ODOUR & ENVIRONMENTAL ENGINEERING CONSULTANTS

Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath

Tel: +353 46 9437922
Mobile: +353 87 6829011
E-mail: info@odourireland.com
john@odourireland.ie
Website: www.odourireland.com

LANDFILL GAS LEAKAGE SURVEY AT CORRANURE LANDFILL, LISMAGRATTY & CORRANURE TOWNLANDS, COOTEHILL ROAD, CAVAN, CO. CAVAN

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF CAVAN COUNTY COUNCIL

PREPARED BY:	Dr. John Casey
ATTENTION:	Ms. Sinead Fox
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Record sheet

Report by Odour Monitoring Ireland (OMI) on behalf of Cavan County Council			
Report title: Landfill Gas Leakage Survey at Corranure Landfill, Lismagratty & Corranure Townlands, Cootehill Road, Cavan, Co. Cavan			
Facility:	Corranure Landfill	**Report Reference No:**	2008A50(1)
Register No:	W077-01	**OMI Staff on-site:**	Dr. John Casey
Licensee staff met during survey on-site	Ms. Sinead Fox	**Date of survey:**	24th January 2008

Executive Summary

Cavan County Council commissioned Odour Monitoring Ireland to perform a landfill gas leakage survey of Corranure landfill facility in order to ascertain any likely sources of landfill gas leakage from the operating landfill. Landfill gas leakage is the predominant source of odour complaints from landfills in Ireland. Although the landfill site is situated in a predominantly rural area, in the past there have been a number of odour-registered complaints from residential properties in the surrounding area.

During the leakage survey, the following tasks were performed on site:

1. Identification the key mechanisms that lead to the release of landfill gas leakage from the site.
2. Identify geographically on a site map, the locations of landfill gas leakage in order to perform remediation of the identified leakage areas.

The following conclusions were drawn from survey:

- A number of leachate chambers require proper sealing to reduce landfill gas leakage,
- A number of vertical wells housed within chambers require investigation to ascertain the reason for leakage. Both leachate chambers and vertical well chamber leakage should be easily remediated.
- Leakage observed on the active phase will be difficult to remediate given the current construction situation (i.e. flanked areas very steep). Flanked areas should be constructed properly to allow for the control landfill gas leakage through easy remediation especially following heavy rainfall. Waste should not be exposed on flanked areas because it lends itself to landfill gas migration and Oxygen ingress. Such issues can give rise to a myriad of secondary problems including reduced flare operation and potential landfill fires. It should be noted that Vertical well abstraction should be considered immediately to control landfill gas leakage from the phase of operations.
- The capping moisture content was very high on the date of the survey. This will reduce the amount of gas leakage observed.

1. Introduction

1.1. Background to work

Odour Monitoring Ireland was commissioned by Cavan County Council to perform a specified independent Volatile organic compound leakage survey at Corranure Landfill Facility. The assessment involved a Volatile organic compound (VOC) leakage survey of the landfill facility in order to ascertain the VOC emission points and mark them upon a map for remediation. This report presents a summary of the findings of a VOC leakage survey at Corranure Landfill, Lismagratty & Corranure Townlands, Cootehill Road, Cavan, Co. Cavan. The report is based on scientific measurements and observations made during a site visit conducted on the 24th January 2008.

1.2. Scope of work

The main aims of the survey included:

- Capping source monitoring using continuous kinematic VOC/GPS system to detect areas of potential landfill gas release/flux;
- Geo-referencing of detected landfill gas flux areas and plotting upon basemap for visual interpretation and remediation;
- Discussion meeting with landfill manager once survey was complete in order to communicate main leakage areas for immediate remediation, where necessary.
- Identification of short-term mitigation measured to be implemented within the operating landfill to reduce perceived odour impacts.

This methodology has been used by Odour Monitoring Ireland as a means of continuous odour and VOC leakage surveying on a number of licensed Irish landfills.

2. Techniques used

This section describes the techniques used throughout the study.

2.1. "Odour hog" monitoring within the landfill

The "Odour hog" VOC analyser is a portable, intrinsically safe, survey VOC dual monitor, which provides fast and accurate readings of organic and inorganic vapours. A Photo ionisation detector (PID) uses an Ultraviolet (UV) light source (*photo*) to ionise a gas sample and detect its concentration. Ionisation occurs when a molecule absorbs the high energy UV light, ejecting a negatively charged electron and forming of positively charged molecular ion. The gas becomes electrically charged. These charged particles produce a current that is easily measured at the sensor electrodes. Only a small fraction of the VOC molecules are ionised. A PID does not respond to methane. A FID is similar to a flame thermocouple detector, but measures the ions from the flame instead of the heat generated. The FID detects the methane fraction, which provides greater sensitivity in terms of methane leakage detection but not necessarily odour hence why the PID data is also interpreted. The FID/PID analyser was calibrated with certified reference material isobutylene and methane before commencement of the survey. The calibration readings were rechecked following completion of the survey.

Using the continuous kinematic "Odour hog" with integrated GPS, the capping of the landfill was surveyed for potential leakage areas. Those areas identified were geo-referenced and highlighted for remediation. This technique is useful for comparison in leakage area within the same landfill facility on different survey's. The leakage maps generated for the particular facility can be used to assess the effectiveness of implemented mitigation techniques and to qualitatively assess the nature of leakage from the facility.

2.2. Meteorological conditions

Table 2.1 illustrates the predominant wind direction during the monitoring exercise. The meteorological conditions were characterised for the day of monitoring and were as follows:

Table 2.1. Meteorological conditions during Corranure landfill facility TVOC survey.

Day 1-24th January 2008	
Average wind speed 4.0 m s^{-1}	Wind direction North westerly
Cloud cover 2 to 4 octaves	1001 mbar
Temperature 9^0C	Relative humidity 60-70%
Sunny day	Capping moisture content (very) high

During the TVOC and gas field survey, wind direction deviated from the North west. Although Sunny weather prevailed on the date of the survey it was noted that heavy rainfall had occurred in the days previous, which resulted in significant moisture retention in the landfill cover material. This will have the effect of decreasing overall leakage from the landfill surfaces in general.

3. Results

3.1. Volatile organic compound leakage locations identified within Corranure landfill facility

Figure 6.1 and Table 3.1 illustrates the results obtained for the capping leakage survey. A total of 11 individual leakage zones were identified. Each leakage zone is discussed separately in this manner in order to allow for the development of remediation strategies to mitigate the individual leakage areas.

Table 3.1. Capping VOC leakage locations results with source identities correlating with *Figure 6.1 (see Appendix I)*.

Location ID	Easting (m)	Northing (m)	Max Range VOC conc. (ppm)	Identification and Mitigation
C1	244274	307633	32 to 9999+	Leachate chamber (L/G13) should be sealed. Gas abstraction should be applied. All emission points should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C2	244307	307664	32 to 9999+	Leachate chamber (L/G11) should be sealed. Gas abstraction should be applied. All emission points should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C3	244329	307685	32 to 4000+	Vertical well chamber (L/G14) should be sealed. Improved gas abstraction should be performed upon vertical wells in the vicinity of this area. Vertical wellheads should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C4	244352	307716	32 to 9999	Leachate chamber (L/G04) should be sealed. Gas abstraction should be applied. All emission points should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C5	244365	307720	32 to 4000+	Vertical well chamber (L/G05) should be sealed. Improved gas abstraction should be performed upon vertical wells in the vicinity of this area. Vertical wellheads should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C6	244409	307734	32 to 9999+	Leachate chamber (L/G07) should be sealed. Gas abstraction should be applied. All emission points should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C7	244400	307740	32 to 4000+	Vertical well chamber (L/G06) should be sealed. Improved gas abstraction should be performed upon vertical wells in the vicinity of this area. Vertical wellheads should be appropriately sealed to prevent the flux of landfill gas to atmosphere while careful consideration should be given to the influx of Oxygen in to the cap in this area.
C8	244119	307980	32 to 390	Waste exposed on flanked area. Low permeability clay (10^{-9} minimum) should be tracked into the area. Flanked areas should be constructed to minimise landfill gas leakage and allow access for track machinery.
C9	244130	308047	32 1142	Waste exposed on flanked area. Low permeability clay (10^{-9} minimum) should be tracked into the area. Flanked areas should be constructed to minimise landfill gas leakage and allow access for track machinery.
C10	244175	308085	32 to 162	Waste exposed on flanked area. Low permeability clay (10^{-9} minimum) should be tracked into the area. Flanked areas should be constructed to minimise landfill gas leakage and allow access for track machinery.
C11	244157	308014	32 to 125	Weak flux of landfill gas from active area.

Eleven sources of landfill gas leakage were identified (*see Figures 6.1 and Table 3.1*) within the landfill.

Leakage locations C1, C2, C4 and C6 appear to be present as a result of insufficient sealing of leachate chambers. These pipes go directly into the waste body. The leachate chambers should be sealed properly with gaskets similar to those used upon the vertical wells. Sealing these pipes will be easily achieved and should reduce leakage markedly. It should be noted that slight abstraction should be applied when sealing has occurred.

Leakage locations C3, C5 and C7 appear to be present as a result of insufficient abstraction from the vertical wells. Leakage was recorded emanating from the chambers, which house the vertical wells. Vacuum pressure should be checked to ensure the negative pressure is being applied to the vertical wells. Further sealing of the area around the vertical well should be carried out also, to reduce leakage. It should be noted that leakage from locations C1 to C7 was very localised and should be very easily remediated without delay.

Leakage locations C8, C9 and C10 appeared to be a result of insufficient cover on flanked areas where waste fill was exposed. If flanked areas are not constructed properly and waste is exposed landfill gas will migrate outwards in the path of least resistance. All flanked areas should be constructed properly to eliminate this sort of leakage. It should be noted that the capping material was extremely logged with moisture on the date of the survey. High moisture in the capping material will reduce the overall amount of leakage recorded.

3.4. Close out meeting with landfill manager

Following completion of the leakage audit, the leakage team and landfill manager discussed all aspects and general conclusions of the survey. The landfill manager was informed of the potential areas of leakage.

4. Conclusions

The following conclusions were drawn from the survey of Corranure Landfill facility. The leakage contour map generated from the kinematic Volatile organic compound (VOC) survey illustrated surface areas of landfill gas leakage. This was a result of the following:

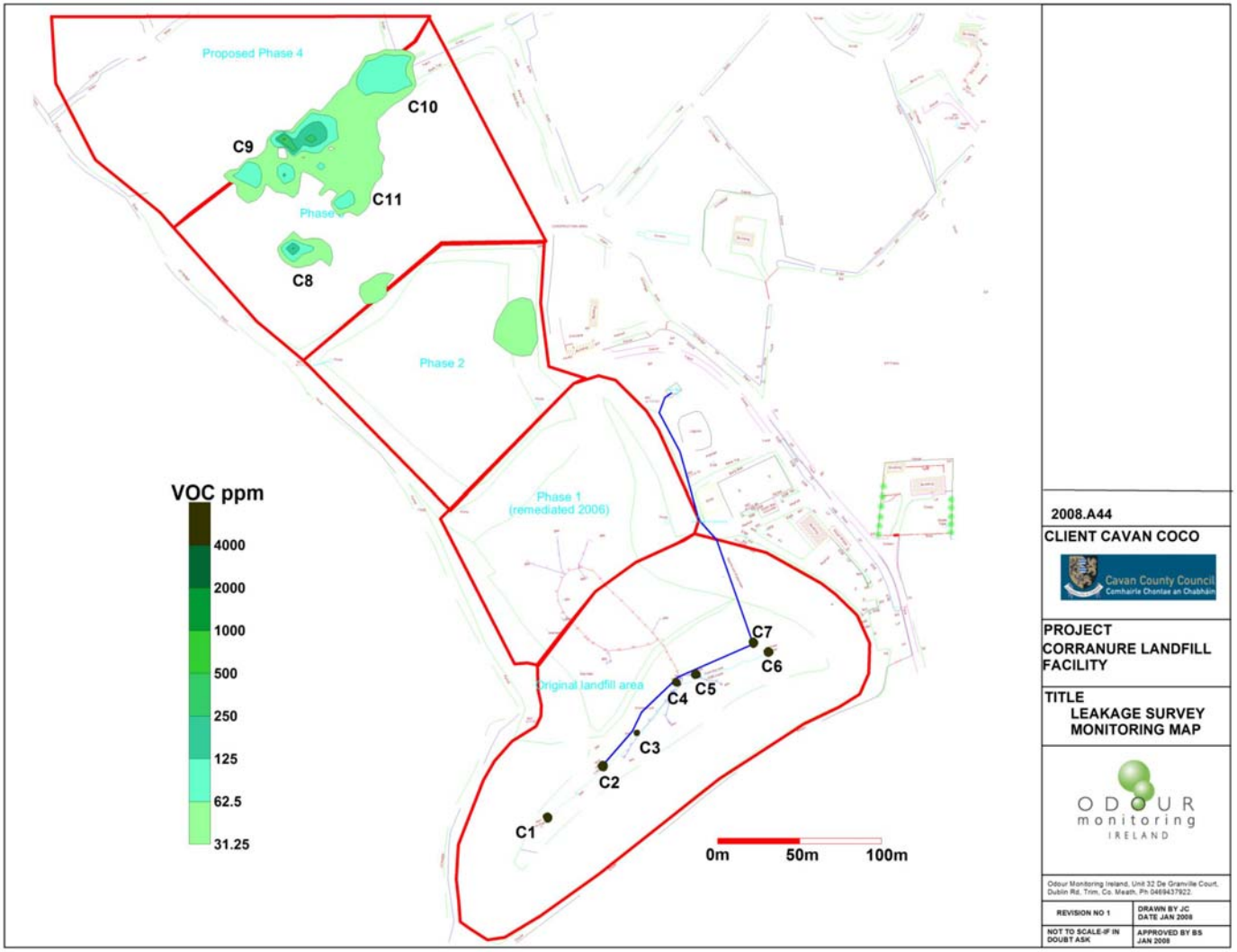
- A number of leachate chambers require proper sealing to reduce landfill gas leakage,
- A number of vertical wells housed within chambers require investigation to ascertain the reason for leakage.
- Both the leachate chambers and vertical well chambers leakage should be easily remediated without delay.
- Leakage observed on the active phase will be difficult to remediate given the current construction situation (i.e. flanked areas very steep). Flanked areas should be constructed to control landfill gas leakage and allow for easy remediation following heavy rainfall. Waste should not be exposed on flanked areas because it lends itself to landfill gas migration and Oxygen ingress. This can give rise to a myriad of other issues including reduced flare operation and potential fires. It should be noted that Vertical well abstraction should be considered immediately to control landfill gas leakage from this operation phase.
- The capping moisture content was very high on the date of the survey. This will reduce the amount of overall leakage observed.

5. References

1. Turner, D. B., (1996). Workbook of Atmospheric Dispersion Estimates, CRH Press, New York, U.S.A.
2. Van Langenhove, H., van Broeck, G., (2001). Applicability of sniffing team observations: experiences of field measurements. Proceedings of the first IWA international conference on odour and VOC measurement, regulation and control techniques. The University of NSW, Sydney, Australia.

6. *Appendix I*-Volatile organic compound leakage contour map.

Figure 6.1. Landfill gas leakage monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale).


Proposed Phase 4
C10
C9
C11
Phase 3
C8
Phase 2
Phase 1
(remediated 2006)
Original landfill area
C7
C6
C5
C4
C3
C2
C1
VOC ppm
4000
2000
1000
500
250
125
62.5
31.25
0m
50m
100m
2008.A44
CLIENT CAVAN COCO
Cavan County Council
Comhairle Chontae an Chabháin
PROJECT
CORRANURE LANDFILL FACILITY
TITLE
LEAKAGE SURVEY MONITORING MAP
ODOUR monitoring IRELAND
Odour Monitoring Ireland, Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath. Ph 0469437922.
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