BMA GeoServices

Geophysical Geotechnical Environmental

Report

Geological and Hydrogeological Study of the Corranure Landfill, County Cavan

for

M. C. O'Sullivan & Co. Ltd.

BMA GeoServices Ltd.
Ground Engineering Consultants
Comhairleoirí Cré-Innealtóireachta

BMA GeoServices Ltd.
8 Strawhall Business Park
Athy Road, Carlow
Co. Carlow
Reg. No. 335742
VAT. No. 6355742G

AUTHOR	CHECKED	JOB No.	DATE
Dr. Davide Gallazzi PGeo	EuroGeol B.J.Murphy M.Sc. DIC MIEI	1229	25th August 2003

FOREWORD

This report has been prepared by BMA GeoServices Ltd. in line with best current practice and with all reasonable skill, care and diligence within the limitations imposed by the survey techniques applied and the resources devoted to it by agreement with the client. The client should take the interpretative basis for any conclusions or opinions contained therein into account in any future use of this report.

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Maps

Appendices

1.3 Site Location and Description

The site is located ca. 2 km to the north-east of Cavan Town, on the north side of the R188 to Cootehill, on the western side of a gently sloping hill (see Map 1). The area of the present landfill has a maximum elevation of ca. 118 m OD. The area of the proposed extension lies to the north and north-west of the present landfill, with elevation between 101 mOD and 116 mOD.

2.2 Local Geology

A total of 9 no. trial pits (see Map 4 for boreholes and trial pits location) were excavated in the proposed extension area with a tracked excavator EX200 during the 2003 study. The depth of excavation varies between 3.90 m and 6.70 m bgl.

A total of 6 no. boreholes were drilled on site with a shell and auger and with a coring rig during the activities undertaken in 1998 in relation to the application for the current Waste Licence.

A further 6 no. boreholes (GW1-3, R01, R02 and R04), each of 150 mm in diameter, were drilled in the proposed extension area in the period 12-27 June 2003 with an air rotary rig (see Map 4 for location). An ODEX technique was used for drilling through the overburden, while rock coring was used in bedrock. The depth of the boreholes varies between 9 m (R04) and 21.50 m (GW3).

2.2.1 Boulder Clay

The trial pit and borehole logs reveal the presence of a firm to stiff brown sandy, gravelly clay with boulders and cobbles (Boulder Clay). Occasionally the Boulder Clay presents intermittent and thin layers more rich in sand or in gravel. The thickness of the Boulder Clay varies between 8 m (R04) and 18 m (GW3). However, a thickness of 25 m is reported in a borehole (RC5) drilled during the previous phase of field activity (1998). The results of the geophysical surveys carried out in 1998 and in 2003 and the borehole logs indicate that the thickness of the boulder clay is increasing toward the west.

2.2.2 Waste

A total of 4 no. boreholes (L 1-4), each of 200 mm in diameter, were drilled in the waste body with a shell and auger rig in the period 12-19 June 2003. Another borehole (SA6) was drilled during the previous field activities.

The boreholes drilled during this phase of field activity intersected a maximum of 20.40 m of waste, while a total of 26.70 m of waste was encountered by SA6 in 1998. In both cases it is evident that the bottom of the waste body is at least 5 m below the elevation of the surrounding ground level. This indicates that the waste was originally dumped in the Lismagratty Lough.

3. HYDROLOGY

3.1 Drainage

The drainage on the higher portion of the area under investigation appears to be quite good, probably as a consequence of fast run-off due to the presence of relatively steep slopes. The presence of boggy grounds in the lower part of the site is evidence of a poorer underlying drainage.

3.2 Surface Water

The area under investigation falls within the catchment area of the Annalee to the north and the Cavan River to the south-west.

3.2.1 Annalee River

Two small streams are present in the boggy area to the north-west and the east of the existing landfill site. Both these streams flow towards the north-west and eventually become tributary of the Annalee River. According to data published by the EPA in 1997 the estimated dry weather flow rate in the Annalee River is 0.02 m^3/s, based on data from a gauging station at Lisdarn.

A biological assessment of the Annalee River, based on samples collected at a station located at the Ballyhaise Bridge ca. 2.5 km to the north, indicates that the Annalee River is classified as "Class 4 Unpolluted" (Mac Garrigle et others, 2000).

3.2.2 Cavan River

The southern half of the site, including the existing landfill, is drained by the Kinneypottle River, which originates in the high grounds to the north of the site. This stream flows south-west towards Cavan Town and eventually becomes a tributary of the Cavan River. According to data published by the EPA in 1997, the estimated dry weather flow in the Cavan River, based on data from a gauging station at Lisdam, is between 0.01 and 0.02 m^3/s.

A biological assessment of the Cavan River carried out by the EPA (Mac Garrigle et others, 2000), based on samples collected at a bridge near Brefni Park, ca. 4.5 Km to the south-west, awards to the river a rating of "Class 4 Unpolluted" (Mac Garrigle et others, 2000).

During field activities undertaken in June 2003 variable head permeability tests were carried out at different depth to measure the permeability of the overburden. These results are summarised in Table 4.2.1§1, and included in Appendix B.

Table 4.2.1§1: Variable Head Permeability Tests

Borehole No.	Depth of Test (mbgl)	Overburden Material	Permeability (m/s)
GW 2	2.50	Stiff gravelly sandy clay	5.0×10^{-09}
GW 2	5.00	Stiff gravelly sandy clay	1.9×10^{-08}
GW 2	10.10	Stiff gravelly very sandy clay	2.8×10^{-06}
GW 3	2.50	Stiff gravelly sandy clay	7.5×10^{-09}
GW 3	4.90	Stiff gravelly sandy clay	3.0×10^{-09}
GW 3	10.00	Stiff gravelly sandy clay	4.5×10^{-09}
R0 1	2.30	Stiff gravelly sandy clay	1.5×10^{-09}
R0 1	5.00	Stiff gravelly sandy clay	1.3×10^{-08}
R0 1	10.00	Stiff gravelly sandy clay	6.0×10^{-09}
R0 2	3.00	Stiff gravelly sandy clay	1.9×10^{-07}

The results of permeability testing indicate very low permeability values (2.8×10^{-06} to 1.5×10^{-09} m/s). The relatively more elevated value from GW 2 at a depth of 10.10 m bgl could be due to the presence of slightly more sand and/or gravel in the soil horizon. These results are consistent with the nature of the overburden and with the results of similar tests undertaken in 1998, which show a permeability of the overburden between 1.89×10^{-06} m/s and 7.01×10^{-08} m/s. It should be noted that these tests generally reflect horizontal rather than vertical permeability, which could be up to an order of magnitude lower.

4.2.2 Bedrock

Due to the lithology of the bedrock fissure flow is the dominant type of groundwater flow.

Four packer tests were performed in bedrock during drilling operations in 1998. The highest permeability value was of 7.8×10^{-06} m/s, indicating a low to moderate permeability.

No further permeability tests were undertaken during drilling in June 2003.

4.2.3 *Vulnerability*

The area under investigation is covered by boulder clay with a thickness generally in excess of 10 m, apart from the area near R04, where the boulder clay has a thickness of 8 m. This implies a general vulnerability rating of low, which would become moderate in the area near R04.

The application of the Response Matrix for Landfills from Groundwater Protection Schemes would give to the area under investigation a rating of R2[1], which could improve to R1 if the area around R04 is excluded from the proposed landfill extension.

4.3 Groundwater Levels

Groundwater levels were measured in the new and in the pre-existing monitoring wells on 25th July 2003, and are reported in Table 4.2.3§1 and Table 4.2.3§2.

Table 4.2.3§1 – Overburden Groundwater Levels

Monitoring Well No.	Depth to Water m b.g.l.	Water Level mOD
GW 1	1.84	110.13
GW 2	4.38	109.44
R0 1	7.41	102.55
R0 2	2.22	100.82

The water levels measured in the standpipes installed in the overburden suggest that a limited amount of groundwater is present in the Boulder Clay. However, it is our opinion that this does not represent a groundwater table extended over the whole area of interest, but is more likely to be the expression of localised almost stagnant perched groundwater table without lateral extension. A reconstruction of the groundwater direction flow was therefore not considered appropriate.

5 HYDROCHEMISTRY

5.1 Surface Water

A total of five surface water sampling locations were selected by the E.P.A. in Table E.4.1 of the Waste Licence No. 77-1 issued to Cavan County Council. Sampling is carried out on a regular basis by Cavan County Council personnel, in accordance with the requirements of the above-mentioned Waste Licence.

Reports compiled by personnel of Cavan County Council involved in the landfill monitoring, relating to the quarterly sampling of surface water from January 2002 to March 2003 are included in Appendix C. An examination of these Reports indicates that the quality of surface water deteriorates between K1 (which is located upstream) and K2 (just downstream from the waste body), and improves in K3 (further downstream), probably due to dilution. The potentially detrimental influence of the landfill on the quality of the surface water can not be excluded. However, it is reported that the fields adjacent to sampling location K2 are used for grazing cattle, which may be the source of the pollution of the stream.

5.2 Groundwater

A total of five groundwater sampling locations were selected by the E.P.A. in Table E.4.2 of the Waste Licence No. 77-1 issued to Cavan County Council, in addition to all the private wells within 500 m of the landfill boundary. At present groundwater sampling is carried out on a regular basis by Cavan County Council personnel, in accordance with the requirements of the above-mentioned Waste Licence at the only groundwater monitoring point available (SA1). The boreholes drilled during this phase of site investigation were completed as monitoring wells in order to fulfil the waste Licence requirements.

Reports compiled by personnel of Cavan County Council involved in the landfill monitoring, relating to the quarterly sampling of surface water from January 2002 to March 2003 are included in Appendix C. An examination of these Reports indicates the presence of groundwater pollution from Phenols, Total and Faecal Coliforms, metals. However, the possibility of a source of pollution other than the waste body can not be excluded at this stage.

9. REFERENCES

Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland, Groundwater Protection Schemes, 1999.

Environmental Protection Agency, Parameters of water Quality –Interpretation and Standards, 2001.

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