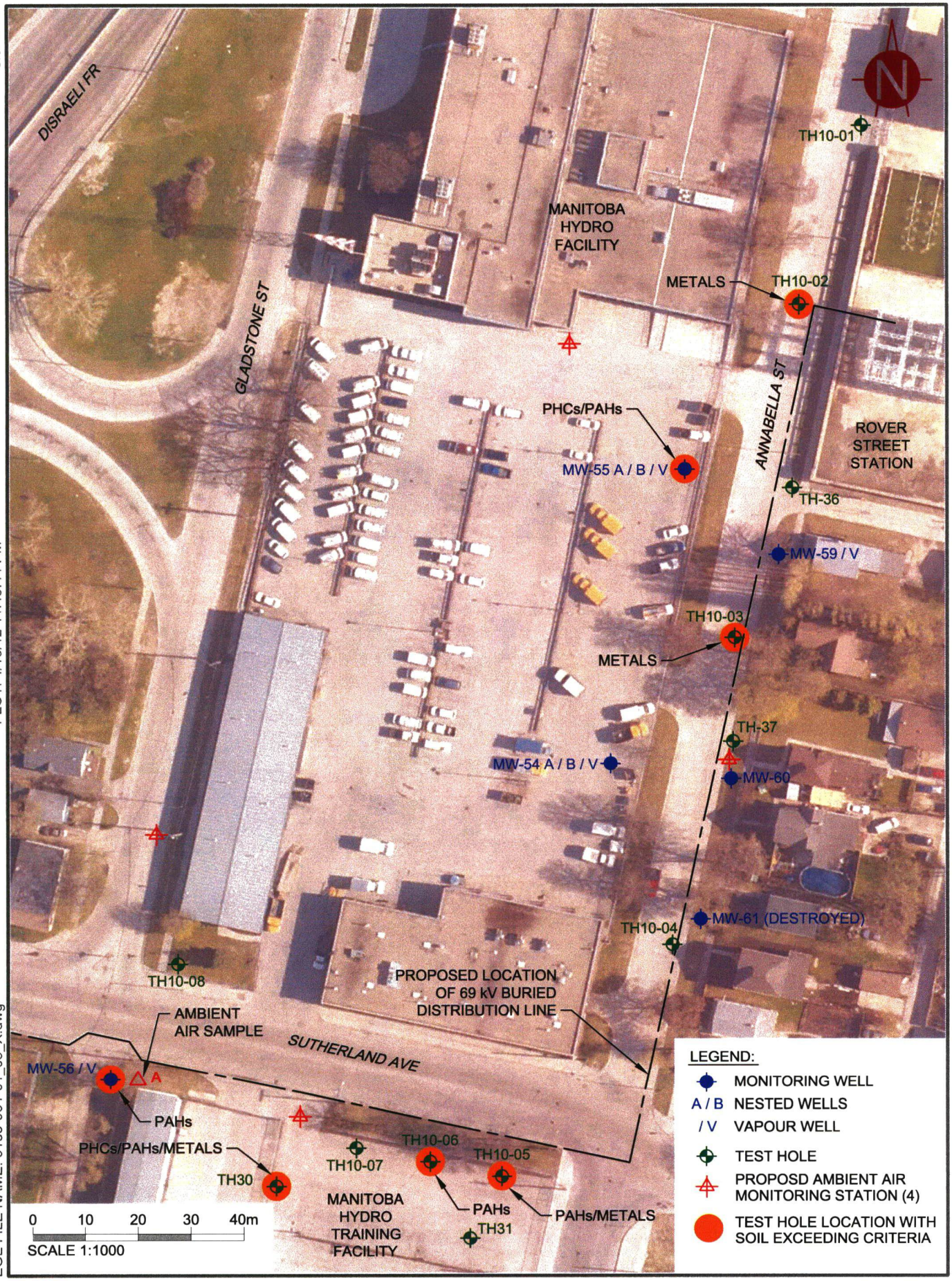
Figure 01

EGE

Manitoba Hydro
Remedial Action Plan
69 kV Buried Distribution Line
Rover Burrows Work Site, Winnipeg, MB

Surrounding Land Use

Figure 02



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Manitoba Hydro

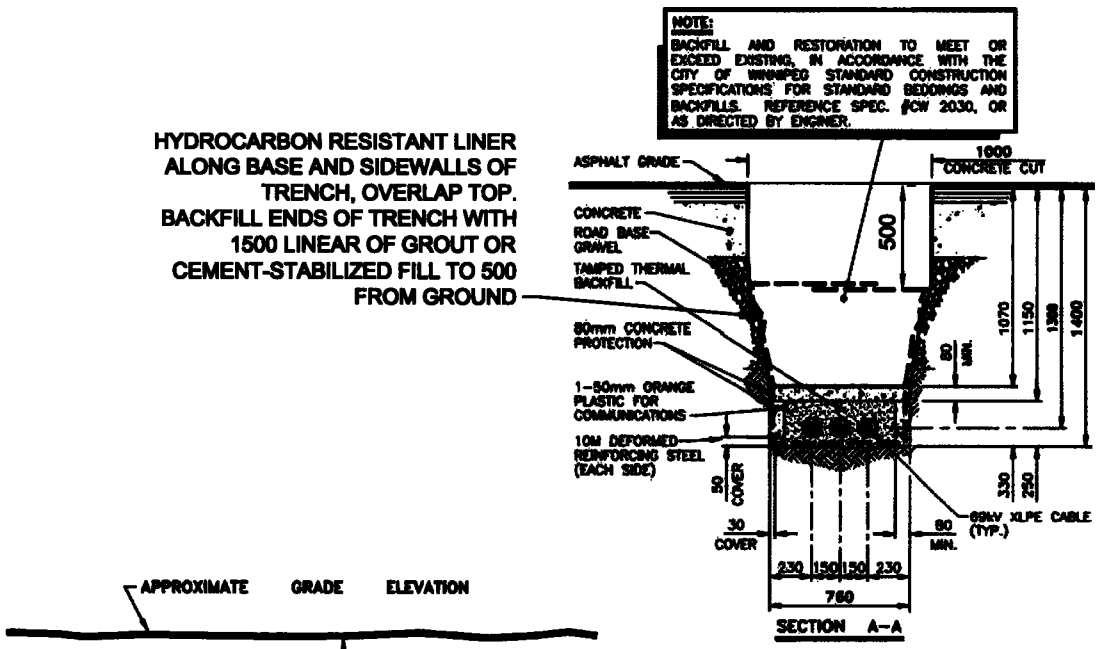
Remedial Action Plan

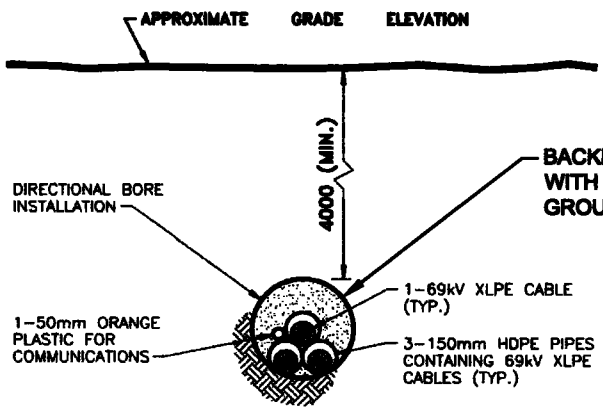
69 kV Buried Distribution Line

Rover Burrows Work Site, Winnipeg, MB

Site Plan

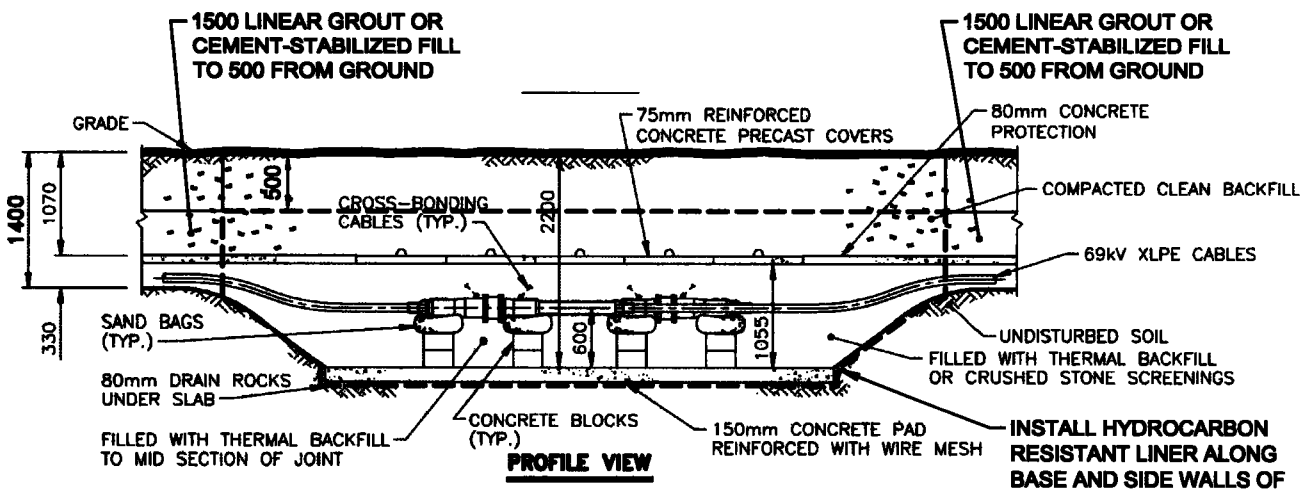
Figure 03





SECTION B-B

NOTE:
IF DIRECTIONAL BORE IS USED BETWEEN ROVER STATION AND GLADSTONE STREET, THE ADJACENT MITIGATION MEASURES ARE PROPOSED.



PROFILE VIEW

TYPICAL JOINT STATION DETAILS

NOTE:
JOINT BAY WILL NOT BE CONSTRUCTED BETWEEN ROVER STATION AND GLADSTONE STREET. HOWEVER, IF CONTAMINATION IS DISCOVERED AT THE JOINT BAY LOCATION WEST OF GLADSTONE, THE ABOVE MITIGATION MEASURES ARE PROPOSED.

EGE

Manitoba Hydro
Remedial Action Plan
69 kV Buried Distribution Line
Rover Burrows Work Site, Winnipeg, MB

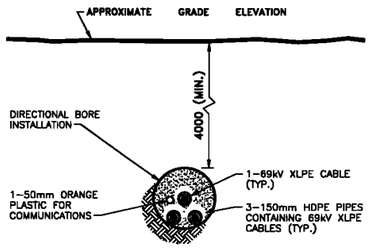
Mitigation Measures In PAH/PHC Impacted Zones
Figure 04

APPENDIX A

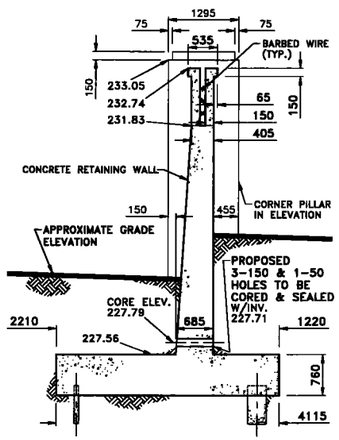
DESIGN DRAWINGS

DB0114

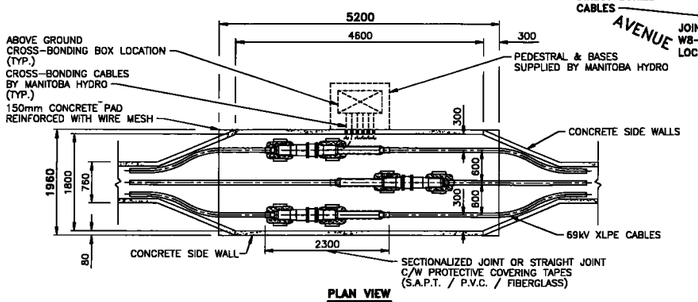
PROPOSED BURROWS (12) SUBSTATION
359 BURROWS AVENUE



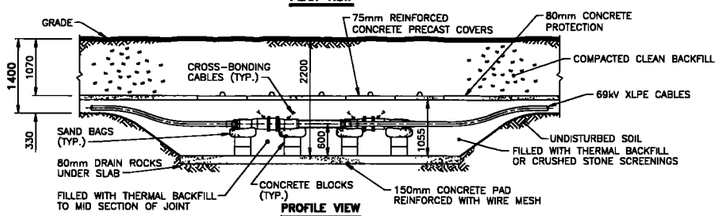
SECTION B-B
SCALE 1:20



ROVER RETAINING WALL SECTION
SCALE 1:50

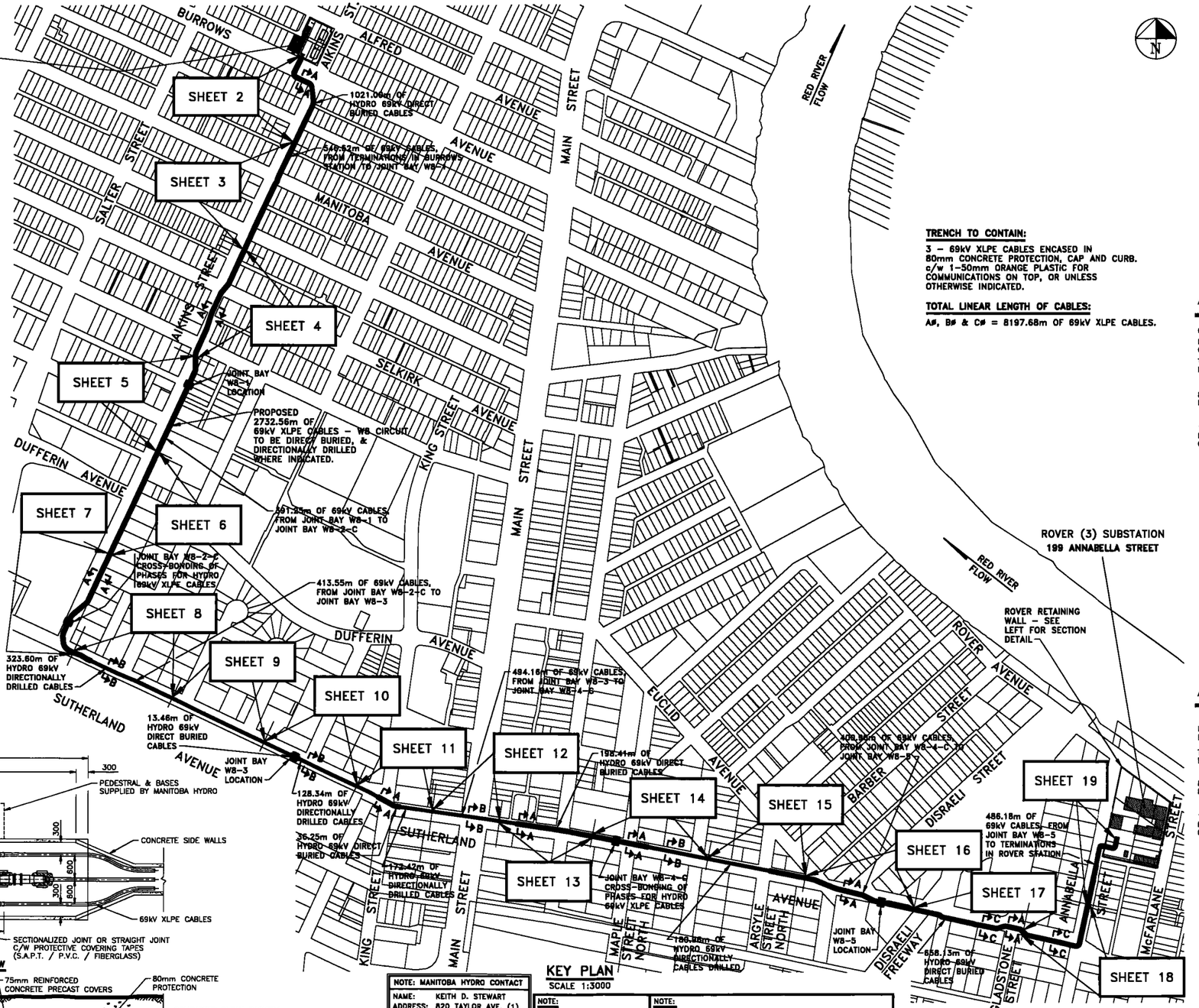


PLAN VIEW



PROFILE VIEW

TYPICAL JOINT STATION DETAILS
SCALE 1:50



KEY PLAN
SCALE 1:3000

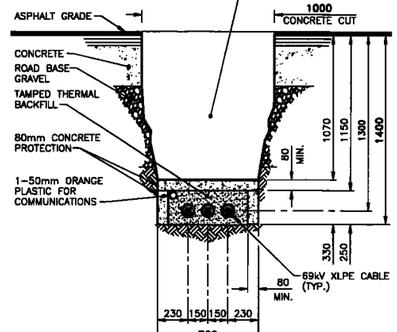
GENERAL NOTES:

1. DEPTH AND LOCATION OF OBSTRUCTIONS ARE APPROXIMATE AND MUST BE DETERMINED PRIOR TO SETTING CABLE GRADE AND INSTALLATION OF UNDERGROUND PLANT.
2. ALL CONCRETE TO BE 35 MPa Type HS WITH 20mm AGGREGATE (MAXIMUM).
3. BEFORE COMMENCING WORK, ALL UNDERGROUND UTILITIES ARE TO BE CONTACTED FOR CLEARANCE.
4. FINAL GRADE / LOCATION OF CABLE JOINT STATIONS TO BE APPROVED BY THE ENGINEER BEFORE COMMENCEMENT OF WORK.
5. CONCRETE SAW TO BE USED TO CUT PAVEMENT. (FULL DEPTH)

TRENCH TO CONTAIN:
3 - 69kV XLPE CABLES ENCASED IN 80mm CONCRETE PROTECTION, CAP AND CURB. c/w 1-50mm ORANGE PLASTIC FOR COMMUNICATIONS ON TOP, OR UNLESS OTHERWISE INDICATED.

TOTAL LINEAR LENGTH OF CABLES:
A#, B# & C# = 8197.68m OF 69kV XLPE CABLES.

NOTE:
BACKFILL AND RESTORATION TO MEET OR EXCEED EXISTING, IN ACCORDANCE WITH THE CITY OF WINNIPEG STANDARD CONSTRUCTION SPECIFICATIONS FOR STANDARD BEDDINGS AND BACKFILLS. REFERENCE SPEC. #CW 2030, OR AS DIRECTED BY ENGINEER.



SECTION A-A
SCALE 1:20

NOTE:
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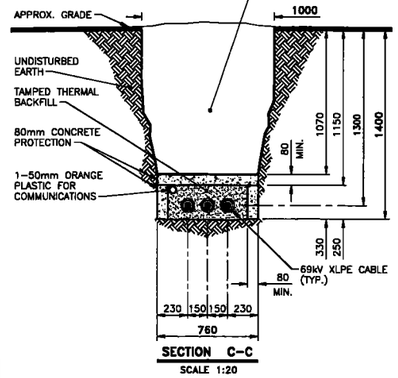


SECTION C-C
SCALE 1:20

NOTE: MANITOBA HYDRO CONTACT	
NAME:	KEITH D. STEWART
ADDRESS:	820 TAYLOR AVE. (1) WINNIPEG, MANITOBA
PHONE:	(204) 226-3888

NOTE:
FOR WORK ORDER DRAWING INFORMATION SEE DWG. 1-04708-DE-50000-0448

NOTE:
THE INDICATION OF OTHER PARTIES ON THIS DRAWING ARE FOR TRENCH LOCATION PURPOSES ONLY. REFER TO THE OTHER PARTY'S DRAWINGS FOR DESIGN DETAILS.

1-04701-DD-10460-0001 0001/00

WBS# P07663 | NETWORK# 526978

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

LOCATIONS APPROVED
UNDERGROUND STRUCTURES

SUPV U/G STRUCTURES DATE
COMMITTEE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT ALL GIVEN LOCATIONS ARE EXACT CONFIRMATION OF EXISTANCE, AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

No.	REVISION	DATE	BY	APP'D.

BENCHMARK: 26-025 - NORTHWEST CORNER OF BURROWS AVENUE & AIKINS STREET, BRASS PLUG 14.4m CONCRETE PILE IN VALVE BOX, 0.3m WEST OF WEST LINE OF AIKINS STREET, 2.4m SOUTH OF NORTH LINE OF BURROWS AVENUE.
ELEVATION: 231.453m

DRAWN BY: BMW	DATE: 2009 07 29
CHECKED BY:	HORIZ: AS NOTED
APPROVED BY:	VERT:

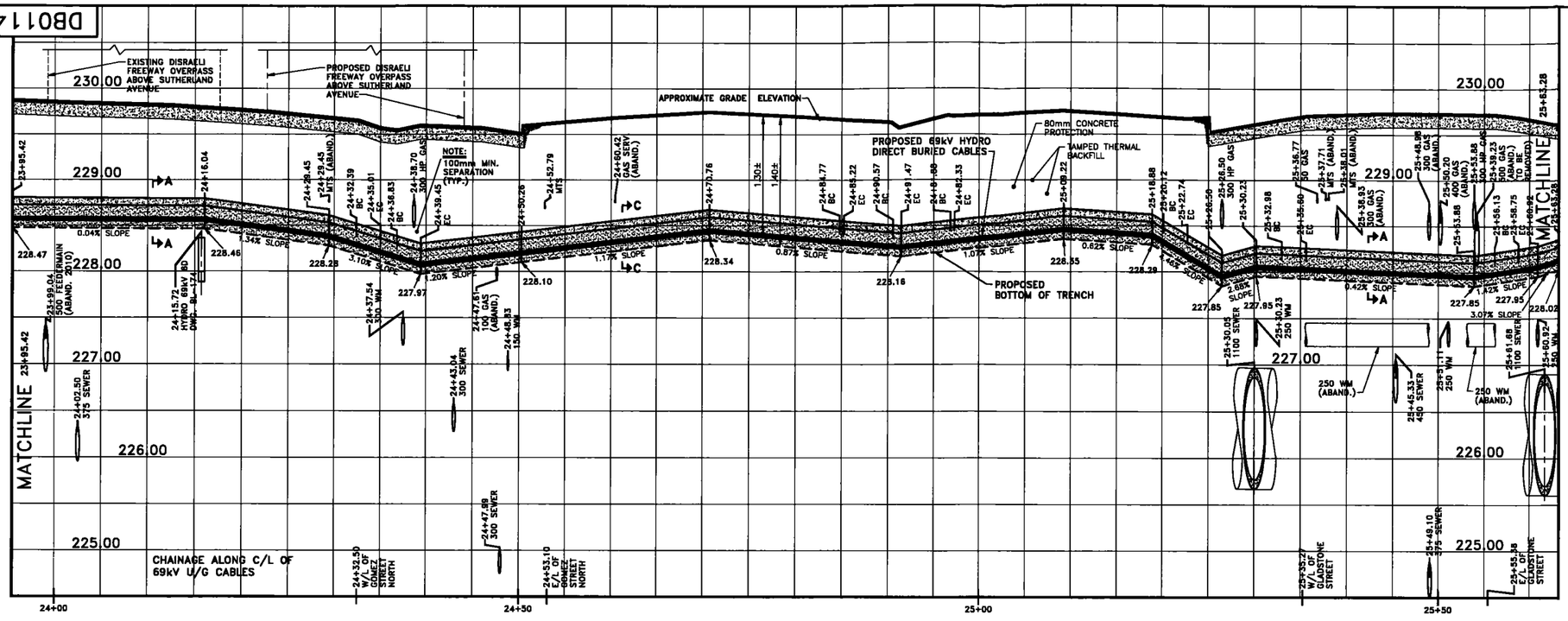
PRELIMINARY ONLY
PLOT GENERATED: 2012.05.02 @ 9:26 AM BY: BMW

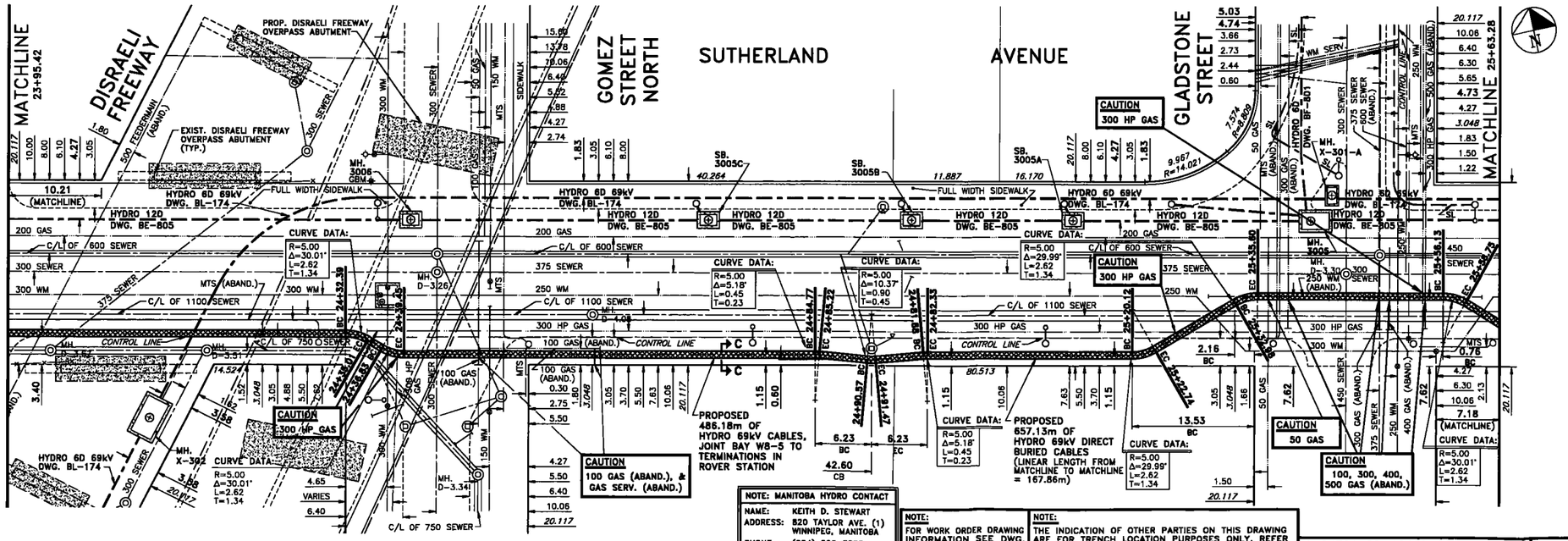
TITLE: 69kV U/G INTERCONNECTION
W8 CIRCUIT
PROPOSED LOCATION OF HYDRO UNDERGROUND 69kV INTERCONNECTION BETWEEN BURROWS (12) SUBSTATION AND ROVER (3) SUBSTATION
BURROWS SUBSTATION TO ROVER SUBSTATION
NORTH AREA

Manitoba Hydro

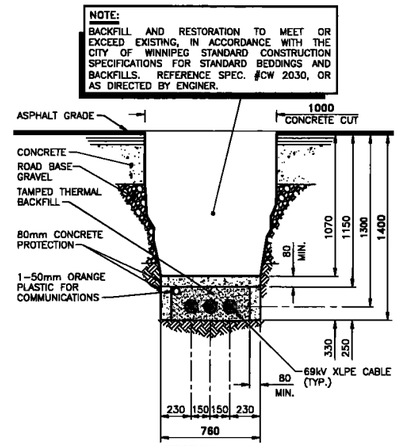
SHEET 1 OF 19
WINNIPEG CENTRAL DRAWING # DB0114
REVISION 00

DB0114



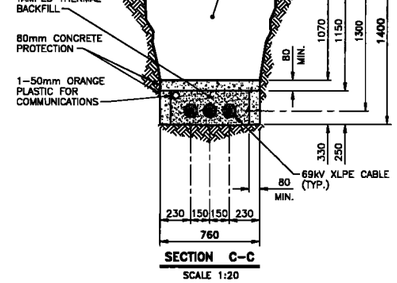


NOTE: BACKFILL AND RESTORATION TO MEET OR EXCEED EXISTING, IN ACCORDANCE WITH THE CITY OF WINNIPEG STANDARD CONSTRUCTION SPECIFICATIONS FOR STANDARD BEDDINGS AND BACKFILLS. REFERENCE SPEC. #CW 2030, OR AS DIRECTED BY ENGINEER.



SECTION A–A
SCALE 1:20

NOTE: BACKFILL AND RESTORATION TO MEET OR EXCEED EXISTING, IN ACCORDANCE WITH THE CITY OF WINNIPEG STANDARD CONSTRUCTION SPECIFICATIONS FOR STANDARD BEDDINGS AND BACKFILLS. REFERENCE SPEC. #CW 2030, OR AS DIRECTED BY ENGINEER.



SECTION C–C
SCALE 1:20

KEY PLAN
SCALE 1:15000

NOTE: MANITOBA HYDRO CONTACT
NAME: KEITH D. STEWART
ADDRESS: 820 TAYLOR AVE. (1) WINNIPEG, MANITOBA
PHONE: (204) 226-3888

NOTE: FOR WORK ORDER DRAWING INFORMATION SEE DWG. 1-04708-DE-50000-0448

NOTE: THE INDICATION OF OTHER PARTIES ON THIS DRAWING ARE FOR TRENCH LOCATION PURPOSES ONLY. REFER TO THE OTHER PARTY'S DRAWINGS FOR DESIGN DETAILS.

EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED
	WATERMAIN (WM)			HYDRANT				
	WWS			VALVE				
	GAS			HYDRO POLE				
	MTS/UNITEL/AT&T/SHAW			LIGHT STANDARD				
	TRAFFIC SIGNALS (TS)			SEWER MANHOLE				
	PROPERTY LINE			CATCH BASIN				
	LOT LINE			CURB INLET				
	CURB			SURVEY BAR		232.12	ELEVATION	232.12
	STREET LIGHTING (SL)			HYDRO MANHOLE		EXIST. LAT	HYDRO	PROPOSED
	HYDRO							

LOCATIONS APPROVED UNDERGROUND STRUCTURES

SUPV U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT ALL GIVEN LOCATIONS ARE EXACT CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

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ELEVATION: 231.453m

DRAWN BY: BMW — DATE: 2009 07 29
CHECKED BY:
APPROVED BY:
HORIZ: 1:250
VERT: 1:25

PRELIMINARY ONLY
PLOT GENERATED: 2012.05.02 @ 9:25 AM BY: BMW

1-04701-DD-10460-0001 0017/00 | WBS# P07663 | NETWORK# 526978

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

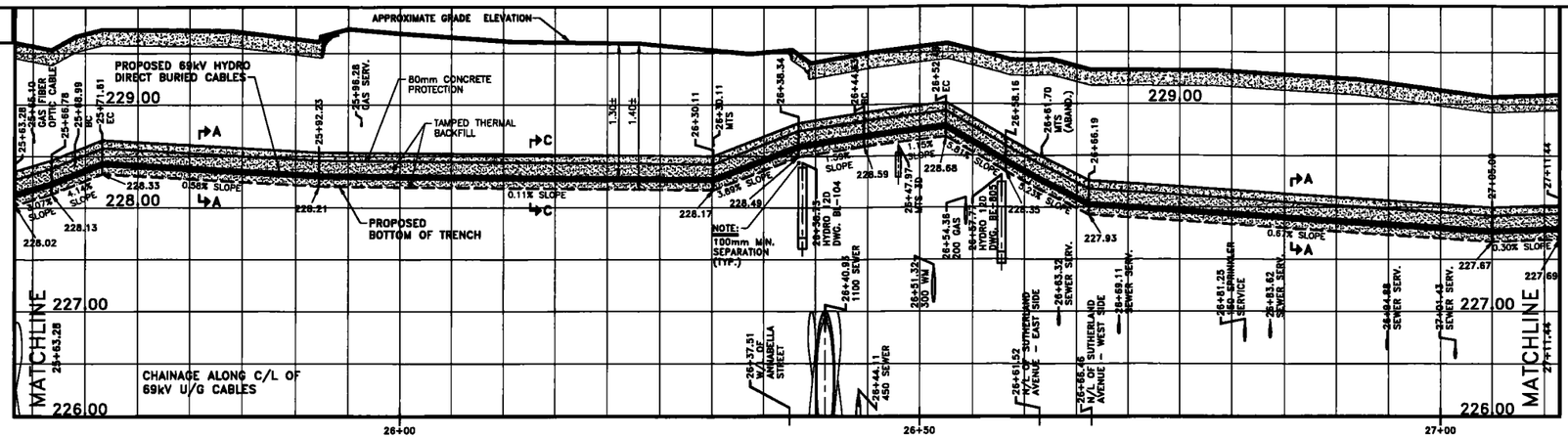
TITLE: 69kV U/G INTERCONNECTION
W8 CIRCUIT
PROPOSED LOCATION OF HYDRO UNDERGROUND 69kV INTERCONNECTION BETWEEN BURROWS (12) SUBSTATION & ROVER (3) SUBSTATION

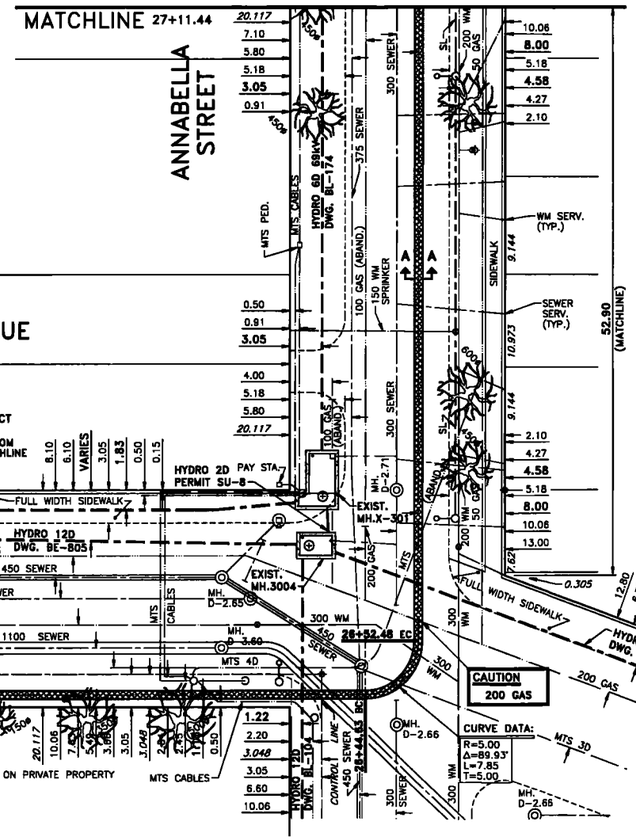
STATION 23+95.42 TO STATION 25+63.28
NORTH AREA

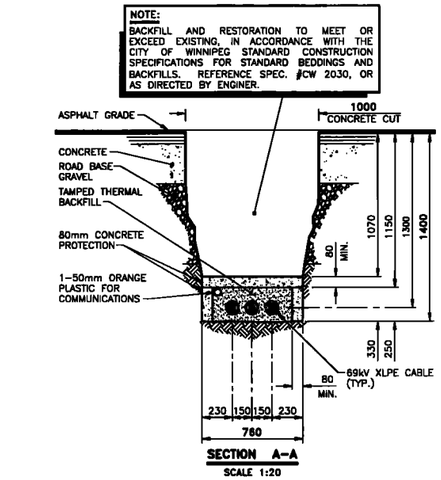
Manitoba Hydro

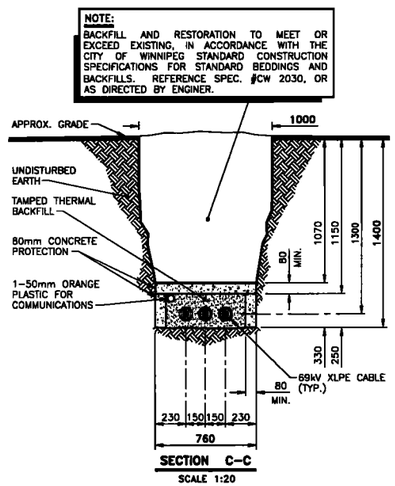
SHEET 17 OF 19
WINNIPEG CENTRAL DRAWING # DB0114 | REVISION 00

DB0114









NOTE: MANITOBA HYDRO CONTACT		NOTE:	NOTE:
NAME:	KEITH D. STEWART	FOR WORK ORDER DRAWING INFORMATION SEE DWG. 1-04708-DE-50000-0448	THE INDICATION OF OTHER PARTIES ON THIS DRAWING ARE FOR TRENCH LOCATION PURPOSES ONLY. REFER TO THE OTHER PARTY'S DRAWINGS FOR DESIGN DETAILS.
ADDRESS:	820 TAYLOR AVE. (1) WINNIPEG, MANITOBA		
PHONE:	(204) 226-3888		

1-04701-DD-10460-0001 0018/00 | WBS# P07663 | NETWORK# 526978

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

WATERMAIN (WM)			HYDRANT						
WWS			VALVE						
GAS			HYDRO POLE						
MTS/UNITEL/AT&T/SHAW			LIGHT STANDARD						
TRAFFIC SIGNALS (TS)			SEWER MANHOLE						
PROPERTY LINE			CATCH BASIN						
LOT LINE			CURB INLET						
CURB			SURVEY BAR		232.12	ELEVATION	232.12		
STREET LIGHTING (SL)					EXIST. LAT		PROPOSED		
HYDRO			HYDRO MANHOLE		EXIST. LAT	HYDRO	PROPOSED		
EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED		

LOCATIONS APPROVED
UNDERGROUND STRUCTURES

SUPV U/G STRUCTURES DATE
COMMITTEE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT ALL GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTANCE, AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

No.	REVISION	DATE	BY	APP'D.

BENCHMARK: 26-025 - NORTHWEST CORNER OF BURROWS AVENUE & AIKINS STREET, BRASS PLUG 14.4m CONCRETE PILE IN VALVE BOX, 0.3m WEST OF WEST LINE OF AIKINS STREET, 2.4m SOUTH OF NORTH LINE OF BURROWS AVENUE.
ELEVATION: 231.453m

DRAWN BY: BMW | DATE: 2009 07 29
CHECKED BY:
APPROVED BY:
HORIZ: 1:250
VERT: 1:25

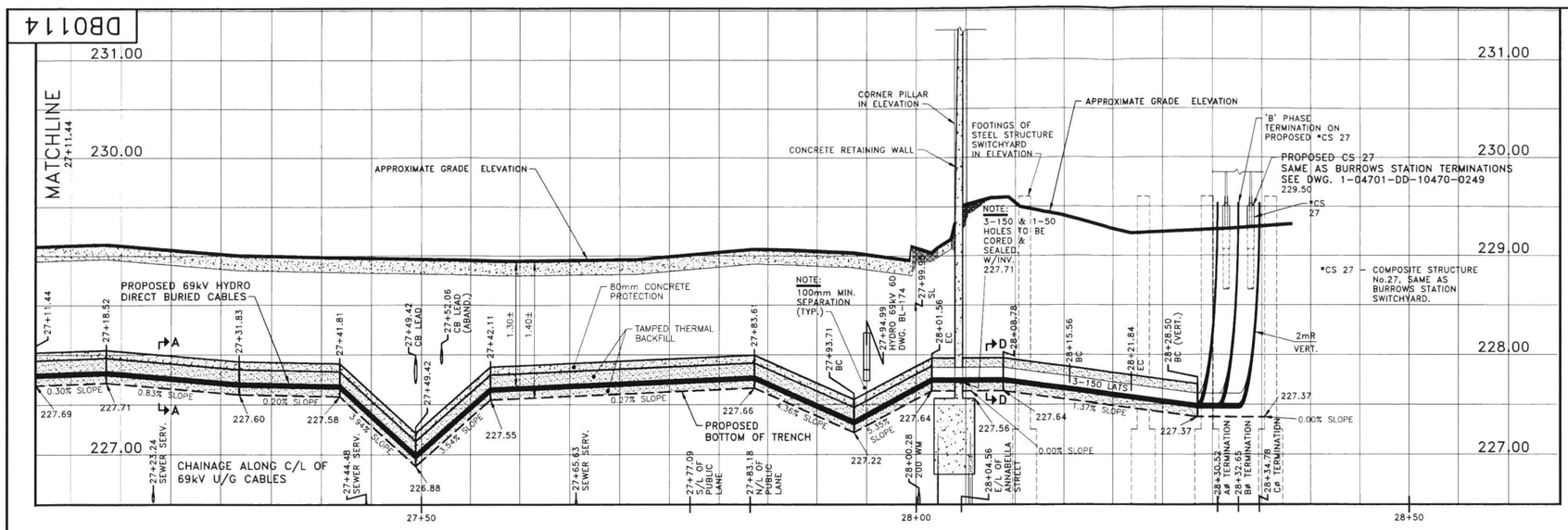
PRELIMINARY ONLY
PLOT GENERATED: 2012.05.02 @ 8:50 AM BY: BMW

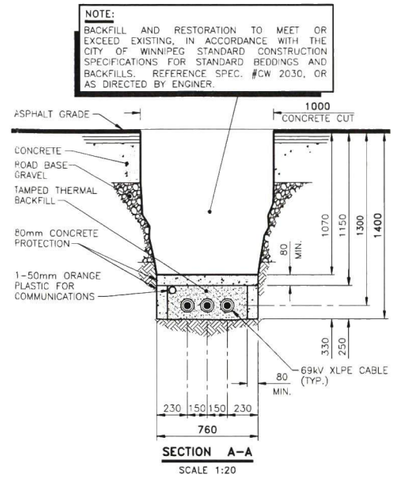
TITLE: 69kV U/G INTERCONNECTION
W8 CIRCUIT
PROPOSED LOCATION OF HYDRO UNDERGROUND 69kV INTERCONNECTION BETWEEN BURROWS (12) SUBSTATION & ROVER (3) SUBSTATION
STATION 25+63.28 TO STATION 27+11.44
NORTH AREA

Manitoba Hydro

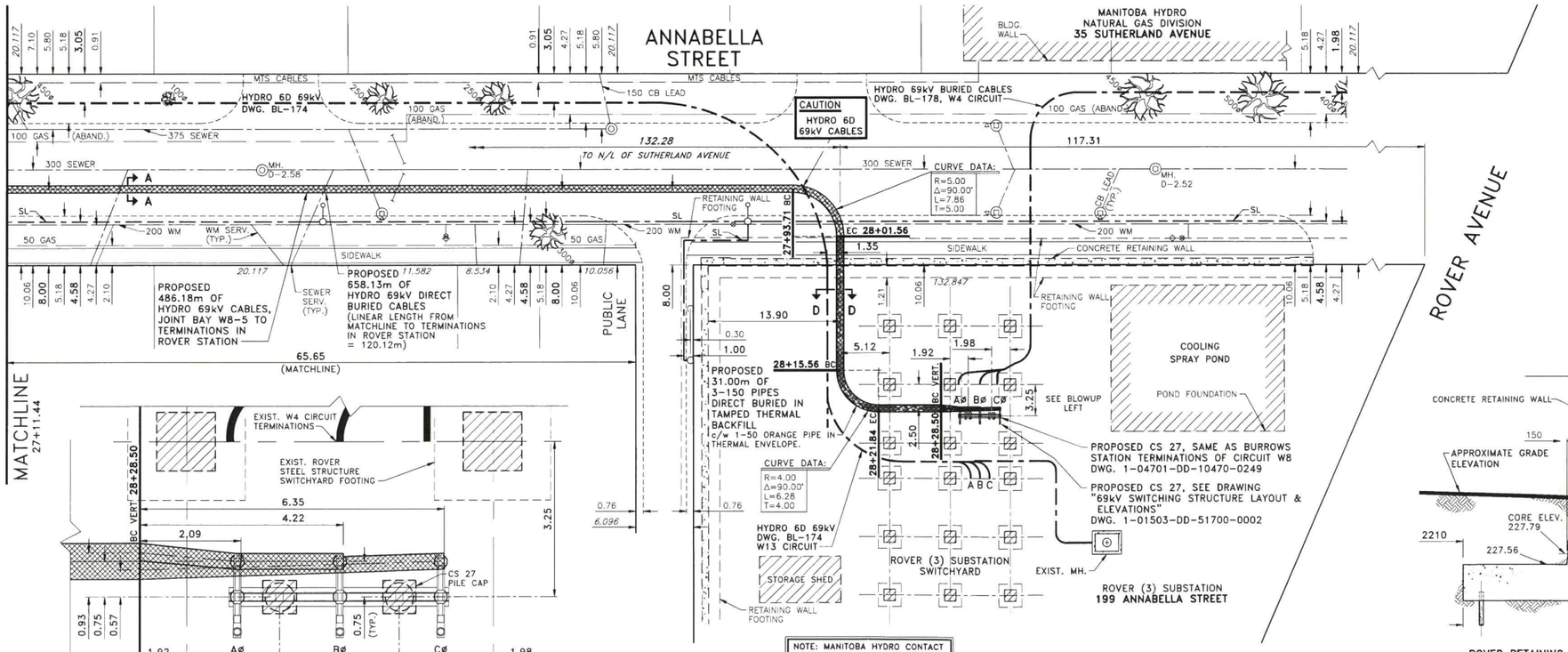
SHEET 18 OF 19
WINNIPEG CENTRAL DRAWING # DB0114
REVISION 00

DB0114

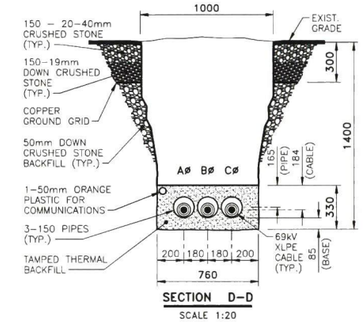




SECTION A-A
SCALE 1:20



ROVER BLOWUP
SCALE 1:50



SECTION D-D
SCALE 1:20

ROVER RETAINING WALL SECTION
SCALE 1:50

KEY PLAN
SCALE 1:15000

NOTE: MANITOBA HYDRO CONTACT
NAME: KEITH D. STEWART
ADDRESS: 820 TAYLOR AVE. (1) WINNIPEG, MANITOBA
PHONE: (204) 226-3888

NOTE: FOR WORK ORDER DRAWING INFORMATION SEE DWG. 1-04708-DE-50000-0448

NOTE: THE INDICATION OF OTHER PARTIES ON THIS DRAWING ARE FOR TRENCH LOCATION PURPOSES ONLY. REFER TO THE OTHER PARTY'S DRAWINGS FOR DESIGN DETAILS.

EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED
	WATERMAIN (WM)			HYDRANT				
	WWS			VALVE				
	GAS			HYDRO POLE				
	MTS/UNITEL/AT&T/SHAW			LIGHT STANDARD				
	TRAFFIC SIGNALS (TS)			SEWER MANHOLE				
	PROPERTY LINE			CATCH BASIN				
	LOT LINE			CURB INLET				
	CURB			SURVEY BAR		232.12	ELEVATION	232.12
	STREET LIGHTING (SL)			HYDRO MANHOLE		EXIST. LAT	HYDRO	PROPOSED
	HYDRO							

LOCATIONS APPROVED
UNDERGROUND STRUCTURES

SUPV U/G STRUCTURES DATE
COMMITTEE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT ALL GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTANCE, AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

No.	REVISION	DATE	BY	APP'D.

BENCHMARK: 26-025 - NORTHWEST CORNER OF BURROWS AVENUE & AIKINS STREET, BRASS PLUG 14.4m CONCRETE PILE IN VALVE BOX, 0.3m WEST OF WEST LINE OF AIKINS STREET, 2.4m SOUTH OF NORTH LINE OF BURROWS AVENUE.
ELEVATION: 231.453m
DRAWN BY: BMW
DATE: 2009 07 29
CHECKED BY:
APPROVED BY:
HORIZ: 1:250
VERT: 1:25

PRELIMINARY ONLY
PLOT GENERATED 2012.05.03 @ 8:37 AM BY BMW

1-04701-DD-10460-0001 0019/00
WBS# P07663 | NETWORK# 526978

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

TITLE: 69kV U/G INTERCONNECTION
W8 CIRCUIT
PROPOSED LOCATION OF HYDRO UNDERGROUND 69kV INTERCONNECTION BETWEEN BURROWS (12) SUBSTATION & ROVER (3) SUBSTATION
STATION 27+11.44 TO STATION 28+32.65
NORTH AREA

Manitoba Hydro

SHEET 19 OF 19
WINNIPEG CENTRAL DRAWING# DB0114
REVISION 00

APPENDIX B

TEST HOLE LOGS

CH2M HILL ENGINEERING LTD.

MONITORING WELL & CONSTRUCTION LOG

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

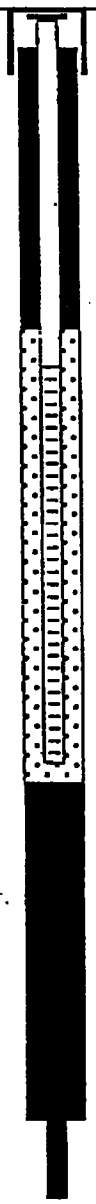
CLIENT NAME: CENTRA GAS Manitoba Inc.
LOCATION: 35 Sutherland Ave. Winnipeg, Man.
DATE DRILLED: September 29, 1993
LOGGER: R. Stacey
DRILL COMPANY: Paddock Drilling Ltd.

DRILLING METHOD: CT250, Hollow-stem Augers
ELEVATION: Surface Elevation: 229.440 (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	<8.2	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					
	SS7	<20	VC		–high silt content, saturated, some clay, napthalene odour, black staining
7					
8	SS8	NA	VC		–wet, fine silty sand, high silt content, some clay, black staining and strong napthalene odour
	SS9	<3	TC		–grey, fine silty sand, wet, less black staining and less napthalene odour than above
9					
					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 bentonoite 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.

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

SURFACE ELEVATION (M) : 229.53

TOTAL DEPTH (M): 9.14

EASTING : NA

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
					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	<1	NC		TOPSOIL (0.76 m) -grass surface, stressed vegetation in area and black staining at surface
1	CS2	0.2	NC		-orange-brown, dry, non cohesive, sandy silt, high organics content
					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
2	CS3	0.1	NC		SANDY SILT FILL (1.52 m to 3.81 m)
	CS4	<2	VC		-brown, moist, soft sandy silt fill, no gravel, no odour or staining , oxidized (CS3)
3					-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
4	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
	CS8	<13	VC		-silty fine sand, wet, black staining, bedded, napthalene odour
6					
7					
8	CS9	<1.4	TC		-as above, some sandy silt with silty sand seams
	CS10	<0.4	NC		SILTY CLAY (8.38 m to 9.14 m) -grey, moist, stiff, cohesive, plastic, very faint napthalene odour, no staining
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.

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-30
LOCATION: Centra training facility - outside roll-up doors		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: ACKER MP-5 c/w 150mm Hollow Stem	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Pulse Flag (ppm) 10 100 1000 / HNu Reading (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - trace gravel, trace sand - black - soft to firm, moist - medium plasticity - organic odor		G269 G270 S271		- PAH, Metals Analyses	0
3		CLAY - silty, trace gravel, trace fine sand, trace silt inclusions, trace black organic inclusions - brown - soft to firm, moist - medium plasticity - slight nuggety structure -some black organic, oxidation, silt, and sulphate inclusions below 3.1m -becoming firm, moist with dark grey and black laminations below 4.2m -dark grey to black with diesel fuel odor below 4.6m -becoming brown, soft, and moist to wet below 4.7m -moist with some oxides, trace black organic inclusions (<9mm diameter), and trace fine sand below 4.9m -silty, trace fine sand seams (<3mm thick), trace oxides, mottled brown, grey and reddish brown, soft, and moist to wet below 6.1m -sandy from 6.3 to 6.4m -becoming grey, soft to firm, and moist below 8.2m -13mm thick silt seam below 8.5m -dark grey with black staining and medium to high plasticity below 9.1m -trace gravel, soft, wet, and medium plasticity from 9.5 to 9.8m -becoming firmer and drier with depth -50mm thick loose, wet, and oxidation stained sand seam below 10.1m -silty, trace black inclusions, dark grey to black, soft to firm, moist, and medium to high plasticity below 10.7m -trace gravel and silt till inclusions (<15mm diameter) below 11.9m		S272 S273 S274 S275 S276 S277 S278		- BTEX, PHC Analyses - BTEX, PHC Analyses	3
12		CLAY (Till) - trace to some sand and gravel - light grey - soft, moist - low plasticity					12
13		SILT (Till) - trace to some sand and gravel, loose, wet, non-plastic					13
14		END OF TEST HOLE AT 13.7m IN SILT TILL					14
18							18

uma

LOGGED BY: Darryl Schmidt	COMPLETION DEPTH: 13.72 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/05/01
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND_UPLAND.GPJ UMA.GDT 03/02/04

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-31
LOCATION: Centra training facility - north east employee parking lot		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: ACKER MP-5 c/w 150mm Hollow Stem	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ⊠ SPLIT SPOON ▤ BULK ◪ NO RECOVERY ▥ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Petro Flag (ppm) 10 100 1000 / 10.6eV Reading (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - trace sand, trace organics - black - firm to stiff, moist - low to medium plasticity - organic odor		S279			0
1				S280			1
2		-silty and sandy below 1.5m - solvent odor from 1.5 to 2.1m -trace silt inclusions (<50mm diameter) and dark brown to black below 2.1m		S281		- PAH, Metals Analyses	2
3		CLAY - silty, trace fine sand, trace silt inclusions (<5mm diameter) - mottled brown and black - firm, moist - medium plasticity					3
4		-trace black organic inclusions, brown, soft to firm, moist, and nuggely structure below 3.1m		S282			4
5		-trace oxidation inclusions below 4.6m					5
6		-mottled brown, grey, and reddish brown below 5.2m		S283			6
7		-some sand and brown to dark brown below 6.1m		S284			7
8		-wet from 6.7 to 7.0m					8
9		-soft and moist to wet below 7.6m		S285			9
10		-50mm thick fine gravel seam below 8.8m -trace gravel and silt till inclusions below 9.1m		S286			10
11		END OF TEST HOLE AT 10.7m IN CLAY.					11
12							12
13							13
14							14
15							15
16							16
17							17
18							

uma

LOGGED BY: Darryl Schmidt	COMPLETION DEPTH: 10.67 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/05/01
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND_UPLAND.GPJ UMA.GDT 09/23/04

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-35
LOCATION: East side of Annabella, 3 m south of streetlight, 12 m north of gate		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: CT250 c/w 150mm Hollow Stem	ELEVATION (m): 229.24

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Petro Flag (ppm) 10 100 1000 / Hnu Reading (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		TOPSOIL - silt and sand, some clay, some organics, black, dry					229
		FILL					
1		- silty clay, trace sand, trace gravel, trace organics, light brown, moist		G317		- Metals Analysis	
				G318			228
2				G319			227
				G320			
3		SILTY CLAY					226
		- trace organics, light brown, moist to wet					
		- silt inclusions, sulphate precipitate inclusions					
		- grey-black staining, product sheen, strong odour		G321			
4		- becoming sandy and wet at 3.8 metres					225
				G322		- BTEX, PHC, PAH, Alkyl PAH Analyses	
		SAND - and silt, light brown, wet					
5		- grey to black staining, strong odour					224
		SILTY CLAY - grey to black staining, wet		G323			
		SAND					
6		- and silt, light brown, wet		G324		- BTEX, PHC, PAH Analyses	223
		- end of grey-black staining at 5.5 metres					
		SAND					
7		- brown, loose, medium-grained, wet					222
		SILT - some clay, grey, soft, wet		G325			
8		SAND - brown, loose, medium-grained, wet					221
		- 0.2 metre silty clay layers present from 7.6 metres to 8.4 metres		G326			
9				G327			220
		End of test hole in Sand @ 9.1 metres below ground surface					
10							219
11							218
12							217
13							216
14							215
15							214
16							213
17							212
18							

uma

LOGGED BY: Rebecca McMillan	COMPLETION DEPTH: 9.14 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/10/23
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND_UPLAND.GPJ UMA.GDT 03/02/24

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-36
LOCATION: East side of Annabella, southwest corner of Winnipeg Hydro wall 1.5 m north of curb		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: CT250 c/w 150 mm Hollow Stem	ELEVATION (m): 229.149

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ☑ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Flourescence (ppm) / Paint Flag (ppm) / STARS Reading (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		FILL - clay and silt, trace sand, trace organics, trace stones, trace rubble, brown to black, soft to firm, dry		G328			229
1				G329			228
		- becoming moist below 1.5 metres					
2				G330			227
3		SAND - and silt, light brown, loose, moist		G331			226
4		SILT - and sand, trace clay, moist to wet - grey to black staining from 3.7 metres to 4 metres		G332 G333		- BTEX, PHC, PAH, Alkyl PAH Analyses	225
5		CLAY - with silt, some fine sand, wet - grey to black staining, odour - black staining from 4.9 metres to 5.5 metres, odour		G334			224
6				G335			223
7		SAND - with silt, grey, loose, wet		G336			222
		CLAY - silty, grey, still, wet		G337			
8		End of test hole in Clay @ 7.6 metres below ground surface					221
9							220
10							219
11							218
12							217
13							216
14							215
15							214
16							213
17							212
18							

uma

LOGGED BY: Rebecca McMillan	COMPLETION DEPTH: 7.62 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/10/23
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENT - SUTHERLAND_UPLAND.GPJ UMA.GDT 03/02/24

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-37
LOCATION: East side of Annabella, 8 m south of street light (159 Annabella)		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: CT250 c/w 150 mm Hollow Stem	ELEVATION (m): 229.307

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Petro Flag (ppm) 10 100 1000 / Hnu Reading (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		FILL - clay and silt, trace sand, trace stones, trace rubble, dry		G338			229
1				G339			228
2		CLAY - silty, light brown, stiff to firm, moist - sulphate precipitate inclusions throughout, laminated structure		G340			227
3		- structure becoming massive below 3 metres - reduced sulphate precipitate inclusions with depth		G341			226
4				G342			225
5				G343			224
6		- no sulphate precipitate inclusions below 6.1 metres - becoming grey below 21 metres		G344			223
7				G345			222
8		End of test hole in Clay @ 7.6 metres below ground surface		G346		- BTEX, PHC, PAH Analyses -	221
9				G347			220
10							219
11							218
12							217
13							216
14							215
15							214
16							213
17							212
18							

uma

LOGGED BY: Rebecca McMillan	COMPLETION DEPTH: 7.62 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/10/23
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND_UPLAND.GRJ UMA.GDT 03/02/04

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-39
LOCATION: East side of Gladstone, 30 m south of Sutherland		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: CT250 c/w 150 mm Hollow Stem	ELEVATION (m): 229.938

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ⊠ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ▯ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Petro Flag (ppm) 10 100 1000 / Hnu Reading (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		FILL - clay and silt, trace organics, black to grey, stiff, dry					229
1				G358			
				G359			
2		CLAY - silty, light brown, firm to stiff, moist - sulphate precipitate inclusions					228
				G360			
3				G361			227
4		- grey to black staining, strong odour		G362		- BTEX, PHC, PAH Analyses	226
				G363			
5		- no staining or odour below 5.2 metres		G364			225
6		- becoming soft, trace fine sand below 5.8 metres		G365			224
		SAND - silty, light brown, wet					
7		CLAY - silty, light brown, soft - sulphate precipitate inclusions		G366			223
				G367			
8		End of test hole in Clay at 7.6 metres below ground surface					222
9							221
10							220
11							219
12							218
13							217
14							216
15							215
16							214
17							213
18							

uma

LOGGED BY: Rebecca McMillan	COMPLETION DEPTH: 7.62 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/10/23
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND UPLAND.GPJ UMA.GDT 03/02/04

PROJECT: Centra Gas Facility Investigation	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-44
LOCATION: West side of Gladstone, 8 m northeast of driveway of 144 Gladstone		PROJECT NO.: 0217-158-02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: CT250 c/w 150 mm Hollow Stem	ELEVATION (m): 229.612

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Fluorescence (ppm) 10 100 1000 / Petro Flag (ppm) 10 100 1000 / Hnu Reading (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		TOPSOIL - silt and sand, some clay, black, loose, dry					229
1		FILL - silty clay, brown, stiff		G407 G408			228
2		CLAY - silty, brown to grey, stiff, moist - silt inclusions		G409 G410		- BTEX, PHC, PAH Analyses	227
3							
4		- no silt inclusions, and becoming firm below 3.7 metres - trace organics, and becoming grey at 3.8 metres		G411 G412			226
5		CLAY - and silt, grey, firm, moist		G413			225
6				G414			224
7		CLAY - silty, grey, firm to soft		G415			223
8		End of test hole in Clay at 7.6 metres below ground surface		G416			222
9							221
10							220
11							219
12							218
13							217
14							216
15							215
16							214
17							213
18							212

uma

LOGGED BY: Rick Gibson	COMPLETION DEPTH: 7.62 m
REVIEWED BY: Rick Gibson	COMPLETION DATE: 02/10/25
PROJECT ENGINEER: Rick Gibson	Page 1 of 1

ENVIRONMENTAL SUTHERLAND_UPLAND.GPJ UMA.GDT 03/02/04

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW05-54
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Maple Leaf Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Vapour Reading (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0			ASPHALT - 100 mm thick GRAVEL (FILL) - sandy - brown - poorly graded, coarse grained					0
1			CLAY - some sand, trace organics inclusions - dark brown to black - damp, stiff		G1 G2 G3			1
2								2
3			CLAY -grey - moist, firm, medium plastic - staining - black at 3.1 m		G4		- noticeable odour in soil between 2.7 and 6.1 m	3
4					G5			4
5					G6 G7			5
6			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. 1. No seepage or sloughing observed during drilling. 2. Monitoring well installed in test hole upon completion.		G8			6
7								7
8								8
9								9
10								

UMA | AECOM

LOGGED BY: Darryl Schmidt	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Larry Blalus	COMPLETION DATE: 12/13/05
PROJECT ENGINEER: Edwin Yee	Page 1 of 1

ENVIRONMENTAL SUTHERLAND 05-06.GPJ UMA.GDT 12/4/06

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW05-55
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Maple Leaf Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Vapour Reading (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0			ASPHALT - 125 mm thick GRAVEL (FILL) - sandy - brown - damp, poorly graded, coarse grained					0
1			CLAY (FILL) - some organics, some sand - black - damp, stiff		G1 G2			1
2					G3		- noticeable odour in soil between 2.3 and 6.1 m	2
3					G4			3
4			CLAY - trace organics - grey/black mottled - damp, firm to stiff, medium plastic - black staining to 5.2 m		G5 G6		- soil sample submitted for BTEX, PHC fractions F1 to F4, and PAH analysis	4
5					G7			5
6			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. Notes: 1. No seepage or sloughing observed during drilling. 2. Monitoring well installed in test hole upon completion.		G8			6
7								7
8								8
9								9
10								

UMA | AECOM

LOGGED BY: Darryl Schmidt	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Larry Blaka	COMPLETION DATE: 12/13/05
PROJECT ENGINEER: Edwin Yee	Page 1 of 1

ENVIRONMENTAL SUTHERLAND 05-05.GPJ UMA.GDT 1/24/06

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW05-56
LOCATION:		PROJECT NO.: 0217 158.03 01
CONTRACTOR: Maple Leaf Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	Vapour Reading (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0			CHIPSEAL - 25 mm thick					0
			CLAY (FILL) - dark brown - damp, firm, medium plastic		G1			
1			CLAY - dark brown to black - damp to moist, firm to stiff, medium plastic		G2			1
2					G3			2
			CLAY - brown - damp to moist, stiff, medium plastic - trace oxidation - staining visible		G4		- strong odour between 3.1 and 4.6 m	
3			- stained black below 3.4 m		G5			3
4					G6			4
			- brown below 4.6 m		G7			
5					G8			5
6			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. Notes: 1. No seepage or sloughing observed during drilling. 2. Monitoring well installed in test hole upon completion.					6
7								7
8								8
9								9
10								

UMA | AECOM

LOGGED BY: Darryl Schmidt | COMPLETION DEPTH: 6.10 m

REVIEWED BY: Larry Bielus | COMPLETION DATE: 12/13/05

PROJECT ENGINEER: Edwin Yee | Page 1 of 1

ENVIRONMENTAL SUTHERLAND 05-05.GPJ UMA.GDT 12/4/06

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW58A/B
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Paddock Drilling	METHOD: 125 mm SSA/200 mm HSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PHC-F2 (ppm) 1000 1500 2000 2500 / PHC-F3 (ppm) 1000 1500 2000 2500 / Vapour Reading (ppm) 10 100 1000 10000	COMMENTS	DEPTH (m)
0				TOPSOIL - 60 mm thick CLAY (Fill) - trace silt - grey - dry to damp, high plastic		G1			0
1				CLAY - frequent silt inclusions - grey/brown mottled - damp, firm, high plastic		G2			1
2						G3			2
3						G4			3
4						G5			4
5				- brown and moist below 4.6 m		G6			5
6				- wet below 6.1 m		G7			6
7						G8	14	- soil sample submitted for BTEX, PHC fractions F1 to F4, and PAH analysis	7
8						G9			8
9				SILT TILL - gravelly, sandy - tan - wet, soft, low plastic		G10			9
10				END OF TEST HOLE AT 10.7 m BELOW GRADE IN SILT TILL. Notes: 1. Seepage observed below 6.1 m. 2. Sloughing observed below 0.9 m after removing hollow stem augers from test hole. 3. Vapour probe MW58A installed to 6.1 m upon completion. 4. Monitoring well MW58B installed to 10.7 m upon completion.		G11			10
11						G12			

UMA | AECOM

LOGGED BY: MR/AH	COMPLETION DEPTH: 10.67 m
REVIEWED BY: AM	COMPLETION DATE: 8/14/06
PROJECT ENGINEER: Tom Wingrove	Page 1 of 1

ENVIRO (VAPOUR/F2/F3) FINAL SUTHERLAND 05-08.GPJ UMA.GDT 5/1/07

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW59
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Paddock Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PHC-F2@ (ppm) 1000 1500 2000 2500 / PHC-F3@ (ppm) 1000 1500 2000 2500 / Vapour Reading @ (ppm) 10 100 1000 10000	COMMENTS	DEPTH (m)
0			TOPSOIL - 50 mm thick CLAY (Fill) - frequent silt inclusions, trace rootlets - brown - dry to damp, low to medium plastic		G1	5		0
1					G2	5		1
2			CLAY - frequent sulphate inclusions - brown - damp, firm, high plastic		G3	5		2
3			- grey with trace oxidized inclusions below 3.1 m		G4	10 20	- soil sample submitted for BTEX, PHC fractions F1 to F4, and PAH analysis	3
4					G5	5		4
5					G6	5		5
6			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. Notes: 1. No seepage or sloughing observed during drilling. 2. Vapour probe installed to 6.1 m upon completion.		G7	5		6
7					G8	5		7
8								

UMA | AECOM

LOGGED BY: MR	COMPLETION DEPTH: 6.10 m
REVIEWED BY: AM	COMPLETION DATE: 8/15/06
PROJECT ENGINEER: Tom Wingrove	Page 1 of 1

ENVIRO (VAPOUR/F2/F3) FINAL SUTHERLAND 06-08.GPJ UMA.GDT 8/1/07

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW60
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Paddock Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PHC-F2 (ppm) 1000 1500 2000 2500 / PHC-F3 (ppm) 1000 1500 2000 2500 / Vapour Reading (ppm) 10 100 1000 10000	COMMENTS	DEPTH (m)
0			TOPSOIL - 50 mm thick CLAY (FILL) - frequent sulphate inclusions, trace rootlets - brown - dry to damp, low to medium plastic - trace oxidation		G1	5		0
1					G2	28		1
2			CLAY - silty, frequent sulphate inclusions - dark brown - damp, firm, high plastic		G3	5		2
3					G4	5		3
4			- moist below 3.7 m		G5	15 15	- soil sample submitted for BTEX, PHC fractions F1 to F4, and PAH analysis	4
5					G6	5		5
6					G7	5		6
7			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. Notes: 1. No seepage or sloughing observed during drilling. 2. Vapour probe installed to 6.1 m upon completion.		G8	5		7
8								

UMA | AECOM

LOGGED BY: MR	COMPLETION DEPTH: 6.10 m
REVIEWED BY: AM	COMPLETION DATE: 8/15/06
PROJECT ENGINEER: Tom Wingrove	Page 1 of 1

ENVIRO (VAPOUR/F2/F3) FINAL SUTHERLAND 05-06.GPJ UMA.GDT 8/14/07

PROJECT: Phase II Environmental Site Assessment	CLIENT: Manitoba Hydro	TESTHOLE NO: MW01
LOCATION:		PROJECT NO.: 0217 158 03 01
CONTRACTOR: Paddock Drilling	METHOD: 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

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

DEPTH (m)	WELL INSTALLATION	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PHC-F2 (ppm) 1000 1500 2000 2500 / PHC-F3 (ppm) 1000 1500 2000 2500 / Vapour Reading (ppm) 10 100 1000 10000	COMMENTS	DEPTH (m)
0			TOPSOIL - 50 mm thick					0
			CLAY (Fill) - frequent sulphate inclusions, trace rootlets - dark brown - dry to damp, low to medium plastic - trace oxidation		G1	5		
1					G2 SS	5	- soil sample submitted for BTEX, PHC fractions F1 to F4, and PAH analysis	1
2			CLAY - frequent silt inclusions - brown - damp, firm, high plastic		G3	5		2
3					G4	5		3
4					G5	5		4
5			- moist below 4.6 m		G6	5		5
					G7	5		
6			END OF TEST HOLE AT 6.1 m BELOW GRADE IN CLAY. Notes: 1. No seepage or sloughing observed during drilling. 2. Vapour probe installed to 6.1 m upon completion.		G8	5		6
7								7
8								

UMA | AECOM

LOGGED BY: MR	COMPLETION DEPTH: 6.10 m
REVIEWED BY: AM	COMPLETION DATE: 8/15/06
PROJECT ENGINEER: Tom Wingrove	Page 1 of 1

ENVIRO (VAPOUR/F2/F3) FINAL SUTHERLAND 06-05.GPJ UMA.GDT 6/1/07

Environmental Investigation – Anabella Street to Sutherland Avenue (Gladstone Intersection)
Rover Station to Burrows Station
December 20-21, 2010

Borehole Logs

Borehole ID: TH10-01	
Depth (m)	**Soil Description**
0 - 0.3	Sand and gravel fill, frozen
0.3 – 3.05	Silty clay fill, trace pea gravel, dark brown to 1.25 m, frozen to 0.75 m
Below 1.25	Moist, firm, light brown
3.05 -4.62	Silty sand, moist to wet, soft, grey, trace petroleum hydrocarbon odour
Below 4.0	Dark brown
Note:	*End of Hole (EOH) at 4.62 m (15 ft) in sand*

Borehole ID: TH10-02	
Depth (m)	**Soil Description**
0 - 0.3	Sand and gravel fill, frozen to 1.20 m
0.3 – 0.8 m	Silty clay fill, some gravel (frozen)
0.8 – 2.52 m	Silty clay, moist, firm, brown
2.52 – 4.52 m	Silty sand, fine-grained, moist, soft, brown
Below 4.2	Sand, moist to wet, soft, grey
Note:	*End of Hole (EOH) at 4.62 m (15 ft) in sand*

Borehole ID: TH10-03	
Depth (m)	**Soil Description**
0 - 0.3	Sand and gravel fill, frozen
0.3 – 0.4	Silty clay fill, some sand, trace gravel, frozen to 0.85 m
0.4 – 3.05	Silty clay, trace silt inclusions firm, dark brown, moist below 0.85 m
Note:	*End of Hole (EOH) at 3.05 m (10 ft) in silty clay*

Borehole ID: TH10-04	
Depth (m)	**Soil Description**
0 – 0.15	Sand and gravel fill, dark brown, frozen
0.15 – 0.5	Silty clay fill, some sand, trace gravel, frozen to 0.5 m
0.5 – 3.05	Silty clay, trace silt inclusions, moist, firm, dark brown
Note:	*End of Hole (EOH) at 3.05 m (10 ft) in silty clay*

Borehole ID: TH10-05	
Depth (m)	**Soil Description**
0 – 0.1	Hot mix asphalt
0.1 – 0.15	Sand and gravel fill, dry, frozen
0.15 – 0.6	Cinder ash, some sand, black, frozen
0.6 – 3.05	Silty clay, trace cinders at 1.1 m, moist, firm
Below 2.4	Trace silt inclusions below 2.4 m, firm to stiff, light brown
Note:	*End of Hole (EOH) at 3.05 m (10 ft) in silty clay*

Borehole ID: TH10-06	
Depth (m)	**Soil Description**
0 – 0.05	Hot mix asphalt
0.05 – 0.1	Sand and gravel fill, dry, frozen
0.1 – 0.75	Cinder ash, some sand, trace petroleum hydrocarbon odour, black
0.75 – 3.05	Silty clay, some sand to 1.0 m, moist, firm, dark brown
Below 1.0	Trace silt inclusions below 1.0 m, firm to stiff, brown
Note:	*End of Hole (EOH) at 3.05 m (10 ft) in silty clay*

Borehole ID: TH10-07	
Depth (m)	**Soil Description**
0 – 0.05	Hot mix asphalt
0.05 – 0.1	Sand and gravel fill, frozen
0.1 – 0.75	Cinder ash, some gravel, some sand, dry, trace petroleum hydrocarbon odour, black
0.75 – 3.05	Silty clay, some sand to 1.0 m, moist, firm, dark brown
Below 1.0	Trace silt inclusions below 1.0 m, firm to stiff, brown
Note:	*End of Hole (EOH) at 3.05 m (10 ft) in silty clay*

Borehole ID: TH10-08	
Depth (m)	**Soil Description**
0 – 0.3	Topsoil, trace gravel, some organics, trace frost, moist, dark brown to black
0.3 – 0.75	Silty clay fill, some gravel, some sand, moist, dark brown
0.75 – 6.25	Silty clay, moist, firm, dark brown
Below 1.5	Increasing silt at 1.5 m, brown-grey below 1.5 m
Below 2.0	Trace silt inclusions below 2.0 m, stiff, light brown
Below 4.5	Increasing moisture below 4.5 m
Below 6.1	Increasing moisture below 6.1 m, grey lensing/mottling, firm
6.25 – 6.26	Silty sand seam, wet
6.25 – 7.62	Silty clay, some sand, wet, light brown, grey mottling
Note:	*End of Hole (EOH) at 7.62 m (25 ft)* *Groundwater well installed:* *Flush mount* *0 – 4.52 mbg – solid PVC schd 40 pipe; bentonite to 4.3 mbg* *7.62 – 4.52 mbg – screened PVC schd 40 pipe, slot 10; silica sand to 4.3 m*

APPENDIX C

CHEMICALLY RESISTANT LINER SPECIFICATION SHEET

LAYFIELD
Product Cut Sheet

Enviro Liner 4000

1. Product Description

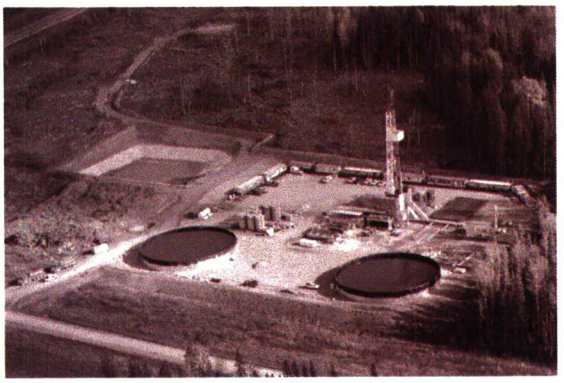
The Enviro Liner® 4000 series is a specialized polyethylene lining material that combines flexibility, UV stability, and chemical resistance. The Enviro Liner® 4000 series was originally designed as a flexible cap material for landfills. Its good flexibility allows it to accomodate differential settlement that is often seen in landfill applications. This flexibility also allows it to be prefabricated (welded, folded and rolled) so that many jobs can be lined using a one-piece liner. The Enviro Liner® 4000 series is manufactured by Layfield. Each step in the production of your liner panel, from the geomembrane production, to fabrication into a custom panel, is governed by Layfield's registered quality management system. Enviro Liner® 4000 is stabilized against UV degradation with carbon black. If you plan to leave the liner exposed then the additional UV stabilizers that we add to the Enviro Liner® 6000^{HD} series might be of interest to you to maximize the exposed life of the liner.

2. Technical Data

Materials information is on page 2.

3. Installation

Layfield's LLDPE is flexible enough to be prefabricated at our facility into large panels (Up to 27,000 square feet at 30 mil). The prefabricated panel is accordian folded, rolled on a core, and delivered to the job site secured to a pallet. Prefabricated panels can often cover a small project with a single panel. Local labor forces can be used to unroll and unfold the panel, while on larger projects layfield installation forces can be used to join panels. Layfield has spent years developing innovative thin film seaming technology. All of our primary field welding of LLDPE is based on hot wedge welding technology. Field wedge welding of LLDPE provides strong seams, and fast installations on large projects. Small welds and repairs can be completed with the Enviro Liner welding kit. Ask us about our Enviro Liner® Welding Gun for small repairs.



4. Availability and Cost

Available from Layfield or distributors. Call
425-254-1075 Pacific time
780-453-6731 Mountain time, or
905-761-9123 Eastern time

5. Manufactured By

Layfield Environmental Systems Corp.
Layfield Geosynthetics & Ind. Fabrics Ltd.

6. Warranty

Products sold will meet Layfield's published specifications. Any extended warranty required by the buyer must be negotiated at the time of order. Extended warranties may be available on this product and may be at extra cost. Full warranty details are available from Layfield.

7. Maintenance

Geomembranes should be inspected at least once per year for damage, stress, or any other detrimental condition. The entire containment area should be visually inspected annually. Layfield provides geomembrane maintenance services on request.

8. Filing Systems

www.LayfieldGroup.com
www.geomembranes.com

9. Enviro Liner 4000 Material Properties

19 Nov 2011	Enviro Liner® 4000 Minimum Properties			
Style	**ASTM**	**Enviro Liner® 4020**	**Enviro Liner® 4030**	**Enviro Liner® 4040**
Thickness (Minimum Average)	D5199	20 mil 0.5 mm	30 mil 0.75 mm	40 mil 1.0 mm
Thickness (Lowest Individual of 10 values)	D5199	-10%	-10%	-10%
Density (Max)	D792	0.939	0.939	0.939
Tensile Strength at Break	D638 Type IV	76 ppi 13.3 N/mm	114 ppi 20.0 N/mm	152 ppi 26.6 N/mm
Elongation	D638	800%	800%	800%
Tear Resistance	D1004	11 lbs 49 N	16 lbs 71 N	22 lbs 98 N
Puncture Resistance	D4833	32 lbs 142 N	42 lbs 186 N	61 lbs 271 N
Carbon Black Content	D1603	2.0-3.0%	2.0-3.0%	2.0-3.0%
Low Temperature Impact Resistance	D746	-69°F -56°C	-69°F -56°C	-69°F -56°C

10. Shop Seam Strengths

19 Nov 2011	Enviro Liner® 4000 Minimum Shop Seam Strengths			
Style	**ASTM**	**Enviro Liner® 4020**	**Enviro Liner® 4030**	**Enviro Liner® 4040**
Heat Bonded Seam Strength	D6392 25.4 mm (1") Strip	30 ppi 5.15 N/mm	45 ppi 7.75 N/mm	60 ppi 10.35 N/mm
Heat Bonded Peel Adhesion Strength	D6392 25.4 mm (1") Strip	FTB 25 ppi 4.3 N/mm	FTB 38 ppi 6.53 N/mm	FTB 50 ppi 8.62 N/mm

11. Field Seam Strengths

19 Nov 2011	Enviro Liner® 4000 Minimum Field Seam Strengths			
Style	**ASTM**	**Enviro Liner® 4020**	**Enviro Liner® 4030**	**Enviro Liner® 4040**
Heat Bonded Seam Strength	D6392 25.4 mm (1") Strip	30 ppi 5.15 N/mm	45 ppi 7.7 N/mm	60 ppi 10.35 N/mm
Heat Bonded Peel Adhesion Strength	D6392 25.4 mm (1") Strip	FTB 25 ppi 4.2 N/mm	FTB 38 ppi 6.5 N/mm	FTB 50 ppi 8.6 N/mm

APPENDIX D

VAPOUR SUPPRESSION PRODUCT INFORMATION

781-482-7900 Contact Us

SEARCH

BIOSOLVE®

HOME APPLICATIONS PRODUCT & TECHNOLOGY HOW TO BUY OUR COMPANY NEWS

A Trusted Solution for Hydrocarbon Cleanup for Over 30 Years

Vapor Suppression & Odor Control

BioSolve® offers a safe, simple and cost effective method of suppressing fugitive VOC emissions from hydrocarbon contaminated soils. BioSolve® works by encapsulating hydrocarbons and reducing their vapor pressure, thus allowing work to continue unabated.

Contractors have been using BioSolve® for vapor suppression on worksites for over twenty years.

- On excavation piles or other soil (e.g., sidewalls) that will remain undisturbed, a single application of BioSolve® to the exposed surfaces may last 10 – 14 days.
- In most cases a 3% solution of BioSolve® will be adequate to keep vapor emissions within acceptable limits and control odor problems on contact.
- Experience has shown that BioSolve is easy to use, economical and effective

BioSolve® has numerous advantages over alternative approaches such as sprayed foam:

- can be applied in wet or windy conditions,
- can be applied on vertical surfaces,
- can be applied during active excavation operations, and
- requires no special equipment beyond standard tanks and spray equipment.

The use of plastic covers for vapor suppression can be effective for stockpiles, but must be removed for access, exposing workers to VOCs.

Contact The BioSolve® Company to receive a more detailed InfoSheet on this application.

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SEARCH

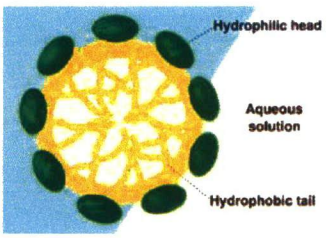
BIOSOLVE®

A Trusted Solution for Hydrocarbon Cleanup for Over 30 Years

Understanding Surfactants

BioSolve is a proprietary, water-based blend of non-ionic and anionic surfactants, and other additives specifically formulated to provide unique benefits for the mitigation of hydrocarbons.

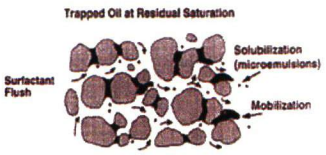
Surfactants are compounds that lower the surface tension of liquids, allowing easier spreading or "wetting" and lower the interfacial tension between two liquids (such as oil and water). These functional characteristics are attributable to the structure of the surfactant molecule, which includes a hydrophilic (water loving) "head" and a hydrophobic (water averse) "tail."



As illustrated in the adjacent figure, surfactant molecules have the tendency to create micelles – spherical structures that can completely encapsulate a microscopic oil droplet so that it will be readily emulsified in an aqueous solution.

The BioSolve formulation was specifically optimized to achieve this encapsulation and emulsification for crude oil and hydrocarbons.

The ability to emulsify hydrocarbons through the creation of micelles is what enables BioSolve to be effective in a wide range of applications involving eliminating or mitigating the presence of hydrocarbons.



BioSolve has been tested under laboratory and field conditions for over 30 years, providing consulting engineers, regulators and contractors with a high level of confidence in its performance.

BioSolve Technical Data

Freeze Temperature: 28°F	**Odor:** Pleasant Fragrance
Freeze Harm: None (may require stirring)	**Flammability:** None
Boiling Point: 265°F	**Health:** Minor Skin Irritant (NCIS Rated 1)
Specific Gravity: 1.00 +/- .01	**Density:** 8.38 pounds per gallon
Surface Tension: 29.1 dyne/cm @ 25°F	**Viscosity (Concentrate):** 490 centipoise
pH: 9.1 +/- 0.3 (depending on dilution water)	**Viscosity (6% Solution):** 15 centipoise
Solvent for Cleanup: Water	**Color:** Clear Liquid or Dyed Red
Shelf Life: Unlimited - Unopened	**DOT Class:** Not Regulated

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MATERIAL SAFETY DATA SHEET

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E-Mail: info@biosolve.com
Web Site: www.biosolve.com

Ref. No.: 2001
Date: 07-01-2011

SECTION I - IDENTITY

Name:	**BioSolve® Pinkwater®**
CAS #:	138757-63-8
Formula:	Proprietary
Chemical Family:	Water Based, Biodegradable, Wetting Agents & Surfactants
HMIS Code:	Health 1, Fire 0, Reactivity 0
HMIS Key:	4 = Extreme, 3 = High, 2 = Moderate, 1 = Slight, 0 = Insignificant

SECTION II - HAZARDOUS INGREDIENTS

Massachusetts Right to Know Law or 29 C.F.R. (Code of Federal Regulations) 1910.1000 require listing of hazardous ingredients.

This product does not contain any hazardous ingredients as defined by CERCLA, Massachusetts Right to Know Law and California's Prop. 65.

DOT Class: Not Regulated/Non Hazardous

SECTION III - PHYSICAL - CHEMICAL CHARACTERISTICS

Boiling Point	: 265°F	Specific Gravity	: 1.00 +/-.01
Melting Point	: 32°F	Vapor Pressure mm/Hg	: Not Applicable
Surface Tension- 6% Solution	: 29.1 Dyne/cm at 25°C	Vapor Density Air = 1	: Not Applicable
Reactivity with Water	: No	Viscosity - Concentrate	: 490 Centipoise
Evaporation Rate	: >1 as compared to Water	Viscosity - 6% Solution	: 15 Centipoise
Appearance	: Clear Liquid unless Dyed	Solubility in Water	: Complete
Odor	: Pleasant Fragrance	pH	: 9.1+/-.3
Pounds per Gallon	: 8.38		

SECTION IV - FIRE AND EXPLOSION DATA

Special Fire Fighting Procedures	: None	Flammable Limit	: None
Unusual Fire and Explosion Hazards	: None	Auto Ignite Temperature	: None
Solvent for Clean-Up	: Water	Fire Extinguisher Media	: Not Applicable
Flash Point	: None		

SECTION V - SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be taken in Handling and Storage: Use good normal hygiene.
Precautions to be taken in case of Spill or Leak -

Small spills, in an undiluted form, contain. Soak up with absorbent materials.
Large spills, in an undiluted form, dike and contain. Remove with vacuum truck or pump to storage/salvage vessel. Soak up residue with absorbent materials.

Waste Disposal Procedures -

Dispose in an approved disposal area or in a manner which complies with all local, provincial, and federal regulations.

SECTION VI - HEALTH HAZARDS

Threshold Limit Values: Not applicable
Signs and Symptoms of Over Exposure-

Acute : Moderate eye irritation. Skin: Causes redness, edema, drying of skin.
Chronic: Pre-existing skin and eye disorders may be aggravated by contact with this product.

Medical Conditions Generally Aggravated by Exposure: Unknown
Carcinogen: No
Emergency First Aid Procedures -

Eyes: Flush thoroughly with water for 15 minutes. Get medical attention.
Skin: Remove contaminated clothing. Wash exposed areas with soap and water. Wash clothing before reuse. Get medical attention if irritation develops.
Ingestion: Get medical attention.
Inhalation: None considered necessary.

SECTION VII - SPECIAL PROTECTION INFORMATION

Respiratory Protection	: Not necessary	Local Exhaust Required	: No, except in confined space as required.
Ventilation Required	: Normal	Protective Clothing	: Neoprene or other chemical resistant gloves, safety goggles or chemical face shield. Wash clothing before reuse.

WHEN UTILIZED IN CONFINED SPACE OPERATIONS, ADDITIONAL PPE MAY BE REQUIRED AS PER OSHA GUIDELINES.

SECTION VIII - PHYSICAL HAZARDS

Stability	: Stable	Incompatible Substances	: None Known
Polymerization	: No	Hazardous Decomposition Products	: None Known

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SECTION IX - TRANSPORT & STORAGE

DOT Class	: Not Regulated/Non Hazardous		
Freeze Temperature	: 28°F	Storage	: 35°F-120°F
Freeze Harm	: None (thaw & stir)	Shelf Life	: Unlimited Unopened

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SECTION X - REGULATORY INFORMATION

The Information on this Material Safety Data Sheet reflects the latest information and data that we have on hazards, properties, and handling of this product under the recommended conditions of use. Any use of this product or method of application, which is not described on the Product label or in this Material Safety Data Sheet, is the sole responsibility of the user. This Material Safety Data Sheet was prepared to comply with the OSHA Hazardous Communication Regulation and Massachusetts Right to Know Law.