



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE &
PLANNING

TUAM HISTORIC LANDFILL - H0192-01

Response To Request For Information

Prepared for:
Galway County Council



Comhairle Chontae na Gaillimhe
Galway County Council

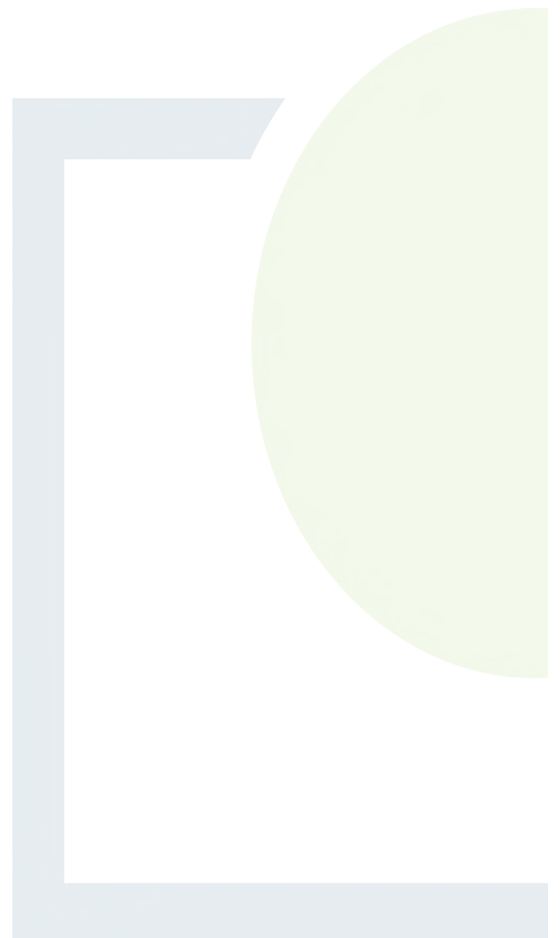
Date: October 2022

J5 Plaza, North Park Business Park, North Road, Dublin 11,
D11 PXT0, Ireland

T: +353 1 658 3500 | E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie



RESPONSE TO REQUEST FOR INFORMATION

REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT

User is responsible for Checking the Revision Status of This Document

| Rev. No. | Description of Changes | Prepared by: | Checked by: | Approved by: | Date: |
|----------|------------------------|--------------|-------------|--------------|------------|
| 1 | Final | BF/SJ/NSC | JON | BG | 25/11/2022 |

Client: Galway County Council

Keywords: Regulation 7, historical landfill, environmental risk assessment.

Abstract: Fehily Timoney and Company (FT) on behalf of Galway County Council (GCC) submitted an application to the Environmental Protection Agency (EPA) for a certificate of authorisation (CoA) for the Tuam Historic Landfill. The EPA determined the application did not comply with Regulation 7(2) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008. The EPA requested that Galway County Council (GCC), in accordance with Regulation 7(4) supply the information listed in Appendix 1. This report provides responses to the queries raised.

TABLE OF CONTENTS

| | |
|---|----------|
| 1. INTRODUCTION | 1 |
| 1.1 Introduction..... | 1 |
| 2. REQUEST FOR INFORMATION | 2 |
| 2.1 Item 1..... | 2 |
| 2.1.1 Request for Information..... | 2 |
| 2.1.2 Response | 2 |
| 2.2 Item 2..... | 2 |
| 2.2.1 Request for Information..... | 2 |
| 2.2.2 Response | 2 |
| 2.3 Item 3..... | 2 |
| 2.3.1 Request for Information..... | 2 |
| 2.3.2 Response | 3 |
| 2.4 Item 4..... | 3 |
| 2.4.1 Request for Information..... | 3 |
| 2.4.2 Response | 3 |
| 2.5 Item 5..... | 4 |
| 2.5.1 Request for Information..... | 4 |
| 2.5.2 Response | 4 |
| 2.6 Item 6..... | 5 |
| 2.6.1 Request for Information..... | 5 |
| 2.6.2 Response to Item 6(i) | 5 |
| 2.6.3 Response to Item 6(ii) | 6 |
| 2.7 Item 7..... | 6 |
| 2.7.1 Request for Information..... | 6 |
| 2.7.2 Response | 7 |
| 2.8 Item 8..... | 7 |
| 2.8.1 Request for Information..... | 7 |
| 2.8.2 Response | 7 |
| 2.9 Item 9..... | 9 |
| 2.9.1 Request for Information..... | 9 |
| 2.9.2 Response | 9 |
| 2.10 Item 10..... | 9 |

| | | |
|--------|-------------------------------|----|
| 2.10.1 | Request for Information..... | 9 |
| 2.10.2 | Response | 9 |
| 2.11 | Item 11..... | 13 |
| 2.11.1 | Request for Information..... | 13 |
| 2.11.2 | Response | 13 |
| 2.12 | Item 12..... | 14 |
| 2.12.1 | Request for Information..... | 14 |
| 2.12.2 | Response | 14 |
| 2.13 | Item 13..... | 14 |
| 2.13.1 | Request for Information..... | 14 |
| 2.13.2 | Response | 14 |
| 2.14 | Item 14..... | 14 |
| 2.14.1 | Request for Information..... | 14 |
| 2.14.2 | Response | 15 |
| 2.15 | Item 15..... | 15 |
| 2.15.1 | Request for Information..... | 15 |
| 2.15.2 | Response to Item 9(i) | 15 |
| 2.15.3 | Response to Item 9(ii) | 15 |
| 2.15.4 | Response to Item 9(iii) | 16 |
| 2.16 | Item 16..... | 18 |
| 2.16.1 | Request for Information..... | 18 |
| 2.16.2 | Response | 19 |
| 2.17 | Item 17..... | 21 |
| 2.17.1 | Request for Information..... | 21 |
| 2.17.2 | Response | 21 |
| 2.18 | Item 18..... | 22 |
| 2.18.1 | Request for Information..... | 22 |
| 2.18.2 | Response | 22 |
| 2.19 | Item 19..... | 22 |
| 2.19.1 | Request for Information..... | 22 |
| 2.19.2 | Response | 22 |

LIST OF APPENDICES

| | |
|-------------|--|
| Appendix 1 | Regulation 7 Notice |
| Appendix 2 | A Letter from the Qualified Body to the Qualified Person |
| Appendix 3 | Figure No. 1.1 'Site Location' |
| Appendix 4 | Updated Geotechnical Report – September 2020 |
| Appendix 5 | Civic Amenity Waste Collection Permit |
| Appendix 6 | Civic Amenity Waste Acceptance 2021 |
| Appendix 7 | Civic Amenity within Site Boundary Figure |
| Appendix 8 | Geotechnical Report – August 2022 |
| Appendix 9 | Updated Geophysical Survey Report |
| Appendix 10 | Updated Figure 4.2 'Surface Water Sampling Locations' |
| Appendix 11 | Certificate of Analysis – Surface Water Monitoring |
| Appendix 12 | Certificate of Analysis – Leachate Monitoring |
| Appendix 13 | Drawing Requested under Point 18 |

LIST OF FIGURES

| | <u>Page</u> |
|--|-------------|
| Figure 2-1: Location of Historic Landfill and Monitoring Stations provided by GCC..... | 16 |

LIST OF TABLES

| | <u>Page</u> |
|---|-------------|
| Table 2.1: Summary of Waste Acceptance 2021 | 3 |
| Table 2.2: Summary of Ground Condition | 5 |
| Table 2.3: Summary of Ground Condition | 6 |
| Table 2.4: Waste Sampling Results – Solid Waste Analysis | 11 |
| Table 2.5: Triaxial Cell Test Results | 13 |
| Table 2.6: Permeameter Test Results | 13 |
| Table 2.7: Surface Sampling Results May 2022 | 17 |
| Table 2.8: Leachate Sampling Results August 2022..... | 19 |
| Table 2.9: Civic Amenity Gas Monitoring Results – August 2022 | 21 |
| Table 2.10: Landfill Footprint Gas Monitoring Results – August 2022 | 22 |



1. INTRODUCTION

1.1 Introduction

Fehily Timoney and Company (FT) on behalf of Galway County Council (GCC) submitted an application to the Environmental Protection Agency (EPA) for a Certificate of Authorisation (CoA) for the Tuam Historic Landfill.

The EPA reviewed the CoA application and determined the application did not comply with Regulation 7(2) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008. The EPA requested that GCC, in accordance with Regulation 7(4) supply the information listed in Appendix 1.

This report provides responses to the queries raised.



2. REQUEST FOR INFORMATION

This section outlines the 19 no. items (including an updated Non-Technical Summary) requested by the EPA and the responses to respective items.

2.1 Item 1

2.1.1 Request for Information

The grid reference numbers for the site stated in Section C.2 of the Application show a different location than the landfill. Provide grid coordinates for the site.

2.1.2 Response

The grid reference for the centre of the site is:

| Type | Coordinates | |
|----------------------|----------------|-----------------|
| Latitude / Longitude | 53.496735N | -8.8467385W |
| Irish Grid | Easting 143862 | Northing 249947 |
| ITM | Easting 543817 | Northing 749970 |

2.2 Item 2

2.2.1 Request for Information

Provide a letter from the Qualified Body to the Qualified Person, as required under Section 2.3 of the EPA Code of Practice – Environmental Risk Assessment for Unregulated Waste Disposal Sites.

2.2.2 Response

A letter (see Appendix 2 of this document) has been prepared from the Professional Body (Engineers Ireland) to the Qualified Person (James O'Neill Chartered Engineer) confirming the Qualified Person has been assessed as a person who is qualified, trained and experienced to the standard set out in Section 2.3 of Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).

2.3 Item 3

2.3.1 Request for Information

The site boundary shown in Figure No. 1.1 'Site Location' dated 18/10/2021 of the application and in Figure (no figure number given) titled 'Site Location Plan' dated 21/09/2020 of the Geotechnical Report differ. State the reason for the differences in the extent of the site boundary in said figures and submit, or refer to, a figure that shows the actual site boundary.



2.3.2 Response

The site boundary shown in Figure (no figure number given) titled 'Site Location Plan' dated 21/09/2020 of the Geotechnical Report was initially assumed as the site boundary. The site boundary was updated after site investigations were undertaken and is reflected as per Figure No. 1.1 'Site Location' dated 18/10/2021, this is the correct site boundary.

The definitive site boundary can be found in Figure No. 1.1 'Site Location', Appendix 3 of this report.

An updated geotechnical report with a corrected site boundary can be found in Appendix 4 of this report.

2.4 Item 4

2.4.1 Request for Information

State what waste is accepted at the on-site civic amenity and provide a copy of the waste authorisation for this activity. Additionally, provide the red line boundary map for this facility.

2.4.2 Response

All waste deposited at the CA site is removed by hauliers and taken to licensed/permitted facilities for further processing. The civic amenity site operated by Barna Recycling, Company Registration number 141912, Waste Collection Permit Number NWCPO-08-03604, see Appendix 5.

The facility accepts domestic waste only.

A summary of the waste accepted by the facility for 2021 is presented in Table 2.1. For the complete records see Appendix 6.

Table 2.1: Summary of Waste Acceptance 2021

| Waste Type | EWC Code | Destination | Tonnes/Year |
|----------------------|----------|---|-------------|
| Aerosols | 160504* | Enva | 0.4 |
| Aluminium Cans | 150104 | Glassco Recycling | 1.785 |
| Batteries (Fence) | 160601 | KMK Metals | 0.654 |
| Batteries (Portable) | 160601 | KMK Metals | 2.365 |
| Bottled Glass | 150107 | Glassco Recycling | 64.462 |
| Bulky Waste | 200307 | Barna Recycling Carrowbrowne Headford Rd Galway | 43.12 |
| Cardboard | 150101 | Barna Recycling Carrowbrowne Headford Rd Galway | 166 |
| Clothes | 200110 | Textile Recycling | 13.13 |
| Cooking Oil | 200125 | Frylite | 0 |
| Flat Glass | 200102 | Barna Recycling Carrowbrowne Headford Rd Galway | 15.5 |
| Flourescent Tubes | 200123 | KMK Metals | 0.758 |
| Fridges | 200135 | KMK Metals | 24.744 |



| Waste Type | EWC Code | Destination | Tonnes/Year |
|------------------|-----------|---|----------------|
| Hard Plastic | 200139 | Barna Recycling Carrowbrowne Headford Rd Galway | 54.35 |
| Mattresses-Bulky | 200307 | - | 1.45 |
| Metal | 200140 | Galway Metal | 78.59 |
| Mixed Recycling | 200301 | Barna Recycling Carrowbrowne Headford Rd Galway | 6.82 |
| Oil Filters | 16 01 07* | Enva | 0.12 |
| Paints | 200127 | Enva | 46.68 |
| Plastic | 200139 | Barna Recycling Carrowbrowne Headford Rd Galway | 76.44 |
| Waste Oil | 13 02 08* | Enva | 0 |
| WEEE | 200136 | KMK Metals | 157.39 |
| Wood | 200138 | Barna Recycling Carrowbrowne Headford Rd Galway | 1.7 |
| Total | | | 756.458 |

It is the intention of Galway County Council to regularise the authorisation for the Civic Amenity site.

Drawing with civic amenity boundary (orange dashed line) within the red line historic landfill boundary is provided in Appendix 7.

2.5 Item 5

2.5.1 Request for Information

State whether or not waste was deposited under the civic amenity and explain how this was determined, considering that no site investigation or geophysical survey was carried out within the extent of the civic amenity area, as indicated in Figure 3.1 'Site Investigation Location Plan' of the Tier 2 Assessment and Map 1 'Geophysical Survey Location Map' of the Geophysical Survey Report.

2.5.2 Response

Installation of 1 no. landfill gas monitoring borehole (BHLFG1) within the civic amenity site as per proposed remediation plan was undertaken on 20th July 2022. BHLFG1 was drilled to depth of 3m BGL, made ground was encountered up to a depth of 2.50m BGL, when natural ground was reached.

A summary of the ground conditions encountered at the borehole within the civic amenity is presented in Table 2.2 with photographs and exploratory hole logs provided in the CGL site investigation report, Appendix 8 of this report.



Table 2.2: Summary of Ground Condition

| Borehole ID | Depth of material (m BGL) | Total Depth (m BGL) | Profile Description |
|-------------|---------------------------|-------------------------------------|---------------------------------------|
| BHLFG1 | – 0.05 (BITMAC) | 3.0 (terminated at scheduled depth) | BITMAC. |
| | 0.05 – 0.40 (Made Ground) | | Sandy GRAVEL with low cobble content. |
| | 0.40 – 2.10 (Made Ground) | | Sandy Gravelly CLAY. |
| | 2.10 – 2.50 (Made Ground) | | Dense GRAVEL. |
| | 2.50 – 3.0 (Peat) | | PEAT. |

Results of the SI indicate waste is likely not present beneath the civic amenity site, however the complete absence of waste under the civil amenity cannot be discarded. It is noted that the site is capped with a bitmac surfacing, which is highly impermeable, preventing rainfall ingress essentially capping this area of the site.

2.6 Item 6

2.6.1 Request for Information

The conceptual site model indicates that waste was deposited onto undisturbed natural ground. Section 2.3 of the Closure & Remediation Plan dated October 1999 states that the landfill rises to a height of approximately 6-7m above the surrounding land. However, the borehole log for borehole BH3, in Appendix I of the same document, recorded a waste ‘depth (thickness)’ of 9m. Provide the following information:

- i. State whether waste was deposited below the natural ground level. If yes, please state the maximum depth of waste below ground level and height of waste measured from the natural ground level. Re-submit a drawing showing the conceptual site model in the event that waste was deposited below the natural ground level.*
- ii. State the maximum depth of the deposited waste.*

2.6.2 Response to Item 6(i)

Site Investigations indicate that the historic landfill is a land raise with waste placed in cutaway bog atop peat.

The reference to the landfill rising to 6-7m above the surrounding land is described from the perspective of the civic amenity/entrance area of the site.

As per the Conceptual Site Model (Figure 2-2) in Tier 3, the natural ground slopes from to the East to West, falling from 41.2 mAOD (in the civic amenity) to 35.2 mAOD (surrounding bogland) hence a recorded waste depth of 9m is possible.



2.6.3 Response to Item 6(ii)

The maximum depth of waste encountered during the additional site investigation was 7.1m BGL (35.72 mAOD) in BH01, 8.4m BGL (36.59 mAOD) in BH02 and 7.0m BGL (36.28 mAOD) in BH03.

A summary of the ground conditions encountered at each borehole is presented in Table 2.3 with photographs and exploratory hole logs provided in the CGL site investigation report, Appendix 8 of this report.

Table 2.3: Summary of Ground Condition

| Borehole ID | Depth of material (m BGL) | Total Depth (m BGL) | Profile Description |
|-------------|---------------------------|--------------------------------------|----------------------|
| BH01 | - 0.90 (Made Ground) | 8.20 (terminated at scheduled depth) | Sandy Gravelly CLAY. |
| | 0.90 – 2.50 (Made Ground) | | Landfill. |
| | 2.50 – 3.0 (Made Ground) | | Sandy Gravelly CLAY. |
| | 3.0 – 8.0 (Made Ground) | | Landfill. |
| | 8.0 – 8.20 (Peat) | | PEAT. |
| BH02 | - 0.90 (Made Ground) | 9.40 (terminated at scheduled depth) | Sandy Gravelly CLAY. |
| | 0.90 – 5.0 (Made Ground) | | Landfill. |
| | 5.0 – 9.0 (Made Ground) | | Sandy Gravelly CLAY. |
| | 9.0 – 9.30 (Made Ground) | | Landfill. |
| | 9.30 – 9.40 (Peat) | | PEAT. |
| BH03 | - 1.0 (Made Ground) | 8.20 (terminated at scheduled depth) | Sandy Gravelly CLAY. |
| | 1.0 – 8.0 (Made Ground) | | Landfill. |
| | 8.0 – 8.20 (Peat) | | PEAT. |

2.7 Item 7

2.7.1 Request for Information

Section 2.5.3 of the Tier 3 Assessment states that no leachate breakouts were observed at the site walkover however, Section 2.7.2 of the same document states that no significant leachate breakout was observed. State whether or not leachate breakouts were observed at the site. Include dates of the observations.



2.7.2 Response

No leachate breakouts were observed at the site during the site walkovers undertaken by FT as per site walkover checklist in Appendix 2 of the Tier 2 Assessment, which accompanies this report.

Section 2.7.2 of the Tier 3 Assessment has been updated in this regard. An updated Tier 3 Assessment Report accompanies this report.

2.8 Item 8

2.8.1 Request for Information

Section 1.3 of the Tier 3 Assessment estimates that 274,784 tonnes to 354,560 tonnes of waste was deposited on site, a difference of 79,776 tonnes. Provide a more precise estimation of the amount of waste deposited. Please also include the volume for the total amount of deposited waste in m³.

2.8.2 Response

The first volume waste estimation has been undertaken with a conservative approach, super estimating the total was deposited on site by using the whole site area site and the average thickness of the waste.

A more accurate and detailed waste volume calculation has been undertaken in response to Item 8.

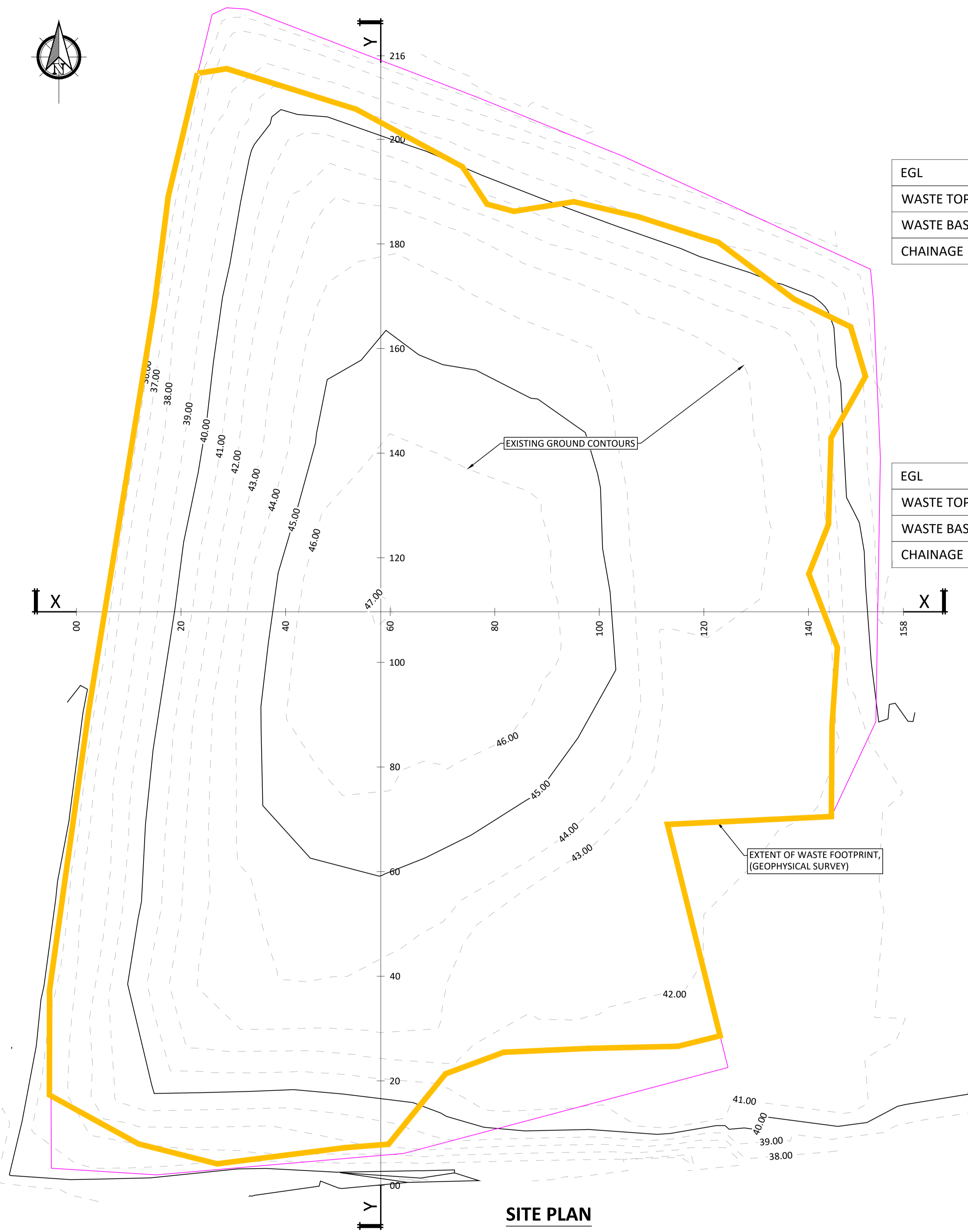
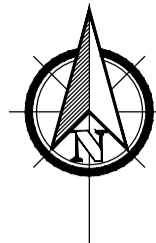
AutoCAD Civil 3D was used to estimate of the total volume of waste deposited at the site. A 3D model was prepared using the following information: 2020 topographical survey (See Appendix 4 of the Tier 2 report), 2020 geophysical surveys (See Appendix 5 of the Tier 2 report) and results of the additional 2022 site investigation works (See Appendix 8 of this report).

The volume was calculated using the existing ground level from the topographical survey (excluding the 300mm of capping material); the area of waste from the geophysical survey and the average base level of waste obtained in the last site investigation, in July 2022 (Appendix 8).

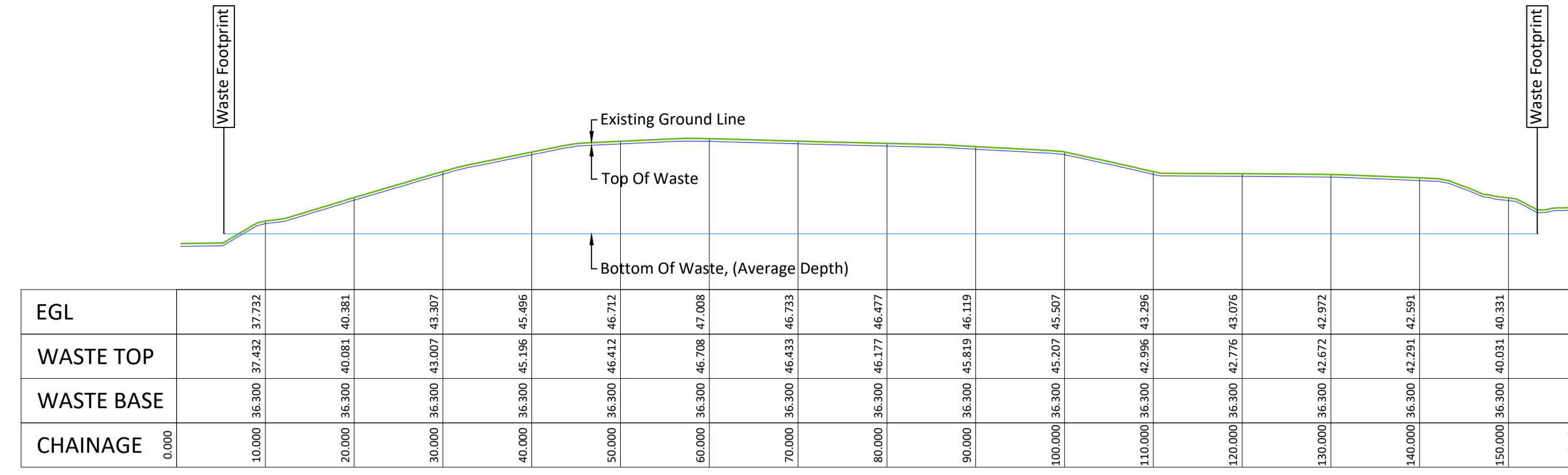
The total estimated volume of waste for Tuam Historic Landfill is 145,407.7 m³, applying an assumed waste density of 1.6 t/m³ equates to 232,652 tonnes of waste present.

The results of the updated waste volume calculation are presented in Drawing No. P22-065-0600-0001 below.

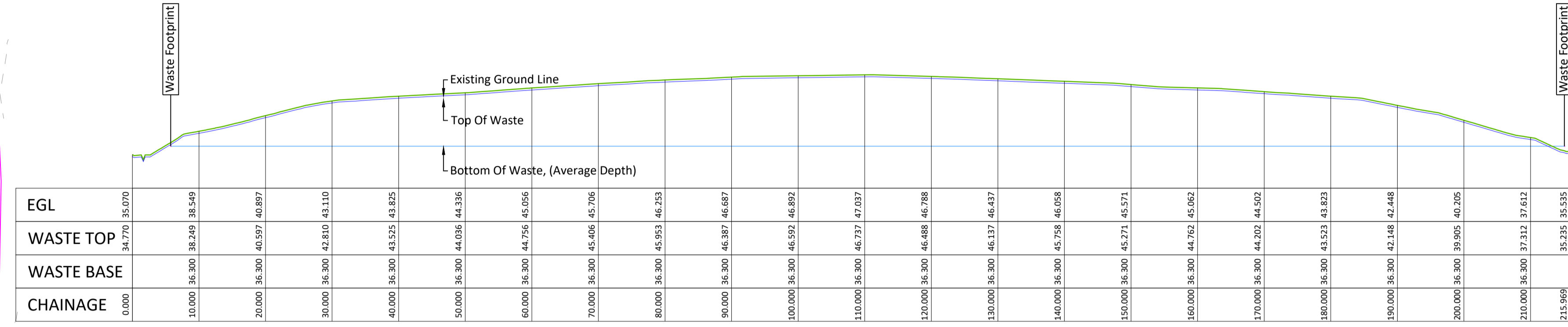
The Tier 2, Tier 3 Assessment Reports and the Non-Technical Summary have been updated to reflect the revised volume of waste calculated for the site and accompany this report



SITE PLAN
Scale 1:500

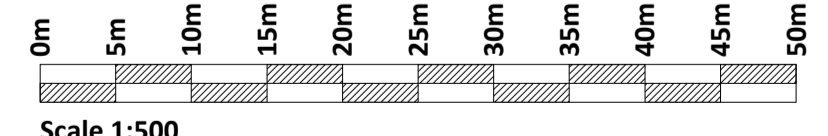


SECTION X-X



SECTION Y-Y

| Volume Summary | | |
|----------------|---------------|-------------------|
| Name | 2d Area | Waste |
| Waste Volume | 23296.390sq.m | 145407.752 Cu. M. |



If Applicable : Ordnance Survey Ireland Licence No. CYAL50221678 © Ordnance Survey Ireland and Government of Ireland



No part of this document may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Fehily Timoney & Company as copyright holder except as agreed for use on the project for which the document was originally issued. Do not scale. Use figured dimensions only. If in doubt - Ask!

| Rev. | Description | App By | Date |
|------|---------------------------------|--------|----------|
| A | REQUEST FOR FURTHER INFORMATION | BG | 17.10.22 |
| | | | |
| | | | |
| | | | |

| | | | | | | | |
|---------|--|--|--|------------|-----------------------|----------------|-------------------|
| PROJECT | TUAM HISTORIC LANDFILL: CoA REGULATION 7 RFI | | | CLIENT | GALWAY COUNTY COUNCIL | | |
| SHEET | WASTE VOLUME REPORT AND SITE CROSS SECTIONS | | | Date | SEPT. '22 | Project number | P22-065 |
| | | | | Drawn by | SK | Drawing Number | P22-065-0600-0001 |
| | | | | Checked by | JON | Scale (@ A1-) | 1:500 |
| | | | | | | Rev | A |

O:\ACAD\2022\P22-065\P22-065-0600-0001

Monday 17 October 2022



2.9 Item 9

2.9.1 Request for Information

The Geophysical Survey Report and Figure 5.1 'Tuam Historic Landfill Conceptual Site Model' of the Tier 2 Assessment indicate that industrial waste was deposited at the site. State the nature of this waste.

2.9.2 Response

Minerex Geophysics Ltd confirmed the waste indicated in the Geophysical Survey Report is best described as commercial and industrial (C&I) type waste i.e skip waste or similar. The site investigations carried out as part of the Tier 2 Assessment and this response to the RFI confirmed the material is non-hazardous in nature.

The Geophysical Survey Report, included in Appendix 9 has been updated to reflect this.

An updated Figure 5.1 'Tuam Historic Landfill Conceptual Site Model' has been prepared and is included in as part of the updated Tier 2 Assessment Report which accompanies this report.

2.10 Item 10

2.10.1 Request for Information

It is noted that no soil samples were analysed against Waste Acceptance Criteria (WAC) in Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of Annex II to Directive 1999/31/EC. Accordingly, please provide such an analysis.

2.10.2 Response

Additional site investigations works were completed in 18th to the 20th of July 2022 by Causeway Geotechnical Ltd. in support of this RFI response.

The following works were completed:

- four boreholes by light cable percussion (BH01 to BH03 and BHLFG1);
- standpipe installation in four boreholes (BH01 to BH03 and BHLFG1);
- permeameter test at two boreholes (BH01 and BH03);
- triaxial permeability tests at 2 No. boreholes (BH01 and BH03); and
- environmental testing in 3 No. soil samples (BH01 to BH03).

A full copy of the geotechnical report is included in Appendix 8.

Bulk waste samples were obtained during the reinstallation of three no. dual leachate and landfill gas monitoring boreholes within waste body i.e. BH1, BH2 & BH3.

3 No. Waste Samples were subject to WAC analysis. The results are shown in Table 2.4.



The results of this analysis indicate waste material encountered within the site are typically inert in terms of their leachate production, with the exception of Total Organic Carbon (TOC) and Loss on Ignition.

Total Organic Carbon (TOC) and Loss on Ignition represent the amount of organic waste deposited at the site, even though they exceed the threshold values for hazardous waste they do not represent any concern regarding the nature of this waste.



Table 2.4: Waste Sampling Results – Solid Waste Analysis

| Parameter | Units | Inert Waste Acceptance Criteria | Non-Hazardous Waste Acceptance Criteria | Hazardous Waste Acceptance Criteria | Sampling Results - Sample ID | | |
|------------------------------|-------|---------------------------------|---|-------------------------------------|------------------------------|-----------|-----------|
| | | | | | BH01 | BH02 | BH03 |
| | | | | | (6.0m) | (2.5m) | (5.0m) |
| Total Organic Carbon | % | 3 | 5 | 6 | 11 | 5.8 | 0.52 |
| Loss On Ignition | % | -- | -- | 10 | 29 | 11 | 10 |
| Total BTEX | mg/kg | 6 | -- | -- | < 0.010 | < 0.010 | < 0.010 |
| Total PCBs (7 congeners) | | 1 | -- | -- | | | |
| TPH Total WAC | mg/kg | 500 | -- | -- | 300 | < 10 | < 10 |
| Total (of 17) PAHs | | 100 | -- | -- | | | |
| pH | | -- | >6 | -- | 8.1 | 8.1 | 8.3 |
| Acid Neutralisation Capacity | mg/kg | -- | To evaluate | To evaluate | 0.013 | 0.032 | 0.02 |
| Arsenic | mg/kg | 0.5 | 2 | 25 | 0.13 | 0.036 | 0.028 |
| Barium | mg/kg | 20 | 100 | 300 | 0.22 | 0.43 | 0.32 |
| Cadmium | mg/kg | 0.04 | 1 | 5 | 0.0053 | < 0.0011 | < 0.0011 |
| Chromium | mg/kg | 0.5 | 10 | 70 | 0.098 | < 0.0050 | 0.01 |
| Copper | mg/kg | 2 | 50 | 100 | 0.39 | 0.01 | 0.041 |
| Mercury | mg/kg | 0.01 | 0.2 | 2 | 0.00094 | < 0.00050 | < 0.00050 |
| Molybdenum | mg/kg | 0.5 | 10 | 30 | 0.26 | 0.18 | 0.12 |
| Nickel | mg/kg | 0.4 | 10 | 40 | 0.21 | 0.084 | 0.13 |
| Lead | mg/kg | 0.5 | 10 | 50 | 0.3 | < 0.0050 | 0.1 |
| Antimony | mg/kg | 0.06 | 0.7 | 5 | 0.19 | 0.039 | 0.15 |



| Parameter | Units | Inert Waste Acceptance Criteria | Non-Hazardous Waste Acceptance Criteria | Hazardous Waste Acceptance Criteria | Sampling Results - Sample ID | | |
|--------------------------|-------|---------------------------------|---|-------------------------------------|------------------------------|--------|--------|
| | | | | | BH01 | BH02 | BH03 |
| | | | | | (6.0m) | (2.5m) | (5.0m) |
| Selenium | mg/kg | 0.1 | 0.5 | 7 | 0.025 | 0.015 | 0.013 |
| Zinc | mg/kg | 4 | 50 | 200 | 0.82 | 0.067 | 0.3 |
| Chloride | mg/kg | 800 | 15000 | 25000 | 130 | 670 | 790 |
| Fluoride | mg/kg | 10 | 150 | 500 | 9.4 | 1.3 | 2.1 |
| Sulphate | mg/kg | 1000 | 20000 | 50000 | 1400 | 4800 | 1800 |
| Total Dissolved Solids | mg/kg | 4000 | 60000 | 100000 | 8400 | 8600 | 5800 |
| Phenol Index | mg/kg | 1 | - | - | < 0.30 | < 0.30 | < 0.30 |
| Dissolved Organic Carbon | mg/kg | 500 | 800 | 1000 | 520 | 310 | 730 |

* Hazardous Waste Landfill Criteria: >6% TOC

* Items in bold are in exceedance of the Inert WAC limit value

* Items shaded in green are in exceedance of the Non-Hazardous WAC limit value

* Items shaded in orange are in exceedance of the Hazardous WAC limit value



2.11 Item 11

2.11.1 Request for Information

Demonstrate that the existing landfill cover material achieves a hydraulic conductivity of less than or equal to 1×10^{-9} m/s.

2.11.2 Response

Additional site investigations works were completed in 18th to the 20th of July 2022 by Causeway Geotechnical Ltd. in support of this RFI response.

The following works were completed:

- four boreholes by light cable percussion (BH01 to BH03 and BHLFG1);
- standpipe installation in four boreholes (BH01 to BH03 and BHLFG1);
- permeameter test at two boreholes (BH01 and BH03);
- triaxial permeability tests at 2 No. boreholes (BH01 and BH03); and
- environmental testing in 3 No. soil samples (BH01 to BH03).

A copy of the geotechnical report is included in Appendix 8.

Two number permeability by Triaxial Cell tests were undertaken on in-situ samples retrieved from BH01 and BH03. The results of the test are shown in Table 2.5 below.

Table 2.5: Triaxial Cell Test Results

| Location | Permeability (m/s) |
|----------|----------------------|
| BH01 | 8.6×10^{-9} |
| BH03 | 2.0×10^{-9} |

Additionally, two no. in-situ Hydraulic Conductivity by double ring infiltrometer assessments were undertaken at BH01 and BH03. The results of the test are shown in Table 2.6 below.

Table 2.6: Permeameter Test Results

| Location | Hydraulic Conductivity (s-1) |
|----------|------------------------------|
| BH01 | 0.0013279 |
| BH03 | 0.0011363 |

The results of the permeability by triaxial cell and in-situ infiltrometer testing demonstrate that the landfill capping does not achieve a hydraulic conductivity of less than or equal to 1×10^{-9} m/s however, the existing capping system is demonstrated to be highly impermeable ranging from 2×10^{-9} to 8.6×10^{-9} m/s.



2.12 Item 12

2.12.1 Request for Information

The Site Walkover Checklist in Appendix 2 of the Tier 2 Assessment refers to Tuam Historic Landfill in Co. Kilkenny. Confirm that the checklist is for the Co. Galway site or alternatively, submit the correct site walkover checklist for the Tuam Landfill.

2.12.2 Response

FT can confirm the site walkover checklist provided refers to Tuam Historic Landfill, County Galway.

An Updated Site Walkover Checklist is provided as Appendix 2 of the updated Tier 2 Assessment Report, which accompanies this report.

2.13 Item 13

2.13.1 Request for Information

Table 4.6 of the Closure & Remediation Plan refers to monitoring at 'leachate contaminated pool' (monitoring location L1). State the purpose of this pool, how it was operating and whether it is still in operation. Provide a drawing showing the location of this pool.

2.13.2 Response

The Closure and Remediation Plan was prepared in 1999 and has been included for historical context and information only.

The exact location of the leachate pool is unknown and cannot be provided on a drawing.

It is understood and clear from current observations of the site that the pool no longer exists and was removed during the remediation works.

2.14 Item 14

2.14.1 Request for Information

Section 3.5 of the Closure & Remediation Plan refers to fields adjacent to the landfill and states that the field to the west of the landfill appears to be contaminated mainly due to the 'large quantity of water pumped into the landfill over the years in an attempt to extinguish fires within the site which subsequently breached the sides of the landfill and partly flooded the adjacent field'. State the cause of these fires and describe the measures that have been implemented to prevent the reoccurrence of fires within the landfill and subsequent flooding of the adjacent fields.



2.14.2 Response

The Closure and Remediation Plan was prepared in 1999 and has been included for historical context and information only. The cause of these fires are unknown.

It is clear upon completion of the remediation works the occurrence of fires and consequent flooding of adjacent fields ceased.

2.15 Item 15

2.15.1 Request for Information

Referring to Figure 4.2 'Surface Water Sampling Locations' of the Tier 2 Assessment, provide the following information:

- (i) It is noted that no land drains or other waterbodies are marked on any figures for surface water monitoring locations SW1, SW2, SW3 and SW4. Please submit a new figure showing the surface water monitoring locations and the associated land drains and other waterbodies. Each land drain or waterbody should be shown in blue and be annotated. Please also include arrows showing water flow directions.*
- (ii) It is noted that upstream surface monitoring location SW1 is located approximately 350m north-east of the landfill. Provide a reason for not carrying out upstream surface water monitoring at a closer location to the landfill.*
- (iii) Considering that groundwater beneath the site flows, amongst other directions, towards the north and north-west, as shown in Figure 4.1 'Groundwater Flow Direction' of the Tier 2 Assessment, provide a reason for not carrying out monitoring of surface water in the Killeelaun river which has its source approximately 115m north of the landfill and flows in a north-westerly direction in close proximity to the site.*

2.15.2 Response to Item 9(i)

Please see Appendix 10 for figure containing all elements above.

2.15.3 Response to Item 9(ii)

Surface water monitoring locations have been chosen to match the historic surface water monitoring done since 1998, See Figure 2-1.



Map showing the location of Tuam landfill and monitoring locations

Figure 2-1: Location of Historic Landfill and Monitoring Stations provided by GCC

2.15.4 Response to Item 9(iii)

Surface water monitoring locations have been chosen to match the historic surface water monitoring done since 1998, as per figure provided above.

Surface water analysis was carried out on 31st May 2022.

A summary of the results from the monitoring round is outlined in Table 2.7, only results that were shown to be above the limit of detection were included. The laboratory reports are presented in Appendix 11.



Table 2.7: Surface Sampling Results May 2022

| Test | Units | AA-EQS Inland surface waters | MAC- EQS Inland surface waters | SW1 | SW2 | SW3 | SW4 |
|---------------------------------------|----------|---------------------------------------|---|--------|--------|--------|--------|
| Carbon | | | | | | | |
| Organic Carbon, Total | mg/l | | | 9.75 | 11.2 | 11.3 | 11.7 |
| Inorganics | | | | | | | |
| Oxygen, dissolved | mg/l | | | 10.1 | 6.07 | 6.81 | 11.4 |
| pH | pH Units | | | 7.79 | 7.84 | 7.88 | 8.07 |
| Sulphate | mg/l | | | 9.9 | <2 | <2 | <2 |
| Chloride | mg/l | | | 20.3 | 20.1 | 24.6 | 23 |
| COD, unfiltered | mg/l | | | 17.9 | 35.5 | 25.1 | 29 |
| Ammoniacal Nitrogen as N (low level) | mg/l | 0.065 | 0.14 | 0.0537 | 0.139 | 0.0285 | 0.0297 |
| Conductivity @ 20 deg.C | mS/cm | | | 0.693 | 0.608 | 0.627 | 0.615 |
| Total Oxidised Nitrogen as N | mg/l | | | 0.265 | 0.126 | 0.22 | <0.1 |
| Alkalinity, Total as HCO ₃ | mg/l | | | 492 | 422 | 434 | 425 |
| Filtered (Dissolved) Metals | | | | | | | |
| Arsenic (diss.filt) | µg/l | 25 | | 0.863 | 1.12 | 1.04 | 1.15 |
| Barium (diss.filt) | µg/l | | | 17.7 | 20.7 | 24.4 | 25.4 |
| Boron (diss.filt) | µg/l | | | <10 | <10 | 17.5 | 14.9 |
| Copper (diss.filt) | µg/l | 30 | | 6.16 | 0.4 | 0.442 | 0.731 |
| Manganese (diss.filt) | µg/l | | | 49.6 | 50.3 | 35.3 | 12.5 |
| Nickel (diss.filt) | µg/l | 4 | 34 | 3.95 | 2.71 | 2.89 | 2.78 |
| Phosphorus (diss.filt) | µg/l | | | 66.4 | 14.3 | 13.3 | 13.8 |
| Zinc (diss.filt) | µg/l | 100 | | 3.55 | 2.1 | 4.06 | 2.72 |
| Sodium (Dis.Filt) | mg/l | | | 9.73 | 11.1 | 13.9 | 13.9 |
| Magnesium (Dis.Filt) | mg/l | | | 7.88 | 7.13 | 8.07 | 7.92 |
| Potassium (Dis.Filt) | mg/l | | | 2.64 | 0.547 | 1.37 | 0.93 |
| Calcium (Dis.Filt) | mg/l | | | 159 | 132 | 132 | 132 |
| Iron (Dis.Filt) | mg/l | | | 0.19 | 0.198 | 0.212 | 0.21 |
| Combined Pesticides / Herbicides | | | | | | | |
| Dieldrin | µg/l | 0.01 | not applicable | <0.01 | <0.01 | 0.0386 | <0.015 |
| Atrazine | µg/l | 0.6 | 2 | <0.01 | 0.0133 | 0.013 | <0.01 |



Notes:

1. Environmental Quality Standard (EQS) as per European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I No. 272 of 2009). Refers to Annual-Average (AA) EQS for relevant parameters.
2. Maximum Admissible Concentration (MAC), as classified by European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I No. 272 of 2009).

* Items shaded in orange are in exceedance of the 2009 EQS Regulations

The results of the surface water monitoring for SW1 to SW4 show only 2 no. exceedances for the EQS threshold values. SW2 exceeds the threshold value for Ammoniacal Nitrogen, which could be an indicative of leachate migration from the landfill to surface water; and SW3 exceeds the threshold value for Dieldrin.

Dieldrin was produced as an insecticide from the 1950s to 1970 and was widely used as pesticide for crops. Dieldrin was also used for mothproofing clothes and carpets¹. *Dieldrin is an organochlorine pesticide (OCPs). OCPs are characterized by their high chemical stability, low solubility, lipophilicity, and volatility, and strong sorption by soil organic matter (SOM). Therefore, they persist in the environment for decades and inevitably bioconcentrate in food chains. [] The OCPs, aldrin and dieldrin are archetypal representatives of this category. In the environment, aldrin is easily oxidized to its epoxide derivative, dieldrin, which is more resilient to chemical degradation. Although aldrin and dieldrin are not produced or used (for more than 30 years in the European Union), they are still detected in a plethora of environmental compartments such as soil, sediments, water, atmosphere, and organisms².*

The presence of Dieldrin in the surface water is likely associated with historical agriculture activities. Results of leachate monitoring do not show the presence of Dieldrin above the limits of detection, as per the response for Item 16 (Section 2.16.2) and the complete results of the leachate monitoring included in Appendix 12.

2.16 Item 16

2.16.1 Request for Information

It is noted that leachate monitoring was carried out in monitoring borehole BH3 and the leachate contaminated pool L1 in 1999. Accordingly, please install leachate monitoring boreholes within the waste body and carry out up-to-date leachate monitoring from these boreholes. The monitoring boreholes should be located taking into account the likely flow-paths of leachate within the waste body in accordance with the EPA Landfill Manuals – Landfill Monitoring.

¹ <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/dieldrin>

² Tsiantas P, Tzanetou EN, Karasali H, Kasiotis KM. A Dieldrin Case Study: Another Evidence of an Obsolete Substance in the European Soil Environment. *Agriculture*. 2021; 11(4):314. <https://doi.org/10.3390/agriculture11040314>



2.16.2 Response

Additional site investigations works were completed in 18th to the 20th of July 2022 by Causeway Geotechnical Ltd. in support of this RFI response.

The following works were completed:

- four boreholes by light cable percussion (BH01 to BH03 and BHLFG1);
- standpipe installation in four boreholes (BH01 to BH03 and BHLFG1);
- permeameter test at two boreholes (BH01 and BH03);
- triaxial permeability tests at 2 No. boreholes (BH01 and BH03); and
- environmental testing in 3 No. soil samples (BH01 to BH03).

A copy of the geotechnical report is included in Appendix 8.

Three no. dual leachate/gas boreholes (BH01 – BH03 inc.) were installed replacing the damaged/lost boreholes within waste body.

Leachate monitoring was undertaken on 9th August 2022.

A summary of the results is included in Table 2.8 below. Only results that were shown to be above the limit of detection were included. Complete results of the leachate monitoring are included in Appendix 12.

Table 2.8: Leachate Sampling Results August 2022

| Parameter | Units | BH1 | BH2 | BH3 |
|---------------------------------------|----------|-------|--------|-------|
| Carbon | | | | |
| Organic Carbon, Total | mg/l | 91.8 | 47.2 | 233 |
| Inorganics | | | | |
| Oxygen, dissolved | mg/l | 1.87 | 7.99 | <0.3 |
| pH | pH Units | 8.06 | 7.79 | 7.56 |
| Sulphate | mg/l | 176 | 133 | 513 |
| Chloride | mg/l | 440 | 70.2 | 739 |
| COD, unfiltered | mg/l | 2380 | 1420 | 1860 |
| Ammoniacal Nitrogen as N (low level) | mg/l | 68 | 96.2 | 255 |
| Conductivity @ 20 deg.C | mS/cm | 3.12 | 1.98 | 6.33 |
| BOD, unfiltered | mg/l | 60.5 | 42.8 | 166 |
| Alkalinity, Total as HCO ₃ | mg/l | 7130 | 2340 | 3310 |
| Filtered (Dissolved) Metals | | | | |
| Mercury (diss.filt) | µg/l | <0.01 | 0.0531 | <0.01 |
| Arsenic (diss.filt) | µg/l | 3.01 | 2.54 | 6.35 |
| Barium (diss.filt) | µg/l | 261 | 215 | 233 |



| Parameter | Units | BH1 | BH2 | BH3 |
|--|-------|-------|-------|-------|
| Boron (diss.filt) | µg/l | 904 | 456 | 1470 |
| Cadmium (diss.filt) | µg/l | <0.08 | 0.163 | <0.08 |
| Chromium (diss.filt) | µg/l | 3.22 | 3.03 | 27.1 |
| Copper (diss.filt) | µg/l | <0.3 | 8.49 | <0.3 |
| Lead (diss.filt) | µg/l | 0.644 | 14.6 | 0.224 |
| Manganese (diss.filt) | µg/l | 141 | 1790 | 3390 |
| Nickel (diss.filt) | µg/l | 13.2 | 10.7 | 57.5 |
| Phosphorus (diss.filt) | µg/l | 290 | 118 | 320 |
| Selenium (diss.filt) | µg/l | 8.45 | 1.88 | 3.99 |
| Zinc (diss.filt) | µg/l | 4.25 | 149 | 4.47 |
| Sodium (Dis.Filt) | mg/l | 1090 | 87.5 | 740 |
| Magnesium (Dis.Filt) | mg/l | 64.9 | 55.6 | 184 |
| Potassium (Dis.Filt) | mg/l | 120 | 59.4 | 227 |
| Calcium (Dis.Filt) | mg/l | 56.7 | 210 | 165 |
| Iron (Dis.Filt) | mg/l | 3.3 | 2.01 | 6.48 |
| Semi-Volatile Organic Compounds (SVOCs) | | | | |
| bis(2-Ethylhexyl) phthalate (aq) | µg/l | 541 | 86.2 | 31 |
| Butylbenzyl phthalate (aq) | µg/l | 59.7 | <10 | <10 |
| Benzo(b)fluoranthene (aq) | µg/l | 21.6 | <10 | <10 |
| Chrysene (aq) | µg/l | 23.1 | <10 | <10 |
| Volatile Organic Compounds (VOCs) | | | | |
| Carbon disulphide | µg/l | 1.48 | <1 | 1.67 |
| Benzene | µg/l | 1.84 | <1 | 3.39 |
| Toluene | µg/l | 1.11 | <1 | 1.8 |
| 1,1,1,2-Tetrachloroethane | µg/l | <1 | 5.23 | <1 |
| Ethylbenzene | µg/l | <1 | 5 | 2.51 |
| m,p-Xylene | µg/l | <1 | 51 | 1.77 |
| o-Xylene | µg/l | <1 | 1.42 | 1.09 |
| 1,3,5-Trimethylbenzene | µg/l | <1 | 1.52 | <1 |
| 1,2,4-Trimethylbenzene | µg/l | <1 | 1.89 | <1 |
| 4-iso-Propyltoluene | µg/l | <1 | <1 | 1.21 |

The leachate monitoring results show elevated concentrations of pollutants commonly encountered within MSW landfill leachate i.e. ammoniacal nitrogen, chloride and COD. The results shown are considered typical of MSW landfill leachate.



2.17 Item 17

2.17.1 Request for Information

It is noted that gas monitoring was carried out at ten locations in July 2020 and August 2020. It is noted however that only one location within the waste body (monitoring borehole BH3, which was used for leachate monitoring in 1999) was monitored. It is also noted that no gas monitoring was carried out to determine whether or not gas is migrating into the civic amenity site in accordance with the EPA Landfill Manuals – Landfill Monitoring. Please note, as per Section 7.5.2 of this manual, that for gas monitoring purposes within the waste body, leachate monitoring boreholes are inappropriate.

2.17.2 Response

Additional site investigations works were completed in 18th to the 20th of July 2022 by Causeway Geotechnical Ltd. in support of this RFI response.

The following works were completed:

- four boreholes by light cable percussion (BH01 to BH03 and BHLFG1);
- standpipe installation in four boreholes (BH01 to BH03 and BHLFG1);
- permeameter test at two boreholes (BH01 and BH03);
- triaxial permeability tests at 2 No. boreholes (BH01 and BH03); and
- environmental testing in 3 No. soil samples (BH01 to BH03).

A copy of the geotechnical report is included in Appendix 8.

Three no. dual leachate/gas boreholes (BH1 – BH3 inc.) were installed replacing the damaged/lost boreholes within waste body.

A landfill gas monitoring borehole (BHLFG1) was installed within the civic amenity site as per proposed remediation plan.

Landfill gas monitoring was undertaken on 9th August 2022.

As per the EPA Landfill Manuals - Landfill Monitoring, 2nd Edition, the trigger level for methane outside the waste body is 1% v/v and for carbon dioxide, 1.5% v/v. The monitoring results for methane, carbon dioxide and oxygen levels for the borehole at the civic amenity and the boreholes within the landfill footprint are summarised in Table 2.9 and 2.10, respectively.

Table 2.9: Civic Amenity Gas Monitoring Results – August 2022

| Sample Station | CH ₄ (% v/v) | CO ₂ (% v/v) | O ₂ (% v/v) | Atmospheric Pressure (mbar) | Staff Member | Weather |
|----------------|-------------------------|-------------------------|------------------------|-----------------------------|--------------|-------------------|
| BHLFG1 | 0.2 | 0.8 | 19.3 | 1026 | Sean Foley | Sunny, Warm, 22°C |



Table 2.10: Landfill Footprint Gas Monitoring Results – August 2022

| Sample Station | CH ₄ (% v/v) | CO ₂ (% v/v) | O ₂ (% v/v) | Atmospheric Pressure (mbar) | Staff Member | Weather |
|----------------|-------------------------|-------------------------|------------------------|-----------------------------|--------------|-------------------|
| BH01 | 25.6 | 9.8 | 1.0 | 1026 | Sean Foley | Sunny, Warm, 22°C |
| BH02 | 41.2 | 11.5 | 1.1 | | | |
| BH03 | 67.7 | 17.2 | 0.5 | | | |

As can be seen in Table 2.9, only small traces of methane and carbon dioxide were detected in the monitoring well located within the civic amenity, below the trigger levels set by the EPA. This indicates that no or very minimal migration of landfill gas is occurring at the site.

Table 2.10 shows the continued production of landfill gas within the landfill footprint.

2.18 Item 18

2.18.1 Request for Information

Please provide one drawing showing all of the following elements interpolated:

- (i) *The site boundary in red;*
- (ii) *The boundary showing the extent of the waste body, in a different colour than red; and*
- (iii) *All leachate, groundwater, gas and surface water monitoring locations.*

2.18.2 Response

Please see Appendix 13 for drawing containing all elements above.

2.19 Item 19

2.19.1 Request for Information

State the proposed future use of the site by the applicant.

2.19.2 Response

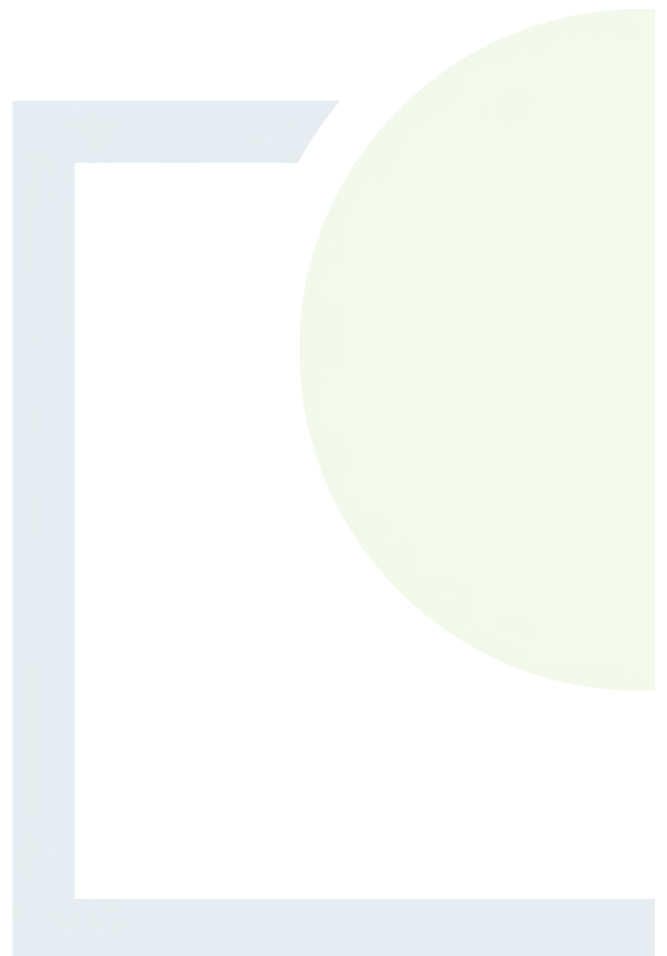
GCC proposes to maintain the site as historical landfill, as per Section 3.1.2.1 of the updated Tier 3 Assessment, which accompanies this report this report.



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

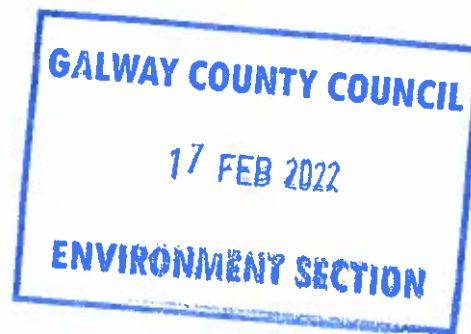
APPENDIX 1

Regulation 7 Notice



Mr. Colin Ryder,
Executive Scientist,
Environment Department,
Galway County Council,
Áras an Chontae,
Prospect Hill,
Galway.

H91 H6KX



16th February 2022

Reg. No. H0192-01

Re: Tuam Historic Landfill – Notice in accordance with Regulation 7(4) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008

Dear Mr. Ryder,

I am to refer to the above referenced application for a certificate of authorisation in relation to the above referenced historic landfill.

Having examined the foregoing, I am to advise that the Agency is of the view that the application does not comply with Regulation 7(2) of the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008.

You are therefore requested in accordance with Regulation 7(4) of the Regulations, to take steps to supply the information detailed below:

REGULATION 7(2) COMPLIANCE REQUIREMENTS

1. The grid reference numbers for the site stated in Section C.2 of the Application show a different location than the landfill. Provide grid coordinates for the site.
2. Provide a letter from the Qualified Body to the Qualified Person, as required under Section 2.3 of the EPA Code of Practice – Environmental Risk Assessment for Unregulated Waste Disposal Sites.
3. The site boundary shown in Figure No. 1.1 '*Site Location*' dated 18/10/2021 of the application and in Figure (no figure number given) titled '*Site Location Plan*' dated 21/09/2020 of the Geotechnical Report differ. State the reason for the differences in the extent of the site boundary in said figures and submit, or refer to, a figure that shows the actual site boundary.
4. State what waste is accepted at the on-site civic amenity and provide a copy of the waste authorisation for this activity. Additionally, provide the red line boundary map for this facility.

5. State whether or not waste was deposited under the civic amenity and explain how this was determined, considering that no site investigation or geophysical survey was carried out within the extent of the civic amenity area, as indicated in Figure 3.1 'Site Investigation Location Plan' of the Tier 2 Assessment and Map 1 'Geophysical Survey Location Map' of the Geophysical Survey Report.
6. The conceptual site model indicates that waste was deposited onto undisturbed natural ground. Section 2.3 of the Closure & Remediation Plan dated October 1999 states that the landfill rises to a height of approximately 6-7m above the surrounding land. However, the borehole log for borehole BH3, in Appendix 1 of the same document, recorded a waste 'depth (thickness)' of 9m. Provide the following information:
 - (i) State whether waste was deposited below the natural ground level. If yes, please state the maximum depth of waste below ground level and height of waste measured from the natural ground level. Re-submit a drawing showing the conceptual site model in the event that waste was deposited below the natural ground level.
 - (ii) State the maximum depth of the deposited waste.
7. Section 2.5.3 of the Tier 3 Assessment states that no leachate breakouts were observed at the site walkover however, Section 2.7.2 of the same document states that no significant leachate breakout was observed. State whether or not leachate breakouts were observed at the site. Include dates of the observations.
8. Section 1.3 of the Tier 3 Assessment estimates that 274,784 tonnes to 354,560 tonnes of waste was deposited on site, a difference of 79,776 tonnes. Provide a more precise estimation of the amount of waste deposited. Please also include the volume for the total amount of deposited waste in m³.
9. The Geophysical Survey Report and Figure 5.1 'Tuam Historic Landfill Conceptual Site Model' of the Tier 2 Assessment indicate that industrial waste was deposited at the site. State the nature of this waste.
10. It is noted that no soil samples were analysed against Waste Acceptance Criteria (WAC) in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*. Accordingly, please provide such an analysis.
11. Demonstrate that the existing landfill cover material achieves a hydraulic conductivity of less than or equal to 1×10^{-9} m/s.
12. The Site Walkover Checklist in Appendix 2 of the Tier 2 Assessment refers to Tuam Historic Landfill in Co. Kilkenny. Confirm that the checklist is for the Co. Galway site or alternatively, submit the correct site walkover checklist for the Tuam landfill.
13. Table 4.6 of the Closure & Remediation Plan refers to the monitoring at 'leachate contaminated pool' (monitoring location L1). State the purpose of this pool, how it was operating and whether it is still in operation. Provide a drawing showing the location of this pool.
14. Section 3.5 of the Closure & Remediation Plan refers to fields adjacent to the landfill and states that the field to the west of the landfill appears to be contaminated mainly due to the '*large quantity of water pumped into the landfill over the years in an attempt to extinguish fires within the site which subsequently breached the sides of the landfill and partly flooded the adjacent field.*' State the cause of these fires and describe the measures that have been implemented to prevent the reoccurrence of fires within the landfill and subsequent flooding of the adjacent fields.
15. Referring to Figure 4.2 'Surface Water Sampling Locations' of the Tier 2 Assessment, provide the following information:
 - (i) It is noted that no land drains or other waterbodies are marked on any figures for surface water monitoring locations SW1, SW2, SW3 and SW4. Please submit a new figure showing the surface water monitoring locations and the associated land drains and other waterbodies.

Each land drain or waterbody should be shown in blue and be annotated. Please also include arrows showing water flow directions;

- (ii) It is noted that upstream surface monitoring location SW1 is located approximately 350m north-east of the landfill. Provide a reason for not carrying out upstream surface water monitoring at a closer location to the landfill.
 - (iii) Considering that groundwater beneath the site flows, amongst other directions, towards the north and north-west, as shown in Figure 4.1 '*Groundwater Flow Direction*' of the Tier 2 Assessment, provide a reason for not carrying out monitoring of surface water in the Killeelaun river which has its source approximately 115m north of the landfill and flows in a north-westerly direction in close proximity to the site.
16. It is noted that leachate monitoring was carried out in monitoring borehole BH3 and the leachate contaminated pool L1 in 1999. Accordingly, please install leachate monitoring boreholes within the waste body and carry out up-to-date leachate monitoring from these boreholes. The monitoring boreholes should be located taking into account the likely flow-paths of leachate within the waste body in accordance with the EPA Landfill Manuals – Landfill Monitoring.
17. It is noted that gas monitoring was carried out at ten locations in July 2020 and August 2020. It is noted however that only one location within the waste body (monitoring borehole BH3, which was used for leachate monitoring in 1999) was monitored. It is also noted that no gas monitoring was carried out to determine whether or not gas is migrating into the civic amenity site. Accordingly, please carry out additional gas monitoring within the waste body and the civic amenity site in accordance with the EPA Landfill Manuals – Landfill Monitoring. Please note, as per Section 7.5.2 of this manual, that for gas monitoring purposes within the waste body, leachate monitoring boreholes are inappropriate.
18. Please provide one drawing showing all of the following elements interpolated:
- (i) the site boundary in red;
 - (ii) the boundary showing the extent of the waste body, in a different colour than red; and
 - (iii) all leachate, groundwater, gas and surface water monitoring locations.
19. State the proposed future use of the site by the applicant.

Your reply to this notice should include a revised non-technical summary, which reflects the information you supply in compliance with the notice, insofar as that information impinges on the non-technical summary.

In the case where any drawings already submitted are subject to revision consequent on this request, a revised drawing should be prepared in each case. It is not sufficient to annotate the original drawing with a textual correction. The revision status, such as revised drawing number and/or revision date should be clearly stated. Also, where such revised drawings are submitted, provide a list of drawing titles, drawing numbers and revision status, which correlates the revised drawings with the superseded versions.

Please supply the requested information within *six weeks* of the date of this notice. Please note that during COVID-19 there are new arrangements in place for the receipt of all correspondence in relation to applications for Certificates of Authorisation. Accordingly, any correspondence in respect of the above referenced application should be sent to the Agency via file transfer by emailing historiclandfillapplications@epa.ie, quoting the Register Number H0192-01. The EPA doesn't accept files to be transferred using any file share application other than MS One Drive. Each file should be in a searchable .pdf format and a size not exceeding 10MB.

Please also note, post COVID-19, you may be contacted to submit the hard copies and CD-ROMs for the submitted electronic correspondence.

Yours sincerely,



Ewa Babiarczyk

Inspector

Circular Economy Programme

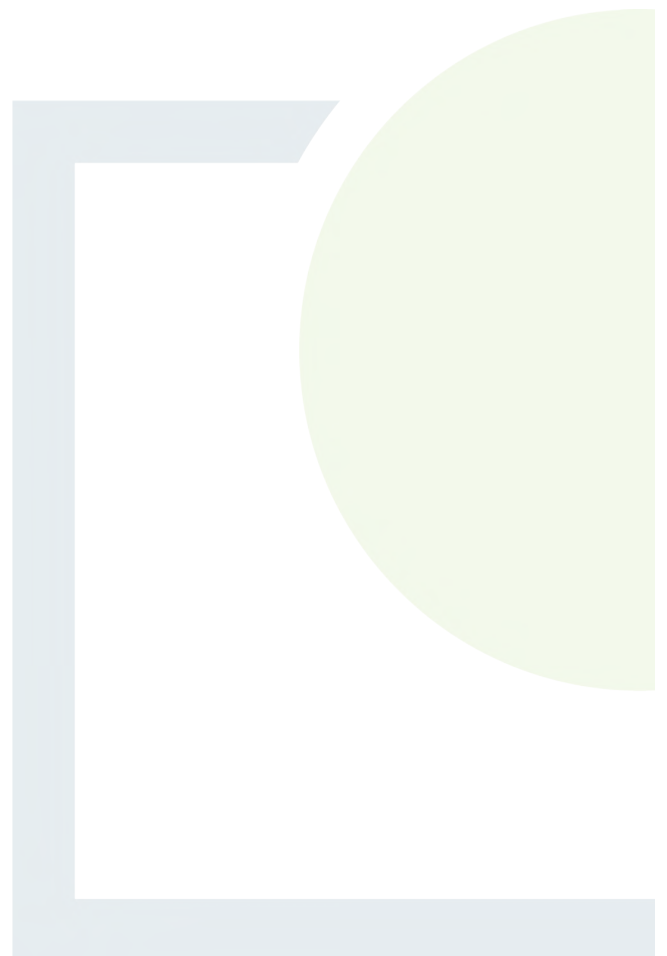
Office of Environmental Sustainability



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 2

A Letter from the Qualified
Body to the Qualified Person



Sent via email only to: james.oneill@ftco.ie

9 November 2022

Re: Register of Chartered Engineers for Historic Landfill Register accordance with Section 2.3 of Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007)

To Whom it May Concern,

This letter confirms that Mr James O'Neill is a member of Engineers Ireland in good standing.

Engineers Ireland confirms that Mr O'Neill has been assessed as a person who is qualified, trained and experienced to the standard set out in Section 2.3 of Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).



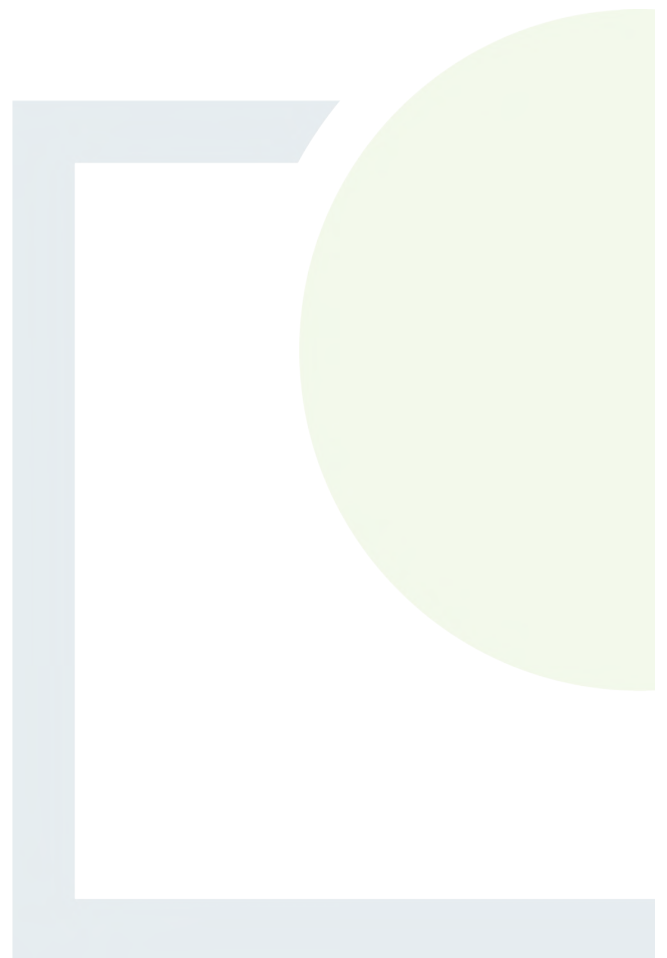
Damien Owens
Director General

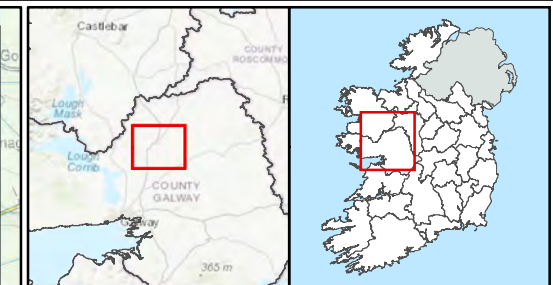
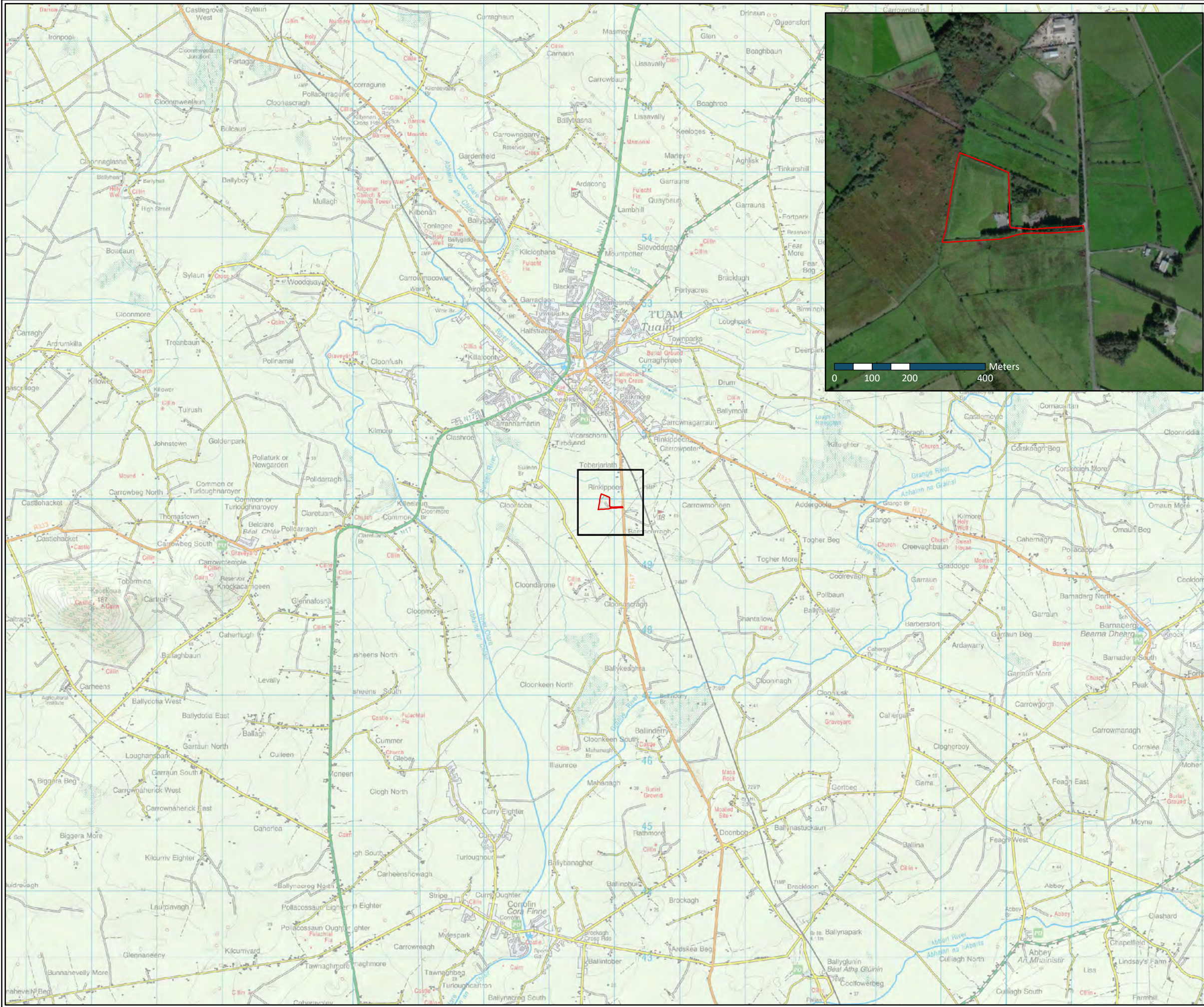


CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 3

Figure No. 1.1 'Site Location'





Site Boundary

| | | | |
|-------------------|------------|----------------------------|----|
| TITLE: | | Site Location | |
| PROJECT: | | Tuam Historic Landfill ERA | |
| FIGURE NO: | | 1.1 | |
| CLIENT: | | Galway County Council | |
| SCALE: | 1:57795 | REVISION: | 0 |
| DATE: | 18/10/2021 | PAGE SIZE: | A3 |
| | | Cork Dublin Carlow | |
| | | www.fehilytimoney.ie | |

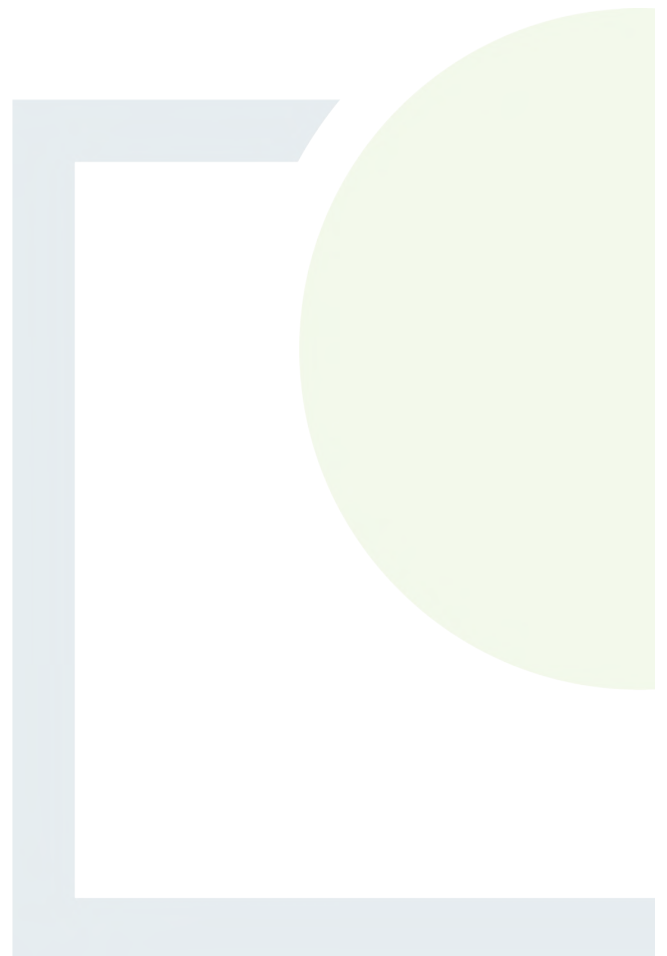




CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 4

Updated Geotechnical Report
– September 2020





CAUSEWAY
— GEOTECH

Galway Historic Landfills – Tuam Ground Investigation

Client: Galway County Council

Client's Representative: Feehily Timoney

Report No.: 19-1465A

Date: September 2020

Status: Final for Issue

CONTENTS

Document Control Sheet




Note on: Methods of describing soils and rocks & abbreviations used on exploratory hole logs

| | | |
|---|---|---|
| 1 | AUTHORITY | 4 |
| 2 | SCOPE | 4 |
| 3 | DESCRIPTION OF SITE | 4 |
| 4 | SITE OPERATIONS..... | 5 |
| | 4.1 Summary of site works..... | 5 |
| | 4.2 Boreholes..... | 5 |
| | 4.3 Standpipe installations..... | 5 |
| | 4.4 Trial Pits..... | 5 |
| | 4.5 Surveying..... | 6 |
| 5 | LABORATORY WORK..... | 6 |
| | 5.1 Geotechnical laboratory testing of soils..... | 6 |
| 6 | GROUND CONDITIONS | 7 |
| | 6.1 General geology of the area | 7 |
| | 6.2 Ground types encountered during investigation of the site | 7 |
| | 6.3 Groundwater..... | 7 |
| 7 | REFERENCES | 8 |

APPENDICES

| | |
|------------|--|
| Appendix A | Site and exploratory hole location plans |
| Appendix B | Borehole logs |
| Appendix C | Trial pit logs |
| Appendix D | Trial pit photographs |
| Appendix E | Geotechnical laboratory test results |

Document Control Sheet

| | | | | | |
|--|-----|---|-----------------|---|-------------------|
| Report No.: | | 19-1465A | | | |
| Project Title: | | Galway Historic Landfills – Tuam | | | |
| Client: | | Galway County Council | | | |
| Client's Representative: | | Feehily Timoney | | | |
| Revision: | A00 | Status: | Final for Issue | Issue Date: | 21 September 2020 |
| Prepared by: | | Reviewed by: | | Approved by: | |
|  Sean Ross BSc MSc MIEI | |  Colm Hurley BSc FGS PGeo | |  Darren O'Mahony BSc MSc MIEI EurGeol PGeo | |

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

| Abbreviations used on exploratory hole logs | |
|--|---|
| U | Nominal 100mm diameter undisturbed open tube sample (thick walled sampler). |
| UT | Nominal 100mm diameter undisturbed open tube sample (thin walled sampler). |
| P | Nominal 100mm diameter undisturbed piston sample. |
| B | Bulk disturbed sample. |
| LB | Large bulk disturbed sample. |
| D | Small disturbed sample. |
| C | Core sub-sample (displayed in the Field Records column on the logs). |
| L | Liner sample from dynamic sampled borehole. |
| W | Water sample. |
| ES / EW | Soil sample for environmental testing / Water sample for environmental testing. |
| SPT (s) | Standard penetration test using a split spoon sampler (small disturbed sample obtained). |
| SPT (c) | Standard penetration test using 60 degree solid cone. |
| (x,x/x,x,x,x) | Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. |
| (Y for Z/ Y for Z) | Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm). |
| N=X | SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm). |
| HVP / HVR | In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa. |
| V VR | Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength |
| Soil consistency description | In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of $N \times 5 = C_u$ is used (as set out in Stroud & Butler 1975). |
| dd-mm-yyyy | Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns. |
| ▽ | Water strike: initial depth of strike. |
| ▼ | Water strike: depth water rose to. |
| Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015 | |
| TCR (%) | Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run. |
| SCR (%) | Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures. |
| RQD (%) | Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run. |
| FI | Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing. |
| NI | Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles. |
| AZCL | Assessed zone of core loss: The estimated depth range where core was not recovered. |
| DIF | Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring. |
| (xxx/xxx/xxx) | Spacing between discontinuities (minimum/average/maximum) measured in millimetres. |

Galway Historic Landfills – Tuam

1 AUTHORITY

On the instructions of Feehily Timoney Consulting Engineers, (“the Client’s Representative”), acting on the behalf of Galway County Council (“the Client”), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the remediation of an historic landfill site in Galway.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results. A discussion on the recommendations for construction is also provided.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client’s Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client’s Representative, included boreholes, trial pits, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on a site located 1km south east of Tuam town centre. The site is accessed off the R347 and is bounded by the R347 and the Tuam Civic Amenity Site to the east, and by agricultural lands to the north, south and west. Works were undertaken in an old landfill site immediately adjacent to the Civic Amenity Site and in the field to the south.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 26th June and 18th September 2020, comprised:

- two boreholes by rotary drilling methods
- a standpipe installation in each borehole; and
- five machine dug trial pits

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

Two boreholes (GW01 and GW02) were put to their completion by rotary drilling techniques only. The boreholes were completed using a Hanjin 8D tracked drilling rig.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to scheduled depth.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in each borehole. Each borehole was also installed with waterra tubing and foot valve to allow future groundwater sampling.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.4 Trial Pits

Five trial pits (TP01–TP05) were excavated using a 13t tracked excavator fitted with a 600mm wide bucket, to a maximum depth of 2.00m. TP01-TP03 and TP05 were undertaken to prove the depth to the existing clay liner.

Bulk samples were taken at depths specified by the Client's Representative.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix C presents the trial pit logs with photographs of the pits and arising provided in Appendix D.

4.5 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **shear strength** (total stress): unconsolidated undrained triaxial tests
- **compaction related:** Moisture Condition Value/moisture content relationship

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990)*.

The test results are presented in Appendix F.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise peat and glacial till. These deposits are underlain by undifferentiated Viséan Limestones.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Topsoil:** encountered across the site with a thickness range of 50-400mm.
- **Paved surface:** 50mm of bitmac was encountered at a depth of 0.25mbgl in TP04.
- **Clay liner:** a geo-composite clay liner was encountered in all trial pits at depths of 0.20-0.40m.
- **Made Ground (fill):** sandy gravel or gravelly silty sand fill encountered beneath topsoil in TP04 and TP05.
- **Made Ground (landfill):** reworked sandy gravel or gravelly silty sand or sandy gravelly silty clay encountered in TP04 to a depth of 2.00m. It should be noted that the trial pit was terminated at 2.00m and this stratum may extend beyond this. Fragments of timber, plastic, glass, steel, wire, clothing, brick and timber were encountered throughout the trial pit.
- **Recent deposits (peat):** peat was encountered in GW01 and GW02 to depths of 1.00m.
- **Glacial till:** sandy gravelly clay/silt with granular pockets were encountered in both boreholes to a depth of 6.40m in GW02. Extent was not proven in GW01 as the borehole terminated at 5.00m.
- **Bedrock (Limestone):** Limestone bedrock was encountered at a depth of 6.40m in GW02.

6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was encountered during rotary drilling in GW02 at a depth of 5.00m. Groundwater was noted during drilling of GW01; however, groundwater was present at the bottom of the hole upon termination of the borehole.

It should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any/additional groundwater strikes and the possibility of encountering groundwater at other depths should not be ruled out.

Groundwater was not noted during excavation of any of the trial pits.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 1.

Table 1: Groundwater monitoring

| Date | Water level (mbgl) | |
|----------|--------------------|------|
| | GW01 | GW02 |
| 21/09/20 | 0.30 | 0.22 |

Seasonal variation in groundwater levels should also be factored into design considerations and continued monitoring of the installed standpipes will give an indication of the seasonal variation.

7 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.



CAUSEWAY
— GEOTECH

APPENDIX A
SITE AND EXPLORATORY HOLE LOCATION PLAN





Project No.: 19-1465A

Client: Galway County Council

Project Name: Galway Historic Landfills - Tuam

Client's Representative: Feehily Timoney

Legend Key



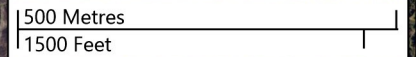
Title:
Site Location Plan

Last Revised:
21/09/2020

Scale:
1:10000



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation





Project No.: 19-1465A

Client: Galway County Council

Project Name: Galway Historic Landfills - Tuam

Client's Representative: Feehily Timoney

Legend Key

- Locations By Type - RO
- Locations By Type - TP



Title:
Exploratory Hole Location Plan

Last Revised:
21/09/2020

Scale:
1:2000





CAUSEWAY
— GEOTECH

APPENDIX B
BOREHOLE LOGS





Project No.
19-1465A

Project Name: Galway Historic Landfills - Tuam

Borehole ID
GW01

Client: Galway County Council

Client's Rep: Feehily Timoney

| | | | | | | | | |
|----------------------------------|--------------------------------|------------------------|-------------------------|--|-----------------------------|-------------------------------|--------------------|-----------------------------|
| Method Rotary Drilling | Plant Used Hanjin 8D | Top (m) 0.00 | Base (m) 5.00 | Coordinates 543727.49 E 749783.09 N | Final Depth: 5.00 m | Start Date: 18/09/2020 | Driller: KW | Sheet 1 of 1 Scale: 1:40 |
| | | | | | Elevation: 34.24 mOD | End Date: 18/09/2020 | Logger: SR | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|-----------|----------------|---------------|------------------|-----------------|-----------|-----------|--------|---|-------|----------|
| | | | | | 34.14 | 0.10 | | TOPSOIL Brown PEAT. (Driller's description) | | |
| | | | | | 33.24 | 1.00 | | Brown sandy gravelly SILT. (Driller's description) | | |
| | | | | | 31.24 | 3.00 | | Grey sandy gravelly CLAY with low cobble content. (Driller's description) | | |
| | | | | | 29.24 | 5.00 | | End of Borehole at 5.00m | | |

| | | | | |
|-----------------------|-------------------|--------------------------------|---------------------|---|
| Water Strikes | | | | Remarks No noticeable groundwater strikes, but water present at the bottom of hole upon completion. |
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) | |
| | | | | |
| | | | | |
| Casing Details | | Water Added | | |
| To (m) | Diam (mm) | From (m) | To (m) | |
| 5.00 | 200 | | | |
| Core Barrel | Flush Type | Termination Reason | Last Updated | |
| | Air | Terminated at scheduled depth. | 21/09/2020 | |





Project No.
19-1465A

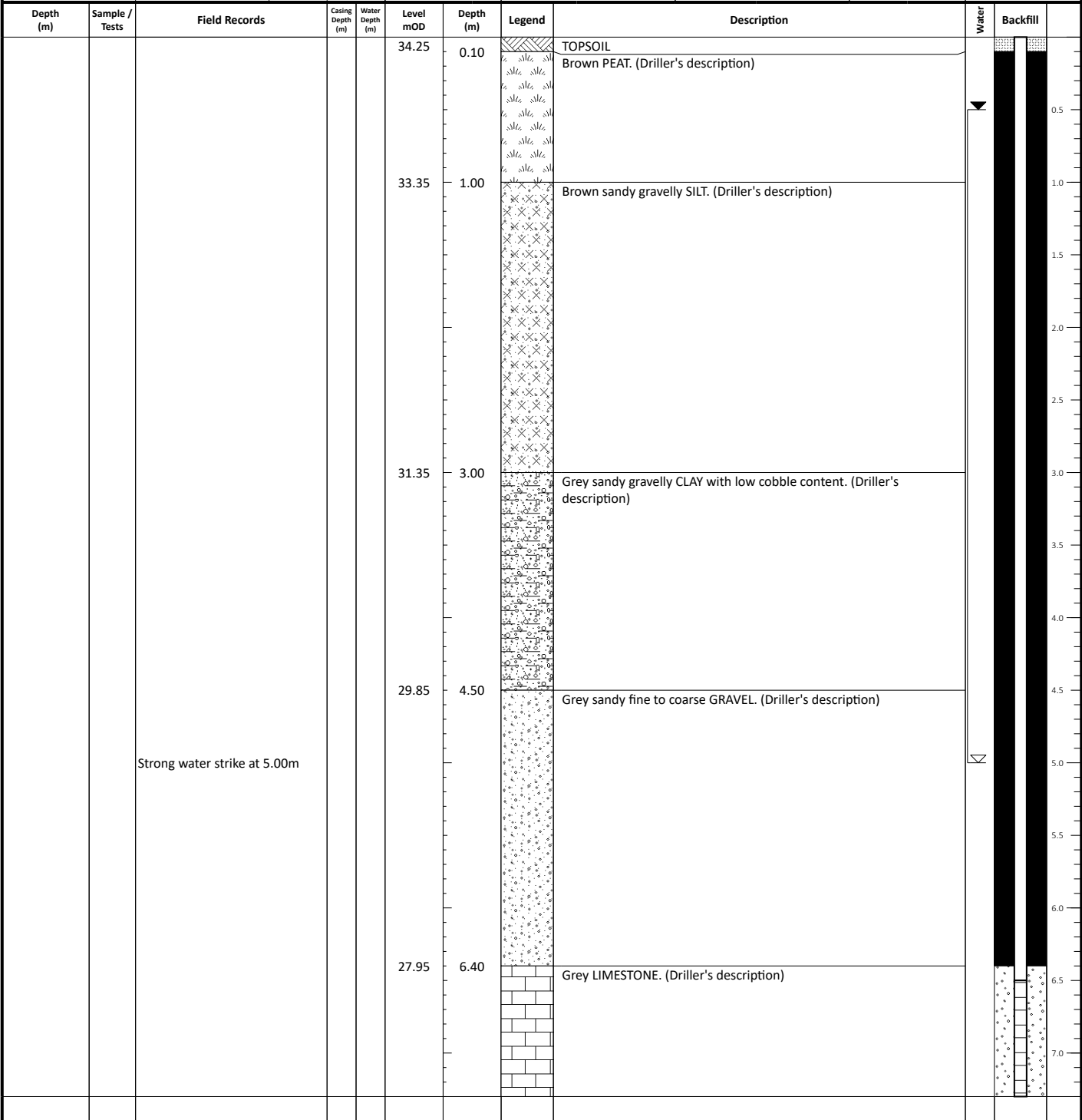
Project Name: Galway Historic Landfills - Tuam

Borehole ID
GW02

Client: Galway County Council

Client's Rep: Feehily Timoney

| | | | | | | | | |
|----------------------------------|--------------------------------|------------------------|--------------------------|--|-----------------------------|-------------------------------|--------------------|-----------------------------|
| Method Rotary Drilling | Plant Used Hanjin 8D | Top (m) 0.00 | Base (m) 12.00 | Coordinates 543727.03 E 749785.25 N | Final Depth: 12.00 m | Start Date: 18/09/2020 | Driller: KW | Sheet 1 of 2 Scale: 1:40 |
| | | | | | Elevation: 34.35 mOD | End Date: 18/09/2020 | Logger: SR | FINAL |



| | | | | | | | | | | | |
|-----------------------|---------------|--------------------|-------------|--------------------|-------------------|--------------------------------|---------------------|--|--|--|--|
| Water Strikes | | | | Remarks | | | | | | | |
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) | | | | | | | | |
| 5.00 | 5.00 | 20 | 0.50 | | | | | | | | |
| Casing Details | | Water Added | | | | | | | | | |
| To (m) | Diam (mm) | From (m) | To (m) | | | | | | | | |
| 12.00 | 200 | | | Core Barrel | Flush Type | Termination Reason | Last Updated | | | | |
| | | | | | Air | Terminated at scheduled depth. | 21/09/2020 | | | | |



Project No.
19-1465A

Project Name: Galway Historic Landfills - Tuam

Client: Galway County Council

Client's Rep: Feehily Timoney

Borehole ID
GW02

| | | | | | | | | |
|----------------------------------|--------------------------------|------------------------|--------------------------|--|-----------------------------|-------------------------------|--------------------|-----------------------------|
| Method Rotary Drilling | Plant Used Hanjin 8D | Top (m) 0.00 | Base (m) 12.00 | Coordinates 543727.03 E 749785.25 N | Final Depth: 12.00 m | Start Date: 18/09/2020 | Driller: KW | Sheet 2 of 2 Scale: 1:40 |
| | | | | | Elevation: 34.35 mOD | End Date: 18/09/2020 | Logger: SR | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|-----------|----------------|---------------|------------------|-----------------|-----------|-----------|--------|---|-------|----------|
| | | | | | 22.35 | 12.00 | | Grey LIMESTONE. (Driller's description) | | |
| | | | | | | | | End of Borehole at 12.00m | | |

| | | | | | | | | | | | |
|-----------------------|---------------|--------------------|-------------|--------------------|-------------------|--------------------------------|---------------------|--|--|--|--|
| Water Strikes | | | | Remarks | | | | | | | |
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) | | | | | | | | |
| 5.00 | 5.00 | 20 | 0.50 | | | | | | | | |
| Casing Details | | Water Added | | | | | | | | | |
| To (m) | Diam (mm) | From (m) | To (m) | | | | | | | | |
| 12.00 | 200 | | | Core Barrel | Flush Type | Termination Reason | Last Updated | | | | |
| | | | | | Air | Terminated at scheduled depth. | 21/09/2020 | | | | |



CAUSEWAY
— GEOTECH

APPENDIX C
TRIAL PIT LOGS





| | | |
|--|--|--|
| Project No. 19-1465A | Project Name: Galway Historic Landfills - Tuam | Trial Pit ID TP01 |
| Coordinates 543837.44 E 749999.13 N | Client: Galway County Council | |
| Method: Trial Pitting | Client's Representative: Feehily Timoney | Sheet 1 of 1 Scale: 1:25 |
| Plant: 13t Tracked Excavator | Elevation 45.05 mOD | Date: 07/07/2020 |
| | | Logger: JG |
| | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|-------------|----------------|---------------|-------------|-----------|--------|---------------------------|-------|
| 0.10 - 0.40 | B1 | | 44.65 | 0.40 | | TOPSOIL | |
| | | | | | | End of trial pit at 0.40m | |

| | | | | | |
|----------------------|---------|---|---|-----------------------------------|--|
| Water Strikes | | Depth: 0.40 Width: 0.40 Length: 1.10 | Remarks: Geocomposite clay liner below topsoil at 0.40m. No groundwater encountered. | Last Updated 21/09/2020 | |
| Struck at (m) | Remarks | | | | |
| | | Stability: Stable | Termination Reason: Geocomposite clay liner proven. | | |



CAUSEWAY
GEOTECH

Project No.
19-1465A

Project Name:
Galway Historic Landfills - Tuam

Trial Pit ID

Coordinates
543812.74 E
749973.63 N

Client:
Galway County Council
Client's Representative:
Feehily Timoney

TP02

Method:
Trial Pitting

Sheet 1 of 1
Scale: 1:25

Plant:
13t Tracked Excavator

Elevation
46.74 mOD

Date:
07/07/2020

Logger:
JG

FINAL

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|-------------|----------------|---------------|-------------|-----------|--------|---------------------------|-------|
| 0.00 - 0.20 | B1 | | 46.54 | 0.20 | | TOPSOIL | |
| | | | | | | End of trial pit at 0.20m | |
| | | | | | | | 0.5 |
| | | | | | | | 1.0 |
| | | | | | | | 1.5 |
| | | | | | | | 2.0 |
| | | | | | | | 2.5 |
| | | | | | | | 3.0 |
| | | | | | | | 3.5 |
| | | | | | | | 4.0 |
| | | | | | | | 4.5 |

| | | | | | |
|----------------------|---------|---|---|-----------------------------------|--|
| Water Strikes | | Depth: 0.20 Width: 0.30 Length: 1.20 | Remarks: Geocomposite clay liner below topsoil at 0.20m. No groundwater encountered. | Last Updated 21/09/2020 | |
| Struck at (m) | Remarks | | | | |
| | | Stability: Stable | Termination Reason: Geocomposite clay liner proven. | | |



CAUSEWAY
GEOTECH

Project No.
19-1465A

Project Name:
Galway Historic Landfills - Tuam

Trial Pit ID

TP03

Coordinates
543774.50 E
749918.67 N

Client:
Galway County Council
Client's Representative:
Feehily Timoney

Sheet 1 of 1
Scale: 1:25

Method:
Trial Pitting


Plant:
13t Tracked Excavator


Elevation
44.26 mOD

Date:
07/07/2020

Logger:
JG

FINAL

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|-------------|----------------|---------------|-------------|-----------|---|---------------------------|---|
| 0.00 - 0.20 | B1 | | 44.06 | 0.20 |  TOPSOIL | End of trial pit at 0.20m | |
| | | | | | | | 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 |

| | | | | | |
|----------------------|---------|---|---|-----------------------------------|---|
| Water Strikes | | Depth: 0.20 Width: 0.60 Length: 1.80 | Remarks: Geocomposite clay liner below topsoil at 0.20m. No groundwater encountered. | Last Updated 21/09/2020 |  |
| Struck at (m) | Remarks | | | | |
| | | Stability: Stable | Termination Reason: Geocomposite clay liner proven. | | |



| | | |
|--|--|--|
| Project No. 19-1465A | Project Name: Galway Historic Landfills - Tuam | Trial Pit ID TP04 |
| Coordinates 543848.05 E 749935.17 N | Client: Galway County Council | |
| Method: Trial Pitting | Client's Representative: Feehily Timoney | Sheet 1 of 1 Scale: 1:25 |
| Plant: 13t Tracked Excavator | Elevation 42.38 mOD | Date: 07/07/2020 |
| | | Logger: JG |
| | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|-----------|----------------|---------------|-------------|-----------|---------|--|-------|
| | | | 42.33 | 0.05 | TOPSOIL | MADE GROUND: Light greyish brown sandy subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse. | |
| | | | 42.13 | 0.25 | BITMAC | MADE GROUND: Very soft to soft light greyish brown sandy gravelly silty CLAY with medium cobble content and fragments of timber, plastic, glass, steel, wire, brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies. | 0.5 |
| | | | 42.08 | 0.30 | | | |
| | | | | | | | 1.5 |
| | | | 41.18 | 1.20 | | MADE GROUND: Soft dark grey and black sandy gravelly silty CLAY with medium cobble content and fragments of plastic, glass, clothing, timber, brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies. | 2.0 |
| | | | 40.38 | 2.00 | | End of trial pit at 2.00m | 2.5 |
| | | | | | | | 3.0 |
| | | | | | | | 3.5 |
| | | | | | | | 4.0 |
| | | | | | | | 4.5 |

| | | | | | | |
|----------------------|---------|---|--|--|-----------------------------------|--|
| Water Strikes | | Depth: 2.00 Width: 0.60 Length: 4.20 | Remarks: Geocomposite clay liner below topsoil at 0.25m. No groundwater encountered. Strong pungent odour present from 0.30-2.00m. Moved into filed at the request of GCC engineer (Colin Ryder). | Termination Reason: Terminated at scheduled depth. | Last Updated 21/09/2020 | |
| Struck at (m) | Remarks | | | | | |



Project No.
19-1465A

Project Name:
Galway Historic Landfills - Tuam

Trial Pit ID

TP05

Coordinates
543859.01 E
749890.35 N

Client:
Galway County Council
Client's Representative:
Feehily Timoney

Sheet 1 of 1
Scale: 1:25

Method:
Trial Pitting

Plant:
13t Tracked Excavator

Elevation
41.73 mOD

Date:
07/07/2020

Logger:
JG

FINAL

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|-----------|----------------|---------------|-------------|-----------|--------|--|-------|
| | | | 41.68 | 0.05 | | TOPSOIL | |
| | | | 41.53 | 0.20 | | MADE GROUND: Light grey slightly gravelly silty fine to coarse SAND. Gravel is subangular fine to coarse of mixed lithologies. End of trial pit at 0.20m | |
| | | | | | | | 0.5 |
| | | | | | | | 1.0 |
| | | | | | | | 1.5 |
| | | | | | | | 2.0 |
| | | | | | | | 2.5 |
| | | | | | | | 3.0 |
| | | | | | | | 3.5 |
| | | | | | | | 4.0 |
| | | | | | | | 4.5 |

| | | | |
|----------------------|---------|---|---|
| Water Strikes | | Depth: 0.20 Width: 0.30 Length: 3.20 | Remarks: Geocomposite clay liner below topsoil at 0.20m. Moved to field side of Civic Area as per GCC engineer request. No groundwater encountered. |
| Struck at (m) | Remarks | | |
| | | Stability: Stable | Termination Reason: Geocomposite clay liner proven. |
| | | Last Updated 21/09/2020 | |