Government of Northwest Territories
Phase I and II Environmental Site Assessment, Fort Providence Ferry Landings - Fort Providence, NWT

Final Report

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Phase I and II Environmental Site Assessment, For Providence Ferry Landings, Fort Providence, NWT

Government of the Northwest Territories

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Submitted by
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EXECUTIVE SUMMARY

A Phase I and II Environmental Site Assessment (ESA) was conducted for the ferry landings at Fort Providence, NWT. The site is owned by the Government of the Northwest Territories.

The Phase I and II ESA was required in the context of the proposed bridge development over the Mackenzie River.

The first part of the investigation included a historic literature review of site activities, regulatory search of historic activities, examination of aerial photos, interviews, and a site reconnaissance visit.

A total of six (6) interviews were conducted of people familiar with the site history. A regulatory search indicated that two (2) fuel spills had occurred at the site in 1990 and 1991.

At the time of the site inspection, the property was used as a ferry landing for the connection of Highway 3 across the Mackenzie River. The property consists of two (2) distinct sites, the northern and southern ferry landings. The subsurface consists mainly of clay fill constructed offshore as a docking area for the ferry. The only utilities at the site are an underground electrical cable powering four (4) lamp posts and two (2) floodlights located on the southern landing. Two (2) winch houses and an electrical power house are the only structures on the southern landing. A single power house exists on the northern landing.

A total of seven (7) areas of potential environmental concern were identified during the Phase I ESA. These areas included the two (2) low lying areas on the northern landing and the drainage ditch on the southern landing, which may have been impacted by road salt. Possible hydrocarbon impacts were identified at the helipad on the northern landing. The area between the ferry haul-outs and the road on the southern landing was identified as the possible location of an old underground storage tank (UST), as well as the probable location of two (2) historic fuel spills. The gravel in the centre of the ferry haul-outs was identified as potentially being affected by the past servicing of ferries. The electrical transformer on top of the wooden pole on the southern landing was identified as possibly containing Polychlorinated Biphenyls (PCBs).

The second aspect of the investigation was an electromagnetic (EM) survey. The EM survey identified possible metallic anomalies at the site as well as elevated conductivity readings, indicating possible salt impacts.

The third part of the investigation was an intrusive drilling program. A total of thirteen (13) boreholes were advanced to an average depth of 3.0 metres. Based on laboratory results, no metallic or hydrocarbon impacted soils were identified during the drilling. The conductivity reading in BH-8 was the only parameter at the site that exceeded any possible applicable guideline. This indicates that all three (3) low-lying areas at the site likely contain elevated levels of road salt and should not be used for parkland or agricultural use.

Based on the results of this Phase I and II ESA, further investigation at the site is not required at this time.

1 INTRODUCTION

Dillon Consulting Limited (Dillon) was retained by the Government of the Northwest Territories to conduct a Phase I and II Environmental Site Assessment (ESA) of the Fort Providence Ferry Landings located on Highway 3, approximately 10 km south of the Town of Fort Providence, Northwest Territories. There are two (2) distinct areas of the site; the northern landing area, which is approximately 40 metres wide, 600 metres long and 1.9 hectares in area; and the southern landing area which forms a rough triangle 100 metres wide, 300 metres long and approximately 2.4 hectares in area.

1.1 Purpose

The Phase I and II ESA was required in the context of the proposed bridge development over the Mackenzie River. The site is currently owned by the Government of the Northwest Territories.

1.2 Objectives and Scope of Work

The Environmental Site Assessment (ESA) process provides a systematic, due diligence approach to identifying, characterizing, and developing management alternatives for environmentally impaired or potentially environmentally impaired sites.

The investigation was divided into three (3) parts, the historical investigation (Phase I), the geophysical investigation and the intrusive investigation (Phase II).

Phase I ESAs are conducted as a preliminary environmental screening tool designed to determine a site's need for further environmental testing on the basis of the current and historic activities on the site or surrounding properties. Phase I ESAs are routinely required for commercial real estate transactions, for obtaining financing or prior to foreclosure when a particular site is held as security. The driving force for Phase I ESAs is often the minimization of environmental liability.

The primary objective of this Phase I ESA was to provide an independent, professional opinion as to whether the subject site is, or may be, subject to actual or potential contamination. The investigation was conducted in accordance with Canadian Standards Association (CSA) standard Z768-01, *Phase I Environmental Site Assessment* ("CSA Z768-01"). The Phase I ESA process is comprised of four (4) principal components including:

- Review of publicly available records (regulatory, historical, and current).
- Site reconnaissance visit and site inspection.
- Interviews with persons having knowledge of the subject site, including property owners, managers and/or tenants.

- Preparation of a report evaluating the information obtained, and summarizing findings, conclusions, and recommendations if any.

Based upon the findings of the Phase I ESA, this report provides comments and conclusions concerning the general status of conformance to regulatory standards and the presence/absence of potential environmental concerns.

A "frequency domain" electromagnetic (EM) geophysical survey was used for this investigation. The fieldwork was completed September 29th through October 30th, 2003.

The EM survey was carried out with a *GEONICS* EM31. The EM31 is a frequency domain electromagnetic device designed for measuring apparent electrical conductivity, and is also well-suited for buried metal detection. The EM31 utilizes the principle of electromagnetic induction to measure the electrical properties of the earth's surficial materials.

The Phase II ESA built upon the Phase I ESA and the electromagnetic survey to further target areas that had been identified as potentially impacted. Phase II ESAs are routinely required to confirm the findings of a Phase I, and generally involve sampling and a lab analysis of the materials at the subject site.

The primary objective of this Phase II ESA was to provide an independent, professional opinion as to whether the subject site is, or may be, subject to actual or potential contamination. The investigation was conducted in accordance with Canadian Standards Association (CSA) standard Z769-00, *Phase II Environmental Site Assessment* ("CSA Z769-00"). The Phase II ESA process in this investigation is comprised of six principal components including:

- Review of Phase I ESA information.
- Development of sampling plan.
- Planning a site investigation.
- Conducting a site investigation.
- Interpretation and evaluation of the data gathered during investigations.
- Preparation of a report evaluating the information obtained, and summarizing findings, conclusions, and recommendations if any.

Based upon the findings of the Phase II ESA, this report provides comments and conclusions concerning the general status of conformance to regulatory standards and the presence/absence of potential environmental concerns.

The ESA was conducted by Mr. Michael Gill, EIT, and reviewed by Mr. Doug Bell, P. Geo.

1.3 Limiting Conditions

This report was prepared by Dillon for the sole benefit of the Government of the Northwest Territories and such third parties as it wishes to designate, and is not to be relied upon by any other party without Dillon's express written consent. The report reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions based on it, are the sole responsibilities of such third parties. Dillon accepts no responsibilities for damages, if any, suffered by any third party as a result of decisions made or action taken based on this report.

PART I – PHASE I

2 SUMMARY OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS

As far as could be determined during this investigation, no previous environmental investigations pertaining to the site have been conducted.

3 SITE CHARACTERIZATION

3.1 Site Location and Description

The site location is shown on Figure 1. A site description is provided in Table 1 (appended) with a more detailed site description provided in Section 5.1. Refer also to the site photographs included in Appendix D. The site is located on the Mackenzie River, at the eastern extent of Great Slave Lake. The site consists of the north and south ferry landings for Highway 3 where it crosses the Mackenzie River. The northern ferry landing is thin and long, and runs from the northeast to the southwest. It is comprised mainly of fill. Sheet piling is located along the southern edge, in order to protect the landing from erosion. The southern ferry landing resembles a triangle with the apex pointing west. The ferry haul-outs are located on the western side of the landing and the road is located on the eastern side. A berm is located along the eastern edge of the southern landing. The northeastern tip of the berm is retained and protected by sheet piling. The north and south landings are reported to be covered in ice and scoured during the spring break-up. The Mackenzie River and forested areas border both sites.

3.2 Geological and Hydrogeological Setting

According to *Geology, Trout River, District of Mackenzie*, (Douglas, R.J.W., Geological Survey of Canada, "A" Series Map, 1371A, 1974), the Fort Providence area is located in the Interior Plains geological region, between the Cordillera and the Canadian Shield. The predominant geology is a Paleozoic sedimentary rock, located in the Hay River Formation and is described as a greenish grey shale, limestone and siltstone.

The surficial geology of the region was taken from *Quaternary Geology of the Canadian Interior Plains, in Quaternary Geology of Canada and Greenland,* (by Fulton, R.J; Geological Survey of Canada, Geology of Canada Series, 1989). Along the Mackenzie River where the site is located, there are floodplain, terrace and delta deposits and widespread flat-lying expanses of glacial lake silts and sands. Glacial lake silts, clays and sands are the most widespread parent materials for soils in the Interior Plains. The soils are predominantly Brunisolic, containing brownish subsurface horizons with weak accumulations of humified organic matter combined with aluminum and iron. The soils also have rocky and stony phases, and are subject to discontinuous permafrost. The natural vegetation associated with this soil type is boreal forest; mixed forest, shrubs and grass; heath and tundra.

3.3 Topographic and Hydrological Setting

The northern ferry landing is approximately 600 metres long and 40 metres wide. It is surrounded by the Mackenzie river on three sides and rises approximately 2.0 metres above the water. The centre of the landing is paved with "chip-seal" approximately 7 metres wide. Over the majority of the landing there is a narrow shoulder on either side of the "chip-seal," approximately half a metre wide before the landing slopes steeply into the river.

The southern landing area forms a rough triangle 100 metres wide and 300 metres long and consists mainly of fill, although native till is present near the southern edge of the landing. The main area of the landing rises out of the water at the northern edge of the landing and gradually slopes upward to the south until it is approximately 5 - 15 metres above water level. A steep berm, 4 metres high, 5 metres wide and 220 metres long is located along the eastern edge of the landing.

3.4 Site Sensitivity Assessment and Applicable Criteria

Applicable criteria were selected from the Canadian Council of Ministers of the Environment (CCME). The CCME has four land use classifications to address different potential soil contaminants. The land use classifications are agricultural, residential/parkland, commercial and industrial. As the subject site is used as part of a greater transportation network (Highway 3), the land is used in a commercial respect. However, as forested areas partially surround the two (2) areas, the residential/parkland criteria might be applicable to the perimeter of the site. Therefore, the analytical results were compared to the CCME soil quality guidelines for both residential/parkland use and commercial land use. The CCME soil quality guidelines for agricultural land use were also included, strictly for comparison purposes.

4 REGULATORY INFORMATION AND PUBLIC RECORDS

Various government and private agencies were contacted during the course of this Phase I ESA. File searches were conducted by each of these agencies to determine past activities on the subject site and surrounding properties.

4.1 Fire Marshals Office

A file search conducted by the Fire Marshall for the Northwest Territories did not produce any records of storage tanks having been registered for the site, or having been on-site previously.

4.2 Northwest Territories Spill Database

A file search was conducted through the Environmental Protection Service, Department of Resources, Wildlife and Economic Development, Government of Northwest Territories, for any spills that may have occurred at the site. The search indicated that five (5) spills had occurred at the site. A summary of these spills is included in the following sections. The original spill reports are included in Appendix D.

4.2.1 File #: 1990201

November 30, 1990 - The second trailer of a fuel tanker punctured while boarding ferry on the south landing. The truck immediately reversed off the ferry and back from the approaches so as to not contaminate the river. Approximately 1000 litres of diesel spilled over an area of 70 metres long by 20 metres wide. Clean-up took place immediately, with all possible fuel burnt off and contaminated snow removed and hauled off to a local waste disposal ground. The report states that “No further action required” and that the file be closed.

4.2.2 File #: 1991205

October 29, 1991 - The line between the two tanks on a tanker truck broke as the vehicle was loading onto the ferry on the south side. An estimated 454 litres of fuel was spilled. Cleanup took place on October 30, 1991. The report states that: “All contaminated snow and gravel that could be removed was hauled to borrow pit near pine view.” It recommended that the file be closed.

4.2.3 File #: 1992235

November 12, 1992 - A hole was punctured in the tanker when the dolly caught on the ramp while loading. Approximately 10 gallons of diesel fuel was spilled. All fuel was reported to have been contained on the deck of the ship and absorbed with pads. The pads were then put into buckets and taken away. The report recommended that the file be closed.

4.2.4 File #: 1994204

November 12, 1994 - A truck hit the ramp while loading and 5-10 litres of fuel spilled onto ferry. The fuel was absorbed by the snow, which was then removed. The file was closed.

4.2.5 File #: 2001196

June 23, 2001 - A hydraulic line on the ship broke and approximately 5 litres of hydraulic oil was lost. All hydraulic fluid washed off deck and into the river. The file was closed.

4.3 Historical and Current Land Titles

A historical and current land titles search was conducted through the Land Titles Office, Department of Justice, Government of the Northwest Territories for the southern landing and through the Department of Municipal and Community Affairs for the northern landing. The northern landing is Commissioner's land and has been reserved for the Department of Transportation. No previous leases/reserves have ever been applied to the northern landing. Administration and control of the southern landing was transferred from the Minister of Indian Affairs and Northern Development to the Commissioner of the Northwest Territories on February 9, 1984. No previous leases or reserves were applied to the site prior to or after the transfer. Land titles are included in Appendix A.

4.4 Historical and Current Aerial Photos

The only aerial photographs that were available for the site were air photos taken in 1998. As shown in the photos, the site has not changed since the photos were taken.

4.5 Discussion of Findings

Based on the information received to date, the only issues of environmental concern were the two (2) spills that occurred at the southern landing in 1990 and 1991. No other issues of environmental concern were noted at the site.

5 INTERVIEWS AND SITE RECONNAISSANCE

A site inspection was conducted by Dillon personnel between September 29 and October 4, 2003. This included a visual inspection of the site, existing facilities, and the surrounding properties. The reconnaissance visit was conducted in order to establish the existing environmental setting and identify any potential environmental concerns as well as any obvious evidence of contamination. Adjacent properties were visually inspected to determine if nearby activities have had, or potentially could have, an environmental impact on the subject site. Interviews were conducted with Mr. Sig Philipp, a contractor with at least fifteen (15) years experience in the area; Richard Lafferty, the Regional Manager of Highway Operations with forty-one (41) years of experience in the area; Robert Dean, a contractor out of Hay River with at least twenty (20) years experience in the area; John Bowen, an engineer with the Structures Division of the Department of Transportation; Les Shaw Director of Marine Operations, Department of Transportation; and Mr. James Christie, the Fort Providence Highway Yard Manager.

A site plan (Figure 1) was prepared with the aid of a metric tape. Photographs taken during the site visit are presented in Appendix D.

5.1 Site Description

The subject site is divided into two (2) distinct sections: the northern landing and the southern landing.

The northern landing is a long strip of artificially constructed land approximately 40 metres wide, 600 metres long and an approximate area of 1.9 hectares. Chip-seal covers the top part of the landing and is approximately 7 metres wide. A narrow shoulder borders the chip seal on either side and slopes into the Mackenzie River. The ferry loading ramp is located at the southwest end of the landing. Sheet piling is located along the southern edge of the ferry landing and is secured by “dead-men”; steel anchors located approximately 5 metres behind the sheet piling. The sheet piling is attached to the anchors by steel cables. A concrete slab approximately 15 metres long by 15 metres wide is buried under 7 cm of gravel and 2 cm of asphalt. A single power house is located on the southern edge of the landing. Various pieces of metal and wood debris are located throughout the site. Photos 1-4 (Appendix D) are of the northern landing.

The southern landing is approximately 100 metres wide, 300 metres long and 2.4 hectares in area. It consists of three (3) areas, an elevated berm, a road and a ferry haul-out area. Approximately half of the site has been constructed with fill. The berm is approximately 4 metres above the rest of the site, runs along the eastern edge and acts as a breakwater for the entire site. Sheet piling is located at the northern edge of the berm, where the landing is exposed to the Mackenzie River. A single, wood power house which provides electricity to the outdoor lamps is located atop the berm. The road is constructed with chip seal, and a 15 metre by 15 metre concrete ramp is located at the northern edge of the landing, where vehicles board the ferry. A drainage ditch is located on the eastern side. The haul-out area is large (approximately 2000m^2), and consists of two (2) wood constructed winch houses, wooden haul-outs, a gravel area, a storage area for various wood and metal debris and two low-lying wet areas. Each winch house is constructed of wood, has a concrete floor and contains a fuel powered engine. There are also overhead electrical lines running between wooden poles with a transformer on top of one of the poles at the southern edge of the landing. Metal cables and debris are strewn about the southern landing area. Photos 5 - 20 (Appendix D) are of the southern landing.

It is understood that the Government of the Northwest Territories wishes to construct a bridge at the site.

The only infrastructure present at the site are the four (4) simple wooden buildings (the north landing power house, the south landing power house and the two (2) winch houses). As none of the buildings contain insulation or air-cooling systems, the sections pertaining to asbestos-containing materials, ozone-depleting materials, and urea formaldehyde foam insulation and "Interior Observations" set out in CSA Z768-01 were not applicable to this site reconnaissance visit.

5.1.1 Property Use

At the time of the site inspection, the property was in use as a ferry landing. During the winter, the ferry is taken out of the water and hauled onto the southern landing for servicing and storage.

5.1.2 Surrounding Property Use

The northern landing is surrounded on three (3) sides (east, south and west) by the Mackenzie River and Highway 3 to the north. A forested area is located across Highway 3 to the north.

The southern landing is also surrounded on three (3) sides (north, east and west) by the Mackenzie river. Forested areas border the site to the south and southwest.

5.1.3 Utilities

The only aboveground utilities are located at the southern edge of the southern landing. Evidence of underground utilities present on the site is as follows (see Figure 2 and Photograph 5):

- Four (4) lamp posts present along the eastern side of the southern landing.
- Two (2) overhead flood lights located adjacent to the winch houses.

5.1.4 Hazardous Materials

No hazardous materials were observed on the site. PCBs are commonly associated with dielectric fluids within electrical equipment manufactured in Canada prior to approximately 1977. Therefore, the transformer located on the electrical pole at the southern edge of the site (Photo 5) may contain PCBs.

5.1.5 Unidentified Substances

No unidentified substances were observed on the site.

5.1.6 Storage Tanks and Containers

Empty 45 gallon drums were located at the southwest corner of the southern landing. Metal waste containers are located along the east side of the road on the southern landing and the west side of the road on the northern landing.

5.1.7 Odours

No odours were observed at the site.

5.1.8 Potable Water Supply

No potable water supply is present at the site.

5.1.9 Topographic, Geologic and Hydrogeologic Conditions

The majority of the northern landing is level with the exception of the low lying areas in the northwest corner where the road banks gently to the west, and the southeast area where water collects on the eastern gravel shoulder. The southern landing has three (3) distinct parts; the elevated berm on the east side which runs the length of the landing; the road; and the haul-out area. The road and the gravel haul-out area gently slope into the Mackenzie River. A low lying area is present between the road and the elevated berm.

Exposed soils in the area appeared to be silty clay in texture overlain by gravel.

5.1.10 Wells

No abandoned or existing wells were observed on-site.

5.1.11 Pits and Lagoons

No pits or lagoons are present on-site.

5.1.12 Stained Materials

The only stained material at the site was a 5 cm perimeter around the western winch house. This staining is possibly due to heavy oil leaking from the engines inside the winch house.

5.1.13 Stressed Vegetation

No stressed vegetation was observed on-site.

5.1.14 Fill

As noted above (see Section 5.1), fill was used in the construction of the site for both the north and south landings.

5.1.15 Waste Water

No waste water or other liquid discharges were observed on-site.

5.1.16 Watercourses, Ditches, or Standing Water

Surface water drains off both sides of the road on both landings. Due to the slope of the road, water flow at the north landing is directed toward the northeast corner. At the southern landing, water flow is directed into the eastern ditch that runs north-south adjacent to the road.

5.1.17 Roads, Parking Facilities and Rights of Way

As mentioned previously (see Section 5.1), Highway 3 is present on both the north and south landings. The road is constructed of “chip-seal”, which is a combination of gravel and tar. The chip-seal is present to the edge of the water on the southern landing and within 40 metres of the loading zone on the northern landing. The remainder of the landing is covered with gravel. Gravel access areas are also present at the southern landing on the west side.

5.2 Interviews

Five (5) interviews were conducted over the phone. Interviews were conducted with Mr. Sig Philipp, a contractor with at least fifteen (15) years experience in the area; Richard Lafferty, the Regional Manager of Highway Operations with forty-one (41) years of experience in the area; Robert Dean, a contractor out of Hay River with at least twenty (20) years experience in the area; John Bowen, an engineer with the Structures Division of the Department of Transportation and Les Shaw; Director of Marine Operations, Department of Transportation. Mr. James Christie was also present for the site inspection and gave detailed information on the historical use of the site. Interview records for phone interviews are included in Appendix E.

5.2.1 Mr. Sig Philipp, Contractor

Mr. Philipp indicated that the site has been rebuilt many times. He stated that the chip-seal was added within the last five (5) years and that pavement has never been used at the site. It is likely that the concrete ramps and anchors are the only metals objects underground at the site. There have been no previous structures and no environmental spills at the site to his knowledge.

5.2.2 Mr. Richard Lafferty, Regional Manager of Highway Operations

Mr. Lafferty indicated that the ferry has been in operation since the 1960's, perhaps 1962 or 1963. The initial construction for the landings started in 1958. Fill for the ramps came from large borrow pits located on both the north and south sides. Due to the erosional power of the Mackenzie river, the ramps are under constant repair and re-shaping.

5.2.3 Mr. Robert Dean, Contractor

Mr. Dean indicated that the landings were constructed of clay, gravel and “fill dirt”. He indicated that the concrete ramp was constructed 15-20 years ago. To his knowledge, there has never been a spill at the site.

5.2.4 Mr. John Bowen, Department of Transportation, Structures Division

Mr. Bowen indicated that the material for the landings came from local sources, mainly “borrow” pits that were located nearby. He indicated that in his opinion, no man-made or metallic objects would have been buried during the initial site construction. However, over the course of the site’s lifetime, there is a very good chance that drums, bolts, or other metallic objects may have been buried. He also indicated that the sheet pilings were anchored by steel rods placed into the ground.

5.2.5 Mr. Les Shaw, Director of Marine Operations

Mr. Shaw indicated that there were four (4) areas of environmental concern at the site. The ferry is hauled out every fall prior to the Mackenzie River freezing up and undergoes maintenance. Mr. Shaw indicated that there is a chance that hydrocarbons may have leaked into the soil under the haul-outs. Helicopters are used during the fall and spring when it is impossible to cross the Mackenzie River by watercraft. Fuelling areas for the helicopters are located on the north and south landing and fuel may have been spilled at these locations in the past. Finally, trucks usually park at the end of the causeway on the northern landing and may have leaked oil or diesel fuel. Mr. Shaw also indicated that the landings were completely covered by water during each spring break-up, thoroughly washing the top of the landings.

5.2.6 Mr. James Christie, Fort Providence Highway Yard Manager

Mr. Christie indicated that he had no recollection of any spills occurring in 1990 or 1991(as noted in Sections 4.2.1 and 4.2.2). Mr. Christie indicated that if a tanker were punctured, the truck would've pulled off the ferry, and up between the road and the haul-outs. Mr. Christie also mentioned that an underground tank was previously located between the haul-outs and the road on the southern landing approximately 35 metres south of the river. However, he wasn't sure when the tank was located there. He indicated that the helipad on the southern landing was immediately adjacent to the highway, but that the helicopter rarely landed on the southern side. No helicopter fuel was ever stored on the southern landing. He indicated that the helicopter landing area on the northern side was located in the northeast corner of the site and that helicopter fuel was stored there.

5.3 Discussion

Based on the site visit and interviews, three (3) areas of environmental concern were identified on the northern landing. The low lying areas in the northeast corner and the gravel shoulder in the southeast may have salt impacts. A clearing at the northeast edge of the landing, used to serve as a helicopter landing pad, may have hydrocarbon impacts. On the southern landing, the area between the ferry haul-outs and the road was the potential location of an old Underground Storage Tank (UST) used for fueling the ferry. As well, this location is the most probable area of the two (2) spills that occurred in 1990 and 1991. The gravel under the ferry haul-outs (approximately 40 meters south of the water) is another area of potential hydrocarbon and metal impacts. It is also likely that the drainage ditch on the eastern side of the road elevated salt levels in the soil. As noted by Mr. Les Shaw (Section 5.2.5), the north and south landings are entirely covered in water and ice during the spring. Due to this coverage, there is a chance that both landings are periodically scoured and cleaned and that the residual soil is free from any contaminants that may have existed at the site previously. There is a good chance that the staining around the perimeter of the western winch house is due to heavy oil used inside the winch house. This staining is limited to the immediate perimeter and most likely does not extend beyond the base of the concrete pad. Finally, the electrical transformer, located on top of the electrical pole on the southern landing may contain PCBs.

6 LIMITATIONS OF ASSESSMENT

No major limitations to the Phase I ESA, such as difficulties with access to the site or lack of responses from regulatory agencies, were experienced during the study.

7 PHASE I CONCLUSIONS

7.1 Actual Environmental Impacts

No existing environmental impacts were noted on the site.

7.2 Potential Environmental Impacts

There is the potential for hydrocarbon and metal contamination on the southern landing at the location of the two (2) historic spills and historic UST. It is also likely that the area where the ferry undergoes maintenance has hydrocarbon and metal impacts. There is potential for hydrocarbon impacts at the northern landing where jet fuel was stored for the helicopter. There is also the possibility that salt impacts are present at the southern landing in the drainage ditch and on the northern landing in the low-lying drainage areas. The staining around the western winch house is most likely limited in extent and is potentially comprised of heavy hydrocarbons. It is possible that the electrical transformer located on the wooden pole on the southern landing may contain PCBs.

PART II - EM-31 SURVEY

8 EQUIPMENT AND THEORY

The electromagnetic (EM) survey was carried out with a *GEONICS* EM31. The EM31 is a frequency domain electromagnetic device designed for measuring apparent electrical conductivity, and is also well-suited for buried metal detection. The EM31 utilizes the principle of electromagnetic induction to measure the electrical properties of the earth's surface.

This instrument generates an electromagnetic field by passing a current through a transmitter coil. As the field passes through the ground, it induces a small current flow within the ground. These ground currents create a secondary EM field in the ground. The receiver coil measures the combined primary (produced by instrument) and secondary (produced by the surrounding materials) EM fields. The instrument converts the quadrature component of the EM field into apparent electrical conductivity measurements of the subsurface in units of milliSiemens per meter (mS/m). The value for the bulk apparent electrical conductivity of the ground represents a hemispherical volume with a radius of 5 to 6 m, centred at the operator. However, the quadrature / apparent conductivity relationship is no longer valid in the presence of an extreme conductor (such as a buried metal object). The inphase component of the EM field is also recorded in units of parts per thousand (ppt) of the primary field, and is generally more susceptible to metal and less affected by changes in ground conductivity. For a complete description of the theory of operation and technical details of the EM31, refer to McNeill, 1980[1].

1 McNeill, J.D. 1980, Electromagnetic Terrain Conductivity Measurements at Low Induction Numbers, Geonics Ltd., Note TN-6, 16 pp.

9 FIELD PROCEDURES

Where possible, permanent features at the site provided the geophysical survey grid origins [0E,0N]. For the north landing, the southwest corner of a concrete pad was designated as the grid origin [0E,0N]; for the south landing, the northeast corner of a concrete pad was designated as a grid reference point [110E,200N]. Note the survey grid reference points are not true north and east coordinates. Base and tie lines were established approximately perpendicular and parallel (Areas 1 and 2) to the main site features in order to allow for future identification of suspect areas.

For the survey, both the apparent conductivity and inphase data were simultaneously collected at approximately a 0.75 m station spacing along lines 2 m apart (Figure 2). Base and tie lines were marked with paint at regular intervals.

As the survey progressed, comments denoting surficial objects (manholes, signs, etc.) that may explain anomalous responses were entered into the data logger. Relevant comments are included on all figures using appropriate symbols.

10 DATA PROCESSING AND PRESENTATION

Upon completion of the survey, the EM31 data was transferred from the data logger to a portable computer and the survey station locations were adjusted, as required. The data was then sorted, gridded, contoured, and plotted at an appropriate scale using Geosoft ™ data imaging software.

A color scheme was used to highlight the variations in the data. The EM31 survey apparent conductivity and inphase (Figures 3 and 4, respectively) data are displayed as color, contoured plots. The data is colored and contoured to represent the complete range of values. Background values are generally shown in green. Red and blue areas represent anomalous readings above and below background, respectively.

11 RESULTS

Anomalous areas not attributed to cultural interference, or other explainable sources, are labeled and highlighted on the interpretation map (Figure 5).

For this survey a background conductivity value of 20 to 40 mS/m has been used in the interpretation for the north landing. The south landing exhibited higher apparent conductivity values across the majority of the area and as a result background conductivity values of 50 to 75 mS/m have been used in the interpretation. Note that the background values are indicative of generally fine grained materials. Also the portion of the South Landing used to establish "background" was limited in area. An inphase background value of -1 to 1 ppt has been estimated for both site interpretations. Broad areas where instrument readings deviate from these background values are considered anomalous, and have been designated with the letter 'C' on the interpretation diagrams.

The apparent conductivity and the inphase response can also be used to detect metal related features. Typically, moderate sized buried metallic objects will produce a decreased (blue) inphase instrument response with the EM31. However, it is our experience that large buried metallic objects may produce a localized extremely positive (magenta) inphase response. A number of factors influence the size of an anomaly resulting from a buried metallic object including, depth of burial, type of fill (background values), cultural interference and the instrument's orientation relative to the buried metallic object. Interpreted metal related anomalies are labeled using the letter "M" and anomalous linear features are identified on the interpretation diagram using the letter 'L'.

Interference from surface metal, fencing, etc. will affect the instrument's response to nearby subsurface anomalous features. Therefore, anomalous conditions located next to, or directly below the source of interference, may go undetected.

A brief description of identified anomalies are as follows:

M1 Represents a broad, strong metal-related response in the immediate vicinity of a large concrete pad observed on site. While a portion of this response may be attributed to metal reinforcing within the concrete, the size and shape of **M1** extends beyond the area of the concrete pad (as observed on surface) and may represent individual or several, buried metallic object(s) in the surrounding area.

M2 – M4 Represent examples of numerous discrete zones of metal-related response present in the north landing survey area observed primarily in the inphase data (Figure 4). These areas likely represent single, buried metal related anomalies and/or areas of fill containing a significant metallic component.

M5 Similar to **M1**, the response at **M5** represents a broad, strong metal-related response in the immediate vicinity of a large concrete pad observed on site. While a portion of this response may be attributed to metal reinforcing within the concrete, the size and shape of **M5** is not consistent with the area of the concrete pad (as observed on surface) and may represent individual, buried metallic objects below this feature.

M6 & M7 Represent examples of discrete zones of metal-related response present immediately adjacent to linear features identified in the inphase data (Figure 4). These areas likely represent single, buried metal related anomalies which may be associated with suspected underground piping/utilities in the immediate area.

M8 & M9 Represent broad areas of scattered metallic response in the south landing data. The size and shape of these zones of response suggest the presence of anomalous fill zones containing a significant metallic component.

M10 - M12 Similar to M2 – M4, these anomalies represent examples of numerous discrete zones of metal-related response present in the south landing survey area observed primarily in the inphase data (Figure 4). These areas likely represent single, buried metal related anomalies and/or areas of fill containing a significant metallic component.

C1 – C3 Represent broad zones of extremely elevated apparent conductivity values (>150 mS/m) and are interpreted to result from areas of anomalously conductive porewater and/or fill material. As these zones coincide strongly with lineations identified in the data, **C1-C3** may represent anomalously conductive fill material used during construction/backfilling operations.

C4 & C5 Represent discrete zones of extremely elevated apparent conductivity values located within the south landing survey area. The size and shape of these anomalies suggest the presence of small pockets of anomalous fill material and/or scattered metallic debris.

C6 & C7 Represent broad areas of moderately elevated apparent conductivity values which encompass the majority of the south landing survey area. As mentioned earlier, the whole of the south landing survey area displays elevated apparent conductivity values which may result from an anomalously conductive fill material or porewater, historical activities (i.e. vehicular traffic carrying road salt), or less likely, geology (i.e. increased clay/silt content).

C8 - C10 These zones of moderately elevated anomalous apparent conductivity response are adjacent and likely associated with **C6** and **C7.** These zones likely reflect the gradually declining conductivity ‘halo’ around the aforementioned zones.

C11 & C12 Represent discrete zones of moderately elevated apparent conductivity values located within the north landing survey area. The size and shape of these anomalies suggest the presence of small pockets of anomalous fill material and/or scattered metallic debris.

L1 – L4 Represent strong linear responses in the north landing survey data. Given the location and orientation of these responses, these lineations are likely attributable to buried underground pipes and/or utilities. **L1** and **L2** match the edge of the paved surface of the roadway quite well and are most likely due to material change. **L3** matches the reported locations of underground sheet anchors at the site and **L4** matches the northern extent of the concrete pad.

L5 – L9 Represent strong linear responses in the south landing survey data. Given the location and orientation of these responses, these lineations are likely attributable to buried underground pipes and/or utilities. **L5** and **L6** are in the general vicinity of a buried electrical utility.

L10 – L15 Represent moderate to weak linear responses in the data. The weaker response of **L10** through **L15** is likely due to smaller and/or more deeply buried pipes/utilities (as compared to **L1** through **L9**) or possibly previous excavations.

PART III - PHASE II

12 SITE ACTIVITES

12.1 Methodology

The Phase II ESA site activities were conducted on October 4, 2003. Activities included:

- Establishing a health and safety plan and ensuring on-site personnel followed the appropriate precautions;
- Monitoring site activities and recovering soil samples during drilling;
- Locating and outlining the utility locations, as indicated in Section 5.3.

12.2 Drilling

Borehole locations were selected in order to effectively investigate any areas of concern determined by the Phase I ESA and the EM-31 survey. These locations were somewhat limited by the grade and layout of the landings as the drill rig could not drill on a slope. Borehole locations are presented in Figure 1.

Dillon personnel mobilized to the site on October 4, 2003, along with Aboriginal Drilling. The objective of the work plan was to advance thirteen (13) boreholes to a median depth of 3 metres and no deeper than 6 metres. The Phase I ESA indicated that a few areas warranted further intrusive investigations such as the area between the haul-outs and the road; the area where the ferry is serviced in the haul-outs on the south landing; and the helicopter fuelling area on the north landing. The EM survey identified several additional areas where there was potentially buried metal and/or salt impacts. Soil was sampled approximately every 0.5 m and subjected to field screening. The lithology of the site was recorded on borehole logs (Appendix F). Boreholes were backfilled with cuttings and capped with asphalt where they had been completed on the road.

The borehole and monitoring well locations were surveyed horizontally using a measuring tape and grid system, which has an accuracy of approximately 1 m.

12.3 Soil Vapour Screening and Sampling

Soil samples were monitored for hydrocarbon vapours using a Gastech organic-vapour meter (OVM) operated in the methane-elimination mode and calibrated to hexane. Soil samples were recovered approximately every 0.5 to 1.0 m and placed in airtight plastic bags for headspace vapour readings. As well, select samples were placed in glass vessels with Teflon-coated lids provided by the analytical lab, for laboratory analysis of metals and hydrocarbons. Soil samples collected for salt analysis were placed in sealed ziploc bags. A total of five (5) soil samples were submitted for laboratory analysis.

13 LABORATORY ANALYSIS

13.1 Contaminants of Concern (CoCs)

The contaminants of concern that were addressed during these investigations were those associated with fuel spills and the servicing of the ferry (particularly diesel, oil and metals), and salt impacts. These contaminants include petroleum hydrocarbons (PHCs), including benzene, toluene, ethylbenzene, and xylenes (BTEX) and hydrocarbon fractions F1 to F4.

13.2 Analysis Rationale

A total of five (5) soil samples were analyzed for the above CoCs using standard analytical methods. A single sample from BH-8 was submitted for salt analysis, while samples from BH-3, BH-6, BH-9 and BH-12 were analyzed for metals and hydrocarbon impacts.

Analytical results are summarized in Tables 2, 3 and 4. Laboratory analytical reports are presented in Appendix G. As mentioned in section 3.4, the analytical soil results were compared to the CCME soil quality guidelines for both residential/parkland use and commercial land use. The CCME soil quality guidelines for agricultural land use were also included, strictly for comparison purposes.

13.3 QA/QC Procedures

Soil and groundwater samples were submitted to Enviro·Test Laboratory Services (ETL). ETL is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL), and routinely conducts internal Quality Control/Quality Assurance (QA/QC) procedures in order to confirm the results of all their analyses. ETL's procedures are described in Appendix G.

14 DATA EVALUATION

14.1 Stratigraphic Conditions

The stratigraphy of the northern landing consisted mainly of clay. The clay was underlain by an organic material on the northern part of the landing (BH-1 to BH-3) at depths ranging from 0.5 metres to 1.7 metres. Near the ferry landing (BH-6), a wet sand was encountered from 1.5 to 2.5 metres. Wet soil, indicating the presence of the water table, was encountered in BH-1 at 1.7 metres and at 1.5 metres in BH-6. All other northern landing boreholes showed signs of damp soil at 0 to 3.0 metres, but no definitive indications of where the water table was located.

On the southern landing the predominant stratigraphy was a sand unit 0.5 metres thick, overlying a clay unit 1.5 metres thick. Black, organic clay was usually encountered at 1.5 to 2.5 metres depth. As with the northern landing, the only indication of water in the boreholes was in the black, organic material.

Borehole logs are presented in Appendix F.

14.2 Hydrocarbon Vapour Concentrations

Soil samples were selected for analysis with the objective of determining the concentrations of contaminants in soil as well as the horizontal and vertical extents of contamination. Soil samples with the highest hydrocarbon vapour concentrations, or those considered likely to have the highest level of contaminants based on field observations, were submitted for laboratory analysis. A total of five (5) soil samples collected throughout the site were selected for analysis. The vapour concentrations in these samples never exceeded 140 ppm, as indicated on the borehole logs (Appendix F).

14.3 Groundwater Conditions

Groundwater was typically not encountered when drilling, with the exceptions of BH-1 and BH-6 at 1.7 and 1.5 metres respectively. Moist and damp soils were encountered in all of the boreholes on the northern landing at depths ranging from 0 to 3.0 metres and some of the boreholes on the southern landing at 1.5 to 2.5 metres depth. No groundwater was encountered in the southern landing.

14.4 Soil Analytical Results

The locations of the boreholes along with soil characteristics are presented in Figure 1. The results of the soil sample analyses are presented in Tables 2, 3 and 4.

Laboratory analytical certificates and chain of custody sheets are included in Appendix G.

PHCs in all soil samples collected were either non-detectable or significantly below the applicable criteria.

The only metal that showed any elevated concentrations was Boron, which exceeded the CCME agricultural criteria in all four (4) samples submitted. All of the other metal parameters were either not detected or below criteria.

The salt analysis was conducted on the sample taken from BH-8 at 0.3 metres. The laboratory results indicated that the soil conductivity was more than double the CCME agricultural land-use criteria. All other parameters were either below the criteria, or didn't have criteria to compare to.

15 SITE ASSESSMENT

As indicated in section 3.4, the site is used for commercial purposes (highway traffic) and the surrounding forested area suggests that the residential/parkland land use criteria is applicable to the perimeter of the site. Therefore the analytical results were compared to the CCME commercial land use criteria as well as the residential/parkland land use criteria. The agricultural land use criteria were also included in the analytical tables.

The Phase I ESA identified a total of seven (7) areas of potential environmental concern. These areas included the two (2) low-lying areas on the northern landing and the drainage ditch on the southern landing, which may have been impacted by road salt; possible hydrocarbon impacts at the helicopter landing area on the northern landing; the area between the ferry haul-outs and the road on the southern landing (the possible location of an old UST as well the probable location of two (2) large historic fuel spills); the gravel in the centre of the ferry haul-outs (likely been affected by the servicing of the ferry over the years); and the electrical transformer on top of the wooden pole on the southern landing which may contain PCBs.

The EM survey further identified twelve (12) areas that may have contained metallic materials. The majority of these areas were most likely attributed to metal debris that was present near the surface. Two (2) boreholes, BH-6 and BH12, were advanced in two (2) areas of metal responses in order to verify any metallic subsurface materials. As noted in the borehole logs no suspicious materials were found during the investigations.

Twelve (12) broad areas that contained elevated conductivity readings were identified at the site. Six (6) boreholes, BH1, BH-7, BH-8, BH-9, BH-10 and BH-11 were all advanced to identify the soil associated with these areas of elevated conductivity. As noted in the borehole logs no suspicious materials were found during the investigations.

Fifteen (15) areas were identified at the site as possibly containing linear anomalies. Some of the lineations are most likely due to buried utilities located at the site. A total of six boreholes, BH-2, BH-4, BH-8, BH-9, BH-10 and BH-11, were used to investigate possible historical buried utilizes. As noted in the borehole logs no suspicious materials were found during the investigations.

Boreholes BH-1, BH-5, and BH-8 addressed the possibility of salt impacts at the site, while borehole BH-7 was placed between the ferry haul-outs and the road, at the most likely location of the historic UST as well as the probable location of the two (2) historic fuel spills. As indicated in the borehole logs, no suspicious materials, beyond decomposing organic material, were encountered during the drilling.

The only elevated metal parameter identified in the lab analysis was Boron. This parameter was detected at a concentration above agricultural criteria, yet was below the CCME residential/parkland and commercial criteria.

Analytical results from borehole BH-8, indicate that the conductivity levels were slightly above the agricultural and parkland guidelines, but below the commercial guidelines. As this soil sample was taken from the drainage ditch adjacent to the road, the elevated parameters were most likely due to road salt. Based on the results of the Phase I ESA and the EM survey, it is likely that the two (2) low-lying areas on the north landing contain salt levels above CCME residential/parkland land use criteria.

In summary, the results of the Phase I ESA, the EM survey and the Phase II ESA suggest there are three (3) areas of concern on the two (2) properties. The first area is the elevated conductivity levels measured in the sample collected from BH-8 on the southern landing. The Phase I ESA and the EM survey also suggest that similar conductivity levels may exist in the two (2) low-lying areas on the northern landing. The second area of concern is the surficial staining of soil surrounding the western winch house. The third issue is the transformer located at the southern edge of the southern landing. This transformer may contain PCBs. Based on the results of the investigation program, further investigation at the ferry landing sites is not required at this time.

16 CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions and recommendations from the results of the Phase I and II ESA:

- Given the soils located in the drainage ditch on the southern landing and the low-lying areas on the northern landing are potentially impacted with road salt, proper disposal of those soils should be considered if further site development occurs.
- The stained soils in the vicinity of the western winch house should also be properly disposed of and treated during future site development.
- The electrical transformer on the southern landing that may contain PCBs should be properly decommissioned when it is removed from the site.

17 CLOSURE

This report was prepared exclusively for the purposes, project, and site location outlined in the report. The report is based on information provided to, or obtained by, Dillon Consulting Limited (Dillon) as indicated in the report, and applies solely to site conditions existing at the time of the site investigation. Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of any contaminants from the site. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule, and budget. It is therefore possible that currently unrecognized contamination or potentially hazardous materials may exist at the site. Further review and updating of the report may be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of the Government of the Northwest Territories and such third parties as it wishes to designate, and is not to be relied upon by any other party without Dillon's express written consent. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the sole responsibilities of such third parties. Dillon accepts no responsibilities for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Respectfully submitted,

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