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20 July 2012

Crossway Baptist Church
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WHITEHORSE PLANNING SCHEME AMENDMENT C123: CROSSWAY BAPTIST CHURCH

LANDFILL GAS RISK ASSESSMENT – FORMER LANDFILL, 51 SPRINGVALE RD, GLEN WAVERLEY

EXECUTIVE SUMMARY

This report is provided in relation to a proposed Planning Scheme Amendment C123 to the City of Whitehorse Planning Scheme: Crossway Baptist Church.

The report provides a review of key off-site landfill gas risk related issues to the Crossway Baptist Church development site (located on the north-west corner of Highbury and Springvale Roads) from the former City of Waverley landfill (located at 51 Springvale Road, Glen Waverley (i.e. the site)).as considered relevant to the Planning Scheme Amendment C123.

The report has been prepared by:

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Qualifications	Bachelor Applied Science (Metallurgy) Diploma in Education
Appointments / Memberships	EPA appointed Environmental Auditor (1998-2007) Member Environment Institute of Australia and New Zealand
Expertise (summary)	Environmental Management, Environmental Impact and Risk Assessment, Regulatory Approvals, Compliance Assessments
Experience (Summary)	Mauro has more than 20 years environmental management experience across industry, regulatory and consulting roles and was an EPA Victoria appointed Environmental Auditor from 1998 to 2007. 2010-2012 Hyder Consulting - Technical Director (Environment) 2004-2010 Coffey Environments - Principal Consultant 1996-2004 Various senior environmental contract consulting roles 1993-1996 Environment Protection Authority (Vic) - Policy Advisor 1989-1993 Liquid Solutions (Industrial Waste Facility) Plant Manager

The Environment Protection Authority (EPA) Victoria is the primary regulatory authority with respect to environmental management and protection in Victoria.

This landfill gas (LFG) risk assessment has been primarily based on the requirements provided in Appendix 2 “Landfill Gas Risk Assessment” of EPA Publication 1323.2.

A conceptual site model is presented in the section titled “Conceptual Site Model” of this report. This includes a description of the potential receptors and pathways. The hazards or aspects are listed in the risk register presented in Attachment A and described in the section titled “Risk Assessment”.

According to EPA Publication 788.1 (2010), building and structure buffer distances apply to closed landfill sites until the site has stabilised to the point where the potential for subsurface gas migration has largely ceased. Typically, this will be a period of about 30 years. It is noted that the site has been closed from about 1972 (i.e. closed for about 40 years).

The risk of off-site LFG migration to the nearest sensitive receptors (residential structures), including the proposed Crossway development, is assessed to be very low, primarily based on the following key issues:

- The landfill was likely only operational for less than 10 years, with closure occurring about 1972;
- The landfill has now reached at least 40 years since closure and LFG generation is now considered to be well into “*Phase V – Aerobic*” stage, (i.e. little if any LFG generation) as shown in Figure 1;
- The landfill cover material would have assisted with minimising odour but would also have allowed for LFG to preferentially permeate through the cover rather than migrate laterally off-site;
- The landfill is most likely unlined and uncapped thereby allowing progressive migration of LFG through the permeable base, sides and capping since its operation and closure;
- Extensive sensitive receptor (e.g. residential) development has occurred adjoining and surrounding the site since the early 1970s, with no indication from Council or EPA of any proven incidents of off-site LFG or odour associated with the former landfill;
- The corner of Highbury and Springvale Roads is considered to represent a topographical low point with respect to both the former landfill site and the Crossway site. Whilst the likelihood of any residual LFG migration reaching this location is considered very low, any drainage and other underground utility services in the vicinity of this intersection are considered likely to provide a conduit for LFG and thereby a barrier preventing LFG migrating to the Crossway site;
- The land associated with the Crossway development is at least 170m from the site and is grassed (i.e. unsealed). Therefore, whilst considered highly unlikely, any potential residual LFG migration from the former landfill site would have manifested in residential developments between the former landfill site and the Crossway site, as well as dissipated through the permeable (grass) surface cover of the Crossway site over the last 40 years or so.

Development has encroached within the recommended buffer distances at the former landfill site to the point where there is effectively no buffer distance between the site and the adjoining housing. Whilst there is a requirement to consider additional construction and contamination management measures to address LFG issues when constructing near to or on a closed landfill area, this requirement appears unnecessary for the Crossway development site given the timeframe that has elapsed since the closure of the landfill and the low risk levels determined by this LFG risk assessment.

In addition, the application of any buffer distance by Council with respect to the former landfill is considered unwarranted given the findings of this LFG risk assessment and the already inadequate (non-existent) buffer applied to the former landfill site by the encroachment of residential development since the early 1970s.

ENVIRONMENTAL REGULATORY CONTEXT

The Environment Protection Authority (EPA) Victoria is the primary regulatory authority with respect to environmental management and protection in Victoria.

Key Victorian landfill gas (LFG) related guidelines (including key relevant publications from the UK), include:

- "*Licence Assessment Guidelines - Guidelines for Using a Risk Management Approach to Assess Compliance with Licence Conditions"*, EPA Publication 1321.2, (June 2011); and
- "*Landfill Licensing Guidelines*", EPA Publication No. 1323.2, (August 2011);
- "*Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills*", EPA Victoria Publication 788.1 (September 2010);
- "*Environmental Guidelines for Reducing Greenhouse Gas Emissions from Landfills and Wastewater Treatment Facilities*", EPA Victoria Publication 722 (November 2000);
- "*Guidance on the management of landfill gas (LFTGN03)*", Environment Agency UK (2004a); and
- "*Guidance on monitoring landfill gas surface emissions (LFTGN07)*", Environment Agency UK (2004b).

This risk assessment has been primarily based on the requirements provided in Appendix 2 "Landfill Gas Risk Assessment" of EPA Publication 1323.2.

Buffer Distances

Buffer distances are set to reflect the potential impacts from landfilling activities. Post-closure buffers are set to manage LFG impacts, including the risk of explosion and/or asphyxiation. Landfill gas potential risks remain for at least 30 years post-closure.

Buffers are measured from the sensitive land use to the edge of the closest cell. All cells, including closed cells, need to be considered in calculating buffers. For sites that cannot demonstrate the above, the premises boundary is the point of measurement.

The following table from EPA Publication 788.1 (2010) summarises the post-closure buffer distances for LFG management.

Table 1: Post-closure buffer distances required for landfill gas migration

Landfill Type	Recommended Buffer Distances
Putrescible	500 metres from buildings and structures
Non-putrescible	200 metres from buildings and structures

The buildings and structures buffer applies to any building or structure (including subsurface structures such as stormwater drains) located near a landfill and is there to provide a protection zone around a landfill for subsurface LFG migration.

According to EPA Publication 788.1 (2010), building and structure buffer distances apply to closed landfill sites until the site has stabilised to the point where the potential for subsurface gas migration has largely ceased. Typically, this will be a period of about 30 years.

Construction on and in the vicinity of landfill sites

Development has encroached within the recommended buffer distances at the former landfill site to the point where there is effectively no buffer distance between the site and the adjoining housing.

LANDFILL GAS OVERVIEW

Generation

Household and commercial/industrial waste typically contains a high proportion of organic material, such as food, paper, wood, and garden trimmings. Once waste is deposited in a landfill, microbes begin to consume the carbon in the organic matter, causing decomposition.

There are a number of complex, sequential microbial phases that develop. Under the anaerobic conditions in landfills, the methane-producing bacteria prevail within the microbial communities. As the microbes gradually decompose organic matter over time, methane (CH_4) (approximately 50%), carbon dioxide (CO_2) (approximately 50%), and other trace amounts of gaseous compounds (< 1%) are generated and form LFG.

The gradual decay of the carbon stock in a landfill generates emissions even after waste disposal has ceased. This is because the chemical and biochemical reactions take time to progress and only a small amount of the carbon contained in waste is emitted in the year this waste is disposed of. Most is emitted gradually over a period of years.

Figure 1 below shows idealised representation of LFG generation in landfills.

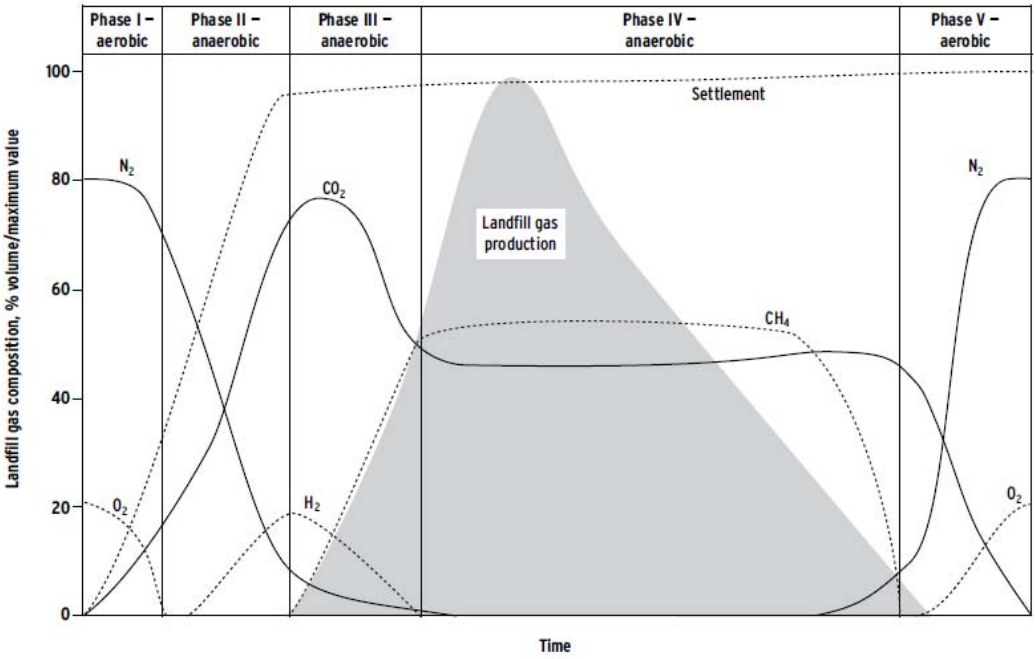

Figure 1: Idealised representation of landfill gas generation in landfills

Composition

The primary constituents of LFG are methane and carbon dioxide. Methane is flammable and forms explosive mixtures with air when present in concentrations between a range of 5% and 15% by volume (v/v). A figure of 5% methane by volume is referred to as the Lower Explosive Limit (LEL). Carbon dioxide is a simple asphyxiant which displaces (excludes) oxygen. A lack of oxygen can lead to unconsciousness or death. Trace components of significance include carbon monoxide and hydrogen sulphide. The type and concentration of trace components will depend on the nature of the waste source.

Movement

Once generated, LFG will move through refuse and soil in a landfill area by both convection and diffusion. Convection is the movement of gas from an area of higher pressure to an area of lower

pressure. Diffusion is the movement of gas from an area of higher concentration to an area of lower concentration.

LFG may not be completely contained within a landfill disposal area and LFG may be discharged through the landfill surface or could potentially migrate through subsurface soils outside the landfill disposal area. The rate of discharge to air is dependent on factors such as the nature of the landfill cover system and whether the landfill includes a LFG control system.

The distance which LFG can migrate is dependent on a number of factors including the quantity of refuse in the landfill, the configuration of the landfill, the geology of the surrounding strata, the presence of man-made pathways, the presence of physical barriers, and the type of cover system on the landfill.

In addition, meteorological conditions such as barometric pressure changes and precipitation can also impact the rate of LFG emissions and migration.

Global warming

Methane and carbon dioxide are greenhouse gases (GHG), whose presence in the atmosphere contribute to global warming and climate change. Methane is a particularly potent GHG, and is considered to have a global warming potential (GWP) at least 21 times that of carbon dioxide.

RISK ASSESSMENT SCOPE AND METHODOLOGY

The risk assessment scope has involved the following activities:

- Collation and review of relevant documents and data to source information, assist in developing an understanding of the landfill's history, and discuss hazards and potential impacts;
- Development of conceptual site model;
- Identification of hazards, pathways and receptors;
- Adoption of risk analysis matrix;
- Development of risk register;
- Population of risk register; and
- Identification of high and medium risks which are to inform the development of a monitoring program, if required.

The methodology developed and applied to the initial screening of off-site LFG risks is based on that provided in Appendix 2 of EPA Publication 1323.2. In summary, this follows a systematic process of identifying the risks, as well as their likelihood and significance, resulting in a qualitative assessment of consequences, as outlined in Tables 4 to 6 below. The process includes:

- Development of a conceptual site model of the landfill and its surrounds, including evaluation of potential sources, pathways, receptors and controls;
- Identification of hazards and risk screening; and
- Simple Quantitative Risk Assessment.

The conceptual site model is presented in the following section of this report. This includes a description of the potential receptors and pathways. The hazards or aspects are listed in the risk register presented in Attachment A and described in the section titled Risk Assessment, which also includes the risk analysis matrix. This is a qualitative risk assessment matrix which is in general accordance with guidance provided in AS/NZS 31000:2009 *Risk Management* and EPA Publication 1321.2.

For a risk to exist, there must be a source (or hazard), a pathway and a receptor (or target). The relationship between these elements can be understood through the conceptual site model. The elements, descriptors, and evidence for the conceptual site model are presented in Table 2.

Table 2: Conceptual Site model elements

Element	Descriptor	Evidence
Source	Composition of Waste and its extent	Extent of waste body; General description of topography; Actual waste type and area deposited on site; Age of waste / period of operation of landfill; and History of site development including age of waste/phases.
Pathway	Landfill Gas Migration	Site geology; Site capping / base / side lining; and Likely presence of underground services/conduits.
Receptors	Landfill Gas Migration	Location of houses, schools, industrial developments, temporary accommodation, and land use (zoned lands) within 500m of the site; and Details and locations of underground services.

The following section of this report provides the basis for the conceptual site model.

CONCEPTUAL SITE MODEL

Site Description and Location

The former City of Waverley landfill (i.e. the site) is located at 51 Springvale Road, Glen Waverley.

The site is currently known as Highview Park which is a grassed, open space, public use recreational reserve. The site includes a children's playground (mulched surface) at the southern end.

The site is currently bounded by:

- North – residential premises then Highvale Court and further residential premises;
- East – Springvale Road then residential premises across Springvale Road;
- South – residential premises then Buller Drive and Tolmey Way and further residential premises;
- West – residential premises then Highvale Rd and Balfour Court and further residential premises.

The Crossway Baptist Church site is located to the north (across Highbury Rd) of the site. The northern and southern boundaries of the site are located approximately 170m and 350m respectively from the southernmost boundary of the Crossway development site.

Site History

Selected aerial photographs (from 1961 to 1984) of the site and surrounds were reviewed. The following table provides a summary of observations from the aerial photographs on and in the immediate vicinity of the site.

Table 3: Aerial Photography Review

Date	Comments
03/1960	**On-site:** The site appears to be a quarry with a major excavation in the south-west corner of the site. The site has been mostly stripped of vegetation. **Off-site:** Native vegetation (trees and grass) appears to the north of the site (south of Highbury Rd). A dwelling appears to the north-west of the site immediately south of Highbury Rd. A small creek is present immediately to the north of Highbury Rd (within the Crossway site). The creek appears to run from west to east towards the corner of Highbury Rd and Springvale Rd where it continues in a south-easterly direction. A farmhouse appears to the west of the site. Orchard (rows of trees) activity appears to the south and south-west of the site. Land to the east (across Springvale Rd) appears to be farmland/paddocks.
10/1968	**On-site:** The majority of the site appears to be filled, including the major excavation area in the south-west corner of the site. The nature of the filling is unclear from the photo. The site appears to have grass cover across the majority of the northern half. **Off-site:** Native vegetation (trees and grass) is still present to the north of the site (south of Highbury Rd). A dwelling is still present to the north-west of the site immediately south of Highbury Rd. A small creek is present immediately to the north of Highbury Rd (within the Crossway site). The creek appears to run from west to east towards the corner of Highbury Rd and Springvale Rd. A new road (including residential development) appears to have been constructed along the original continuation (in a south-easterly direction) of the creek. (i.e. the creek drainage may have been replaced by the road drainage). A farmhouse is still present to the west of the site. Orchard (rows of trees) activity is still present to the south and south-west of the site. Residential development has commenced on the land to the east (across Springvale Rd) including a number of streets and residential premises.
04/1972	**On-site:** The majority of the site has been filled. The nature of the filling is unclear from the photo. The site appears to have grass cover across the majority of the northern half and parts of the southern half. **Off-site:** Much of the native vegetation to the north of the site (south of Highbury Rd) has been cleared. The northern half of Highvale Rd and all of Highvale Court has been constructed with several residential premises present along the northern and southern sides of Highvale Rd and Highvale Court. The premises on the southern side of Highvale Court and Highvale Rd directly adjoin the northern and north-western boundaries, respectively, of the former quarry/landfill site. The original dwelling (from 1961 photo) to the north-west of the site immediately south of Highbury Rd is still present. A small creek is present immediately to the north of Highbury Rd (within the Crossway site). The creek appears to run from west to east towards the corner of Highbury Rd and Springvale Rd where its original continuation (in a south-easterly direction) has been replaced by roadway. Residential development has also occurred further to the south of the site, however, no premises directly adjoin the site to the south. The farmhouse to the west of the site appears to have been demolished and orchard activity to the south and south-west of the site has been significantly cleared or reduced. Land to the east (across Springvale Rd) has undergone significant residential development. Residential premises have also been constructed on the immediate eastern side of Springvale Rd directly across from the former quarry/landfill site.

Date	Comments
03/1984	**On-site:** The site appears to be fully grassed. Rows of trees running north-south appear along the western and eastern boundaries of the site. A roadway running north-south along the length of the park is evident and appears to provide access to the park from the south-eastern corner (continuation of the service road running parallel to Springvale Rd). There does not appear to be any infrastructure (e.g. children's playground) on the site. **Off-site:** Further residential premises have been constructed along Highvale Rd and Highvale Court. The southern half of Highvale Rd has been constructed. The premises on the southern side of Highvale Court and Highvale Rd directly adjoin the northern and north-western boundaries, respectively, of the former quarry/landfill site. The original dwelling (1961 photo) to the north-west of the site immediately south of Highbury Rd is still present. A small creek is present immediately to the north of Highbury Rd (within the Crossway site). The creek appears to run from west to east towards the corner of Highbury and Springvale Roads where its original continuation (in a south-easterly direction) has been replaced by roadway. Further residential development has occurred further to the south of the site with a number of residential premises constructed directly adjoining the southern boundary of the site. Orchard activity to the south and south-west of the site has been replaced by residential development. Land to the east (across Springvale Rd) has been completely developed for residential purposes. Further residential premises have been constructed on the immediate eastern side of Springvale Rd directly across from the former quarry/landfill site.

Geology

The Geological Survey of Victoria (GSV), Ringwood Mapsheet 1:63.360 shows that the site is located within the Silurian formation which consists of massive siltstones, interbedded with thin sandstones, and occasional bunches of massive, laminated and current bedded greywackes, conglomerates and clast beds.

The GSV Ringwood mapsheet also indicates the presence of a quarry (possibly Tally Ho Quartz Diorite) at the site.

Topography

The Victorian Topographical map 1:30,000 (No. T7922-3-1-3) 2011 indicates that the site slopes from west to east with an elevation of about 120m Australian Height Datum (AHD) at the western boundary to between 105 and 110m AHD at the eastern boundary.

In comparison, the relative elevation of the Crossway site (across Highbury Rd and to the north of the former landfill site) generally slopes from north to south with an elevation of about 110m AHD at the north to 100m AHD at the southern end.

Extent of Waste Body

The extent and depth of landfilling across the site is not known nor is the original depth and capacity of the landfill. If landfilling has occurred at the site it is considered most likely to have occurred in the south-western portion of the site where significant excavation was evident from aerial photos. It is considered less likely that any deep waste burial occurred in the northern portion of the site.

The depth of the waste body is not known but is considered unlikely to be greater than 20m given the potential nature of the quarrying activities (i.e. quartz extraction rather than clay or sand pit), the relative surrounding ground and road levels, and the proximity of a major arterial (i.e. Springvale Rd) which is located less than 20m to the east of the site.

Waste Type and Age

The precise waste type deposited at the landfill is unknown, however, it is considered likely to have comprised a combination of putrescible waste (i.e. domestic refuse) and solid inert waste, including building/demolition waste.

Whilst the precise age of the landfill is unknown, a review of aerial photographs suggests that the site was most likely to have been filled from the mid 1960s, with landfilling completed by about 1972.

The EPA in Victoria was established in 1970. It is understood that the first landfill licences were issued in about 1974 to 1975. As such, it is considered unlikely that the former landfill site was licensed by EPA. This is supported by correspondence from EPA to the City of Whitehorse dated 28 May 2012 which states that "*EPA found no records relating to a landfill at 51 Springvale Road and as such the Highview Park site may have been an unlicensed landfill*".

Given the era of operation, the landfill most likely comprised a single, unlined cell and waste was most likely deposited directly onto the floor of the site with no floor or side lining. It is considered unlikely that any LFG collection system was implemented during or subsequent to the landfill operation.

Site Capping

The landfill operated well before current landfill best practice guidelines were in place. Whilst the actual site capping is unknown, the landfill capping most likely comprised of soil cover material and topsoil, given the era of operation. This represents a relatively permeable cap.

A site inspection was conducted on 27 June 2012. The site cover comprised mostly grass cover with several areas of trees which were established post landfill closure. The southern end of the park contained a children's playground which had mulch cover. The site cover was generally observed to be in good condition with no major evidence of exposed waste, denuded vegetation or significant erosion.

Zoning and Nearest Sensitive Receptors

The site is located within the City of Monash whereas the Crossway site is located within the City of Whitehorse.

The Monash Planning Scheme shows that the site is zoned Public Park and Recreation Zone (PPRZ). Land immediately surrounding the site in all directions (i.e. north, south, east and west) up to Highbury Road is zoned Residential 1 Zone (R1Z), with the exception of Springvale Rd which is zoned Road Zone Category 1 (RDZ1).

North of Highbury Road, the Whitehorse Planning Scheme shows that the Crossway site on the north-west corner of Highbury and Springvale Roads is zoned Business 2 Zone (B2Z). Land immediately to the west of the Crossway site is zoned R1Z.

The nearest sensitive receptors to the site include a significant number of low and medium density residential premises directly adjoining and surrounding the site in all directions.

Other nearby sensitive receptors include:

- Retirement Village located approximately 250m to the north-west of the site; and
- Two primary schools located approximately 500m to the north-east and south-east, respectively, of the site.

The Tally Ho Business Park is located approximately 500m to the north of the site.

Underground Services

Given the significant number of residential premises completely surrounding the site and the nearby major roadways, there is considered to be an extensive network of underground services located in

the immediate vicinity of the site (particularly along Highbury Road and Springvale Road), including utilities associated with:

- Electricity supply;
- Gas supply;
- Water supply;
- Stormwater drainage;
- Sewer drainage; and
- Telecommunications.

RISK ASSESSMENT

Risk analysis matrix

The level of risk is a combination of the likelihood of a risk event occurring and the consequence if it does. The level of risk posed can be determined from the matrix shown in Table 4.

Table 4: Qualitative risk assessment matrix

Consequences	Likelihood				
	Almost certain	Likely	Probable	Unlikely	Rare
Severe	V	V	V	V	H
Significant	V	V	V	H	H
Medium	V	H	H	M	M
Minor	H	H	M	L	L
Negligible	H	M	L	L	L

Legend:
V = Very High risk, immediate action required
H = High risk, management required by senior staff
M = Medium risk, specify required risk
L = Low risk, manage with standard operating procedure

The qualitative measures of consequence, as listed in Table 4 above, are provided in Table 5.

Table 5 - Qualitative Measures of Consequence/Impact

Rating	Indicator	Descriptor[(1)]
5	Severe	Human deaths, operations cause catastrophic off-site impacts, immense financial losses
4	Significant	Extensive human injuries, operations cause substantial off-site impacts, major financial losses
3	Medium	Some health impacts to human, operations cause some external impacts, large financial loss
2	Minor	First aid treatment, operations cause some minimal off-site impacts, small financial loss
1	Negligible	Operations cause no injuries, negligible off-site impacts, negligible financial loss

[(1)]Assessment of potential on-site and off-site operational impacts has considered all relevant beneficial uses

The qualitative measures of likelihood, as listed in Table 4 above, are provided in Table 6.

Table 6: Qualitative Measures of Likelihood

Rating	Indicator	Description	Frequency
5	Almost certain	Multiple incidents have been recorded	Is expected to occur almost all of the time
4	Likely	Several incidents have been recorded	Is expected to occur most of the time
3	Probable	Some incidents have been recorded	Might occur
2	Unlikely	Few incidents have been recorded	Might occur but not expected to
1	Rare	No recorded or known incidents	Only expected to occur under atypical conditions

Landfill Risk Assessment Register

The *Landfill Risk Assessment Register* (refer Attachment A) documents the hazards and environmental aspects of the landfill's activities, their potential impact and an analysis of the level of risk posed.

For each of the identified risks the register identifies:

- Location (where the risk is likely to come from);
- Environment category (the element the risk relates to, e.g. air, water, land);
- Aspects (the environmental aspects and hazards of the landfill site);
- Description of potential impacts (description of impacts should the risk occur);
- Pathways for risk; (factors influencing the likelihood of the risk occurring);
- Existing controls (controls in place to prevent or mitigate the risk);
- Likelihood (likelihood of the risk occurring;
- Consequence (consequence if the risk should occur (including the impact on receptors));
- Risk (risk level based on likelihood and consequence); and
- Comments.

Landfill Gas Pathways

Potential pathways and mechanisms for LFG to migrate from landfills and then have an impact on air quality and/or occupational health and safety as diffuse flow from the soil surface, or to enter structures (underground or above surface), are summarised in the following table.

Table 7: Pathways for LFG Migration

Exposure Route	Comment
Soil zones allowing LFG to migrate from site and possibly the ground surface	LFG may migrate laterally and/or horizontally and may accumulate in sub-surface utility structures, garden sheds or other small structures placed directly on the soil or in basements installed below the soil
Tension cracks through the cap of the landfill or damage to the cap	These are a common feature of landfill caps and should be anticipated at most landfill sites
Cracks or unsealed penetrations in concrete slabs of buildings	it should be assumed that such cracks occur unless demonstrated otherwise

Exposure Route	Comment
Vertical structures in the ground (flagpoles, fence posts, lighting towers, electrical poles, etc.)	These structures would need to be hollow (or have an open annulus) to allow the passage of LFG and reach a depth where sufficiently permeable soils with high LFG are penetrated
Sub-surface migration through the soil or along underground service pits, trenches and roadways.	LFG often collects in the permeable backfill around such structures in the vicinity of landfills, which then act as conduits for LFG migration. The significance of this depends on the presence of preferred flow paths (e.g. permeable soils or tension cracks discharging at high rates to the surface)
Construction works involving excavation or boring	Construction / excavation works may remove surface cover/cap and/or expose waste material providing pathway for migration of LFG.
Direct release to atmosphere	Lateral emissions from the landfill through the surface cap and boundaries result from pressure differentials.

The most likely pathways for LFG to migrate from the former landfill site are considered to be:

- Soil zones allowing LFG to migrate from site and possibly the ground surface;
- Sub-surface migration through the soil or along underground service pits, trenches and roadways; and
- Construction works at the site involving excavation or boring.

SUMMARY OF FINDINGS

The risk of off-site LFG migration to the nearest sensitive receptors (residential structures) is assessed to be very low, primarily based on the following key issues:

- The landfill was likely only operational for less than 10 years, with closure occurring about 1972;
- The landfill has now reached at least 40 years since closure and LFG generation is now considered to be well into "*Phase V – Aerobic*" stage, (i.e. little if any LFG generation) as shown in Figure 1;
- The landfill cover material would have assisted with minimising odour but would also have allowed for LFG to preferentially permeate through the cover rather than migrate laterally off-site;
- The landfill is most likely unlined and uncapped thereby allowing progressive migration of LFG through the permeable base, sides and capping since its operation and closure;
- Extensive sensitive receptor (e.g. residential) development has occurred adjoining and surrounding the site since the early 1970s, with no indication from Council or EPA of any proven incidents of off-site LFG or odour associated with the former landfill;
- The corner of Highbury and Springvale Roads is considered to represent a topographical low point with respect to both the former landfill site and the Crossway site. Whilst the likelihood of any residual LFG migration reaching this location is considered very low, any drainage and other underground utility services in the vicinity of this intersection are considered likely to provide a conduit for LFG and thereby a barrier preventing LFG migrating to the Crossway site;
- The land associated with the Crossway development is at least 170m from the site and is grassed (i.e. unsealed). Therefore, whilst considered highly unlikely, any potential residual LFG migration from the former landfill site would have manifested in residential developments between the former landfill site and the Crossway site, as well as dissipated through the permeable (grass) surface cover of the Crossway site over the last 40 years or so.

Development has encroached within the recommended buffer distances at the former landfill site to the point where there is effectively no buffer distance between the site and the adjoining housing on the northern, western and southern boundaries of the site. Whilst there is a requirement to consider additional construction and contamination management measures to address LFG issues when constructing near to or on a closed landfill area, this requirement appears unnecessary for the Crossway site given the timeframe that has elapsed since the closure of the landfill and the low LFG risk levels determined by this risk assessment.

In addition, the application of any buffer distance by Council with respect to the former landfill is considered unwarranted given the findings of this LFG risk assessment and the already inadequate (non-existent) buffer applied to the former landfill site by the encroachment of residential development since the early 1970s.

We trust that the above provides adequate information to address Council's requirement for a landfill gas risk assessment.

Yours sincerely

Mauro De Thomasis
Principal Consultant

Attachments
A – Landfill Gas Risk Register (1 page)

Site: Highview Park (Glen Waverley)

Item No.	Environmental Category	Aspect	Pathways for risk	Description of potential impacts	Key LFG issues/impacts (e.g. from desktop review and/or site observations)	Existing controls/monitoring	Likelihood	Consequence	Risk Rating	Comment
1	Air - landfill gas	Gas emissions from landfill	Soil zones allowing LFG to migrate from site through the ground surface	Health and safety of onsite workers when conducting work on site infrastructure	• No major visual evidence of LFG impact at the site from site observations • Site surface is grassed and site capping is considered unlikely to meet best practice requirements • Children's playground located at southern end of site	• No site specific controls or monitoring infrastructure was observed or considered warranted	Possible	Insignificant	Low	• LFG may migrate laterally and/or horizontally and may accumulate in sub-surface utility structures, garden sheds or other small structures placed directly on the soil or in basements installed below the soil.
2	As above	As above	Tension cracks through the cap of the landfill or damage to the cap	• Health and safety of site users. • Risk to vegetation.	• No major tension cracks or damage to site cover from site observations • Site surface is grassed and site capping is considered unlikely to meet best practice requirements	• No site specific controls or monitoring infrastructure was observed or considered warranted	Unlikely	Low	Low	Tension cracks are a common feature of landfill caps and should be anticipated at most landfill sites
3	As above	As above	Cracks or unsealed penetrations in concrete slabs of buildings	• Health and safety of building users. • Asset damage.	• No buildings on the site	• No site specific controls or monitoring infrastructure was observed or considered warranted	Rare	Insignificant	Low	Such cracks were not found on this site
4	As above	As above	Vertical structures (penetrations) in the ground (e.g. flagpoles, fence posts, lighting towers, electrical poles, etc.)	Health of onsite workers and site users.	• Children's playground at southern end of site may have some shallow penetrations	• No site specific controls or monitoring infrastructure was observed or considered warranted	Unlikely	Low	Low	These structures (penetrations) would need to be hollow (or have an open annulus) to allow the passage of LFG and reach a depth where sufficiently permeable soils with high LFG are penetrated
5	As above	As above	Sub-surface migration through the soil or along underground service pits, trenches and roadways.	• Health and safety of onsite workers and site users. • Asset damage.	• Risk of gas build up and human exposure • Risk of gas ignition and asphyxiation	• No site specific controls or monitoring infrastructure was observed or considered warranted	Unlikely	Low	Low	LFG often collects in the permeable backfill around such structures in the vicinity of landfills, which then act as conduits for LFG migration. The significance of this depends on the presence of preferred flow paths (e.g. permeable soils or tension cracks discharging at high rates to the surface)
6	As above	As above	Sub-Surface migration through the soil along underground service pits, trenches and roadways in the area of nearby sensitive receptors	• Health and safety of nearby sensitive receptors (e.g. residents) • Potential reduction in nearby amenity	• Risk of gas build up and human exposure • Risk of gas ignition and asphyxiation	• No site specific controls or monitoring infrastructure was observed or considered warranted	Unlikely	Low	Low	Nearest sensitive receptor(s) (with site occupation) is residential area adjoining site boundary to the north, west and south. Residential buildings have sealed pavements.
7	As above	As above	Construction works involving excavation or boring	Health of onsite workers and site users.	• Risk of human exposure • Risk of gas ignition	• No site specific controls or monitoring infrastructure was observed or considered warranted	Possible	Insignificant	Low	Construction / excavation works may remove surface cover/cap and/or expose waste material providing pathway for migration of LFG.
8	As above	As above	Direct release to atmosphere through grassed surface	• Health of onsite workers and site users. • Risk to vegetation	• Risk of human exposure • Risk of gas ignition	• No site specific controls or monitoring infrastructure was observed or considered warranted	Unlikely	Low	Low	Vertical emissions from the landfill through the surface cap and boundaries may result from pressure differentials.