
**GROUNDWATER MONITORING PLAN
CARMACKS SOLID WASTE FACILITY**

VILLAGE OF CARMACKS, YT

EBA File: 1240011.002

October, 2004

**GROUNDWATER MONITORING PLAN
CARMACKS SOLID WASTE FACILITY
VILLAGE OF CARMACKS, YT**

Submitted To:

Village of Carmacks

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
Whitehorse, Yukon

EBA File: 1240011.002

October 2004



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1.0 INTRODUCTION

At the request of the Village of Carmacks, EBA Engineering Consultants Ltd. (EBA) has developed this Groundwater Monitoring Plan for the Carmacks Solid Waste Disposal Site. Development of the plan presented in this report was a requirement of the Government of Yukon's Environment Department pursuant to Section 2.5.2 of Solid Waste Permit Number 80-008.

EBA has previously coordinated the installation, monitoring and sampling of ten monitoring wells in the vicinity of the solid waste disposal site (the Site) as part of an ongoing Hydrogeological Investigation of this area. Six monitoring wells were installed in 2002 as part of the initial study, and four additional monitoring wells were installed in 2003.

This Groundwater Monitoring Plan (GMP) has been prepared in accordance with generally accepted hydrogeological practices. For additional information and limitations regarding the use of this report, please refer to the attached General Conditions, which form a part of this report.

1.1 Objectives for Groundwater Monitoring Plan

The hydrogeology and groundwater sampling work completed to date have enabled a detailed understanding of the groundwater regime in the vicinity of the Site including: seasonal groundwater fluctuations, flow direction, gradient, velocity and travel times between potential contaminant sources and receptors as detailed in previous EBA reports. Figure 1 indicates groundwater monitoring well locations and the inferred groundwater flow direction. Baseline groundwater quality in the vicinity and downgradient from the solid waste disposal facility and former metals dump has been established and detailed in previous EBA reports.

The objectives of the Groundwater Monitoring Plan are:

- to provide immediate and long-term monitoring of groundwater levels and assessment of groundwater chemical quality in the vicinity of, and downgradient from the Site;
- to determine whether potential leachate deriving from the solid waste disposal facility, or former metals dump is impacting groundwater quality;
- to continue the collection of data pertaining to the seasonal fluctuations and potential changes in groundwater flow directions and velocities;

- to provide recommendations for modifications to the GMP based on the interpretation of the data.

1.2 Authorization

EBA was authorized to complete the Groundwater Monitoring Plan in an email sent by Bob Jackman, CAO, Village of Carmacks on October 13th, 2004.

2.0 SITE CHARACTERISTICS

2.1 Location of Study Area

The solid waste disposal site is located on Commissionaire's land within the boundaries of the Village of Carmacks approximately 1 km south of the village core on the North Klondike Highway at a latitude of 62° 06' N and longitude of 136° 18' W. The Site is at the base of a glaciofluvial terrace in the Nordenskiold River Valley near the confluence of the Nordenskiold and Yukon Rivers.

2.2 Surficial Geology

The Carmacks region lies near the northern extremity of the most recent (McConnell) glaciation. The majority of surficial materials in the study area are glaciofluvial in origin, deposited by streams flowing from or in contact with glacial ice. Recent fluvial activity has reworked these materials and deposited alluvial sediments. A veneer of eolian (wind-deposited) sand and silt blankets much of the river valleys and may be up to 2 m in thickness in certain areas.

The glaciofluvial and recent alluvial sediments are generally coarse grained and well drained. Floodplains adjacent to the Yukon River are typically fine sand and silt. Where glacial ice masses became stagnant, more complex deposits formed that contain sand and gravel with minor quantities of silt and clay. These glaciofluvial ice-stagnation deposits are often characterized by discontinuous deposits and associated with topographic features such as hummocks and kettles.

Discontinuous permafrost is present in the Carmacks region. Ground ice was noted between depths of 5 m and 8 m in one of eleven boreholes drilled for the Carmacks Bypass geotechnical study (Hoggan, 1998 and 1999).

Bedrock exposed on higher-relief, and resistant bluffs at the southeast boundary of the study area is mapped as conglomerate, sandstone, and shale with coal seams.

2.3 Hydrogeology

The conceptual hydrogeological model developed from previous investigations (see Section 3.0) is summarized below:

- The primary groundwater flow direction in the vicinity of the site is northeast.
- The elevation of the Nordendkiold River was higher than the groundwater levels observed in the water wells and monitoring wells east of the River. Given that the hydrograph for the Nordenskiold River (Figure 7 in Desk-top report, EBA 2001) indicates that river water levels are relatively constant throughout the year (based on data from May to November) and that they had been observed to be approximately 2.5 m higher during a flood event in May of 1992, it is expected that a gradient away from the river exists throughout the year.
- It is expected that this gradient is not controlled by water losses from the river to the permeable sand and gravel aquifer surrounding the river, but by the more regional groundwater regime extending from the upper watershed to the west, down to the Yukon River.

3.0 SUMMARY OF PREVIOUS INVESTIGATIONS

3.1 Hydrogeological Assessment and Monitoring Well Installations, February 2003

EBA completed the first phase of this project in 2002 – 2003. A summary report was produced in February 2003 (EBA, 2003). During the initial investigation, six monitoring wells were successfully installed at the locations selected based on the conceptual hydrogeology of the area. The wells were sampled to collect representative groundwater samples for laboratory analysis of contaminants of potential environmental concern. Based on the observed groundwater elevations, flow directions and gradients at the time of monitoring were inferred. As well, EBA completed permeability tests at three selected groundwater monitoring wells. This information was used to define the regional groundwater flow, and provide recommendations for future groundwater monitoring and sampling.

The following conclusions were made based on the findings of the initial hydrogeological investigations:

- The first phase of this study enabled the development of a revised conceptual hydrogeology model. The observed groundwater flow regime was different than the original conceptual model. Unfortunately, the monitoring well locations were selected based on this preliminary conceptual model, and since the actual groundwater flow direction was significantly different than anticipated, many of the well locations are not located downgradient of the potential contaminant sources.
- Based on the revised conceptual model, EBA identified potential receptors downgradient of the solid waste facility. These included the water wells located in the core Village of Carmacks, and the Yukon River. The Industrial Area is also upgradient of the water wells in the core Village of Carmacks.
- Based on the hydrogeological assessment, it was estimated that the groundwater travel time between the Site, and downgradient drinking water wells is somewhere in the order of one month to one year. At the time of reporting, given the well network that was installed, it was not possible to assess whether there was leachate being generated from the existing solid waste site, or the metals dump area.

To assess the impact to groundwater of potential contaminant sources at the solid waste disposal site, EBA recommended the following:

- The installation of two monitoring wells directly north of the existing landfill, and
- The installation of two monitoring wells directly north of the metals dump area.

This information would be very important to assess if the identified receptors are at risk of potential contamination.

3.2 Hydrogeological Investigation – Additional Monitoring Well Installations – June 2004

During this additional investigation, four monitoring wells were installed, bringing the total number of wells in the study area to ten. The wells were sampled to collect representative groundwater samples for laboratory analysis of contaminants of potential environmental concern.

The following conclusions were made based on the findings of the additional hydrogeological investigation:

- Four monitoring wells were successfully installed at the locations selected based on the revised conceptual hydrogeology of the area. Based on the observed groundwater equipotential contours, these wells appeared to be immediately downgradient of the existing solid waste disposal site (MW07 and MW08), and the former metals dump area (MW09 and MW10).
- With the exception of LEPHw concentrations at MW07, all concentrations of all parameters analyzed were below applicable drinking water, and aquatic life standards.

- Extractable petroleum hydrocarbon concentrations observed at MW07, MW08 and MW09 were not likely representative of groundwater quality in those areas. Re-sampling was recommended to confirm this theory.
- There did not seem to be evidence of significant amounts of leachate being generated from the existing solid waste facility, or the former metals dump area.
- Based on the information collected to date, there was no evidence of a significant health risk to potential domestic water well receptors approximately 1 km downgradient of the disposal sites.

To further assess the impact to groundwater of potential contaminant sources at the solid waste disposal site, EBA recommended the following:

- Resample the following wells in 2004 for the parameters indicated in (brackets):
 - MW05 (LEPH_w, HEPH_w, metals);
 - MW07 (LEPH_w, HEPH_w);
 - MW08 (LEPH_w, HEPH_w);
 - MW09 (LEPH_w, HEPH_w); and
 - MW10 (LEPH_w, HEPH_w).

3.3 Groundwater Monitoring and Sampling Program - 2004

EBA completed the recommended follow-up sampling at selected wells in August 2004 (EBA, 2004b). The main purpose of the re-sampling was to investigate the presence or absence of hydrocarbon parameters at MW07, MW08, MW09 and MW10. The sample results obtained were each below the analytical detection limits and applicable CSR aquatic life and drinking water standards. This suggests that the low extractable hydrocarbon concentrations observed in previous investigations (immediately after drilling) may have been introduced through the Air Rotary drilling process. As in previous monitoring events, there were no indications of significant leachate production from the existing solid waste facility and the former metals dump area.

4.0 MONITORING WELL DETAILS

Due to the very coarse nature of the soils at the site, each of the monitoring wells was installed using an air rotary ODEX system advancing 150 mm diameter threaded casing. Monitoring wells consist of 50 mm diameter PVC factory 10 slot (0.010") slotted sections with solid riser pipes completed above surface. Borehole logs and detailed monitoring well completion details are provided in Appendix A. Table 1 provides a summary of monitoring well details and

groundwater elevations from July 2003. Potential contaminant sources at the Site in relation to the monitoring well network are described in the following sections.

4.1 Existing Solid Waste Disposal Site

The existing solid waste disposal site has operated at the present location for approximately 50 years. The Yukon Government established and operated a trench and burn operation in the existing low area of a glacial kettle depression prior to the incorporation of the Village of Carmacks in 1984. Since incorporation, the Village has operated the solid waste disposal site. Approximately four years ago, the trench and burn operation was terminated, and a “consolidate and cover” approach was adopted.

The community, including the Little Salmon Carmacks First Nation (LSCFN), have raised concerns about the potential of the solid waste disposal site contaminating the groundwater and potentially impacting their drinking water quality. The monitoring well network was designed taking these concerns into consideration, and to provide monitoring locations for immediate and long-term monitoring of groundwater quality.

Monitoring wells MW07 and MW08 were installed immediately downgradient of the existing solid waste disposal site, and MWO6 was installed between the Site, and LSCFN domestic water wells on Ptarmigan Rd.

4.2 Proposed Expansion for Solid Waste Disposal Site

The existing solid waste disposal site is nearing capacity and will be closed within the near future. An expansion area is being considered in a natural low area immediately to the south of the current site (See Figure 1).

Monitoring well 1240011-MW08 is considered to be downgradient of the proposed expansion area. MW03 is immediately adjacent to the proposed expansion area, however it has remained dry since installation. Permafrost was observed during the drilling and installation of this monitoring well.

4.3 Western Copper Leach Pit Column Test Area

Western Copper conducted a leach column pilot test at the location shown on Figure 1, on Commissioner's Land under permit from the Yukon Government. It was suggested that it should be the Yukon Government's responsibility for undertaking any necessary testing to confirm that the site had not been contaminated and was not presenting future liability.

Monitoring wells 1240011-MW04 and MW05 were installed in an area that is inferred to be downgradient of the former leach pit column test area. No investigations were completed in the immediate vicinity of the former Western Copper Leach Pit Column Test Area during either of the previous EBA investigations.

4.4 Metals Dump

Metals debris had been landfilled in a small depression approximately 350 m south of the existing solid waste facility for approximately 20 years. During the site reconnaissance visit in 2002 (EBA, 2003) it was observed that due to the uncontrolled access to the area, domestic and some other wastes (paint, car batteries etc.) had been discarded in this area. Between the time of the site reconnaissance visit in July 2002, and the drilling program in July 2003, the metals dump area had been completely covered over with imported fill material.

1240011-MW09 and MW10 were installed downgradient of the former metals dump.

4.5 Background Monitoring Wells

Monitoring wells MW01 and MW02 are considered to provide background groundwater quality. These wells are inferred to be upgradient of each of the potential contaminant sources. The area upgradient of MW01 and MW02 is currently undeveloped.

5.0 COMPONENTS OF GROUNDWATER MONITORING PLAN

Recommendations for this Groundwater Monitoring Plan are made in consideration of the Site conditions and potential receptors. Currently there are Carmacks residents utilizing domestic water wells for drinking water supply in the Village Core, which is downgradient of the solid waste disposal site. LSCFN members also have domestic wells and a semi-public water supply well in the Ptarmigan Road area within 500 m of the Site.

During the previous investigations, there has been no indication of leachate being derived from the solid waste disposal site nor the former metals dump. Due to the low precipitation in the area, and the thickness of the unsaturated zone below the waste sites, the potential impacts of leachate on the groundwater quality is considered to be relatively low at present. Since there are sensitive potential downgradient receptors (potable water supply wells), a once per year sampling frequency is recommended. The sampling event should be timed to coincide with the spring freshet.

It is recommended that the sampling and monitoring program be initiated in 2005. Table 2 provides a summary of the proposed Groundwater Monitoring Plan for the Carmacks Solid Waste Facility.

A piped distribution system from a community well(s) is being considered, and it appears likely that a community system will be constructed at some time in the relatively near future. In the event that the Village constructs the proposed community water supply system with piped distribution, it would be possible to alter the Groundwater Monitoring Plan in consideration of this. It is understood that the GMP will be a working document that should be updated based on a review and interpretation of the data collected.

The tasks to be completed for the annual GMP are summarized in the following sections:

5.1.1 Water Level Monitoring

Using an electronic water level sounder, the depth to the water table shall be measured and recorded for each of the 10 existing monitoring well locations. The electronic water level sounder shall also be used to detect and measure non-aqueous phase liquid thickness (NAPL) such as hydrocarbon. The water level sounder shall be decontaminated between sampling locations.

5.1.2 Groundwater Sampling

Monitoring wells that are considered important to assess the long-term groundwater quality downgradient of the Carmacks Solid Waste Facility are MW04, MW05, MW07, MW08, MW09 and MW10. MW06 is also an important monitoring well for routine sampling due to its proximity to the LSCFN Ptarmigan Subdivision domestic water supply wells and multi-user well.

Parameters that are typically representative of leachate deriving from domestic solid waste facilities should be included for future analyses. For those wells immediately downgradient of the landfilled areas (MW07, MW08, MW09 and MW10) and MW06, these parameters should include:

- Physical Tests (conductivity, total dissolved solids, hardness, pH, total suspended solids).
- Dissolved Anions (alkalinity, bromide, chloride, fluoride, sulphate).
- Nutrients (ammonia, nitrate nitrogen, nitrite nitrogen, phosphate).
- Dissolved Metals.
- Halogenated Volatiles.
- Non Halogenated Volatiles (benzene, toluene, ethylbenzene, xylene, styrene, VH and VPH).
- Polycyclic Aromatic Hydrocarbons.
- Extractable Hydrocarbons (EH_{W10-19}, EH_{W19-32}, LEPH and HEPH).
- Bacteriological Tests: Total and Fecal Coliforms.

At MW04 and MW05, which are downgradient of the Former Western Copper Leach Pilot Study area, a shortened list of parameters is recommended. These include:

- Physical Tests (conductivity, total dissolved solids, hardness, pH, total suspended solids).
- Dissolved Anions (alkalinity, bromide, chloride, fluoride, sulphate).
- Dissolved Metals.

All samples shall be submitted in coolers with ice under chain of custody to an accredited laboratory.

Permafrost has been observed at MW03 during drilling, and it is not likely that groundwater will ever be observed in MW03. Therefore, it is unlikely that this well will require sampling. In the event that groundwater does appear at MW03, this well should be sampled for the full suite of parameters indicated above.

Background groundwater chemistry has been established at MW01 and MW02, which are considered to upgradient of the Site. These wells should be monitored and sampled for field chemistry (see Section 5.1.3), however, further laboratory analytical work is not likely to be required.

As mentioned previously, in the event of a change in the downgradient water use, the frequency of the monitoring and sampling could be reduced, and it is likely that monitoring and sampling every 2 years would be adequate.

5.1.3 Field Chemistry

In addition to monitoring groundwater levels at all monitoring well locations, and obtaining groundwater samples for chemical analysis at select wells, it is recommended that field chemistry analysis also be completed. Field chemistry readings should be obtained for temperature, conductivity (EC), total dissolved solids (TDS) and pH using portable field equipment.

5.1.4 Other Recommendations

As part of the Groundwater Management Plan, some consideration should be given to posting a sign at the solid waste disposal facility that indicates “Disposal of hazardous chemicals could result in pollution of the groundwater that is the source of drinking water for many residents of your community. Respect your communities water supply source and dispose of hazardous chemicals properly”.

6.0 CLOSURE

EBA trusts this report meets your present requirements. If you have questions or concerns, please do not hesitate to call the undersigned.

Respectfully submitted;

EBA Engineering Consultants Ltd.

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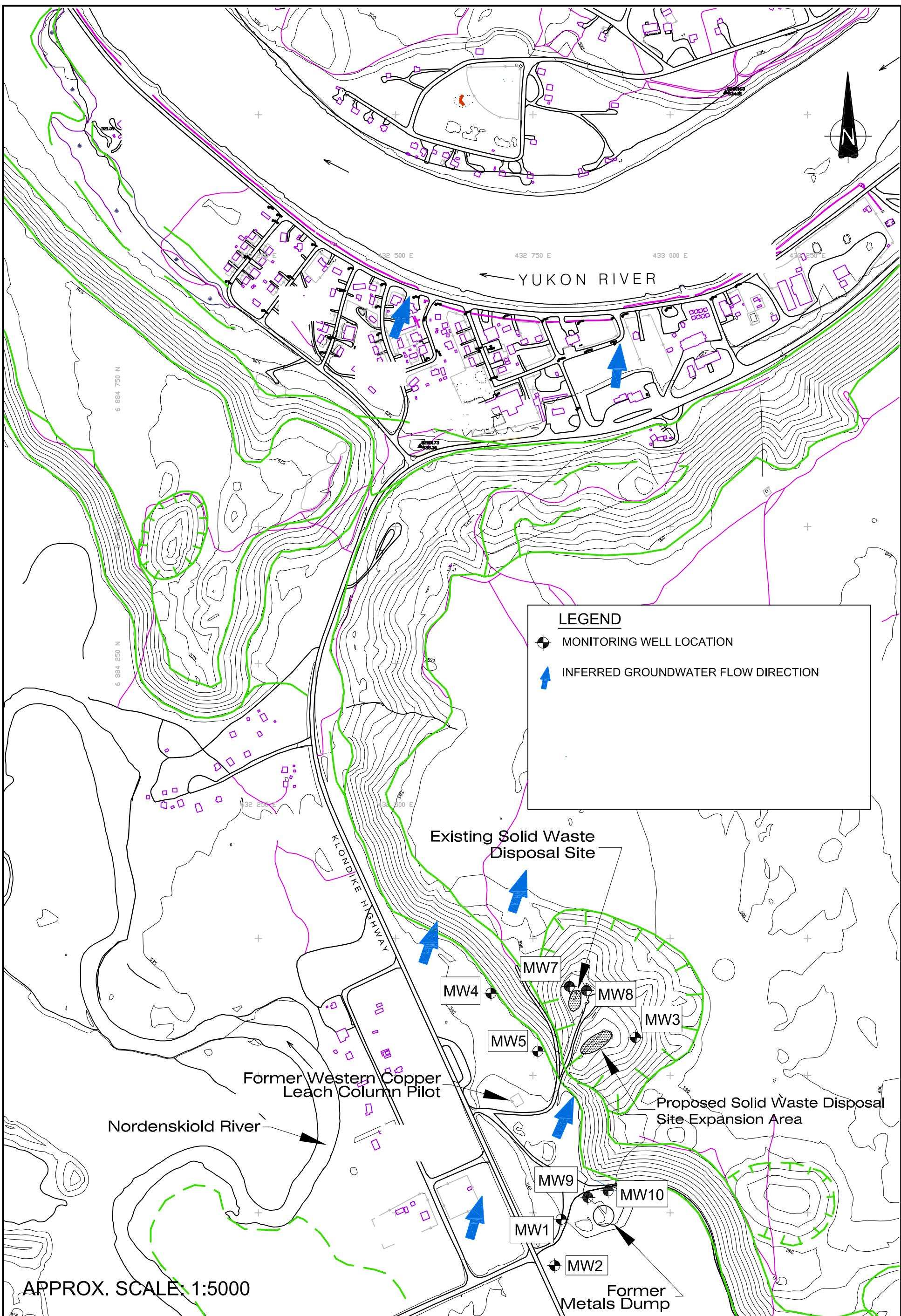
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FIGURES



CLIENT: VILLAGE OF CARMACKS				
DATE	OCT 2004	DWN.	CPC/JSB	CHKD. RMM

PROJECT: GROUNDWATER MONITORING PLAN SOLID WASTE FACILITY - CARMACKS, YUKON			
TITLE: SITE PLAN SHOWING MONITORING WELL LOCATIONS, AND INFERRED GROUNDWATER FLOW DIRECTION			
FILE NO.	1240011002	DRWG.	FIGURE 1
REVISION			

TABLES

**TABLE 1 - WELL DETAILS AND GROUNDWATER ELEVATIONS
VILLAGE OF CARMACKS
GROUNDWATER MONITORING PLAN**

MONITORING WELL DETAILS								Observed Groundwater Levels	
								July 2,3 2003	
LOCATION	TOP OF PIEZOMETER ELEVATION (m-asl)	GRADE ELEVATION (m-asl)	WELL SCREEN AND PVC CASING DIAMETER (mm)	WELL SAND PACK DIAMETER (mm)	SCREEN LENGTH (m)	SCREEN INTERVAL - TOP - (m-asl)	SCREEN INTERVAL - BOTTOM - (m-asl)	WATER TABLE DEPTH (m-btpc)	WATER TABLE ELEVATION (m-asl)
MW01	542.04	541.45	50.00	150.00	1.50	537.00	535.50	5.791	536.25
MW02	542.74	542.11	50.00	150.00	1.50	536.90	535.40	6.35	536.39
MW03	547.57	546.96	50.00	150.00	3.00	545.10	542.10	DRY	<537
MW04	540.78	540.12	50.00	150.00	1.50	532.60	531.10	8.845	531.93
MW05	541.75	541.05	50.00	150.00	1.50	532.20	530.70	9.395	532.35
MW06	536.81	536.34	50.00	150.00	1.50	527.80	526.30	8.615	528.19
MW07	543.64	543.20	50.00	150.00	1.50	532.00	530.50	11.97	531.67
MW08	544.28	543.90	50.00	150.00	3.00	532.40	529.40	12.60	531.68
MW09	545.34	545.06	50.00	150.00	1.50	537.10	535.60	9.33	536.01
MW10	545.64	545.31	50.00	150.00	1.50	534.90	533.40	10.37	535.27

m-asl = metres above sea level

m-btpc = metres below top of piezometer casing



TABLE 2
PROPOSED LONG TERM GROUNDWATER MONITORING PLAN FOR CARMACKS SOLID WASTE FACILITY

WELL ID	Description	Field Monitoring						Analytical Testing							
		Water Level	H/C Presence	Temp.	pH	EC	TDS	Physical Tests	Dissolved Anions	Nutrients	Dissolved Metals	Non-Halogenated Volatile	Halogenated Volatiles	EPH and PAHs	Bacteriological Testing
MW01	Background Upgradient of Site	X	X	X	X	X	X	No samling recommended as background concentrations have been established.							
MW02	Background Upgradient of Site	X	X	X	X	X	X	No samling recommended as background concentrations have been established.							
MW03	Dry Monitoring well close to proposed Landfill expansion area.	X						Perpetually dry to date. In the event that groundwater is observed at MW03 at some time in the future, this well should be sampled for full suite of parameters.							
MW04	Potentially downgradient of Former Western Copper and Industrial Ar	X	X	X	X	X	X	X	X		X			X	
MW05	Potentially Downgradient of Former Western Copper	X	X	X	X	X	X	X	X		X			X	
MW06	Upgradient of Ptarmigan Multiple User Well	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW07	Immediately Downgradient of Existing Solid Waste Disposal Site	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW08	Immediately Downgradient of Existing Solid Waste Disposal Site	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW09	Downgradient of Former Metals Dump Area	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW10	Downgradient of Former Metals Dump Area.	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes:

- 1) In the event that the Village of Carmacks constructs a community water supply system, this GMP could be modified to reflect a decreased risk to Village residents.
- 2) This program may require some adjustment from year to year, based on a review of the data.



APPENDIX A

Borehole Logs

Hydrogeological Investigation		CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW01
Carmacks Solid Waste Facility		DRILL: Prospector	PROJECT NO: D201-1240011
Carmacks, YT		UTM ZONE: - N6883238 E432801	ELEVATION: 541.45 m
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> STANDARD PEN.
	<input type="checkbox"/> 75 mm SPOON	<input type="checkbox"/> CRREL BARREL	
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH
	<input type="checkbox"/> GROUT	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SAMPLE TYPE WELL INSTALLATION	SOIL DESCRIPTION	VAPOR EMISSIONS (PPM)		PERCENT GRAVEL		PERCENT SAND		PERCENT SILT OR FINES		PERCENT CLAY		ELEVATION (m)
			100	200	300	400	20	40	60	80	20	40	
0.0		SILT - trace to some sand and organics; damp; poor recovery; brown											541.0
1.0													540.0
2.0		SAND AND GRAVEL - occasional cobbles (likely), trace of silt; moist; brown											539.0
3.0		GRAVEL - some cobbles (likely), trace to some sand; dry; grey											538.0
4.0													537.0
5.0		SAND - medium grained; uniform; wet; brown - wet below 4.7 m											536.0
6.0		END OF BOREHOLE @ 6.1 m - water depth is 5.1 m below grade on November 28, 2002											535.0
7.0													534.0
8.0													533.0
9.0													532.0
10.0													531.0
11.0													530.0
12.0													529.0
13.0													

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

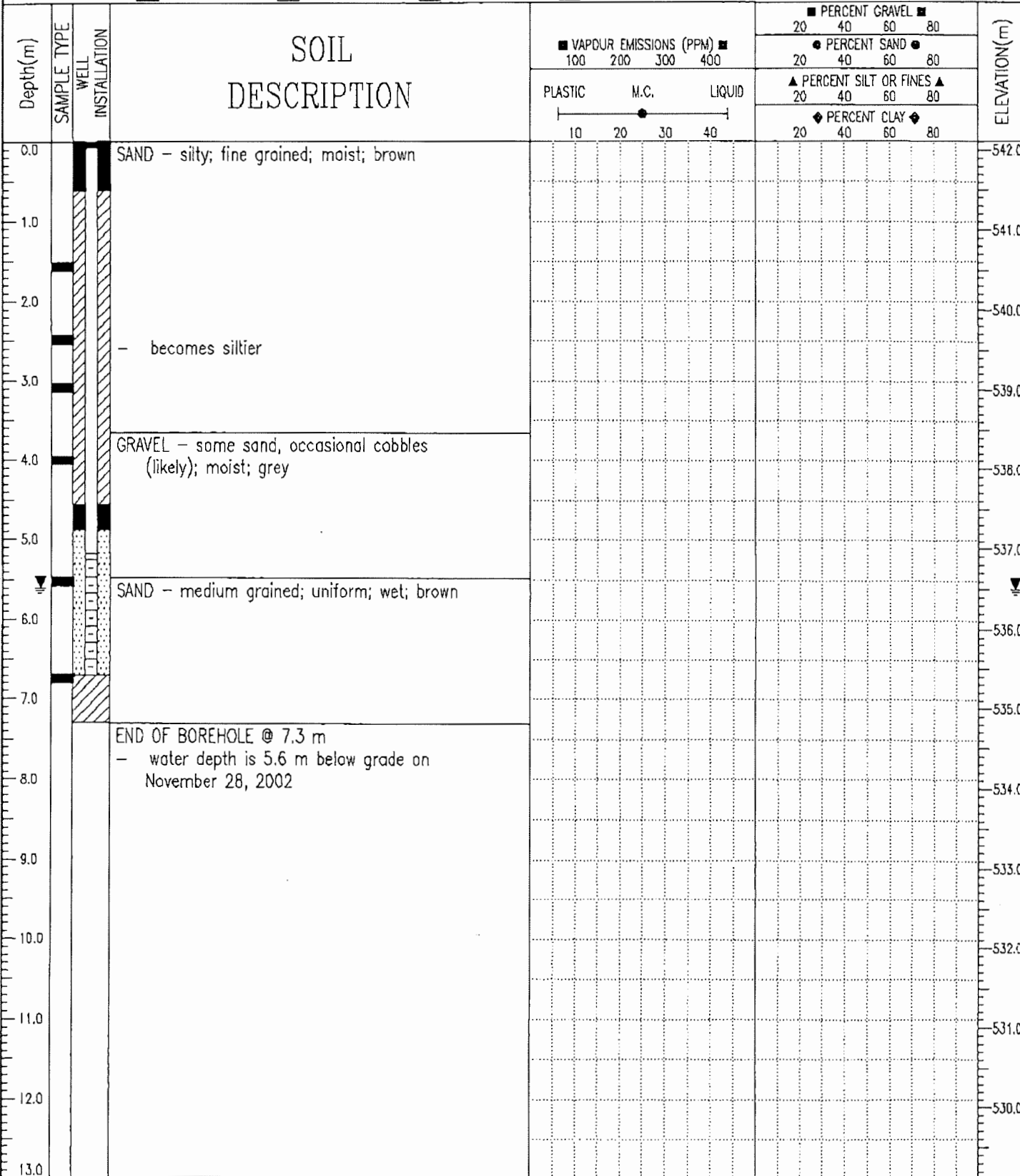
LOGGED BY: RMM

REVIEWED BY: JRT

COMPLETION DEPTH: 6.1 m

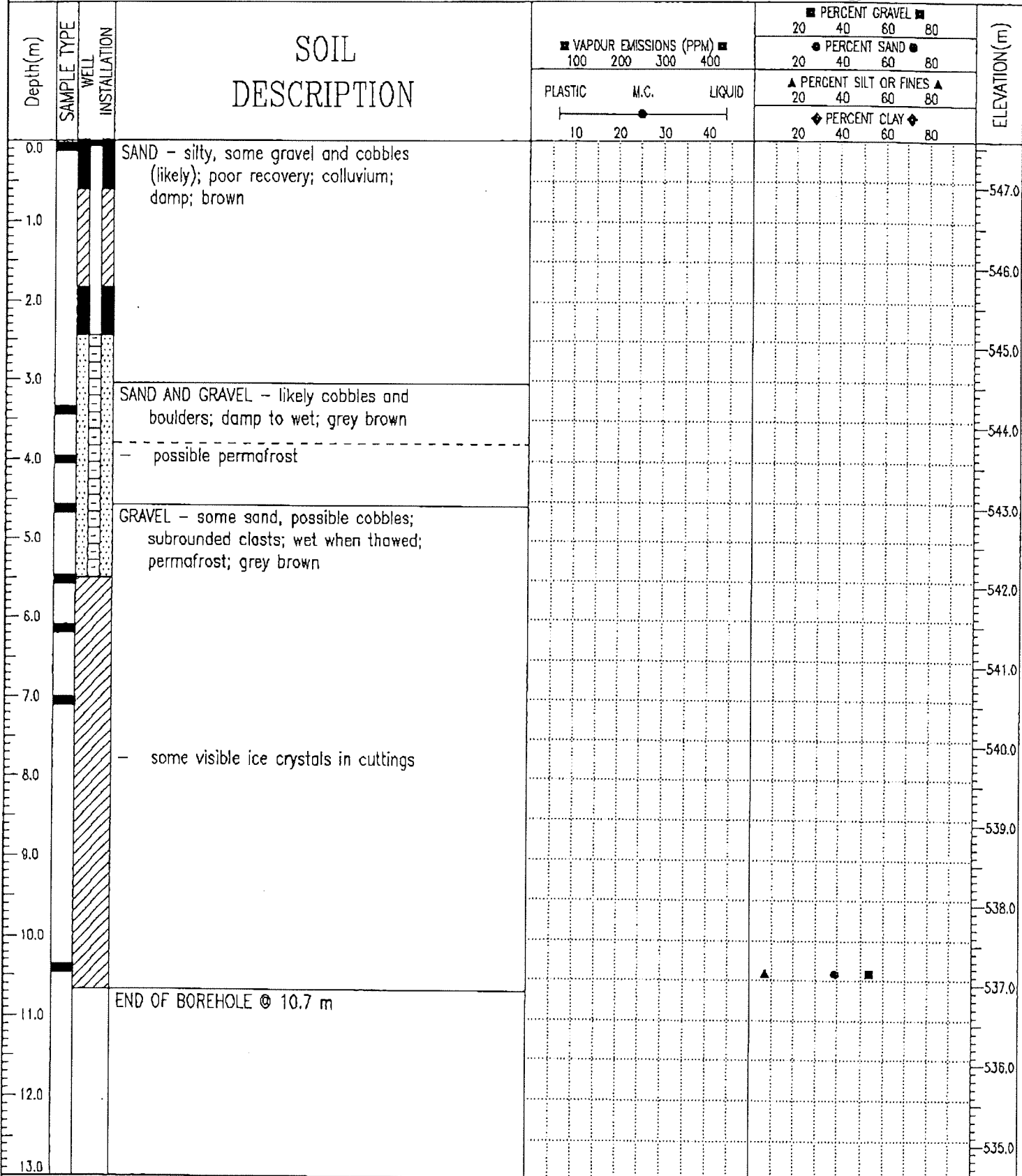
COMPLETE: 28/11/02

Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW02				
Carmacks Solid Waste Facility	DRILL: Prospector	PROJECT NO: 0201-1240011				
Carmacks, YT	UTM ZONE: - N6883151 E432790	ELEVATION: 542.106 m				
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> STANDARD PEN.	<input type="checkbox"/> 75 mm SPOON	<input type="checkbox"/> CRREL BARREL	
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM	COMPLETION DEPTH: 7.3 m
	REVIEWED BY: JRT	COMPLETE: 28/11/02
		Page 1 of 1

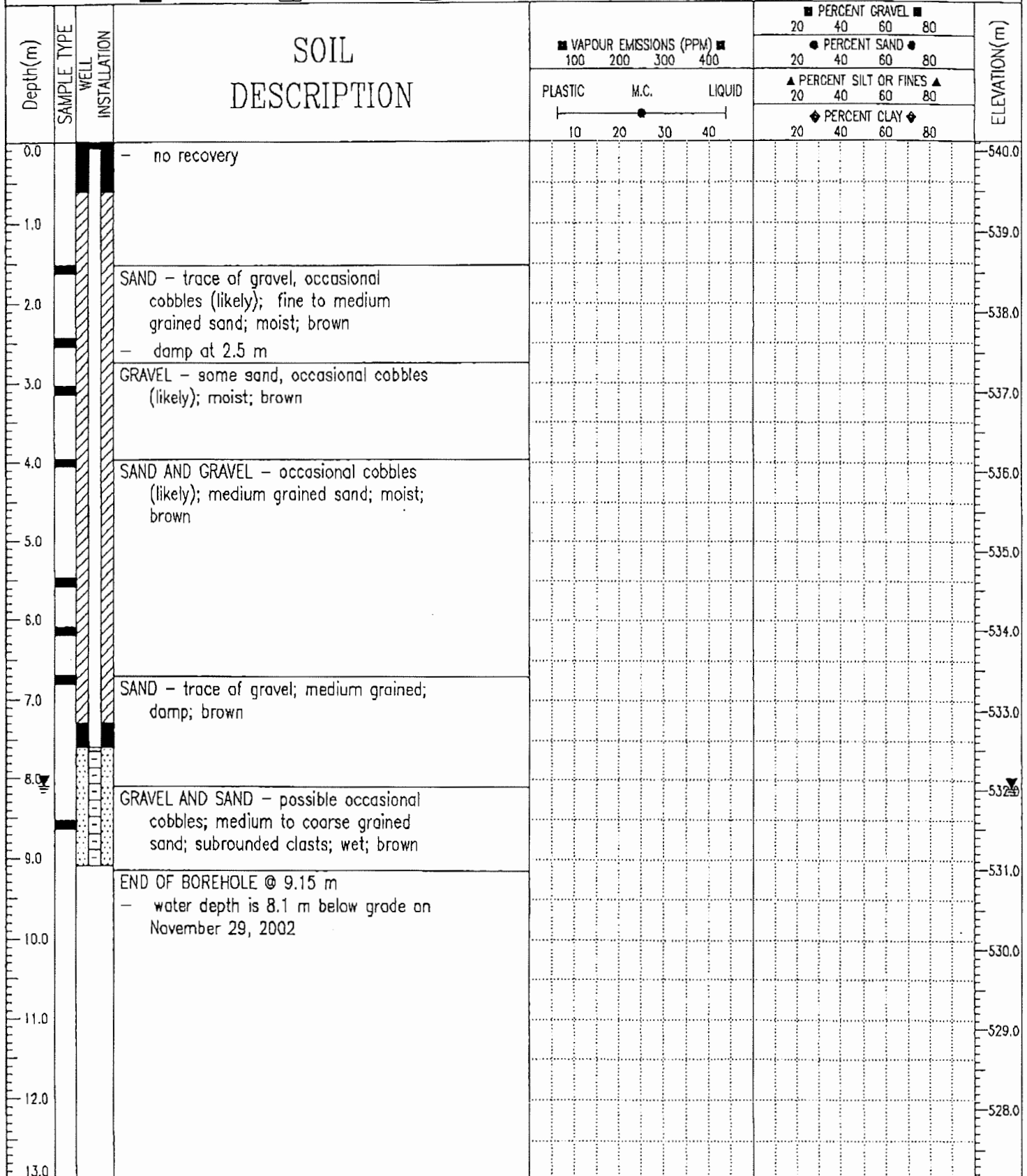
Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW03				
Carmacks Solid Waste Facility	DRILL: Prospector	PROJECT NO: 0201-1240011				
Carmacks, YT	UTM ZONE: - N6883569 E432937	ELEVATION: 547.568 m				
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM	COMPLETION DEPTH: 10.7 m
	REVIEWED BY: JRT	COMPLETE: 28/11/02
		Page 1 of 1

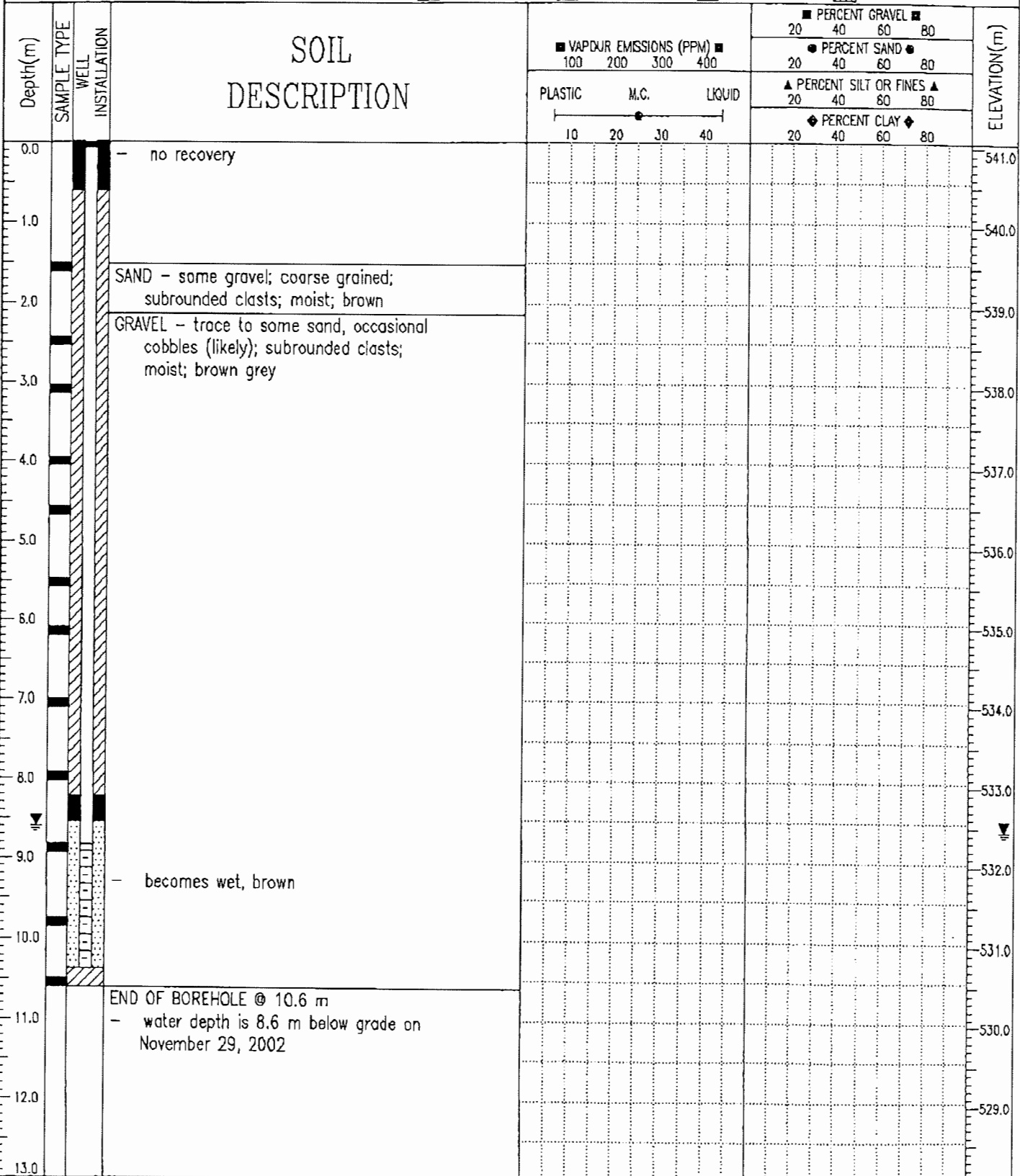
Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW04
Carmacks Solid Waste Facility	DRILL: Prospector	PROJECT NO: 0201-1240011
Carmacks, YT	UTM ZONE: - N6883650 E432674	ELEVATION: 540.118 m

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EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM REVIEWED BY: JRT	COMPLETION DEPTH: 9.15 m COMPLETE: 29/11/02
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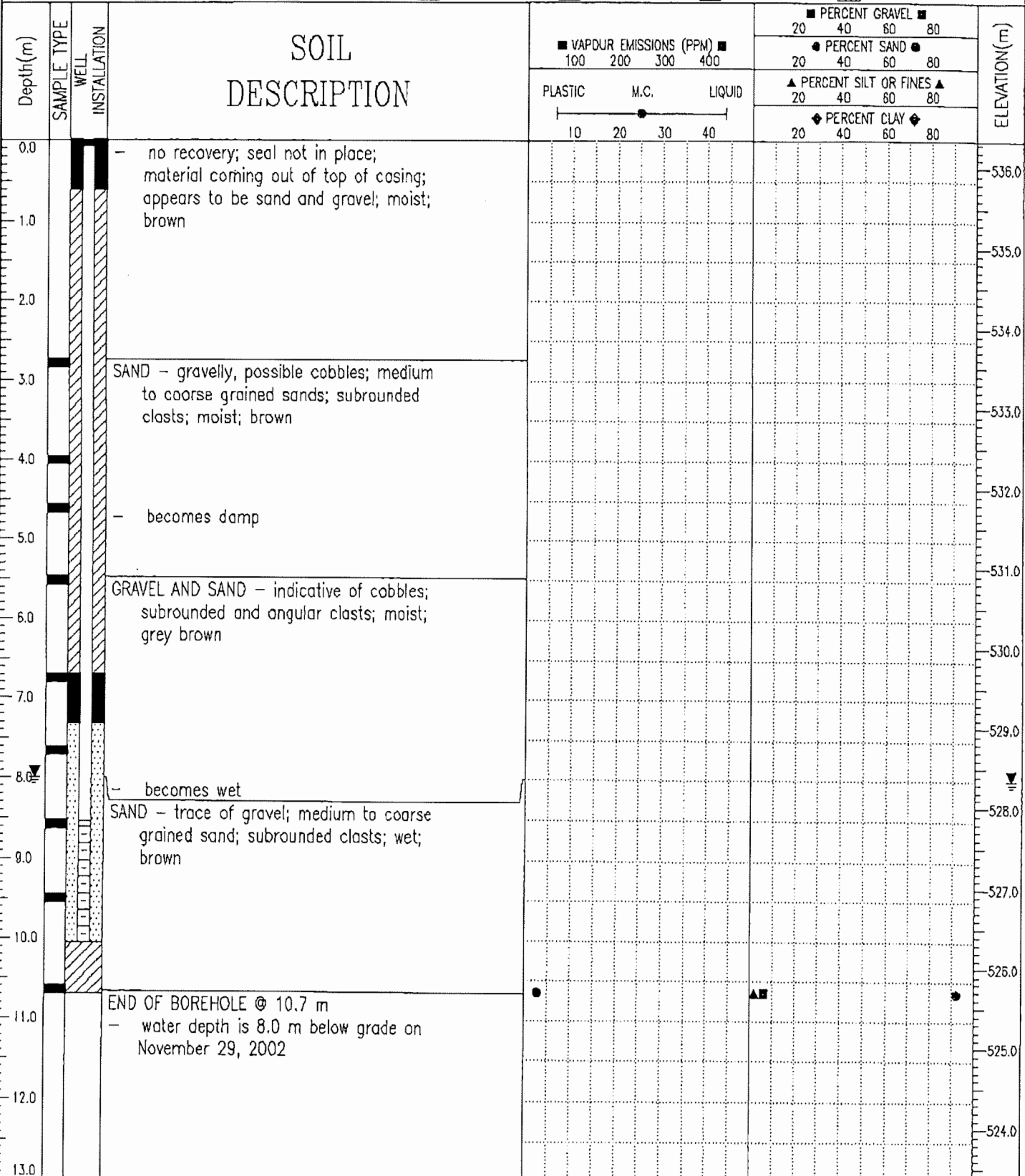
Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW05
Carmacks Solid Waste Facility	DRILL: Prospector	PROJECT NO: 0201-1240011
Carmacks, YT	UTM ZONE: - N6883544 E432759	ELEVATION: 541.052 m
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH <input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND	



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM REVIEWED BY: JRT	COMPLETION DEPTH: 10.6 m COMPLETE: 29/11/02
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Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW06
Carmacks Solid Waste Facility	DRILL: Prospector	PROJECT NO: 0201-1240011
Carmacks, YT	UTM ZONE: - N6883962 E432372	ELEVATION: 536.336 m

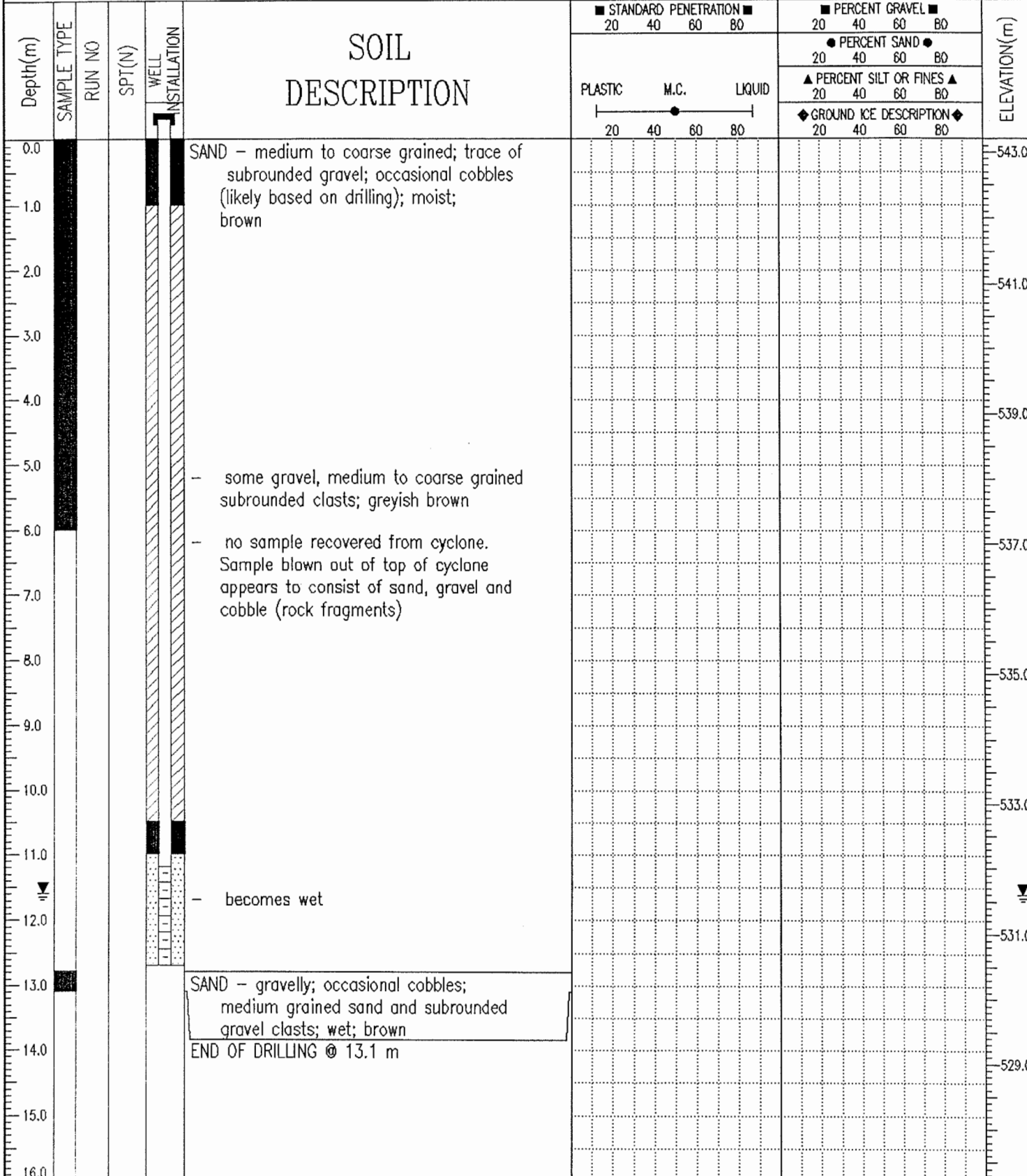
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



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Whitehorse, Yukon

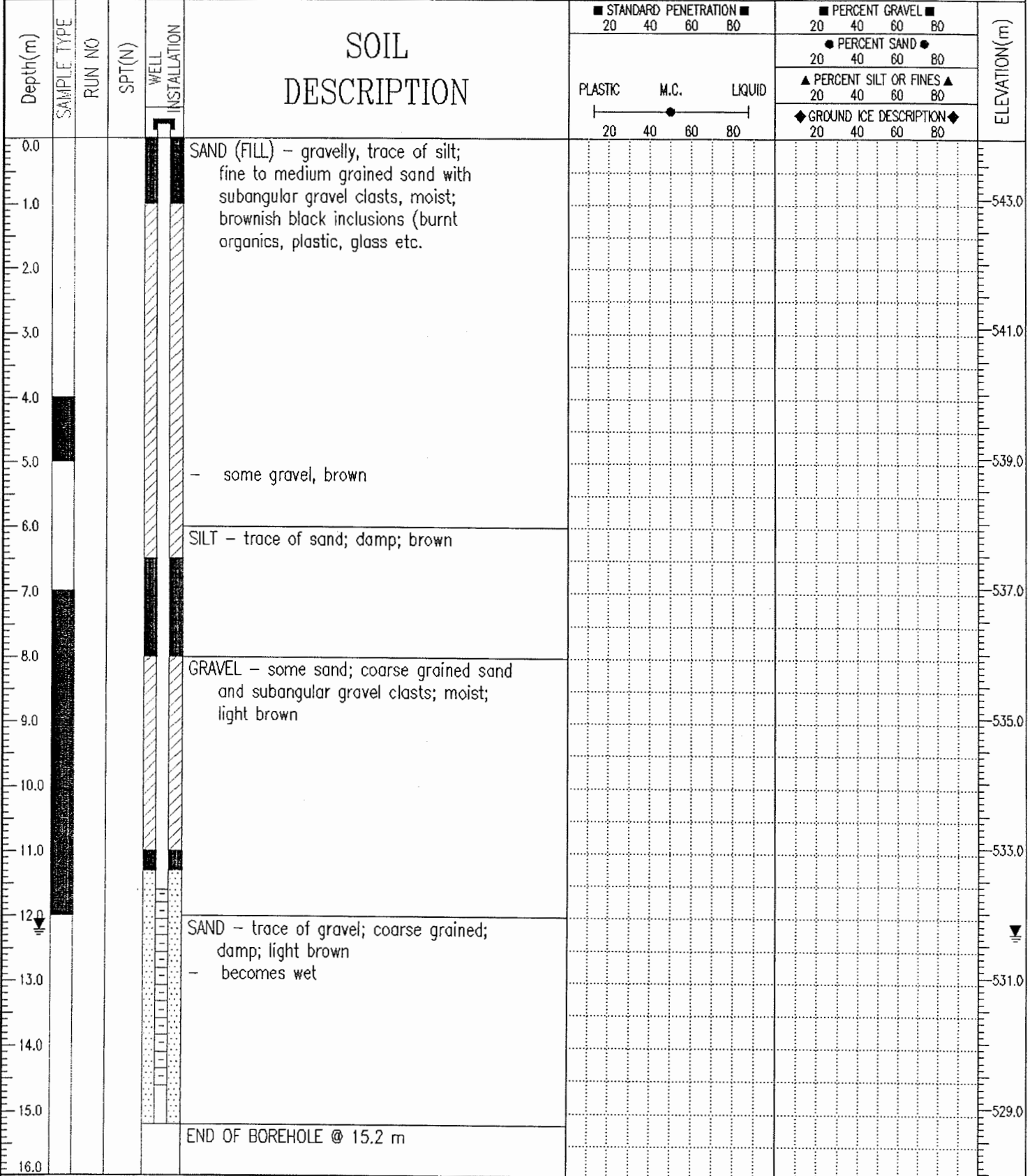
LOGGED BY: RMM	COMPLETION DEPTH: 10.7 m
REVIEWED BY: JRT	COMPLETE: 29/11/02

SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> STANDARD PEN.	<input type="checkbox"/> 75 mm SPLIT SP.	<input type="checkbox"/> CRREL BARREL	<input type="checkbox"/> NW CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



04/06/00 11:30:4M (WELL15)

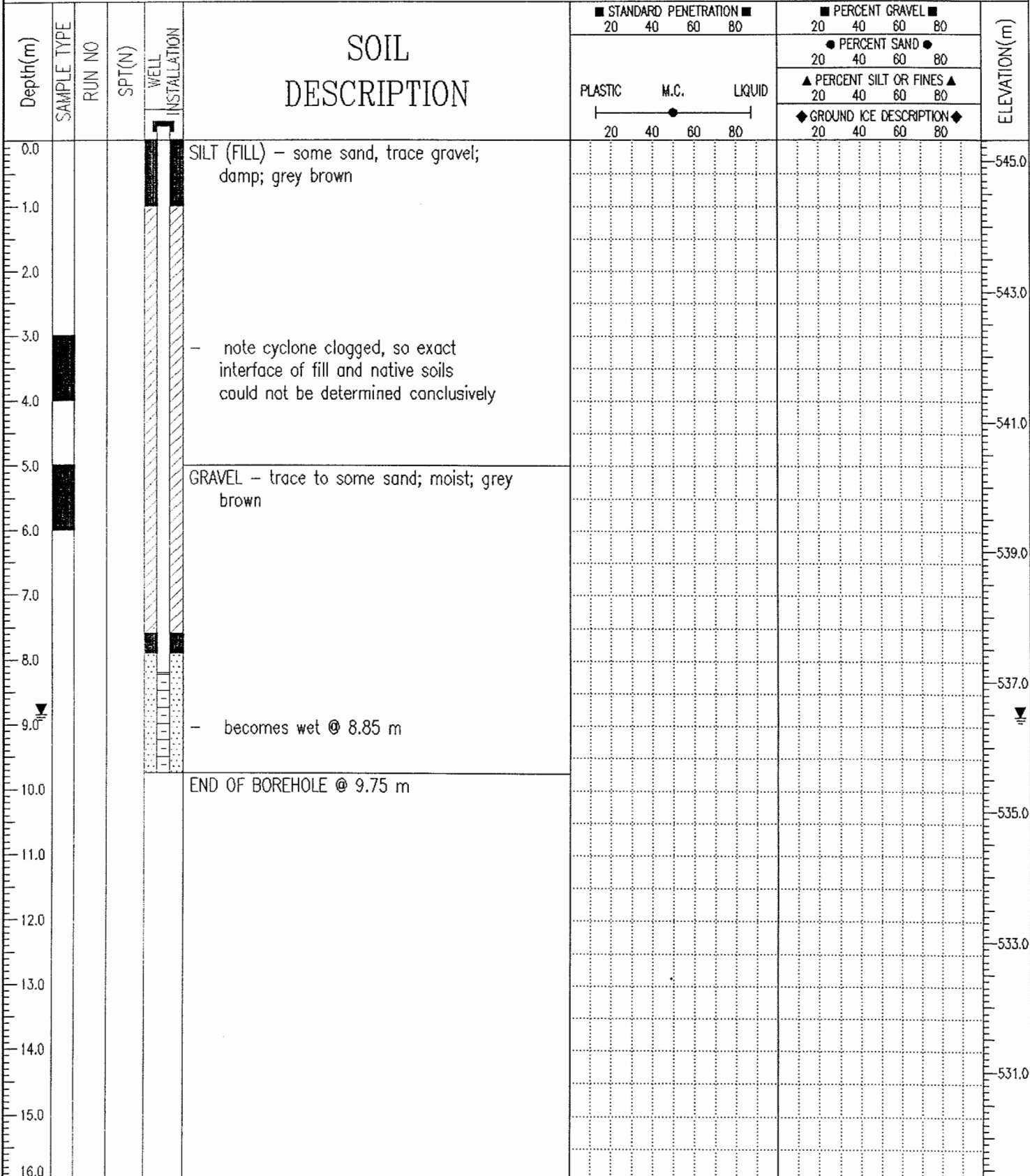
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Carmacks Solid Waste Facility	DRILL: Schramm	PROJECT NO: 1240011001				
Carmacks, YT	UTM ZONE: 8 N6883655 E432850	ELEVATION: 543.9 m				
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input type="checkbox"/> NO RECOVERY	<input type="checkbox"/> STANDARD PEN.	<input type="checkbox"/> 75 mm SPLIT SP.	<input type="checkbox"/> CRREL BARREL	<input type="checkbox"/> NW CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM	COMPLETION DEPTH: 15.2 m
	REVIEWED BY: GW	COMPLETE: 02/07/03

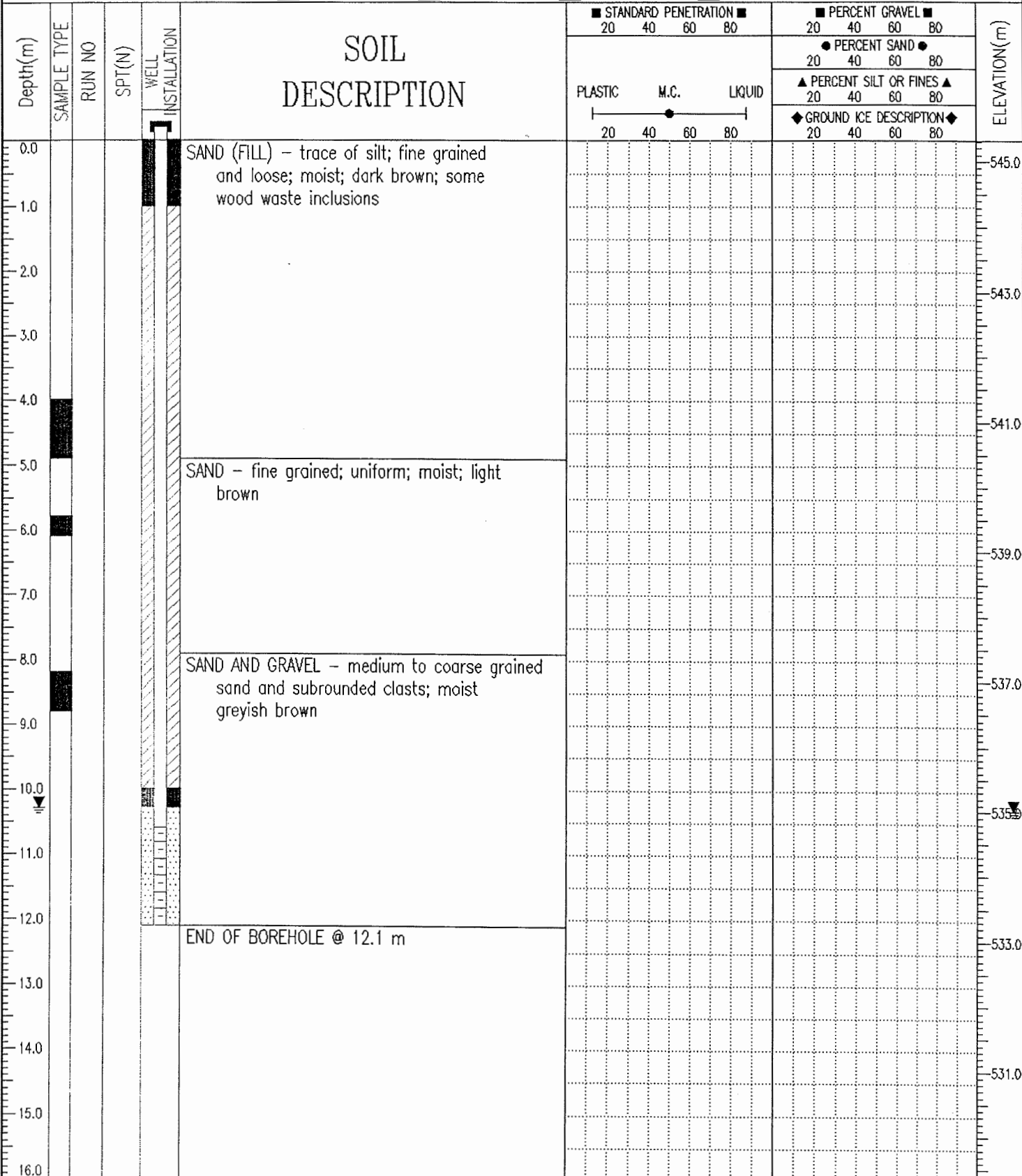
Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW09
Carmacks Solid Waste Facility	DRILL: Schramm	PROJECT NO: 1240011001
Carmacks, YT	UTM ZONE: 8 N6883280 E432850	ELEVATION: 545.31 m

SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> STANDARD PEN.	<input type="checkbox"/> 75 mm SPLIT SP.	<input type="checkbox"/> CRREL BARREL	<input type="checkbox"/> NW CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM	COMPLETION DEPTH: 9.75 m
	REVIEWED BY: GW	COMPLETE: 02/07/03

Hydrogeological Investigation	CLIENT: Village of Carmacks	BOREHOLE NO: 1240011-MW10				
Carmacks Solid Waste Facility	DRILL: Schramm	PROJECT NO: 1240011001				
Carmacks, YT	UTM ZONE: 8 N6883285 E432890	ELEVATION: 545.31 m				
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB SAMPLE	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> STANDARD PEN.	<input type="checkbox"/> 75 mm SPLIT SP.	<input type="checkbox"/> CRREL BARREL	<input type="checkbox"/> NW CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: RMM	COMPLETION DEPTH: 12.1 m
	REVIEWED BY: GW	COMPLETE: 03/07/03