

# Assessment of Hazards from Waste Transfer Site on New Housing

Project number: 60586805

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## Quality information

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# 1. Introduction

The objective of this report is to describe the potential consequences of a fire or toxic release originating from a waste transfer station located in Cannock and operated by Axil Integrated Services Ltd (hereafter referred to as 'the site') on nearby housing and surrounding area. This housing was built by the developer Galliford Try Partnership. Whg had no involvement in the construction of the housing nor the initial planning application.

This report has been produced by safety and environmental specialists at AECOM at the request of whg, to provide an independent opinion on the potential hazards to the housing from operations at the site. This report supplements an earlier study reproduced in part as Appendix C of this document, which presents the results of a consequence modelling assessment to calculate thermal radiation and toxic concentration levels for defined scenarios.

AECOM has produced two Event Tree diagrams contained in Appendices A and B which show the consequences for a range of scenarios associated with the main hazards from the site, which are a fire and/or toxic release. These event tree diagrams are intended to provide a visual overview of the scenarios, taking into consideration factors which could prevent the hazard from occurring. It also takes into consideration the factors which would reduce the severity of a fire / toxic release should this occur. This includes for example, employees being present on site to identify leaks, raise the alarm and take the appropriate emergency actions.

The scenarios which AECOM have assessed are based on credible accidents which could occur on site. There have been fires at the site, prior to the site being operated by Axil.

A previous operator of the site was fined £90,000 following a fire in 2009, which was started as a result of the open storage of chemicals which reacted with rainwater creating heat which caused flammable material to ignite. The effects of the fire caused the lids on metal drums to be ejected from the site as projectiles and large smoke clouds were produced, however no-one was injured<sup>1</sup>.

An incident occurred on site in November 2010, in which an explosion resulted in a release of acid gases. Two site staff members were taken to hospital and other personnel and emergency service responders had to undergo decontamination<sup>2</sup>.

The site has been in operation for around 27 years and has an Environmental Permit which is regulated by the Environment Agency. The Environmental Permit sets limits on the operations at the site, including preventing releases of materials which can cause fires and toxic releases. The conditions of the permit have been taken into consideration in developing these event tree diagrams along with feedback from a site visit and other general sources of information.

The site is required to comply with health and safety legislation, including the Health and Safety at Work Act (HSWA) 1974, which is regulated by the Health and Safety Executive (HSE) and Axil, as the current operator must ensure that its operations are carried out in accordance with applicable health and safety legislation. The legislative obligations of the site operator with regard to safety and fire protection are described in Section 4 of this report.

## 2. Fire Scenario Assessment

### 2.1 Flammable Materials

A fire requires fuel, a source of ignition and oxygen, present in the atmosphere.

The site stores a number of different types of waste materials, some of which are classified as flammable therefore these are a source of fuel for a fire. Flammable materials are present on site in quantities up to a

<sup>1</sup> <https://www.expressandstar.com/news/2009/04/22/firm-fined-90k-over-waste-fire/>

<sup>2</sup> <https://www.bbc.com/news/uk-england-stoke-staffordshire-11702124>

maximum of around 60 tonnes and are stored in containers such as Intermediate Bulk Containers (IBCs). Examples of IBCs on site are shown in Figure 1.



As the site stores flammable and other dangerous materials, it is required to comply with the Dangerous Substances and Explosive Atmospheres (DSEAR) Regulations<sup>3</sup>. The key requirements of this legislation are summarised in Section 4.

The flammable materials stored on site include liquid solvents such as acetone and hexane. If containers of flammable materials are damaged and leak, or liquids are spilled during operation of the site, a flammable vapour cloud could form from this liquid.

If ignited, a flammable vapour could result in a fire and/or an explosion. Flammable materials can be released by a number of mechanisms such as the following:

- Leak from a metal container due to corrosion,
- Spills during transfer of liquids from one container to another, and/or
- Dropped containers or objects falling onto containers causing damage which results in leaks.

There are no automatic gas detectors on site, therefore site personnel may be alerted to leaks and spills by detecting the characteristic solvent smell.

## 2.2 Sources of Ignition

There are a number of potential sources of ignition which could be present and initiate a fire if flammable material has leaked or been spilled. These are listed in Table 1 below and include ignition sources on site and due to the proximity of housing, sources offsite.

It would be expected that the site would have the appropriate equipment and procedures in place to control sources of ignition. These are described further in Section 4.

**Table 1. Sources of Ignition**

Category	Description
Electrical	Electrical distribution including junction boxes, lighting, short circuit, overloading, electrical arc, earth faults.
Mechanical	Friction and overheating, grinding
Chemical	Reactions, self-heating, impact and heat sensitive substances.
Heat	Heaters, solar radiation, off-site fires
Others	Smoking, radio frequency, vehicles, arson, fireworks, barbeques.

<sup>3</sup> <http://www.legislation.gov.uk/uksi/2002/2776/contents/made>

The risk of a house fire at one of the new properties spreading to the site was considered by C.S.Todd and Associates in April 2018<sup>4</sup> which concluded that heat from off-site fires represented a low risk to the site. Todd's report focused on house fires and bonfires and did not consider the potential role of the acoustic fence in fire spread for a fire starting on site.

### 2.3 Effects of Fire on People

In the event of a fire on site, there is the potential for this to cause harm to people nearby.

In this study, two types of fire scenario have been considered by AECOM, using knowledge and expertise gained from many years of safety and environmental consultancy support to clients. The first scenario is considered to be representative of a typical fire which could occur on a site such as the one in question. The second scenario is considered to be representative of a worst case fire, which spreads to the entire site and occurs when the inventory of material stored on site is at its maximum permitted level.

AECOM have used computer modelling tools to assess the distance from a fire on site to defined levels of thermal radiation. The range of thermal radiation levels assessed is from 4 kW/m<sup>2</sup> which is the level at which a typical person can be expected to escape from in the event of a fire, to 37.5 kW/m<sup>2</sup> which is the level at which a person would not be expected to survive.

Most people can safely escape from thermal radiation levels of 4kW/m<sup>2</sup> or below. Using computer modelling, AECOM have calculated that if open-air escape routes are within 58 metres of the site, escape will be impeded which could include from housing near the site.

For the worst-case fire scenario, a thermal radiation level of 37.5 kW/m<sup>2</sup> could be reached at 20m from the site.

### 2.4 Fire Scenario Event Diagram

The diagram contained in Appendix A describes four fire scenarios and their respective consequences at nearby receptors, including residential housing and nearby industrial and leisure units.

The scenarios range from small leaks of a few litres of flammable material to major spills of up to the maximum volume stored which is 60 tonnes. For each scenario, the factors which would affect the outcome are noted and the level of harm for each scenario is described. This can range from 'No harm' where a small spill is immediately detected, does not ignite and there is no fire. Where the release is ignited but detected by site operators, a small spill can result in minor damage to the site but no harm offsite.

For a small spill which goes undetected and ignites, the fire could spread across the site consuming flammable and combustible material and eventually to neighbouring properties before the local fire service are able to bring it under control.

Projectiles such as the lids of metal chemical drums could be created during fires and explosions, similar to the incident in 2009. These can reach the nearby receptors where they could cause significant harm.

Significant amounts of smoke can be generated from fires involving the types of materials stored on the site, as was observed in 2009. In addition to being harmful to people, the location of the site near to major roads can potentially obscure the vision of drivers. Consequently, roads have been added as a receptor on the diagram.

In the event of a major failure releasing a large volume of flammable material which goes undetected and ignites, the results could be serious harm to neighbouring people and properties. The probability of this scenario occurring is low, but the potential consequences are severe. Calculating the likelihood of the scenario would require a detailed Quantitative Risk Assessment (QRA), which considers the failure rate of equipment and human factors such as failure to follow procedures and is outside the current workscope.

If a cloud of flammable vapour forms, there is the potential for an explosion to occur, breaking glass and creating projectiles. The heat on site could cause highly toxic materials to form from the decomposition of wastes such as sodium cyanide which could be fatal if inhaled. A toxic release is described in further detail in Section 3.

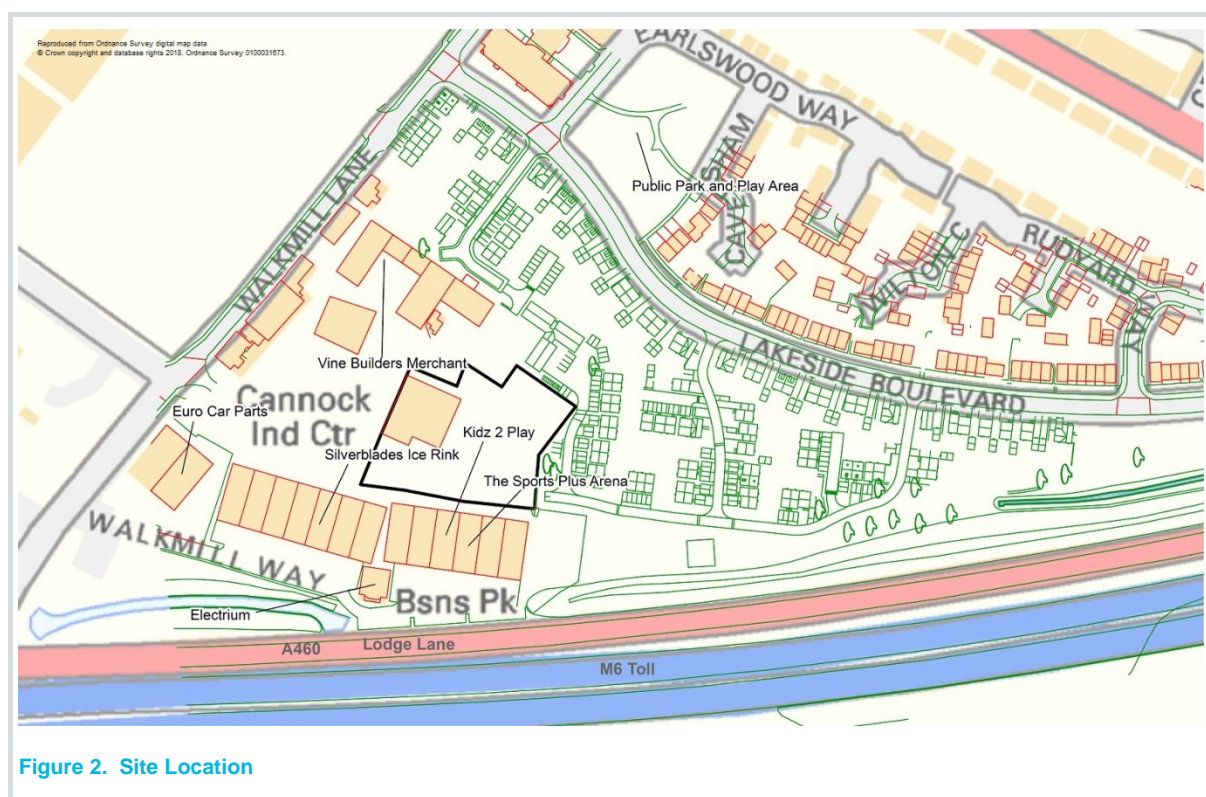
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<sup>4</sup> C.S.Todd & Associates Ltd, 2018, Assessment of Risk of External Fire Spread at Lakeside Boulevard, Cannock.

The location(s) affected by a plume of smoke and/or a toxic release would depend on the direction of the wind, however due to the proximity of receptors on all sides of the site, there is the potential to harm people regardless of wind direction. The site location is shown on the figure below, which shows the location of housing to the north and east of the site, leisure and industrial and retail receptors to the south and west.

In the event of an incident on site, Cannock Community Fire Station is located approximately 2 miles to the north of the site. The response times would typically be around 10 mins.

AECOM staff visited the site on 13<sup>th</sup> November 2018 and observed a site layout that was very similar to the layout as it would have at the time of the initial planning application. The site demonstrated a good standard of house keeping and safe working practices were evident within the site induction process and on site. Management plans for the management of fire risks were viewed while on site and these documents included discussion of off site land uses as both receptors and the associated potential additional mechanisms for onsite fire ignition. Procedures of identifying and responding to fires were described by Axil site management staff and included the use of a 3<sup>rd</sup> party security firm and security cameras out of hours to inform the responsible member of staff of unusual activity, including evidence of fire on site, including live streaming images to staff smart phones.





## 3. Toxic Scenario Assessment

### 3.1 Toxic Materials

The most hazardous waste material stored on site is Sodium Cyanide (NaCN). This is stored as a liquid and site personnel will frequently collect small quantities received onto site in small containers within a larger IBC for temporary storage prior to transfer offsite for disposal. The Environmental Permit specifies the maximum quantity of waste materials which can be present on site at any one time, however does not state how long that waste can be present on site for.

Sodium Cyanide can form highly toxic Hydrogen Cyanide (HCN) gas by any of the following mechanisms which are described as follows. The ways in which the site prevents the formation of toxic HCN are also summarised.

1. Contact with carbon dioxide in air.

*The site stores sodium cyanide in sealed containers to prevent exposure to air.*

2. Contact with water.

*Site surfaces should not be allowed to accumulate rainfall which could increase the formation rate of HCN should NaCN leak or be spilled.*

3. Contact with acids.

*The storage of acids is segregated from flammable and toxic materials.*

4. Contact with heat source including fire.

Site facilities and procedures for the control of heat and ignition sources is described in Section 2.

### 3.2 Detection and Effects of HCN

As there are no fixed automatic toxic gas detectors on site, if HCN is formed, detection will be by persons on or off-site detecting the odour and raising an alarm.

HCN is colourless gas, lighter than air therefore disperses rapidly and has a characteristic almond odour. The ability to smell this however is genetic, not all people are able to detect it and can be between 20 to 60% of the population.

Inhalation of HCN results in very rapid toxicity, causing significant harm and possible fatalities. Symptoms of exposure to HCN include the following (Ref: <https://publicsafety.tufts.edu/ehs/files/Cyanides-SOP.pdf>):

- Weakness, difficulty breathing;
- Headache, confusion, dizziness, vertigo;
- Nausea, vomiting;
- Skin goes pink/cherry red from cyanide-haemoglobin complexes; and
- Continued exposure can cause coma, pulmonary oedema, and cardiac arrest.

### 3.3 Toxic Scenario Event Diagram

The diagram contained in Appendix B describes four toxic release scenarios and their respective consequences.

The scenarios range from small leaks of a few litres of NaCN which are immediately contained to prevent formation of HCN, to major spills of up to the maximum volume stored which is 1 tonne which fully converts to HCN gas.

For each scenario, the factors which would affect the outcome are noted and the level of harm for each scenario is described. This can range from 'No harm' where a small spill is immediately contained, does not produce HCN

and there is no toxic gas released offsite. For both minor and major scenarios where NaCN is released but undetected, there is the potential to cause significant harm both onsite and offsite due to the toxicity of HCN.

In the event of a major fire on site affecting the toxic storage area, the heat would cause NaCN to produce HCN. In addition to being toxic, this gas is flammable and potentially explosive creating an additional hazard.

AECOM staff visited the site on 13<sup>th</sup> November 2018 and Axil site management staff confirmed that the site does not have sensors installed to detect a spillage of toxic materials. There are visual checks undertaken during operational hours and spill kits available to site staff, should a spill be observed.

## 4. Aggregating and Mitigating Factors

The site is required to manage the operation of this facility to ensure the safety of people onsite and office, in accordance with a number of statutory regulations, primarily the Health and Safety at Work Act (HSWA), 1974<sup>5</sup>. The HSE and Local Authorities are responsible for enforcing this Act.

One of the primary requirements of the HSWA is the duty to properly maintain the premises and work equipment. By complying with this Legislation, Axil are fulfilling their legal responsibilities for safety at their site.

The site is also required to comply with the terms of their Environmental Permit, which includes the types of material which they are allowed to store.

In the event of a release of flammable and/or toxic materials, there are a number of factors which could help to prevent an incident or make it more or less harmful should it occur.

These factors include the following:

### 1. Operational Hours

One of the key factors in the severity of an incident is the presence of personnel on site. The site can operate 24 hours a day, but currently operates during standard business hours with motion sensitive CCTV coverage outside these times. CCTV would not detect a fire should this occur; it is more likely that a nearby member of the public would call the fire service therefore the fire will be well developed by this stage. If site personnel are present and a fire breaks out, it is more likely that the fire could be contained on site.

Raising the alarm in the event of a fire is required as part of the site's Fire Risk Assessment (FRA). The site is responsible for producing and maintaining a FRA in accordance with the Regulatory Reform (Fire Safety) Order (RRFSO) 2005<sup>6</sup>. This legislation requires sites such as this to comply with the following extract from the Regulations. Complying with these regulations satisfies the sites' legal requirements for fire detection.

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<sup>5</sup> <https://www.legislation.gov.uk/ukpga/1974/37>

<sup>6</sup> <http://www.legislation.gov.uk/uksi/2005/1541/contents/made>

### **Fire-fighting and fire detection**

**13.—(1)** Where necessary (whether due to the features of the premises, the activity carried on there, any hazard present or any other relevant circumstances) in order to safeguard the safety of relevant persons, the responsible person must ensure that—

- (a) the premises are, to the extent that it is appropriate, equipped with appropriate fire-fighting equipment and with fire detectors and alarms; and
- (b) any non-automatic fire-fighting equipment so provided is easily accessible, simple to use and indicated by signs.

(2) For the purposes of paragraph (1) what is appropriate is to be determined having regard to the dimensions and use of the premises, the equipment contained on the premises, the physical and chemical properties of the substances likely to be present and the maximum number of persons who may be present at any one time.

(3) The responsible person must, where necessary—

- (a) take measures for fire-fighting in the premises, adapted to the nature of the activities carried on there and the size of the undertaking and of the premises concerned;
- (b) nominate competent persons to implement those measures and ensure that the number of such persons, their training and the equipment available to them are adequate, taking into account the size of, and the specific hazards involved in, the premises concerned; and
- (c) arrange any necessary contacts with external emergency services, particularly as regards fire-fighting, rescue work, first-aid and emergency medical care.

(4) A person is to be regarded as competent for the purposes of paragraph (3)(b) where he has sufficient training and experience or knowledge and other qualities to enable him properly to implement the measures referred to in that paragraph.

Figure 3. RRFSO – Part 2, Fire Safety Duties

## 2. Gas Detectors

There are no automatic fire and gas detectors present onsite. If installed, gas detectors could be programmed to send an alarm link to the site manager and/or the fire and rescue service.

Fixed toxic gas detectors are not installed. Sites storing cyanides would however typically require personnel to wear portable monitors when handling these substances. This would help to alert personnel to leaks and spills.

## 3. Proximity of Site to Public

AECOM have assessed the thermal radiation levels which could be harmful to people resulting from a fire at the site and concluded that even small fires could be harmful to people living or working near the site. Thermal radiation can also cause damage to property within a short distance of the site. For example, wooden structures such as fencing will catch fire at thermal radiation levels of around 12 kw/m<sup>2</sup>. For the worst case fire scenario, this could be up to 40m from the site.

## 4. Site Surfacing

Flammable materials are stored on site in concrete bays which are sloped to a kerb. This structure can collect minor spills and leaks and prevent them from spreading across the site, increasing of exposure to a source of ignition. In accordance with their Environmental Permit, the site is required to keep their surfacing in good condition, promptly repairing any damage or cracks.

At the time that AECOM staff visited the site on 13<sup>th</sup> November 2018, the surfacing materials and bay walls were in good condition. There was some small pools of rain water retained within the kerbed bays, that would be removed for disposal.

## 5. Dangerous Substances and Explosive Atmosphere (DSEAR) Compliance

Sites which store and/or use certain dangerous substances are required to produce a risk assessment to determine the potential for harm to people from these substances. The site is required by this legislation to demonstrate that it has carried out a risk assessment and has reduced the risks from the dangerous substances present on site to level which is considered by regulatory guidance to be tolerable. AECOM did not ask to view the site DSEAR during the site visit on 13<sup>th</sup> November 2018.

Compliance with DSEAR is the responsibility of the employer who operates the site and the Regulations are enforced by the Health and Safety Executive (HSE).

The HSE may inspect the employer's premises and review their DSEAR Risk Assessment. If there was to be an incident such as a fire which caused serious harm to people, the HSE would be involved. If the investigation found deficiencies in DSEAR compliance, the HSE would take the lead in a prosecution.

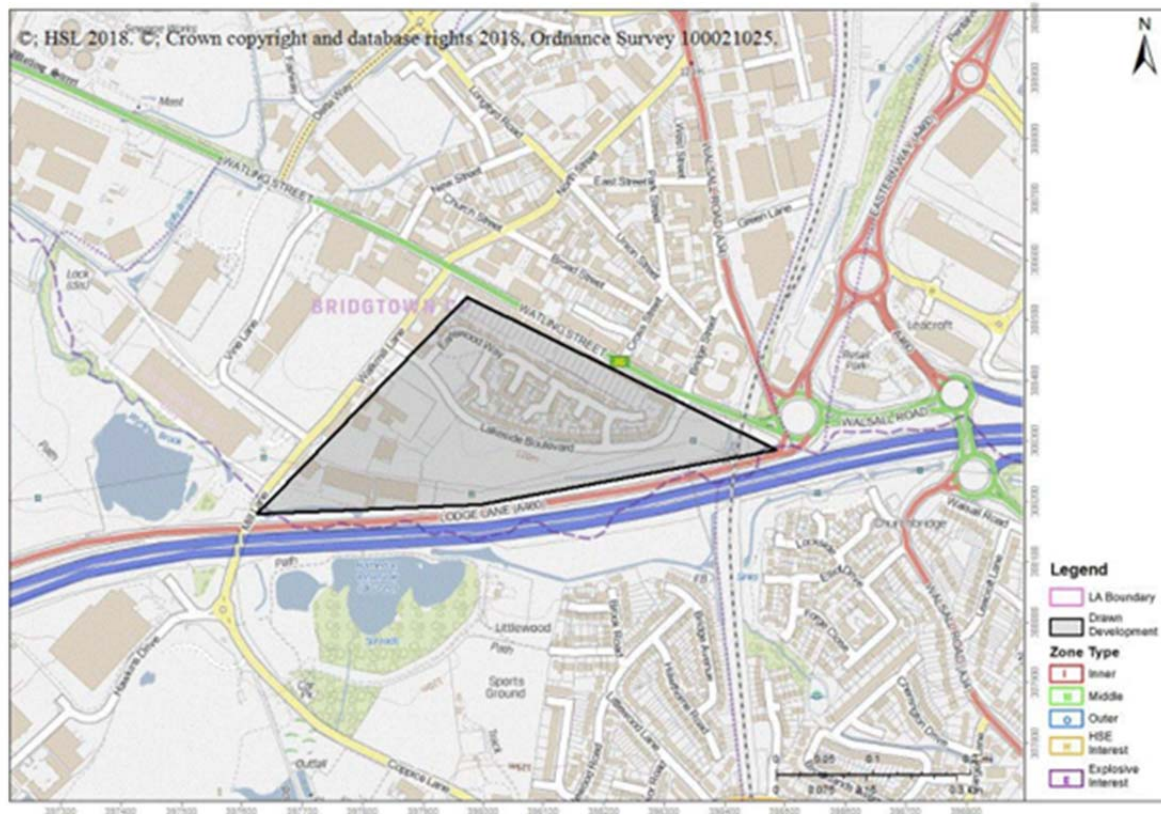
The HSE would not stop occupation of housing nearby a site which is required to comply with DSEAR. For example, fuel stations are required to comply with DSEAR and these are often located in residential areas. Sewage pumping stations are also required to comply with DSEAR due to the production of flammable gases from sewage.

Compliance with DSEAR is not a consideration during planning and the HSE would not be a formal consultee for the development of housing in the vicinity of the site unless the site was categorised by the Control of Major Accident Hazard (COMAH) Regulations as an Upper Tier Installation. These sites typically include oil refineries and large chemical manufacturers. The volume of substances stored on the site is much lower than the volume required for the site to be upper tier COMAH.

The HSE website includes a Land Use Planning tool, where prospective developers can check to see if the HSE should be consulted on the planning application. AECOM have entered the site location into this tool and the results are shown in the following Figure 4. This shows that the HSE would not have been a consultee for this development.

### Advice : HSL-181206115052-386 Does Not Cross Any Consultation Zones

Your Ref: Cannock Waste  
Development Name:  
Comments:



The proposed development site which you have identified does not currently lie within the consultation distance (CD) of a major hazard site or major accident hazard pipeline; therefore at present HSE does not need to be consulted on any developments on this site. However, should there be a delay submitting a planning application for the proposed development on this site, you may wish to approach HSE again to ensure that there have been no changes to CDs in this area in the intervening period.

This advice report has been generated using information supplied by Alison Couley at AECOM on 06 December 2018.

Figure 4. HSE Planning Advice Tool Results

#### 6. Ignition Source Control

As a site which is required to comply with the DSEAR Regulations, within areas of the site used for the storage of flammable liquids, the site must only use appropriately rated electrical and mechanical equipment to reduce the potential for an ignition source.

Site procedures must also be in place to control ignition sources, such as prevention of smoking and use of mobile phones in certain areas. Prevention of static discharge by earthing should also be in place.

#### 7. Acoustic Mitigation Measures

The introduction of an acoustic barrier in the form of a wooden fence that extends above the existing concrete site wall and runs along the eastern site boundary introduces combustible material into the area adjacent to the flammables storage area and the oily rags storage areas. In addition to the wooden fence providing a mechanism

to enable more rapid spread of a fire that starts on site, the accumulation of material (leaves, litter etc.) in the gap between the two barriers has introduced an additional site for fire to start from. The acoustic barrier was required as a condition of the planning consent for the development of nearby houses.

## 5. Options to Reduce Risks

In general terms, there are limited options to minimise risks of harm to future occupiers of the properties that whg has currently left unoccupied, or to the surrounding other uses. Ideally the planning process would have considered the risks in more detail when determining what was an appropriate use of the land adjacent to this waste management facility, although AECOM has not reviewed the planning decision to determine how much consideration was given to such risks.

Starting from the circumstances as they are today there are some options available, although these mostly require the voluntary co-operation of the operator of the waste site. This is an important detail as the site is undertaking activities that it is consented to undertake and does not have to change its working practices or the nature of its operations because of the presence of the new residential units. Axil should however continue to take surrounding uses and any harm that could be arise as a result of the site's operations as part of its compliance with applicable health and safety law.

In the long term – a solution in which the industrial units are no longer present on the site would remove the hazard.

In the short term – If whg, the site operator (currently Axil) and the planning authority were able to bring forward a single concrete barrier to replace the section of the wooden acoustic barrier and parallel section of old concrete site wall, this would remove the additional risks introduced by the construction of the acoustic barrier. We expect that as the wooden fence was constructed as acoustic mitigation, this would require the agreement of the planning authority. We do not consider a new concrete barrier as being a barrier that would entirely prevent the spread of fire off site, but it would contribute to reducing the risk of fires starting or spreading to additional flammable materials.

In the short term – whg should assess the distance from the site that emissions of odorous substances from the site, such as solvent vapour, would have a significant adverse impact on the amenity of occupiers of the currently unoccupied properties. Our experience during the site visit was that solvent odour was recognisable at least 20m from the flammable liquids storage bays.

In the medium term – Axil could consider voluntarily making modifications to its working practices while a long term solution is considered, especially if the barrier to an alternative method of working is primarily financial. Options Axil could consider include:

- If the toxic waste is being sent offsite for disposal and not reclamation, then it may be practicable to neutralise the material onsite so that HCN could no longer be emitted.
- If HCN sensors were installed on site and linked to site management mobile phones via SMS systems, the risk of a release occurring undetected until after harm had occurred would be reduced.
- Not all solvents would burn with a visible flame and therefore may pass undetected by the current motion sensors used on site until the fire had spread and become a more difficult incident to manage. The use of heat sensors would be more useful from a fire risk perspective.

These short and medium terms measures have the potential to reduce the risk of an event occurring. Only the long term change of land use at the site would directly address the magnitude of the potential consequences from a fire or toxic release.

# Appendix A Fire Scenario Review

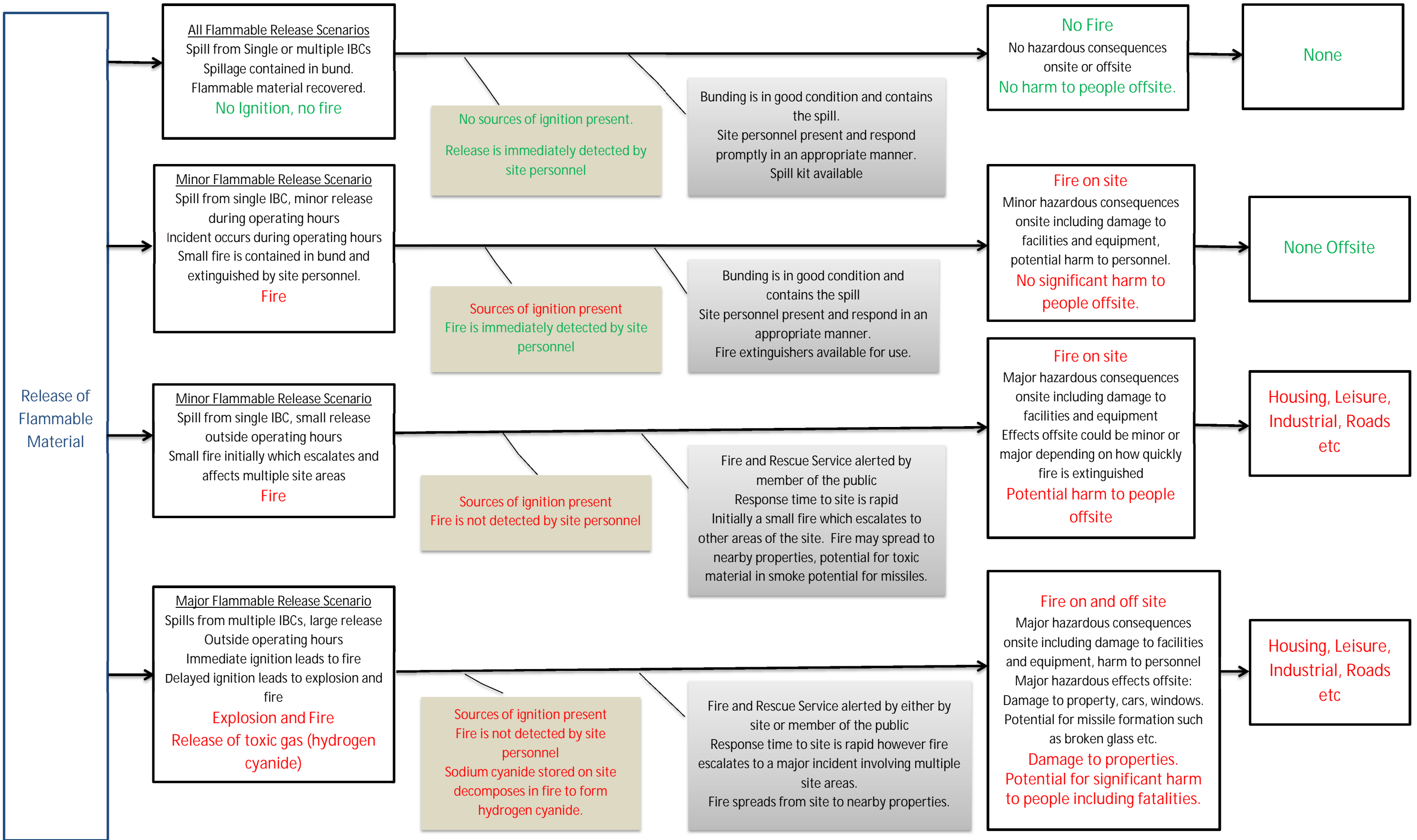
Event

What Happens

Site Controls

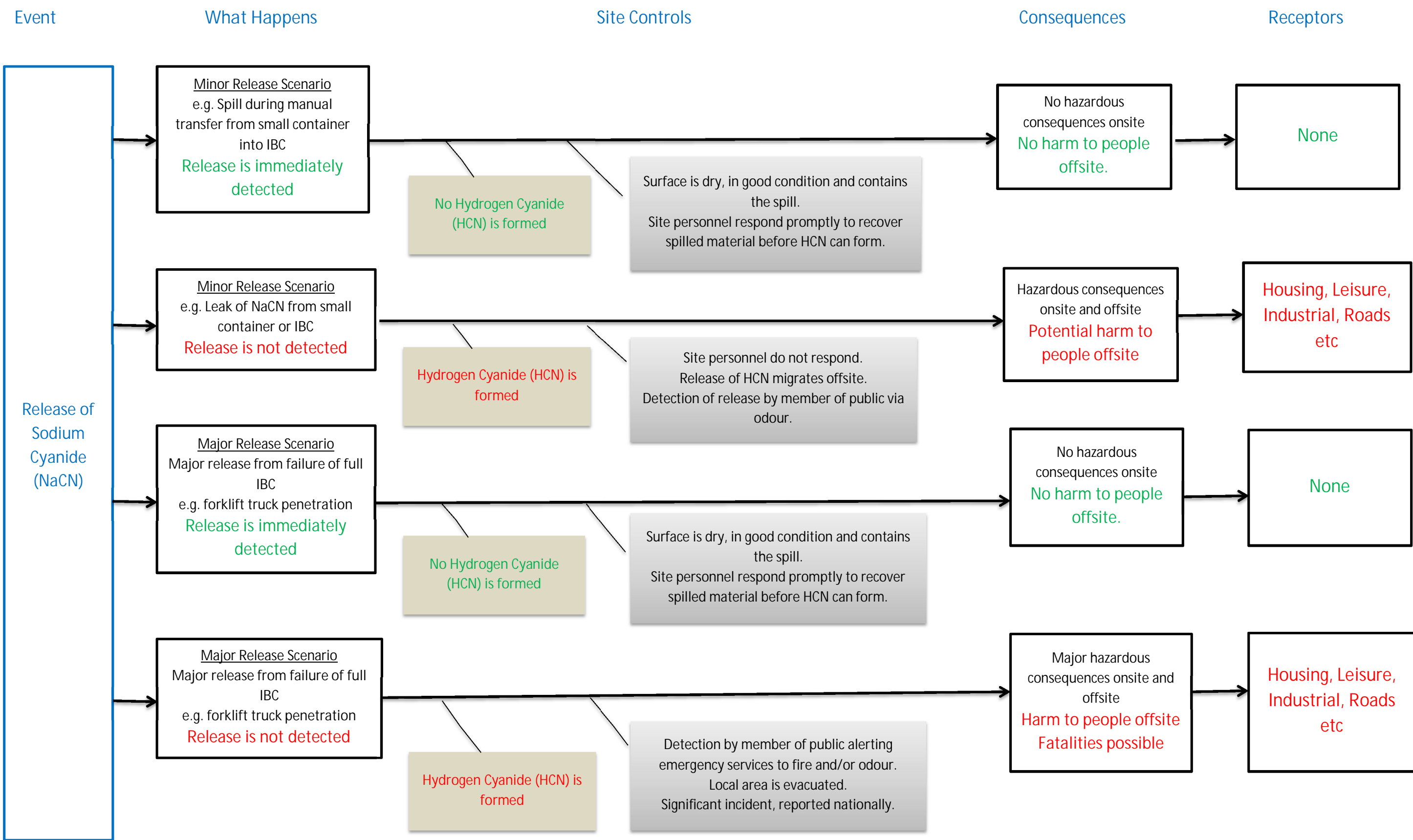
Consequences

Receptors





# Appendix B Toxic Scenario Review



## APPENDIX C: AECOM PHAST Modelling



Client	whg Housing Association
Site	Cannock
Job n°	60586805
Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
Doc n°	60586805

# Scenario Sheets

Revision n°	Date	By Name / Company	Comments
0	27/09/2018	HARTZ / AECOM	Initial version
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
			Doc n°	60586805
Definition	Flammable release contained within bay			
Case	N-hexane			

**Description and assumptions**

Release of liquid waste material from a single IBC (1000 l), contained within the flammable bay area (bay 7 or 8).  
 Bay dimensions : 12 m long, 7 m wide, 2.5 m block wall height (for 3 bay sides at site boundary).  
 Liquid waste assimilated to n-hexane (hydrocarbons, smoky flame flag).

**Consequence**

Pool fire (PF)

**Weather conditions and substrate data**

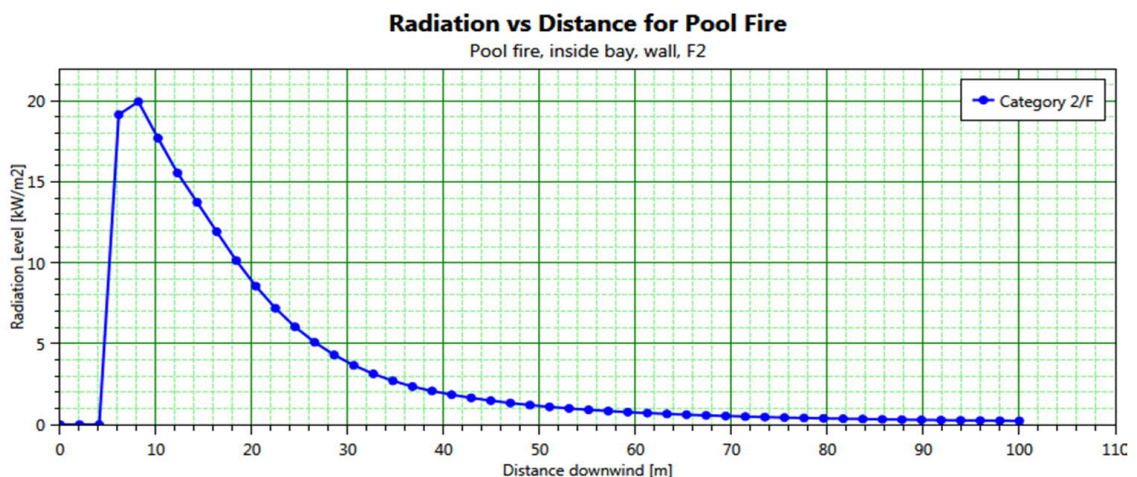
Pasquill stability class	F	D		
Wind speed at 10 m (m/s)	2	5		
Ambient temperature (°C)	15	20		
Surface temperature (°C)	15	20		
Relative humidity (%)	70	70		
Surface roughness (m)	1.0	1.0		

**Results**

Software PHAST 8.11

		Réf. 1A-PF			
		F2	D5		
Flame length (m)		17.6	17.1		
Elevation (m)		2.5	2.5		
Flame angle to vertical (°)		35.2	52.1		
Flame emissivity (kW/m <sup>2</sup> )		61.5	61.5		
Pool diameter (m)		8.85	8.85		
Distance 1 (m)	37.5 kW/m <sup>2</sup>	N/A	N/A		
Distance 2 (m)	24 kW/m <sup>2</sup>	7	10		
Distance 3 (m)	12.5 kW/m <sup>2</sup>	17	21		
Distance 4 (m)	6.3 kW/m <sup>2</sup>	25	27		
Distance 5 (m)	4 kW/m <sup>2</sup>	30	32		
Origin		Pool centre			

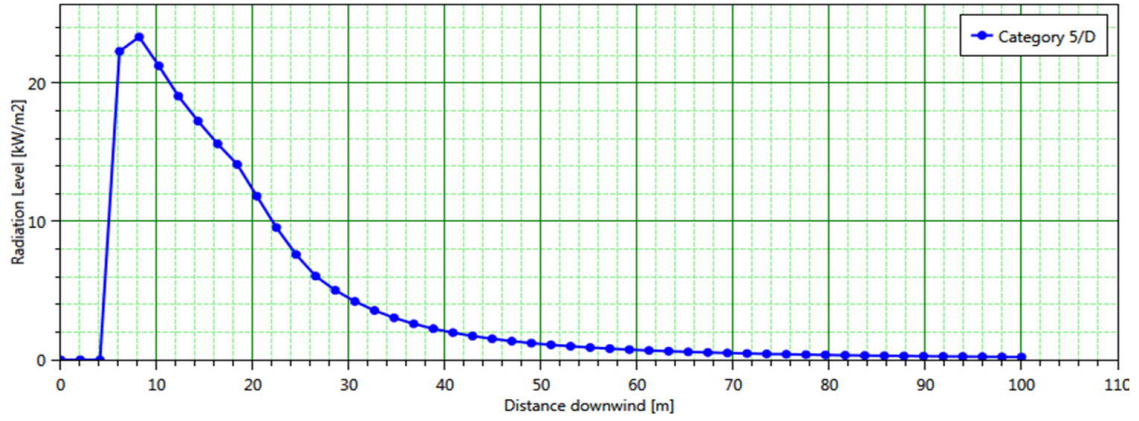
**Graphs**



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
	N°	1A	Doc n°	60586805
Definition	Flammable release contained within bay			
Case	N-hexane			

### Radiation vs Distance for Pool Fire

Pool fire, inside bay, wall, D5



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
			Doc n°	60586805
Definition	N°		1B	
Case	Flammable release contained within bay			
	Ethanol			

**Description and assumptions**

Release of liquid waste material from a single IBC (1000 l), contained within the flammable bay area (bay 7 or 8).  
 Bay dimensions : 12 m long, 7 m wide, 2.5 m block wall height (for 3 bay sides at site boundary).  
 Liquid waste assimilated to ethanol (alcohol, general flame flag).

**Consequence**

Pool fire (PF)

**Weather conditions and substrate data**

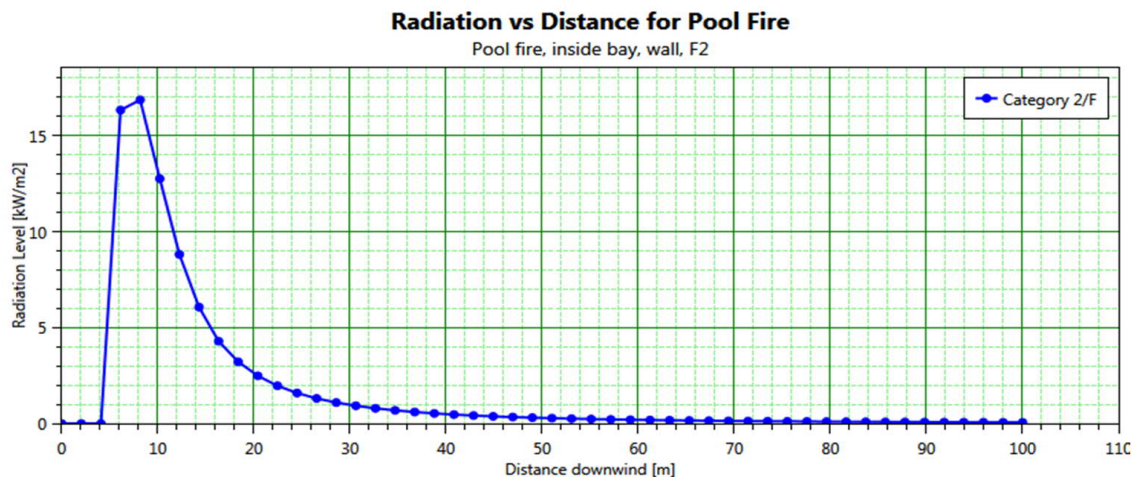
Pasquill stability class	F	D		
Wind speed at 10 m (m/s)	2	5		
Ambient temperature (°C)	15	20		
Surface temperature (°C)	15	20		
Relative humidity (%)	70	70		
Surface roughness (m)	1.0	1.0		

**Results**

Software PHAST 8.11

<b>Pool fire</b>		Réf. 1B-PF		
Flame length (m)		F2	D5	
Elevation (m)		6.2	6.0	
Flame angle to vertical (°)		2.5	2.5	
Flame emissivity (kW/m <sup>2</sup> )		35.2	52.3	
Pool diameter (m)		52.2	52.3	
Distance 1 (m)	37.5 kW/m <sup>2</sup>	8.85	8.85	
Distance 2 (m)	24 kW/m <sup>2</sup>	N/A	N/A	
Distance 3 (m)	12.5 kW/m <sup>2</sup>	N/A	N/A	
Distance 4 (m)	6.3 kW/m <sup>2</sup>	11	12	
Distance 5 (m)	4 kW/m <sup>2</sup>	14	15	
Origin		17	18	Pool centre

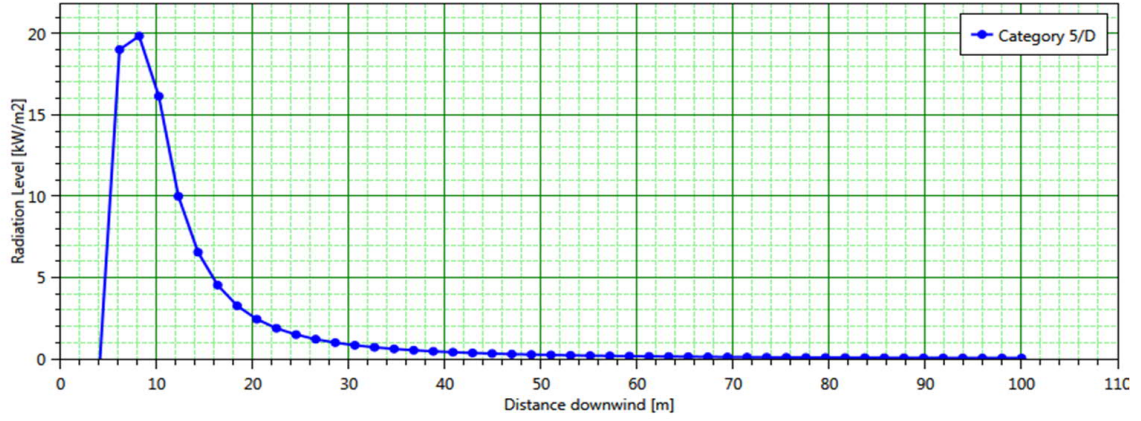
**Graphs**



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
	N°	1B	Doc n°	60586805
Definition	Flammable release contained within bay			
Case	Ethanol			

### Radiation vs Distance for Pool Fire

Pool fire, inside bay, wall, D5





<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			2A	Consequence Modelling
			Doc n°	60586805
Definition	N° 2A			Flammable release expanding outside bay
Case	N-hexane			

**Description and assumptions**

Release of liquid waste material from multiple IBCs (max 60 x 1000 l), expanding outside the flammable bay area (bay 7 or 8) to site.  
 Circular pool with 10 cm thickness.  
 Liquid waste assimilated to n-hexane (hydrocarbons, smoky flame flag).

**Consequence**

Pool fire (PF)

**Weather conditions and substrate data**

Pasquill stability class	F	D		
Wind speed at 10 m (m/s)	2	5		
Ambient temperature (°C)	15	20		
Surface temperature (°C)	15	20		
Relative humidity (%)	70	70		
Surface roughness (m)	1.0	1.0		

**Results**

Software PHAST 8.11

Pool fire

Réf. 2A-PF

	F2	D5		
Flame length (m)	44.9	43.6		
Elevation (m)	0.0	0.0		
Flame angle to vertical (°)	27.9	45.5		
Flame emissivity (kW/m <sup>2</sup> )	24.2	24.2		
Pool diameter (m)	28	28		
Distance 1 (m)	37.5 kW/m <sup>2</sup>	N/A	N/A	
Distance 2 (m)	24 kW/m <sup>2</sup>	15	17	
Distance 3 (m)	12.5 kW/m <sup>2</sup>	24	28	
Distance 4 (m)	6.3 kW/m <sup>2</sup>	41	51	
Distance 5 (m)	4 kW/m <sup>2</sup>	53	62	

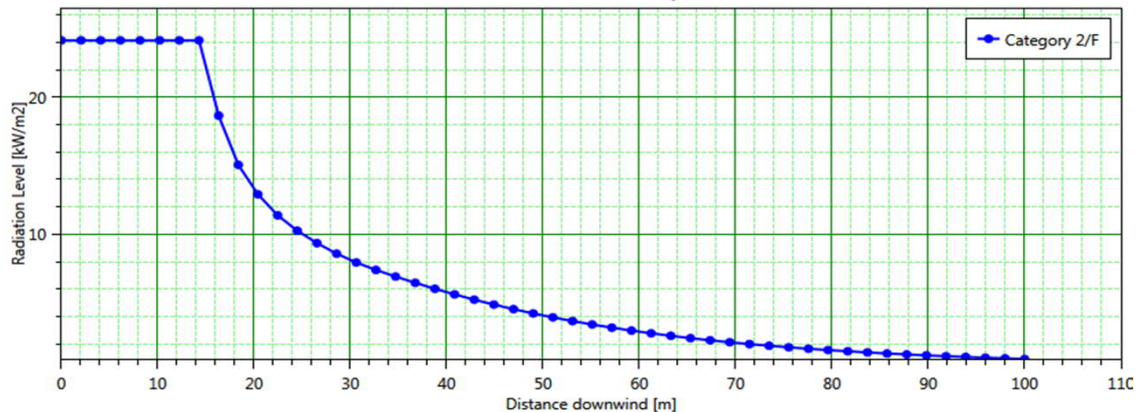
Origin

Pool centre

**Graphs**

**Radiation vs Distance for Pool Fire**

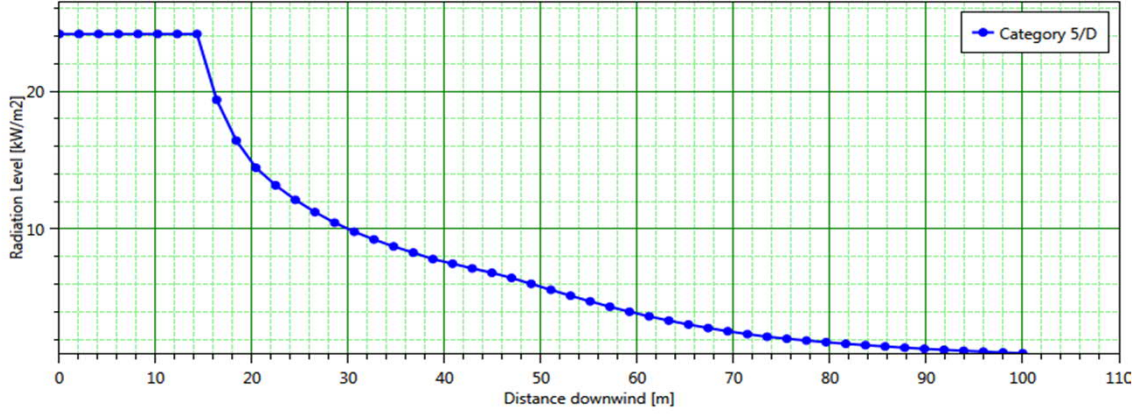
Pool fire, outside bay



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			2A	Consequence Modelling
			Doc n°	60586805
Definition	N°		2A	
Case	Flammable release expanding outside bay			
	N-hexane			

### Radiation vs Distance for Pool Fire

Pool fire, outside bay



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
			Doc n°	60586805
Definition	N°	2A		
Case	Flammable release expanding outside bay			
	Ethanol			

**Description and assumptions**

Release of liquid waste material from multiple IBCs (max 60 x 1000 l), expanding outside the flammable bay area (bay 7 or 8) to site.  
Circular pool with 10 cm thickness.  
Liquid waste assimilated to ethanol (alkohol, general flame flag).

**Consequence**

Pool fire (PF)

**Weather conditions and substrate data**

Pasquill stability class	F	D		
Wind speed at 10 m (m/s)	2	5		
Ambient temperature (°C)	15	20		
Surface temperature (°C)	15	20		
Relative humidity (%)	70	70		
Surface roughness (m)	1.0	1.0		

**Results**

Software PHAST 8.11

Pool fire

Réf. 2B-PF

	F2	D5		
Flame length (m)	19.3	18.9		
Elevation (m)	0.0	0.0		
Flame angle to vertical (°)	27.9	45.5		
Flame emissivity (kW/m <sup>2</sup> )	68.3	68.3		
Pool diameter (m)	28	28		
Distance 1 (m)	37.5 kW/m <sup>2</sup>	23	27	
Distance 2 (m)	24 kW/m <sup>2</sup>	29	33	
Distance 3 (m)	12.5 kW/m <sup>2</sup>	37	40	
Distance 4 (m)	6.3 kW/m <sup>2</sup>	48	50	
Distance 5 (m)	4 kW/m <sup>2</sup>	57	58	

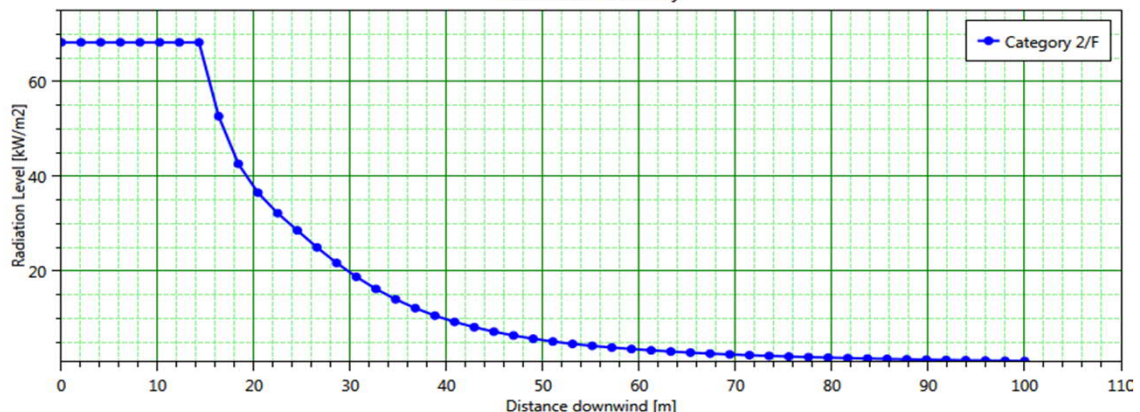
Origin

Pool centre

**Graphs**

**Radiation vs Distance for Pool Fire**

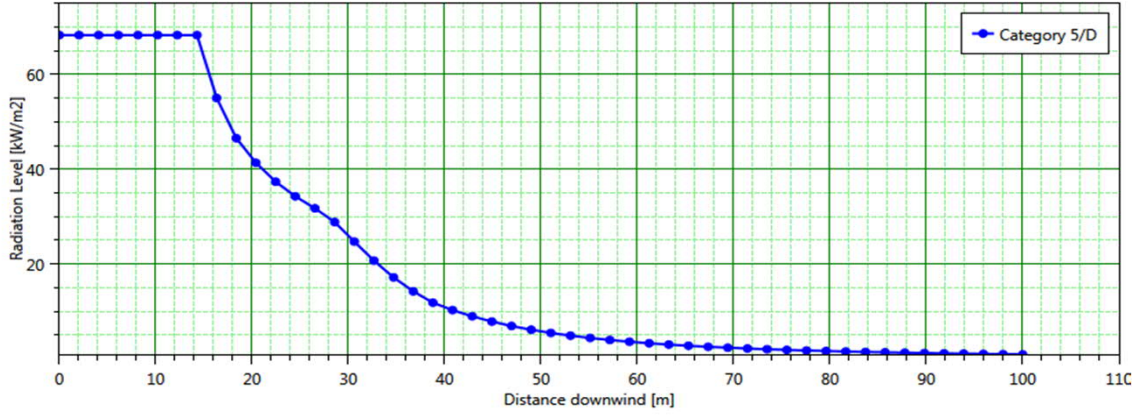
Pool fire, outside bay



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
	N°	2A	Doc n°	60586805
Definition	Flammable release expanding outside bay			
Case	Ethanol			

### Radiation vs Distance for Pool Fire

Pool fire, outside bay



<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
			Job n°	60586805
			Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development
			Doc n°	60586805
Definition	N° 3		Toxic release	
Case	Toxic fumes of Hydrogen Cyanide (HCN)			

### Description

Release of NaCN 15%w solution from a single IBC (1000 l), contained within the toxic bay area (bay 11).  
 Bay dimensions : 12 m long, 7 m wide, 2.5 m block wall height (for 3 bay sides at site boundary).

NaCN would produce toxic hydrogen cyanide gas (HCN) when exposed/engulfed in a fire.  
 It would release toxic hydrogen cyanide gas in contact with strong acids:  $\text{NaCN} + \text{H}^+ \leftrightarrow \text{HCN} + \text{Na}^+$

It is assumed that NaCN is converted in HCN over a release duration of 5 minutes.

### Release source

Segment	1	2	3
Release rate (kg/s)	0.277		
Release duration (s)	300		
Mass (kg)	83.1		
Velocity (m/s)	<1		
Liquid fraction (-)	0		

### Consequence

Toxic dispersion (T)

### Weather conditions and substrate data

Pasquill stability class	F	D		
Wind speed at 10 m (m/s)	2	5		
Ambient temperature (°C)	15	20		
Surface temperature (°C)	15	20		
Relative humidity (%)	70	70		
Surface roughness (m)	1.0	1.0		

### Results

Software PHAST 8.11

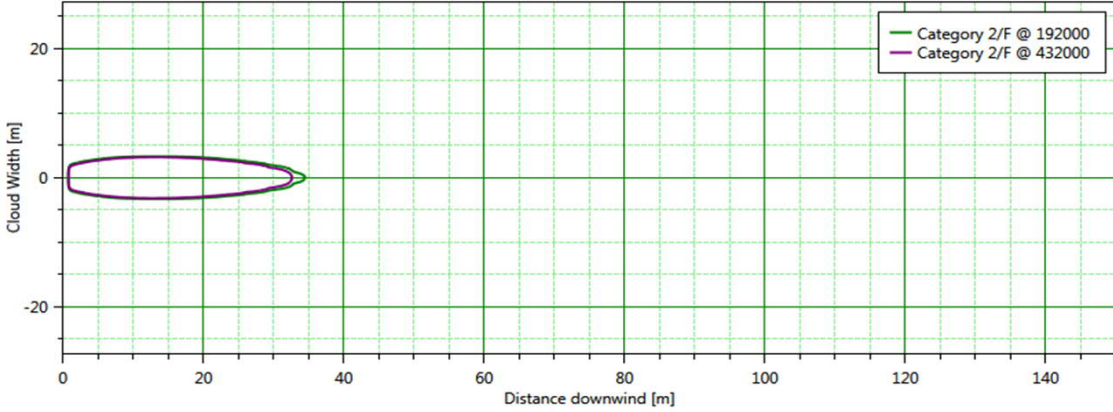
	Réf. 3-T			
	F2	D5		
Exposure time (min)	5	5		
Distance SLOD (m)	4.32E+05	32	90	
Distance SLOT (m)	1.92E+05	35	116	
Origin	Equipment			

<b>AECOM</b>	<b>Scenario Sheet</b>		Client	whg Housing Association
			Site	Cannock
	Job n°	60586805		
	Document Title	Assessment of Hazards from Waste Transfer Site on New Housing Development		
	N°	3	Doc n°	60586805
Definition	Toxic release			
Case	Toxic fumes of Hydrogen Cyanide (HCN)			

**Graphs**

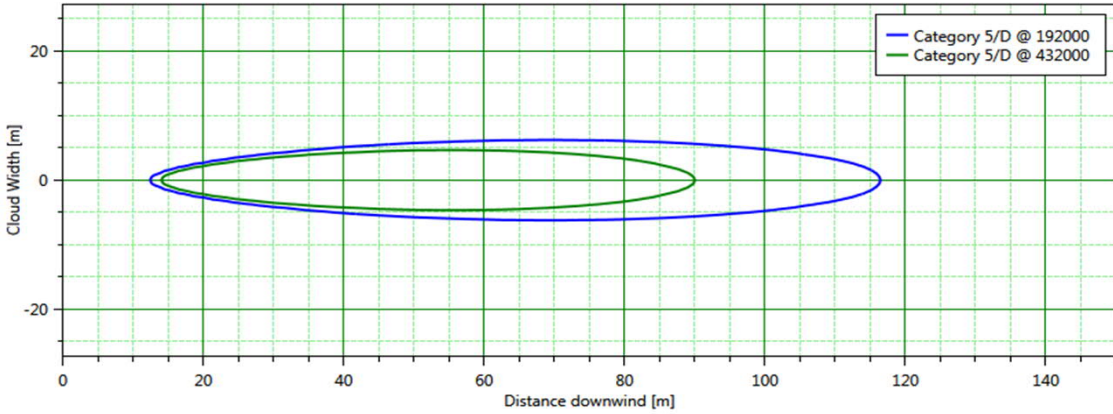
**Toxic Outdoor Dose Footprint**

Toxic HCN dispersion (leak)



**Toxic Outdoor Dose Footprint**

Toxic HCN dispersion (leak)



## Annex A: Predicted thermal radiation levels

Figure A1: Thermal Contours for a 10 m pool of N-hexane, windspeed 2 m/s

Figure A2: Thermal Contours for a 10 m pool of N-hexane, windspeed 5 m/s

Figure A3: Thermal Contours for a 10 m pool of ethanol, windspeed 2 m/s

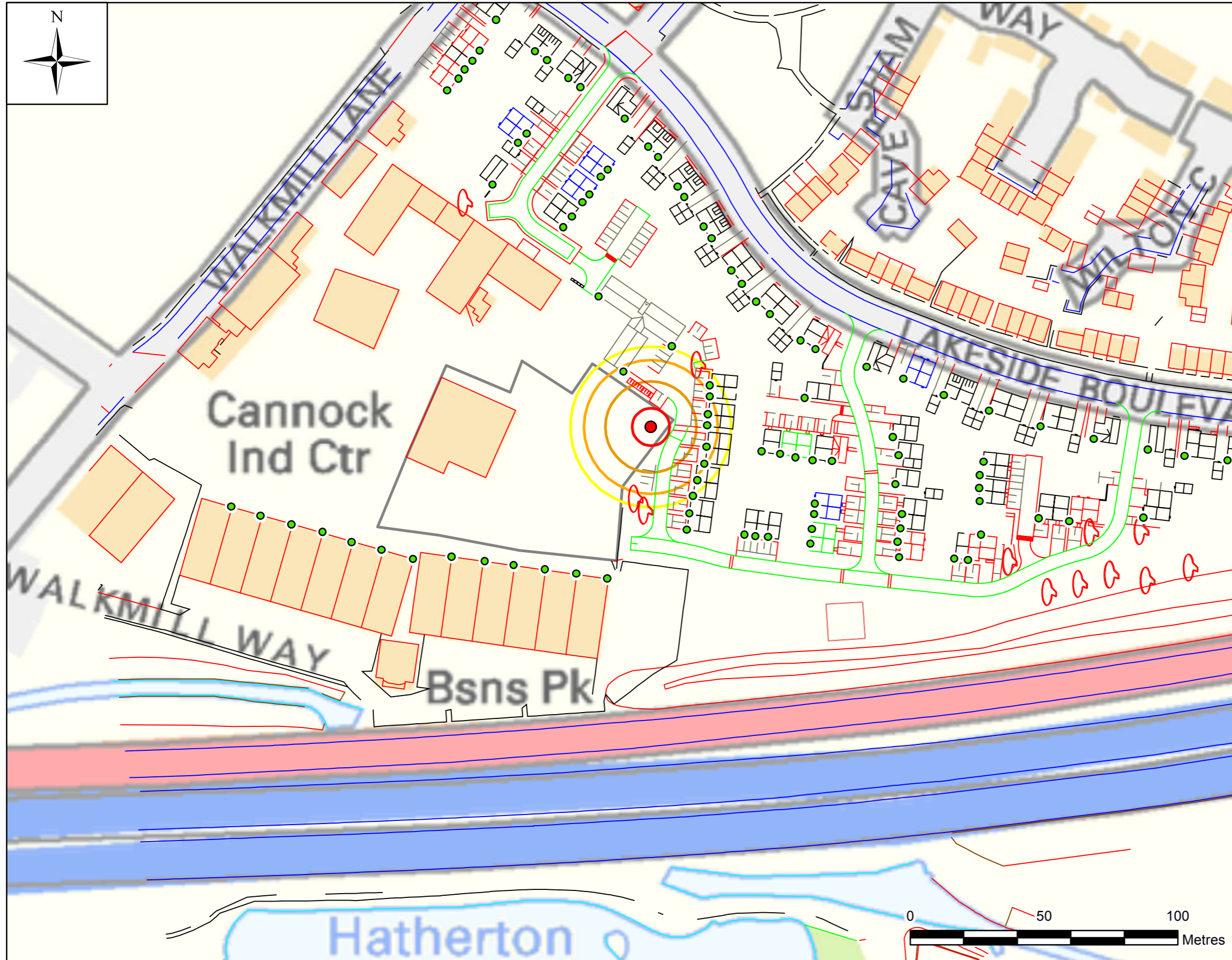
Figure A4: Thermal Contours for a 10 m pool of ethanol, windspeed 5 m/s

Figure A5: Thermal Contours for a 40 m pool of N-hexane, windspeed 2 m/s

Figure A6: Thermal Contours for a 40 m pool of N-hexane, windspeed 5 m/s

Figure A7: Thermal Contours for a 40 m pool of ethanol, windspeed 2 m/s

Figure A8: Thermal Contours for a 40 m pool of ethanol, windspeed 5 m/s



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (30m radius)
- 6.3 kW/m<sup>2</sup> (25m radius)
- 12.5 kW/m<sup>2</sup> (17m radius)
- 24 kW/m<sup>2</sup> (7m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of N-hexane as a 10m diameter pool remained within a storage bay. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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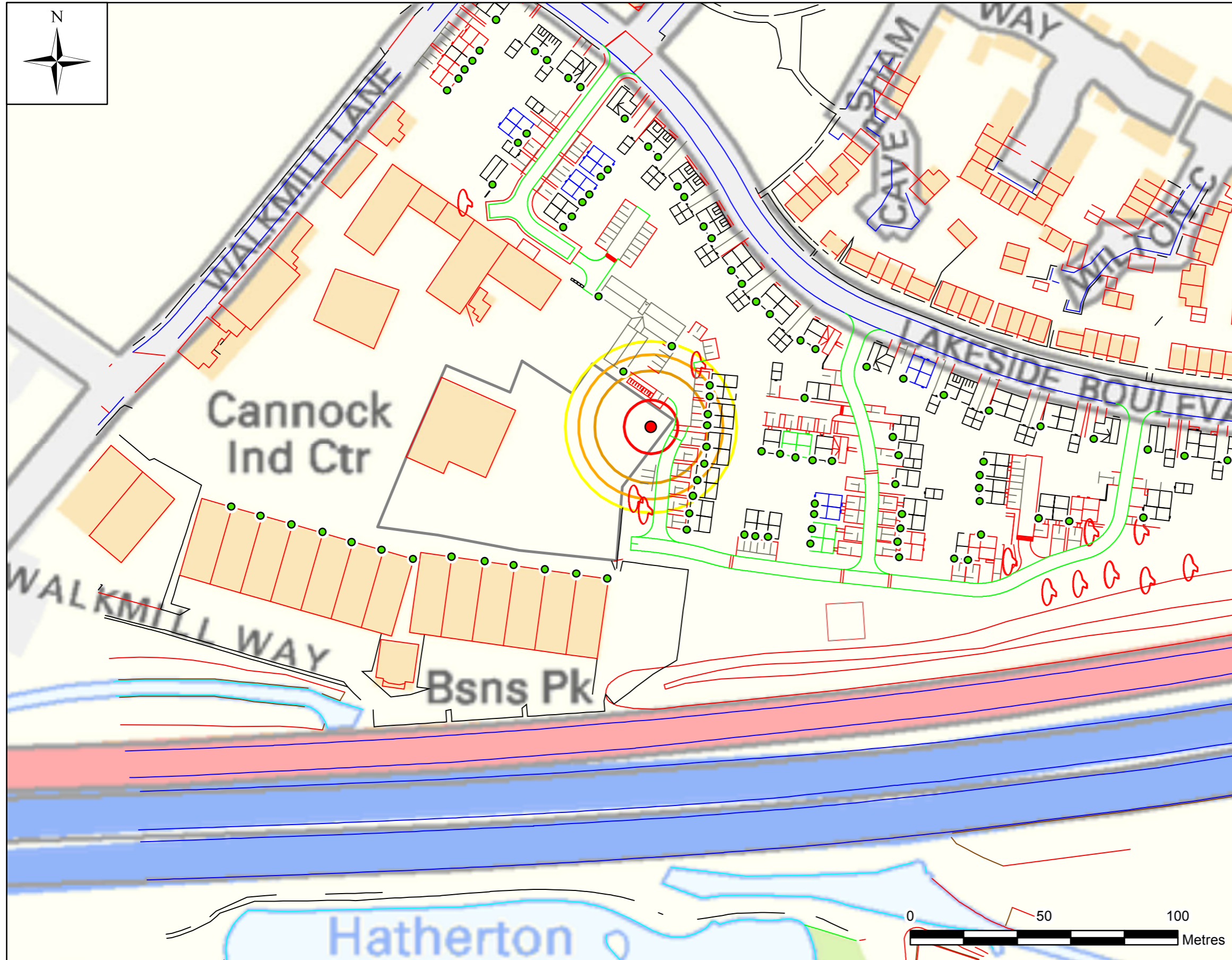
Client:	Walsall Housing Group
Project:	Lakeside Boulevard Cannock

Title:	Thermal Contours for a 10 m pool of N-hexane, windspeed 2 m/s
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Date:	29/10/2018	Scale at A3:	1:1,500
<b>Figure A1</b>			<b>A3</b>





**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (32m radius)
- 6.3 kW/m<sup>2</sup> (27m radius)
- 12.5 kW/m<sup>2</sup> (21m radius)
- 24 kW/m<sup>2</sup> (10m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of N-hexane as a 10m diameter pool remained within a storage bay. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

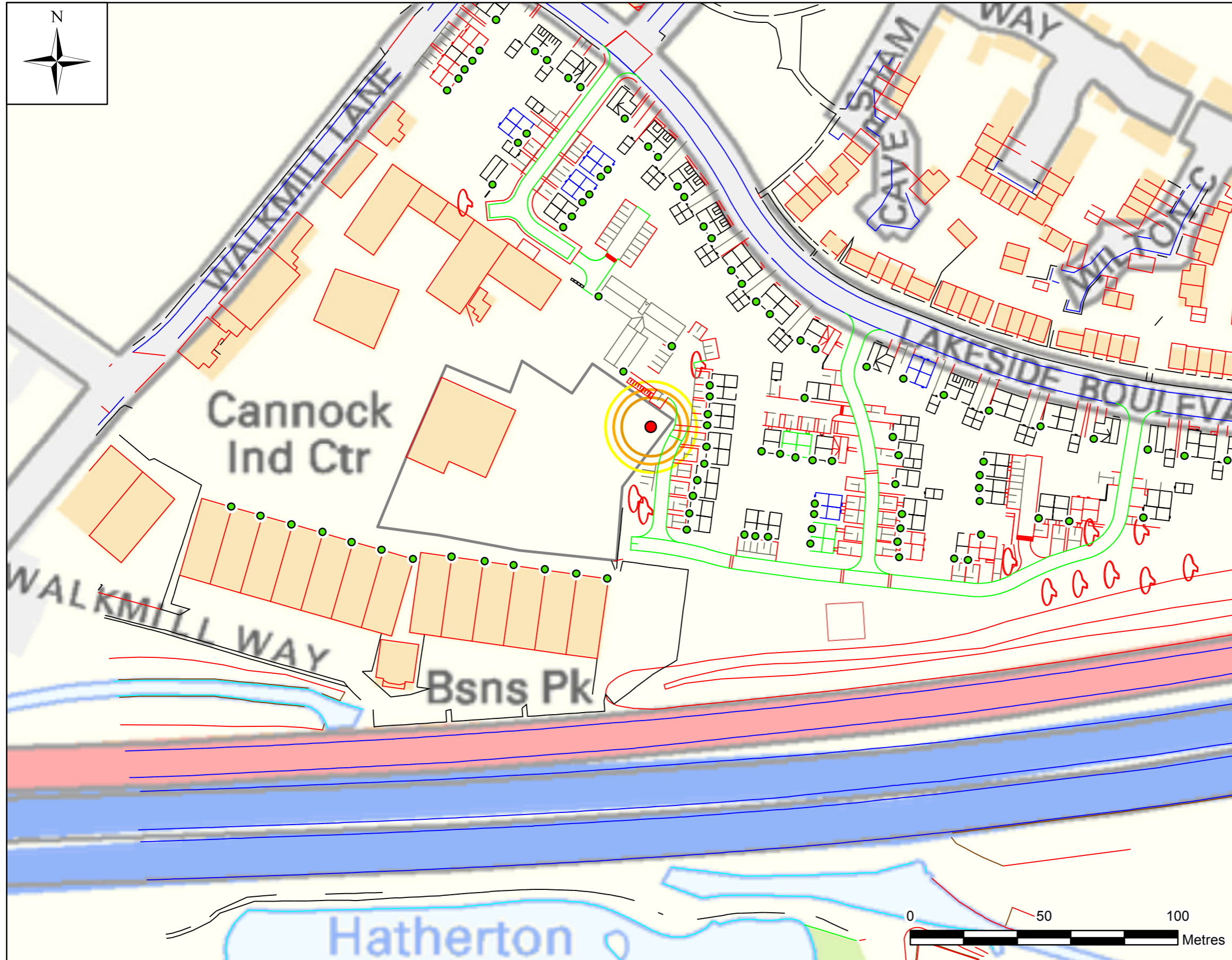
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<b>Figure A2</b>			<b>A3</b>



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (17m radius)
- 6.3 kW/m<sup>2</sup> (14m radius)
- 12.5 kW/m<sup>2</sup> (11m)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of ethanol as a 10m diameter pool remained within a storage bay. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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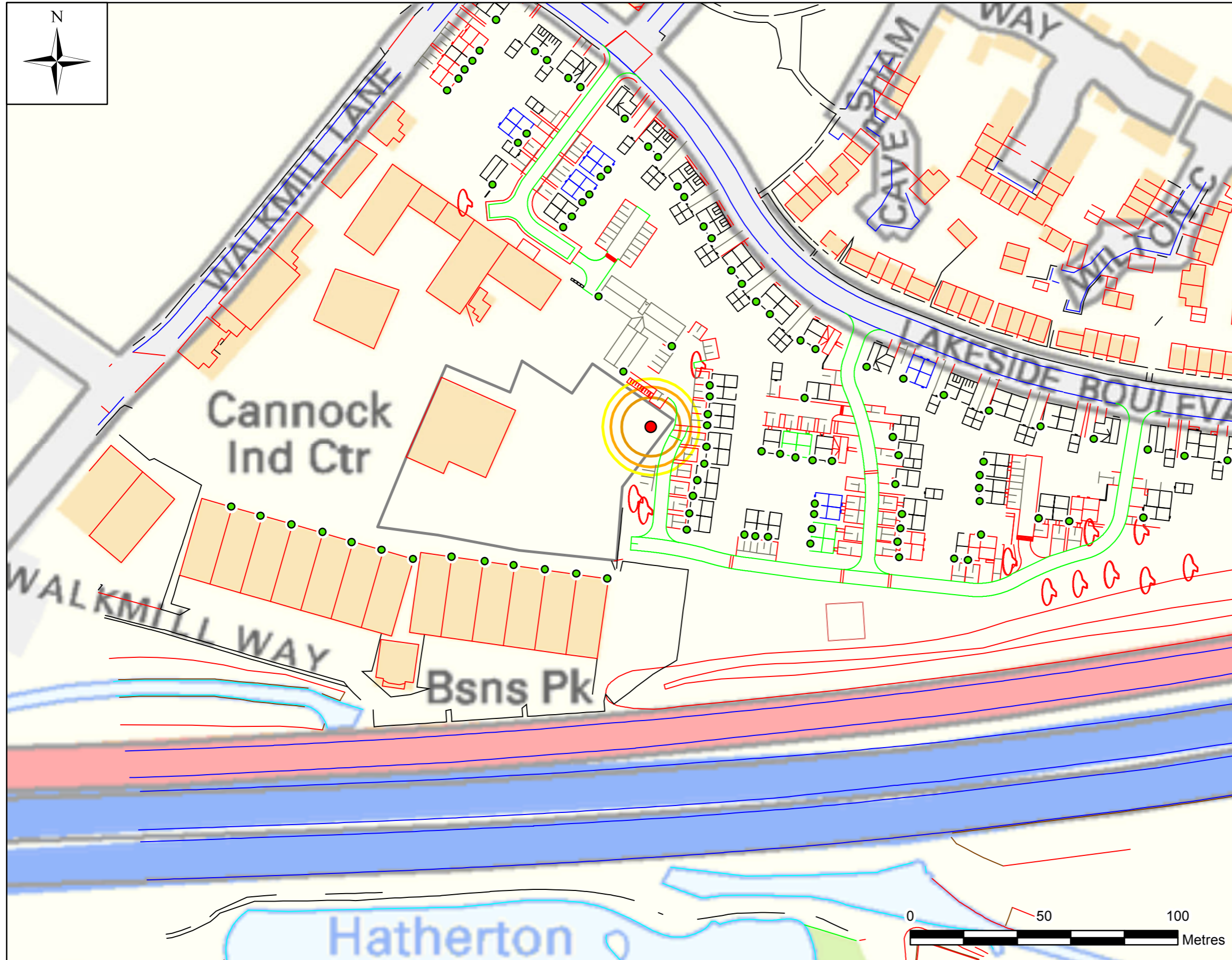
Title:	Thermal Contours for a 10 m pool of ethanol, windspeed 2 m/s
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<b>Figure A3</b>			<b>A3</b>



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (18m radius)
- 6.3 kW/m<sup>2</sup> (15m radius)
- 12.5 kW/m<sup>2</sup> (12m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of ethanol as a 10m diameter pool remained within a storage bay. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

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Client:	Walsall Housing Group
Project:	Lakeside Boulevard Cannock

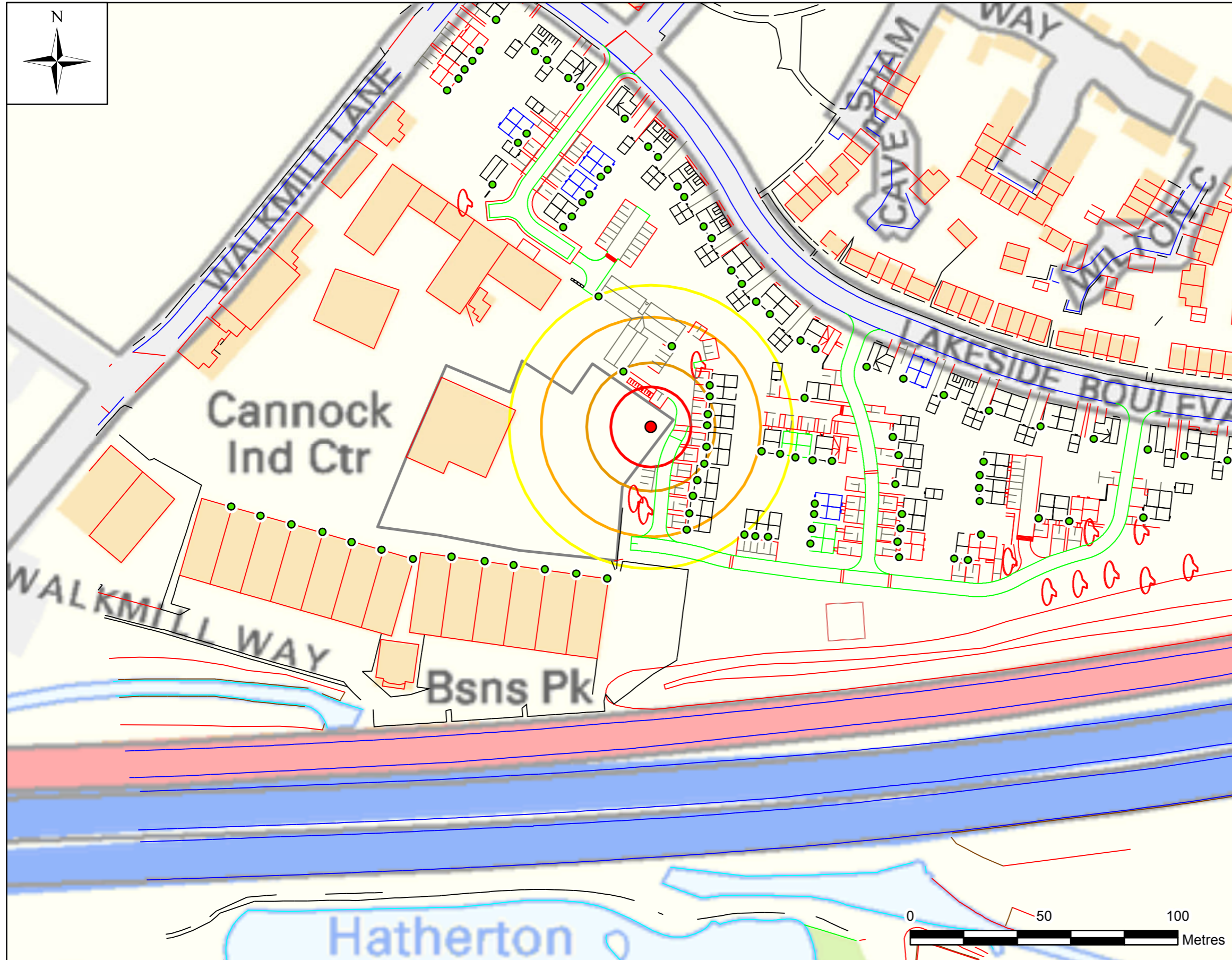
Title:	Thermal Contours for a 10 m pool of ethanol, windspeed 5 m/s
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Figure A4			A3



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (53m radius)
- 6.3 kW/m<sup>2</sup> (41m radius)
- 12.5 kW/m<sup>2</sup> (24m radius)
- 24 kW/m<sup>2</sup> (15m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of N-hexane as a 40m diameter pool that moves into the main site. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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Project:	Lakeside Boulevard Cannock

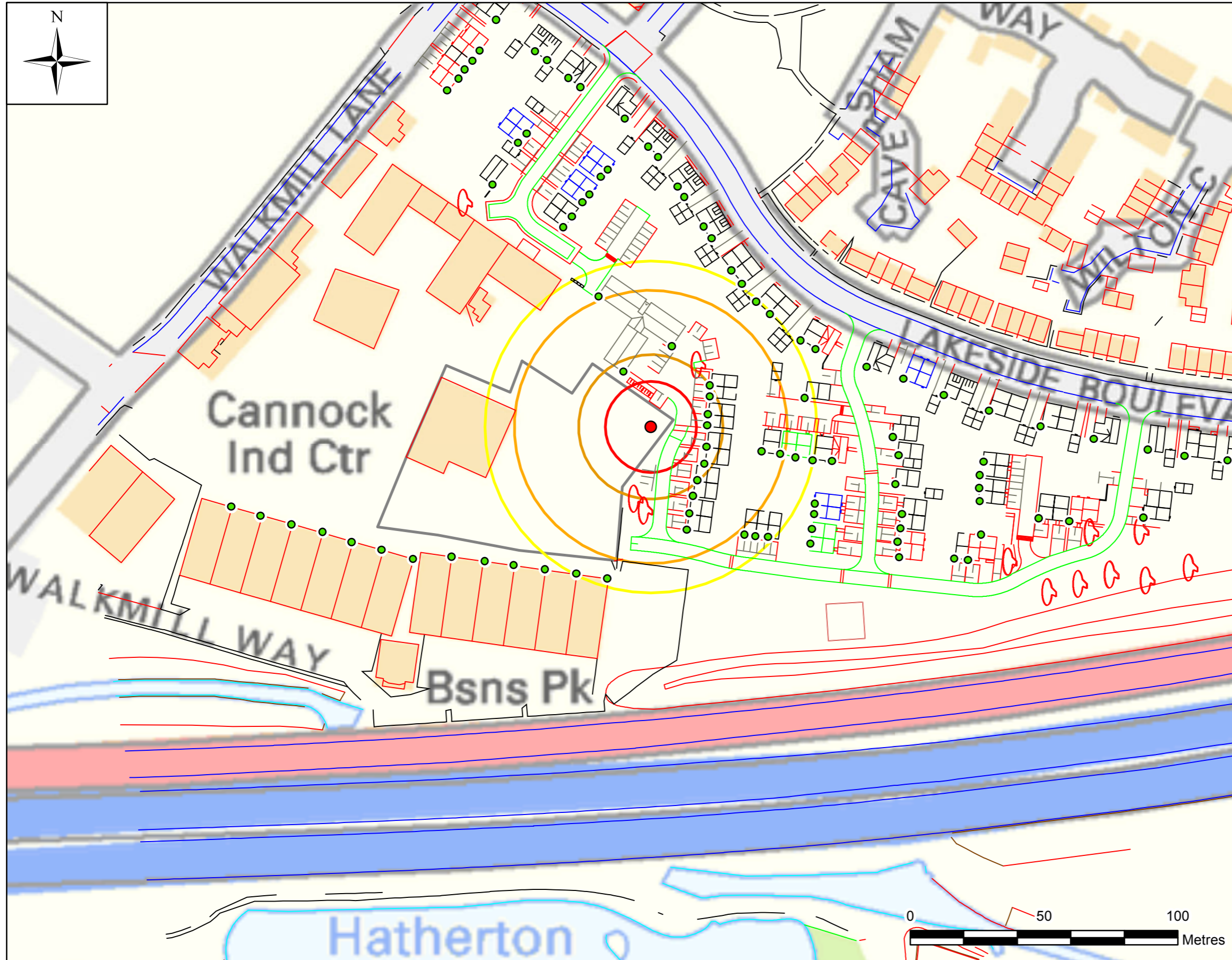
Title:	Thermal Contours for a 40 m pool of N-hexane, windspeed 2 m/s
--------	---

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Figure A5			A3



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (62m radius)
- 6.3 kW/m<sup>2</sup> (51m radius)
- 12.5 kW/m<sup>2</sup> (28m radius)
- 24 kW/m<sup>2</sup> (17m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of N-hexane as a 40m diameter pool that moves into the main site. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

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Project:	Lakeside Boulevard Cannock

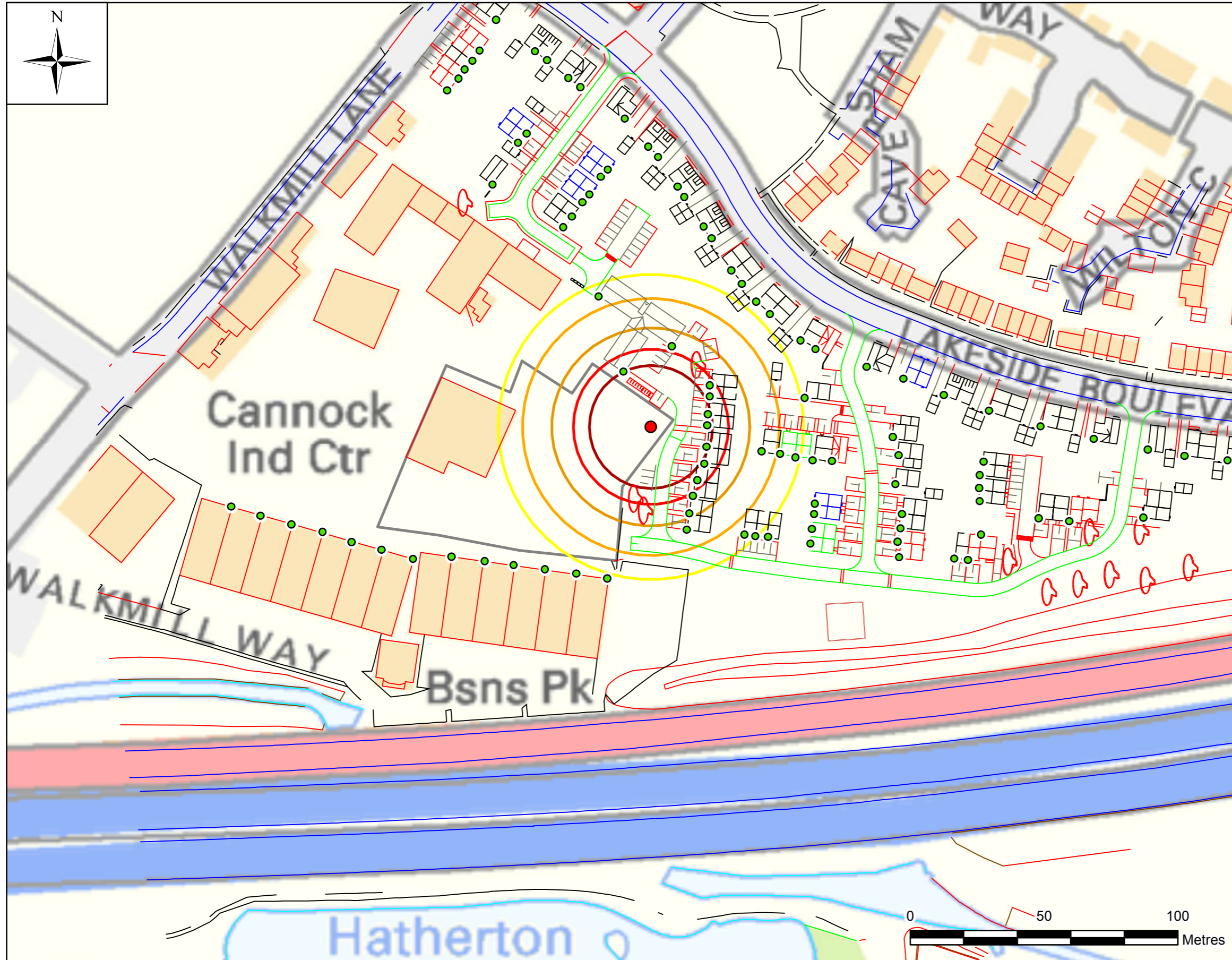
Title:	Thermal Contours for a 40 m pool of N-hexane, windspeed 5 m/s
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Date:	29/10/2018	Scale at A3:	1:1,500
<b>Figure A6</b>			<b>A3</b>



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 4 kW/m<sup>2</sup> (57m radius)
- 6.3 kW/m<sup>2</sup> (48m radius)
- 12.5 kW/m<sup>2</sup> (37m radius)
- 24 kW/m<sup>2</sup> (29m radius)
- 37.5 kW/m<sup>2</sup> (23m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of ethanol as a 40m diameter pool that moves into the main site. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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Client:	Walsall Housing Group
Project:	Lakeside Boulevard Cannock

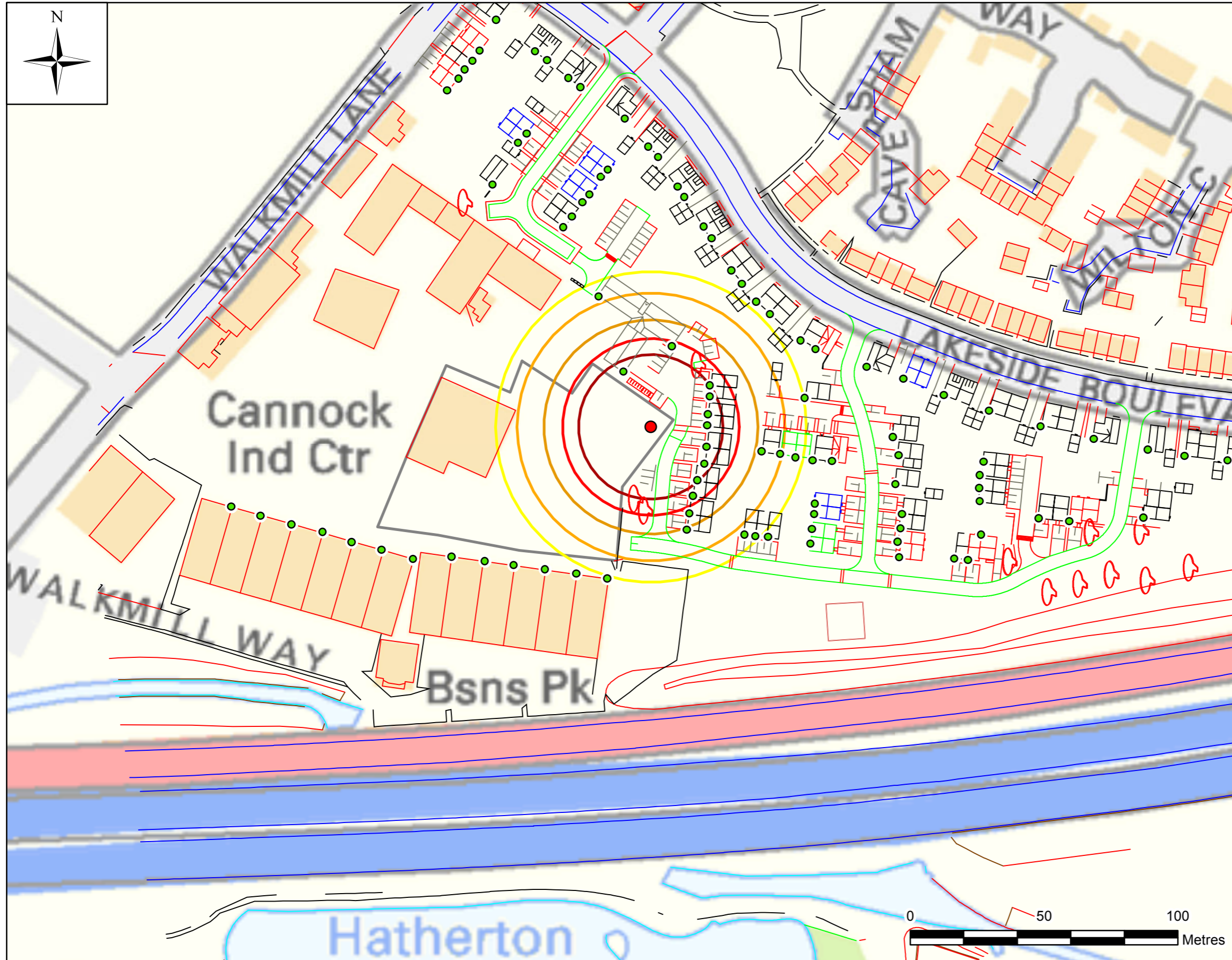
Title:	Thermal Contours for a 40 m pool of ethanol, windspeed 2 m/s
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Date:	29/10/2018	Scale at A3:	1:1,500
<b>Figure A7</b>			<b>A3</b>



**LEGEND**

- Release Point
- Receptors
- Site Outline
- 37.5 kW/m<sup>2</sup> (27m radius)
- 24 kW/m<sup>2</sup> (33m radius)
- 12.5 kW/m<sup>2</sup> (40m radius)
- 6.3 kW/m<sup>2</sup> (50m radius)
- 4 kW/m<sup>2</sup> (58m radius)

**Description of Diagram:**

This scenario presents the thermal radiative intensity (kW/m<sup>2</sup>) for the modelled release of ethanol as a 40m diameter pool that moves into the main site. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

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Client:	Developer
Project:	Cannock Phast Modelling

Title:	Thermal Contours for a 40 m pool of ethanol, windspeed 5 m/s
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Date:	29/10/2018	Scale at A3:	1:1,500
<b>Figure A8</b>			<b>A3</b>

## Annex B: Predicted Toxic Hazards

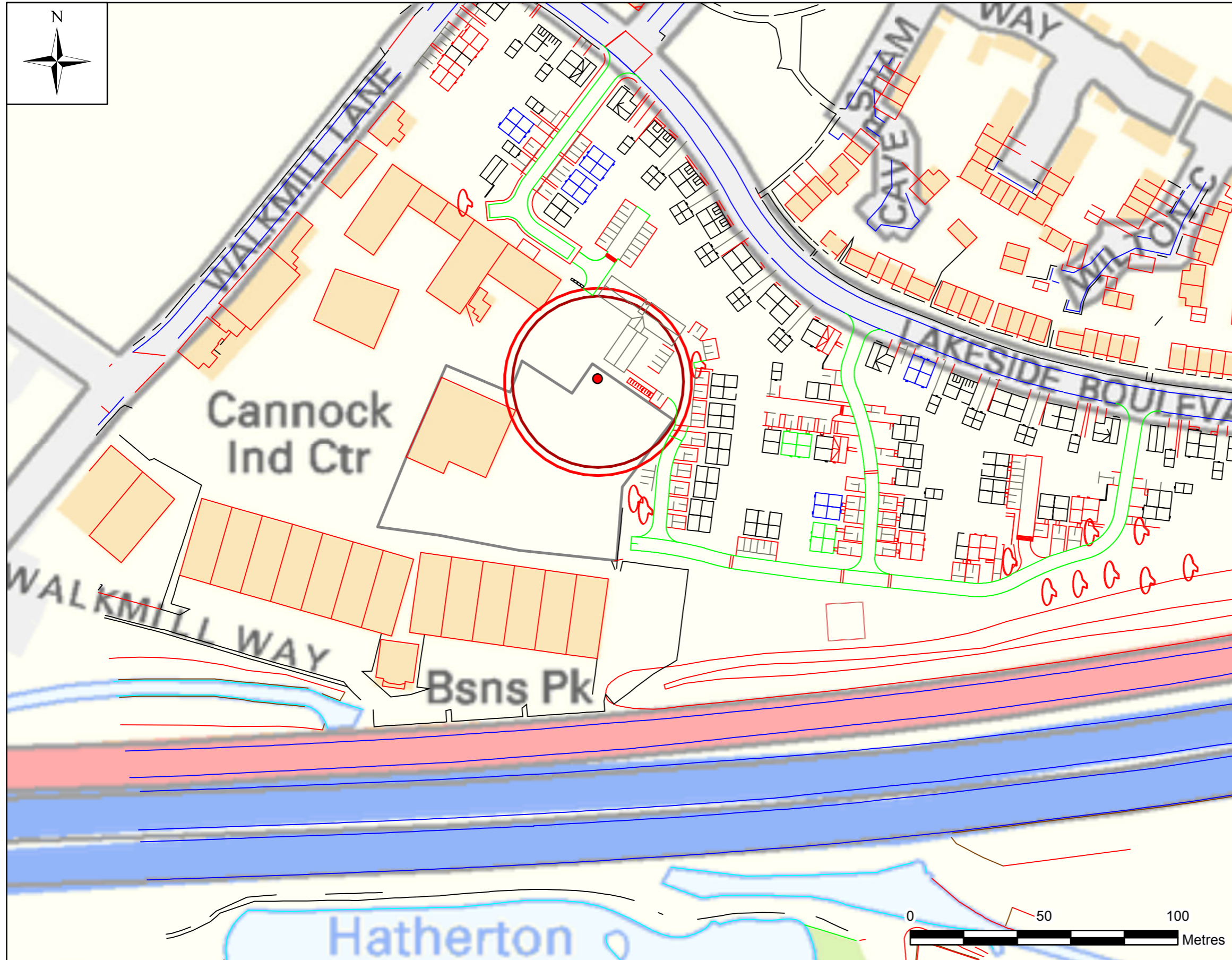
Figure B1: Contours for SLOT and SLOD from HCN release at bay 11, windspeed 2 m/s

Figure B2: Contours for SLOT and SLOD from HCN release at bay 11, windspeed 5 m/s

Figure B3: Contours for SLOT and SLOD from HCN release at bay 4, windspeed 2 m/s

Figure B4: Contours for SLOT and SLOD from HCN release at bay 4, windspeed 5 m/s





**LEGEND**

- Release Point
- Site Outline
- HCN SLOD (35 m radius)
- HCN SLOD (32 m radius)

Description of Diagram:

This scenario presents the predicted distance SLOD and SLOD due to a release of HCN. For the purpose of this illustrative diagram the source is in bay 11. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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Client:	Developer
Project:	Cannock Phast Modelling

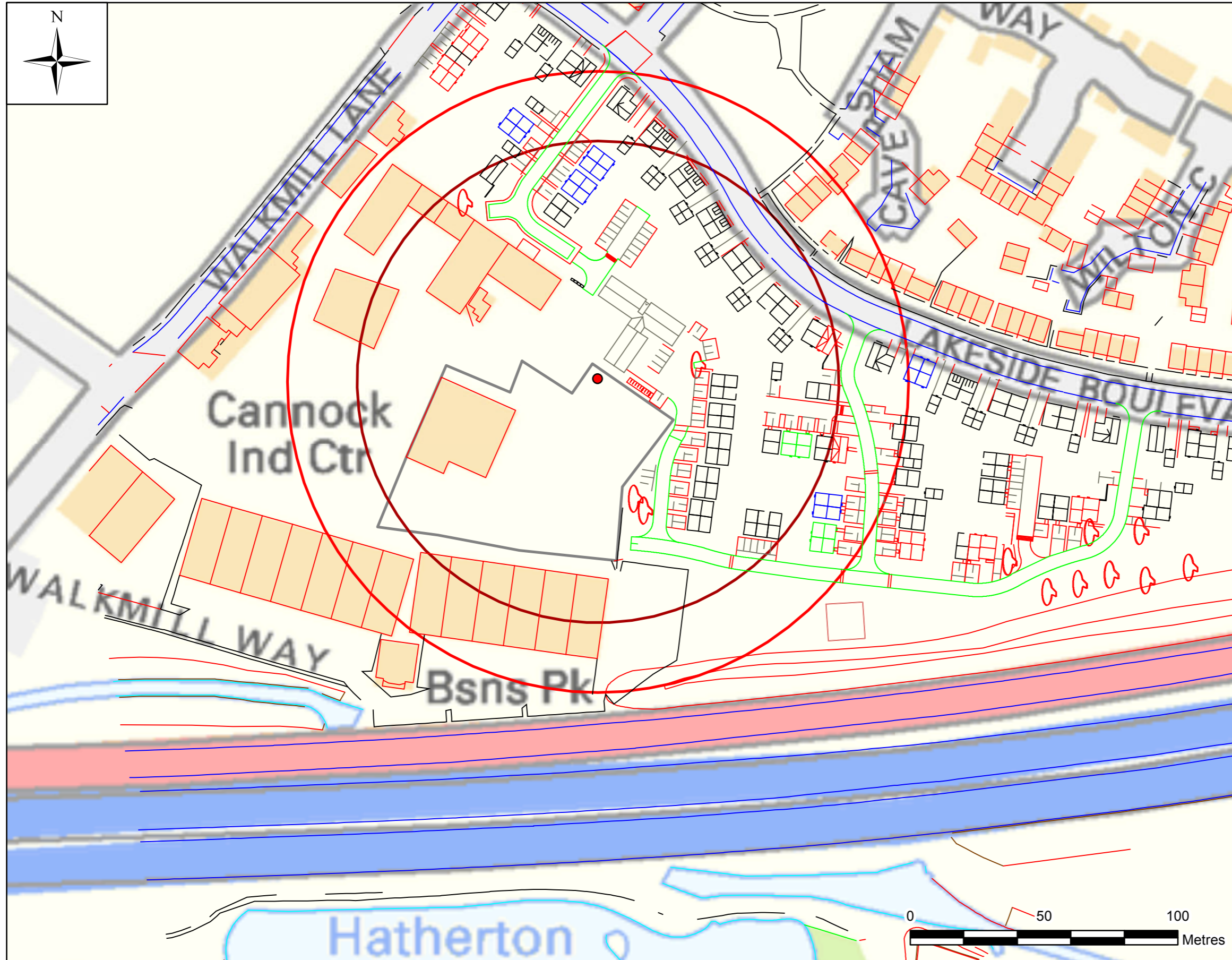
Title:	Contours for SLOD and SLOD from HCN release at bay 11, windspeed 2 m/s
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Chk'd:	GG	App'd:	GG
Date:	29/10/2018	Scale at A3:	1:1,500
Figure B1			A3



**LEGEND**

- Release Point
- Site Outline
- HCN SLOT (116 m radius)
- HCN SLOD (90 m radius)

**Description of Diagram:**

This scenario presents the predicted distance SLOT and SLOD due to a release of HCN. For the purpose of this illustrative diagram the source is in bay 11. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

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Client:	Developer
Project:	Cannock Phast Modelling

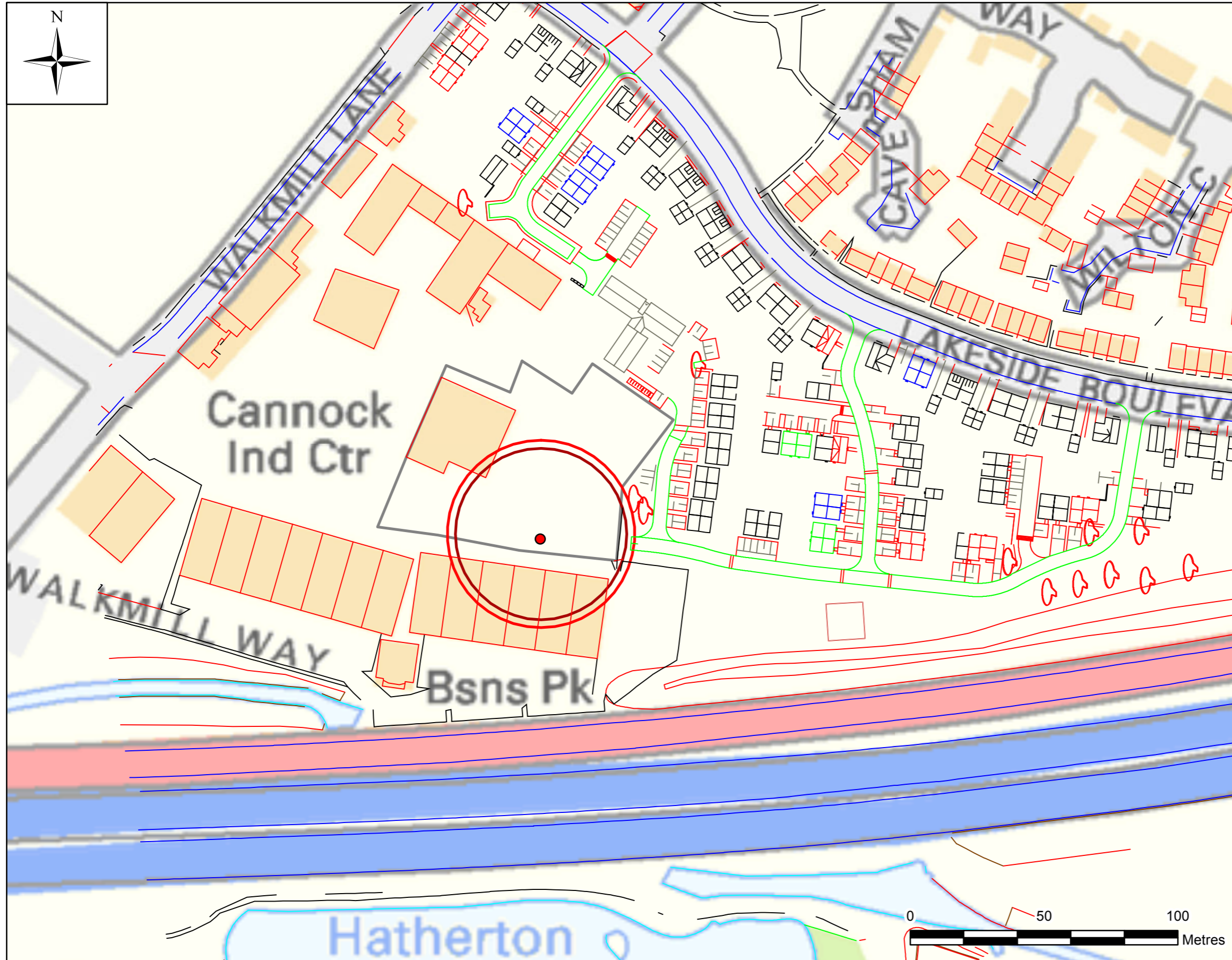
Title:	Contours for SLOT and SLOD from HCN release at bay 11, windspeed 5 m/s
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12 Regan Way  
Chetwynd Business Park  
Chilwell  
Nottingham  
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Date:	29/10/2018	Scale at A3:	1:1,500
Figure B2			A3



**LEGEND**

- Release Point
- Site Outline
- HCN SLOT (32 m radius)
- HCN SLOD (32 m radius)

**Description of Diagram:**

This scenario presents the predicted distance SLOT and SLOD due to a release of HCN. For the purpose of this illustrative diagram the source is in bay 4. Meteorological conditions are consistent with Pasquill stability class F and a wind speed of 2 m/s.

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Client:	Developer
Project:	Cannock Phast Modelling

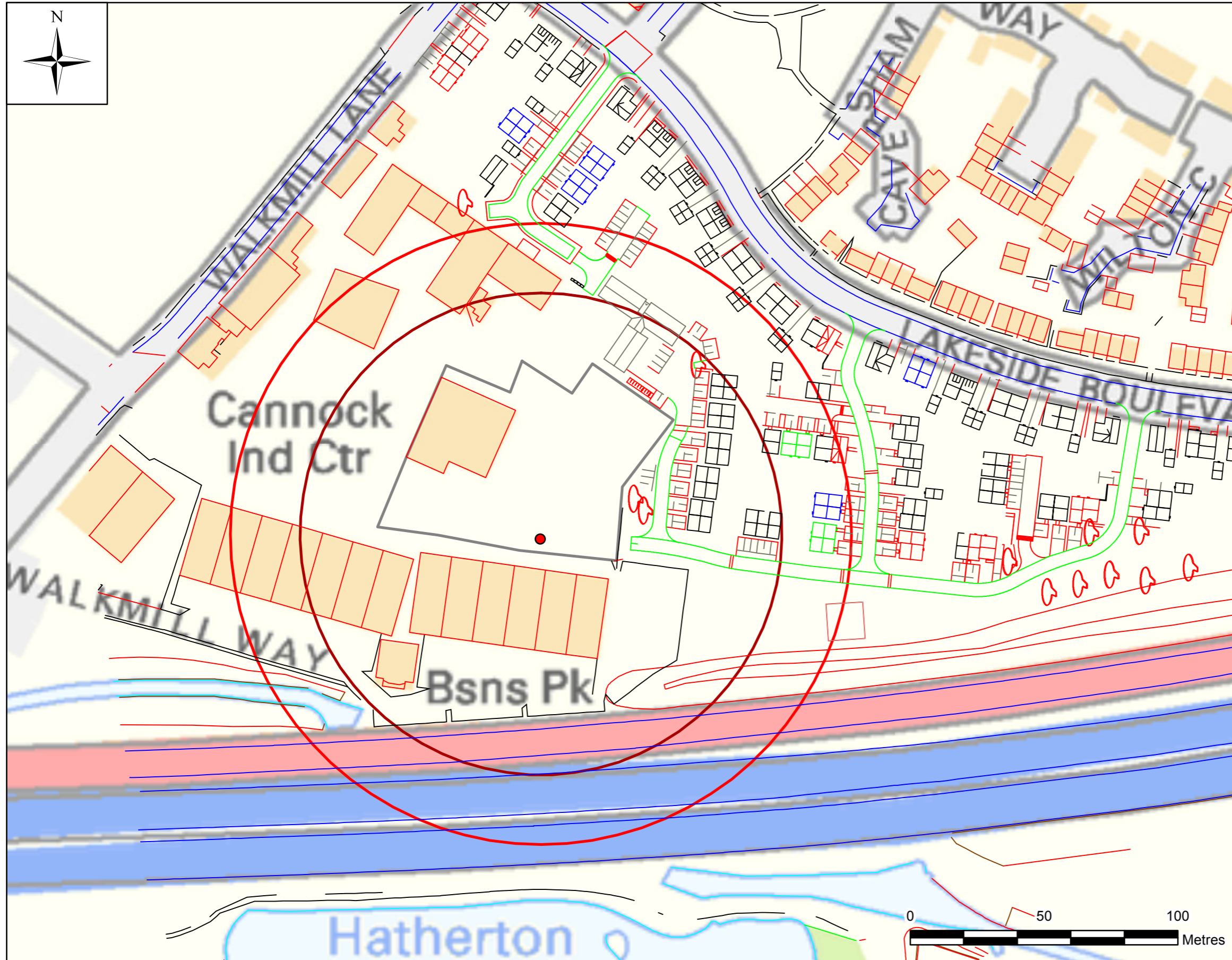
Title:	Contours for SLOT and SLOD from HCN release at bay 4, windspeed 2 m/s
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Date:	29/10/2018	Scale at A3:	1:1,500
Figure B3			A3



**LEGEND**

- Release Point
- Site Outline
- HCN SLOT (116 m radius)
- HCN SLOD (90 m radius)

Description of Diagram:

This scenario presents the predicted distance SLOT and SLOD due to a release of HCN. For the purpose of this illustrative diagram the source is in bay 4. Meteorological conditions are consistent with Pasquill stability class D and a wind speed of 5 m/s.

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Client:	Developer
Project:	Cannock Phast Modelling

Title:	Contours for SLOT and SLOD from HCN release at bay 4, windspeed 5 m/s
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Chk'd:	GG	App'd:	GG
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Figure B4			A3



# Appendix C PHAST Modelling



# HUDSON CONSULTANTS LTD

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Date: 7<sup>th</sup> November 2016

Company no. 5573113  
VAT. No. 868395267

To: Gene Wilson & James Cooper - Augean

## **Augean Cannock – Consequence Modelling results rev 1**

### Background

The Augean Cannock site is a transfer station allowing the acceptance of mixed loads and the segregation and storage of these containers before they are sent as full loads to other sites for further processing.

There is concern within Augean with the proximity of a residential development currently under construction to the site boundary. Therefore, it was requested that consequence modelling is carried to assess the potential impact of the flammable and toxic substances, stored on site, to people who will live in the adjacent offsite housing development.

### Site Visit

A visit to the Cannock site was carried out on the 6<sup>th</sup> September 2016 with Marcin Tomczyk (Assistant Site Manager). The entire site was reviewed as per the site plan in appendix 1. A google earth image of the site is shown in appendix 2.

Some relevant photos are included in appendix 3 with reference notes of the discussions.

### Basis of the consequence modelling carried out

Following discussions with Mark Pennington (see appendix 4) and subsequently with Gene Wilson, the consequence modelling has been based on the following criteria

Flammables: 60 tes (max in 1 bay and release contained in bay)

Flammables: Large release involving multiple IBCs which migrates into the yard area and produces a pool with a maximum diameter of 40 m (approx site area)

Toxic gas release: Release of Hydrogen Cyanide from an IBC of 15% Sodium Cyanide

Note: the prevailing wind is a south-westerly which would direct smoke/vapours towards the north and east site boundaries which are the sides where the residential development is being built.



### Conclusions (including assumptions made)

The consequence modelling carried out (see appendix 5) indicates that both the fire and toxic gas release scenarios could potentially result in significant onsite and offsite consequences including fatalities to people.

The representative fire and toxic gas release scenarios have a potential fatal impact (see definitions in the section below) of approx 30-90m from the source of the event.

<b>Scenario</b>	<b>Worst case distance to edge of SLOD (m)</b>	<b>Detail</b>
Fire – which is contained in bay	33	Luminous substance (Butane) fire to 24 kW/m <sup>2</sup> under D5 conditions
Fire – which escalates to site	92	Luminous substance (Butane) fire to 24 kW/m <sup>2</sup> under D5 conditions
Toxic Gas release	30	5 min SLOD of Hydrogen Cyanide gas release under D5 conditions

It should be noted that various assumptions have been made as part of this work which have been noted where significant.

For example, the storage of waste flammable solvents is not the only source of fire. The site stores oily rags and diesel for example that are clearly combustible.

There are various toxic substances stored on the site and the toxic scenario chosen is only considered to be representative of an incident that is known on waste sites to occur (acidification of a waste to release toxic gas). There will also be potential site scenarios of, for example, a major site fire where toxic combustion products are released. This is considered to be outside of the scope of this report.

This report does not assess the likelihood of the fire and toxic gas release scenarios. This is relevant when considering the risk (as risk is the product of consequence and likelihood).

### Models used

ADMS 5.1 is a practical, short range dispersion model that simulates a wide range of buoyant and passive releases to the atmosphere. It is described as a ‘new generation’ dispersion model in that it uses two parameters: the boundary layer height; and the Monin-Obukhov length to describe the atmospheric boundary layer. Using a skewed Gaussian concentration distribution allows calculation of the dispersion under convective conditions. The model is applicable up to 60 kilometres downwind of the source.

The model has been extensively validated against field data sets. Since 1992, the ADMS developers CERC (Cambridge Environmental Research Consultants Ltd) have been key participants in the series of ‘Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes’ workshops.

A meteorological pre-processor developed by the UK Met Office is part of the model and calculates the boundary layer information required by ADMS 5.1 from the input meteorological data.

ADMS has been used in the risk analysis to model the effects of combustion products present in the smoke plume from warehouse fires on site. For the ADMS modelling each scenario has been modelled under two sets of weather conditions, in order to demonstrate the range of possible outcomes from each event. The weather conditions used are: F2 and D5. F2 and D5 weather is typical for UK weather patterns. F2 is representative of night time weather and D5 as daytime weather, and are usually used in consequence analyses.

HSE use a level of toxicity called the Specified Level of Toxicity (SLOT) in relation to the provision of land use planning advice. HSE define the SLOT as leading to the following effects:

- Severe distress to almost everyone in the area;
- A substantial fraction of the exposed population requiring medical attention;
- Some people being seriously injured, requiring prolonged treatment; and
- Highly susceptible people possibly being killed.

The toxic load corresponding to the SLOT is given by:

$$\text{Toxic load} = c^n \cdot t$$

Where  $c$  = concentration, ppm

$n$  = an integer, and

$t$  = duration of exposure, minutes

For Hydrogen Cyanide SLOD:

Toxic Load is  $4.32 \times 10^5$  and  $n=2$  (ref: <http://www.hse.gov.uk/chemicals/haztox.htm>)

The concentration, for a given substance, to give a Dangerous Toxic Load corresponding to the SLOT can therefore be calculated which gives an approximate 1-5% chance of fatality in the region affected, if the individual is exposed outdoors for the related duration.

A similar procedure is followed to derive a toxic load equation to predict exposure conditions for a DTL relating to the mortality of 50% of an exposed population, a specified level known as the SLOD DTL (Significant Likelihood of Death – Dangerous Toxic Load).

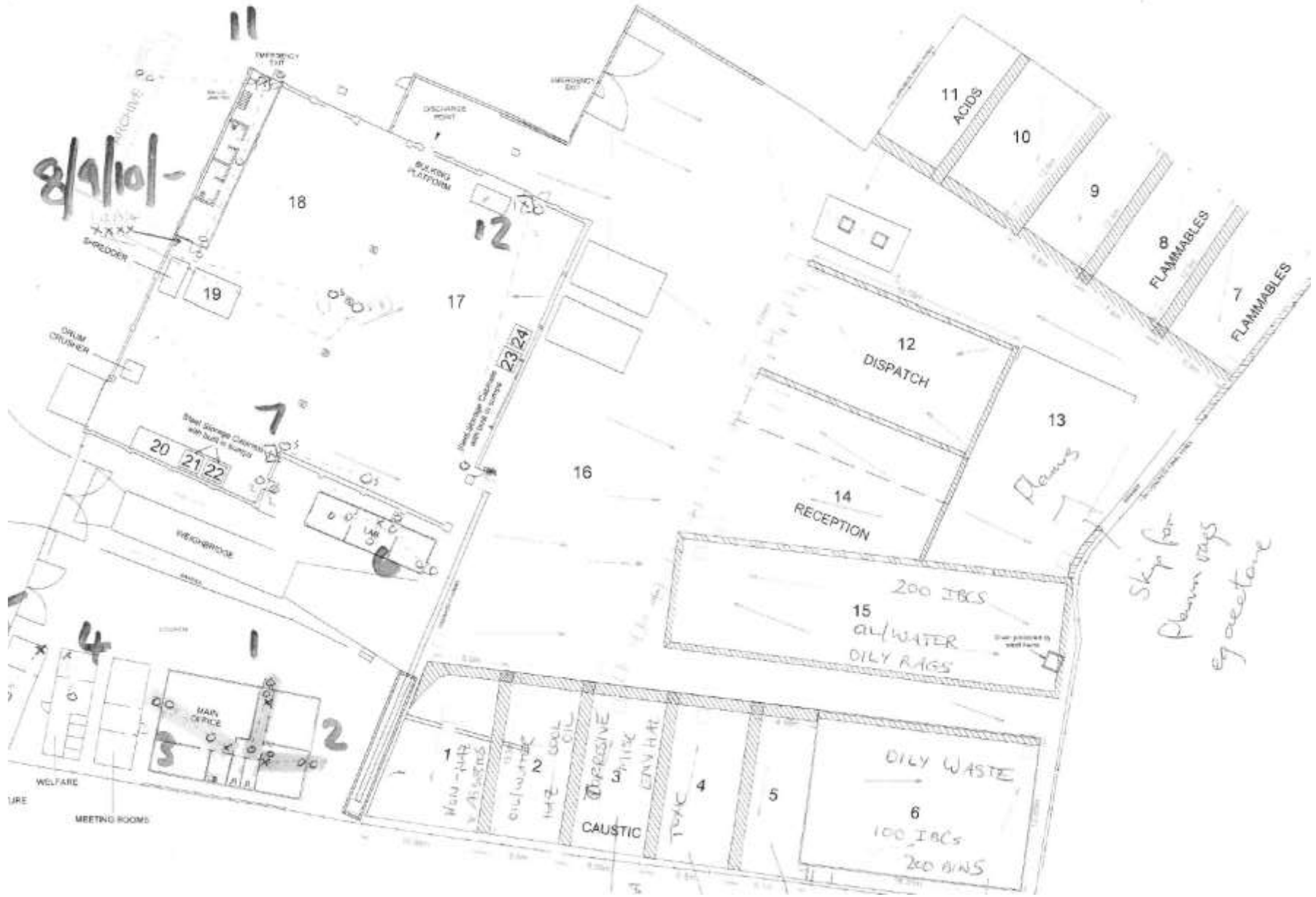
The consequence modelling package PHAST (Process Hazard Assessment Safety Tool), provided by DNV, has been used to model the radiation effects of a site fire.

PHAST is a software package which uses built in chemical and parameter data, along with scenario and meteorological data supplied by the user. PHAST is updated periodically by DNV, and Version 6.1 was used in this case.

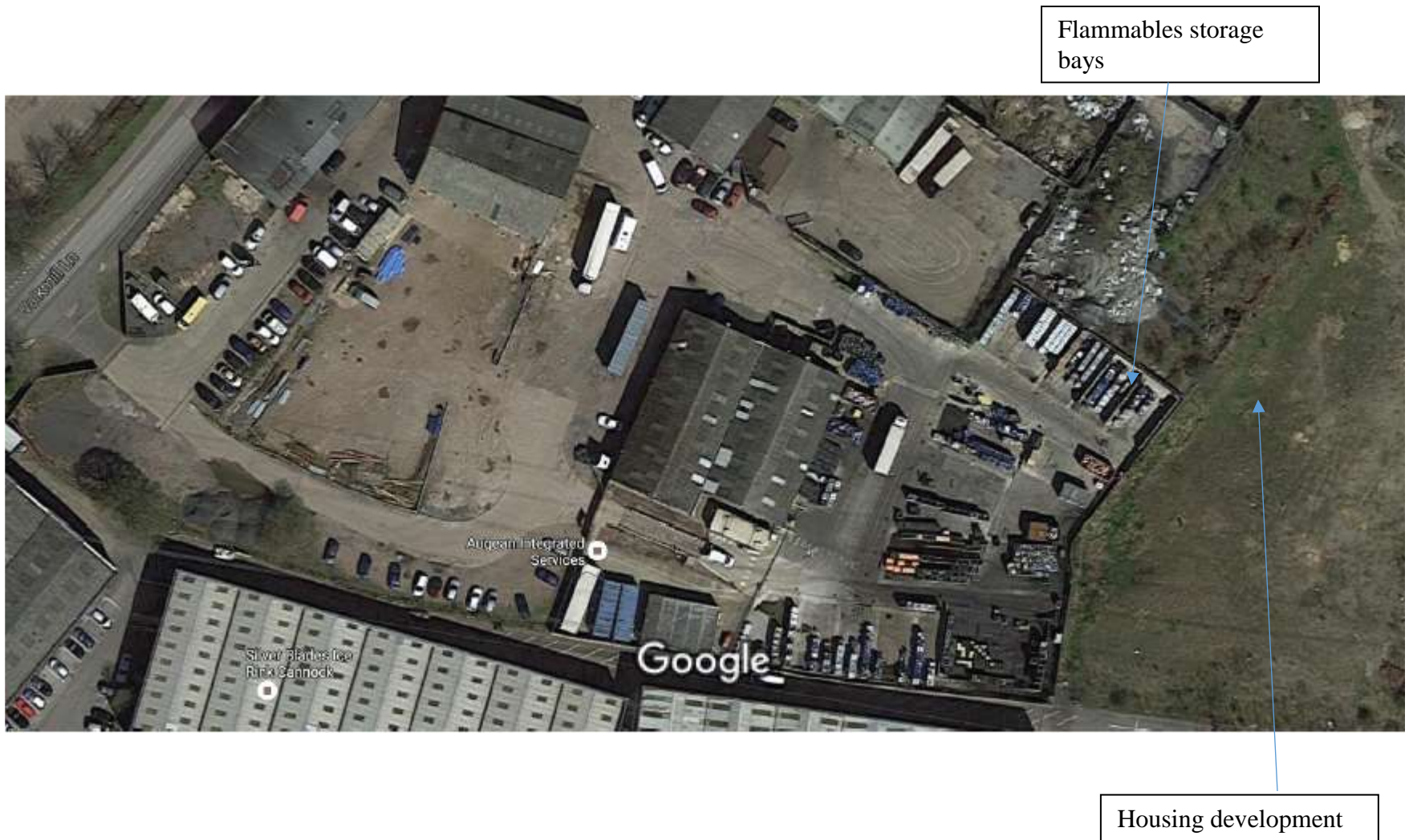
The resultant radiant heat flux from a fire could threaten anyone in the vicinity. The following criteria is used when carrying out modelling:

- 100% lethality is assumed for any duration of exposure to  $24\text{kW/m}^2$ .
- Distances to  $12.5\text{kW/m}^2$  are shown for potential impact on building and structures.
- $6.5\text{kW/m}^2$  is the level above which escape may be impaired.

Appendix 1 Augean Cannock site plan



Appendix 2 – Augean Cannock site – Google Earth image



Appendix 3 – Augean Cannock photos from site tour 6/9/16



Site eastern boundary



Site southern boundary looking across area 6 (used for oily rags storage).

Across from boundary are retail units including an ice rink.



View across eastern boundary wall to land being developed.



Bay 11 where toxics and oxidisers are stored.

Toxics are stored elsewhere on site i.e. bay 4.

Bay 11 is closest to the site boundary (north) adjacent to the residential development.



Bay 7 - flammables

Upto 60 tonnes  
(approx) of material  
in each bay.



Bay 8 - flammables

#### Appendix 4: Discussions with Mark Pennington about basis of modelling

#### **Response to question: Gene has asked me to do the modelling for flammables and toxics based on the permitted quantities. Do you know what these are?**

The answer is possibly not so simple as the site can accept 100,000Te/yr of containerised waste for disposal & recovery going by the permit. Clearly this is a huge volume and we wouldn't want to be anywhere near this for the types of waste you have asked about.

COMAH would restrict us to less than 5Te of very toxic (as it used to be known) or 50Te of toxic or a combination worked through aggregation. In terms of flammables, there are 2 bays against the perimeter boundary where the developers are working and each can hold 60 pallets (60Te to a first approximation). It is also possible that the reception bay and dispatch bay could be full of flammables at any one time (not desirable and I have never encountered this scenario but worst case situation it could happen although reception would be for a maximum of 5 days and dispatch for 1 day

#### **Toxics**

I would suggest we model acidification of an IBC of "strong" cyanide say 10%. I could see this as a potential if these items were stored in the reception bay in the middle of the yard but would of course require double jeopardy i.e. 2 IBCs to fail which is (hopefully) unlikely. The site is still permitted to undertake treatment if we wanted to in the future (currently no infrastructure or intent) as it seemed sensible to retain the option on the permit rather than have to go down the road of re-applying. The maximum throughput would be 10Te/d

#### Subsequent email/discussion with Gene Wilson 4/10/16

In my email to you asking you to proceed with the work I stated: For avoidance of doubt the modelling should be based on storage of hazardous substances just under the quantities that would trigger the COMAH regulations subject to being acceptable under the Environmental Permit.

As you identify in the report the COMAH quantities are

- 5000t for flammable
- 5t for very toxic
- 50t for toxic

The Permit says at table S2.10:

#### **Quantities**

The maximum quantity of all waste types that can be accepted at the site shall be 100,000 tonnes per year. The maximum total quantity of waste that can be stored at the site at any one time shall be less than 1000 tonnes. The maximum quantity of Hazardous Waste for recovery listed in this table that can be stored at the site shall not exceed 800 tonnes at any one time.

So in my mind 1000t is the figure to work with but we have used only 60tonnes (I appreciate that this is the extent of the current storage bay) but this is a theoretical exercise based on what we potentially can do under the permit rather than limited by current infrastructure.

Note from RAS (modelling): The model is based on pool area, rather than volume of fuel. We have modelled a larger pool area to simulate a larger pool from more fuel spilt.



## Augean Cannock

### Phast Modelling – Flammable release contained on bay

Modelling has been carried out in Phast to assess the extent of thermal radiation contours that could be produced during a pool fire at the Augean Waste Storage site in Cannock.

The site has a bay containing 60 tonnes of mixed solvents, possessing both smoky and luminous properties.

The bay is 7 m wide and 12 m long which for the purposes of the modelling software could produce a pool with a maximum diameter of 10.2 m.

### Modelling inputs

The following substances have been selected:

Table 1 Substances

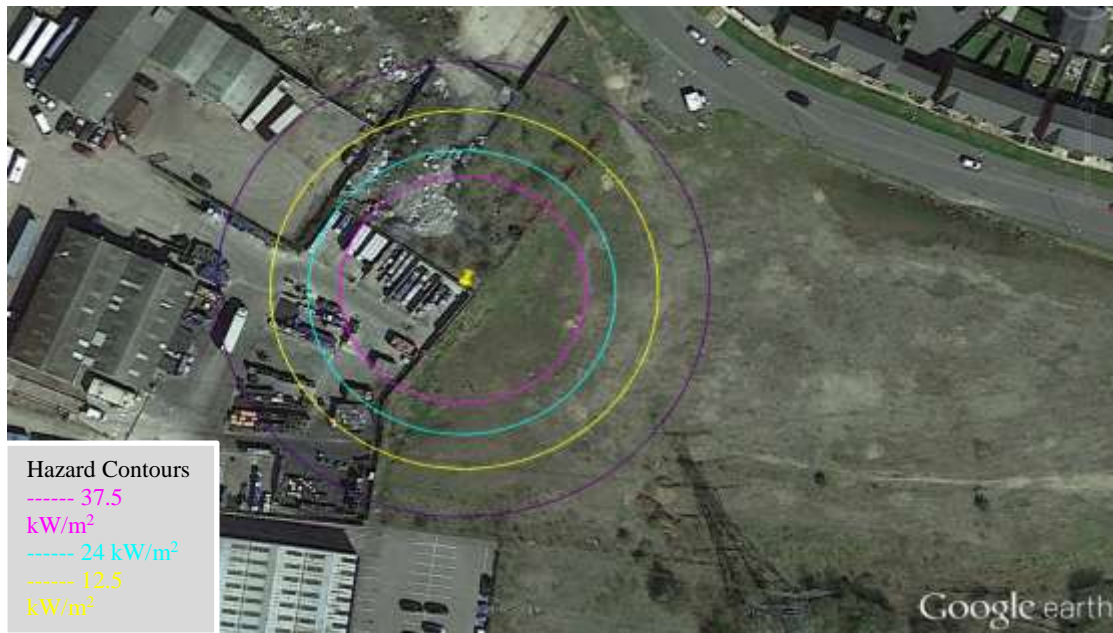
Substance	Luminous or Smoky flame flag
Butane	Luminous
Propane	
Pentane	Smoky
Heptane	
Ethanol	General
Methanol	

### Results

The results produced under both D5 and F2 weather conditions for each substance are shown in the tables below. Maps have also been produced for the substance from each category (luminous versus smoky) which has produced the worst-case results.

Table 2 Luminous substance results

Substance	37.5 kW/m <sup>2</sup>	24 kW/m <sup>2</sup>	12.5 kW/m <sup>2</sup>	6.3 kW/m <sup>2</sup>
<b>D5 Weather</b>				
<b>Butane</b>	<b>27</b>	<b>33</b>	<b>41</b>	<b>50</b>
Propane	26	32	40	50
<b>F2 Weather</b>				
<b>Butane</b>	<b>21</b>	<b>28</b>	<b>37</b>	<b>50</b>
Propane	20	27	36	48



Of the two

luminous substances chosen, **Butane** produced slightly further hazard contours, which are displayed on the maps below.

Figure 1 Butane Pool Fire Thermal Radiation Contours - D5 Weather

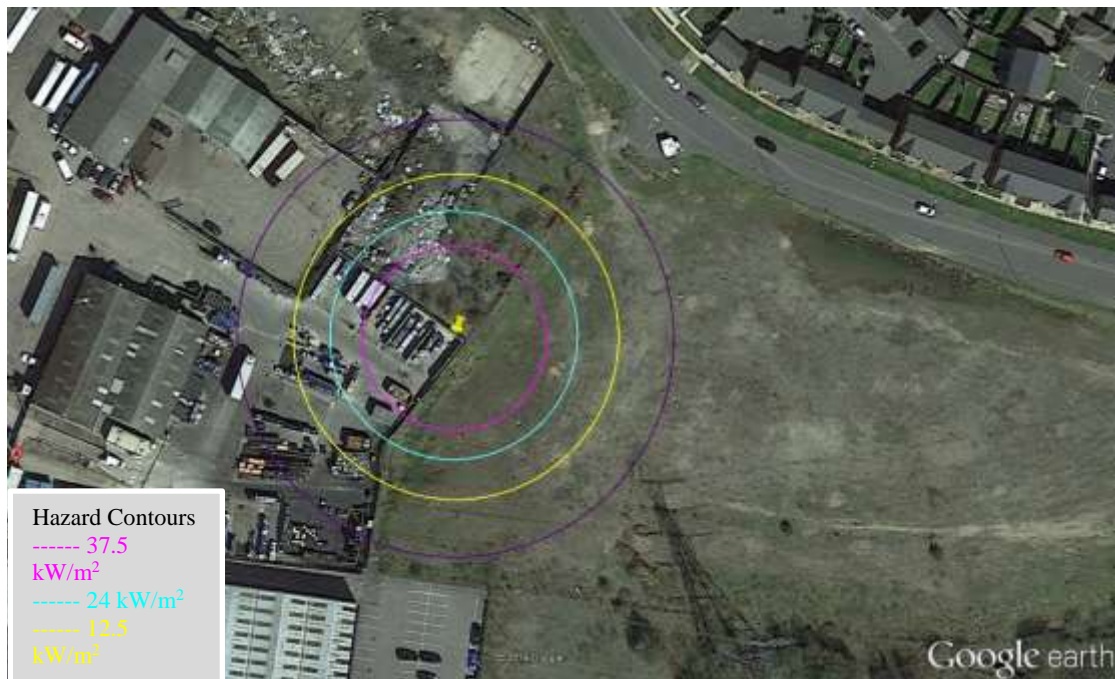
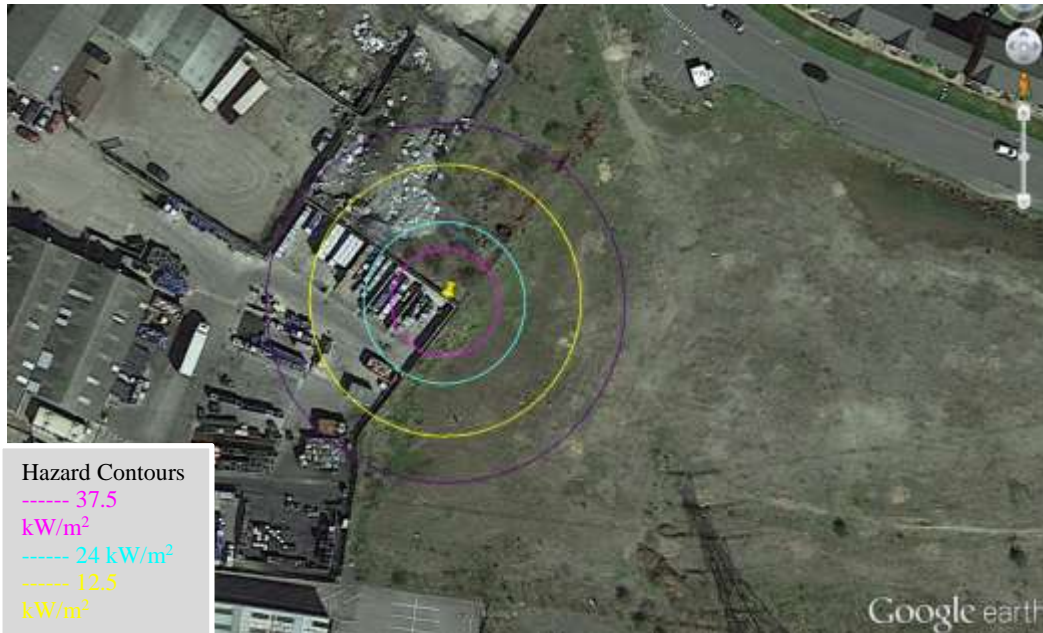


Figure 2 Butane Pool Fire Thermal Radiation Contours – F2 Weather

**Table 3 Smoky substance results**

Substance	37.5 kW/m <sup>2</sup>	24 kW/m <sup>2</sup>	12.5 kW/m <sup>2</sup>	6.3 kW/m <sup>2</sup>
<b>D5 Weather</b>				
<b>Pentane</b>	<b>10</b>	<b>15</b>	<b>26</b>	<b>34</b>
Heptane	9.9	15	24	31
<b>F2 Weather</b>				
<b>Pentane</b>	<b>8.6</b>	<b>12</b>	<b>21</b>	<b>30</b>
Heptane	8.5	12	20	27

Of the two luminous substances chosen, **Pentane** produced slightly further hazard contours.



**Figure 3 Pentane Pool Fire Thermal Radiation Contours - D5 Weather**



**Figure 4 Pentane Pool Fire Thermal Radiation Contours – F2 Weather**

Thermal radiation contours have also been produced for substances which are defined as having a 'general' flame flag and are neither smoky nor luminous, in order to convey the impact the flag has on the contours.

**Table 4 General substance results**

<b>Substance</b>	<b>37.5 kW/m<sup>2</sup></b>	<b>24 kW/m<sup>2</sup></b>	<b>12.5 kW/m<sup>2</sup></b>	<b>6.3 kW/m<sup>2</sup></b>
<b>D5 Weather</b>				
Ethanol	9.8	14	17	20
Methanol	Not reached	9.1	12	15
<b>F2 Weather</b>				
Ethanol	8.5	12	15	20
Methanol	Not reached	7.9	11	14

## Phast Modelling – Flammables release which escalates to site

Modelling has been carried out in Phast to assess the extent of thermal radiation contours that could be produced during a pool fire at the Augean Waste Storage site in Cannock.

The site has a bay containing 60 tonnes of mixed solvents, possessing both smoky and luminous properties.

The bay is 7 m wide and 12 m long however it is only enclosed on three sides. In the event of a small release it is expected that it would be contained in the bay. However, a large release involving multiple IBCs is conservatively assumed to have the potential to migrate into the yard area and produce a pool with a maximum diameter of 40 m.

### Modelling inputs

The following substances have been selected:

**Table 5 Substances**

Substance	Luminous or Smoky flame flag
Butane	Luminous
Propane	
Pentane	Smoky
Heptane	
Ethanol	General
Methanol	

### Results

The results produced under both D5 and F2 weather conditions for each substance are shown in the tables below. Maps have also been produced for the substance from each category which has produced the worst-case results.

**Table 6 Luminous substance results**

Substance	37.5 kW/m <sup>2</sup>	24 kW/m <sup>2</sup>	12.5 kW/m <sup>2</sup>	6.3 kW/m <sup>2</sup>
<b>D5 Weather</b>				
Butane	76	92	118	152
Propane	74	90	116	149
<b>F2 Weather</b>				
Butane	62	79	108	145
Propane	59	77	105	141

Of the two luminous substances chosen, **Butane** produced slightly further hazard contours, which are displayed on the maps below.

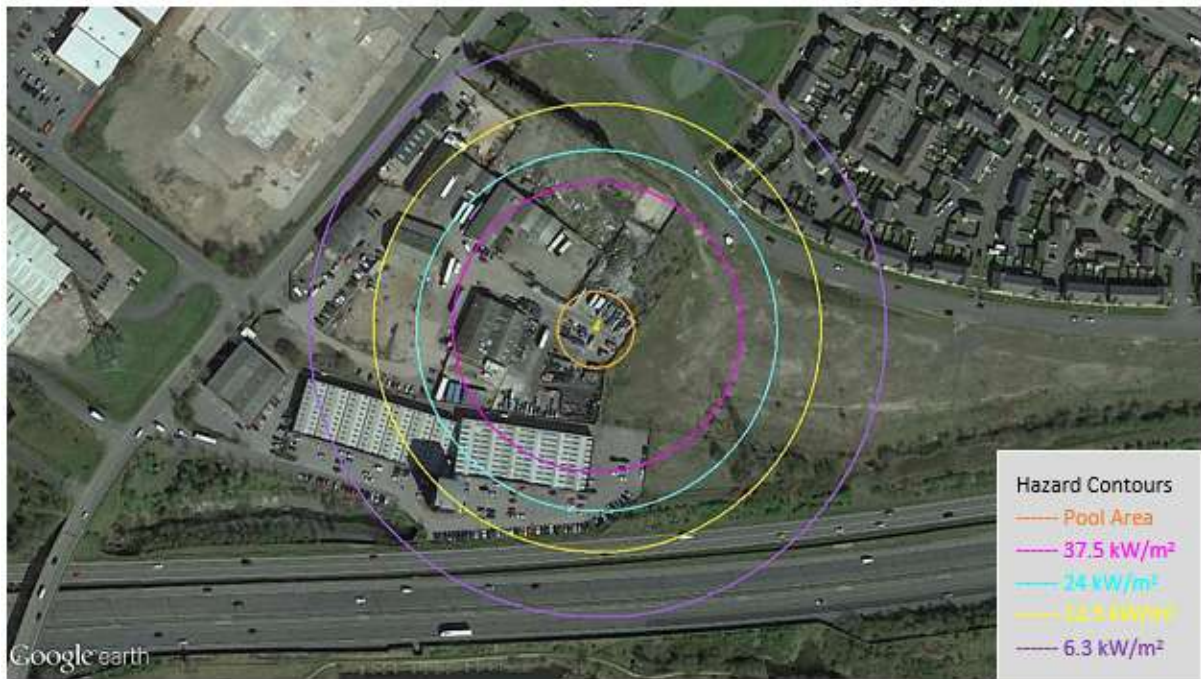


Figure 5 Butane Pool Fire Thermal Radiation Contours - D5 Weather



Figure 6 Butane Pool Fire Thermal Radiation Contours – F2 Weather

Table 7 Smoky substance results

Substance	37.5 kW/m <sup>2</sup>	24 kW/m <sup>2</sup>	12.5 kW/m <sup>2</sup>	6.3 kW/m <sup>2</sup>
<b>D5 Weather</b>				
Pentane	Not reached	Not reached	32	62
Heptane	Not reached	Not reached	32	60
<b>F2 Weather</b>				
Pentane	Not reached	Not reached	29	50
Heptane	Not reached	Not reached	29	49

Of the two luminous substances chosen, **Pentane** produced slightly further hazard contours.

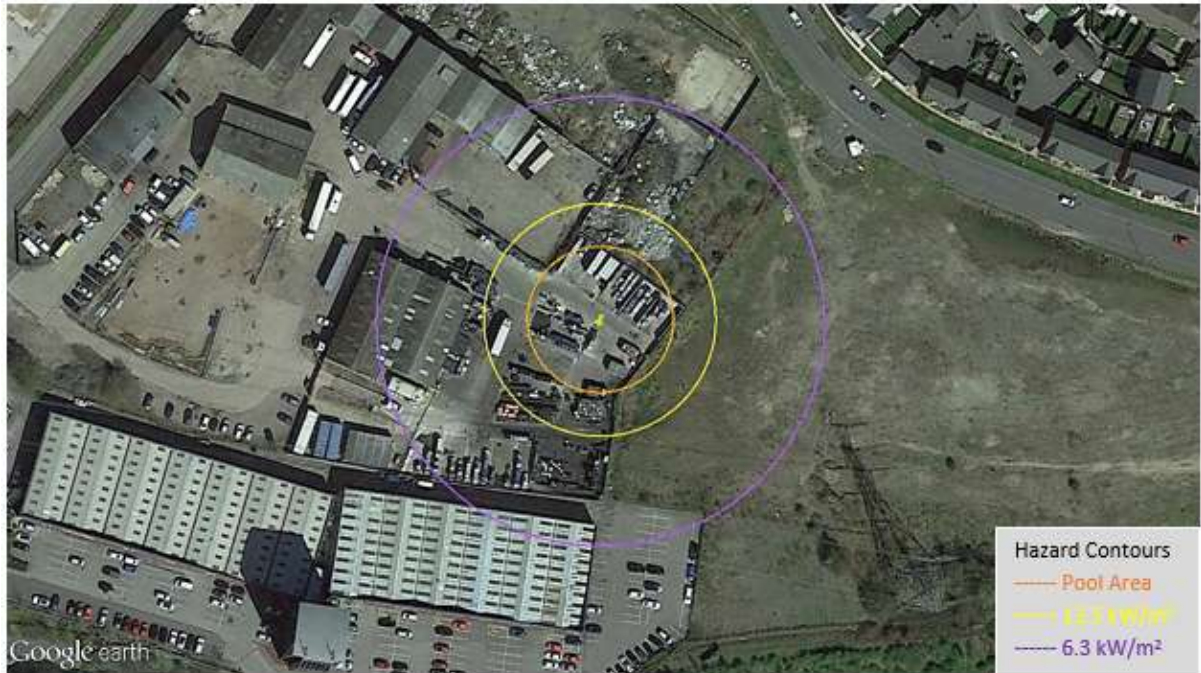


Figure 7 Pentane Pool Fire Thermal Radiation Contours - D5 Weather

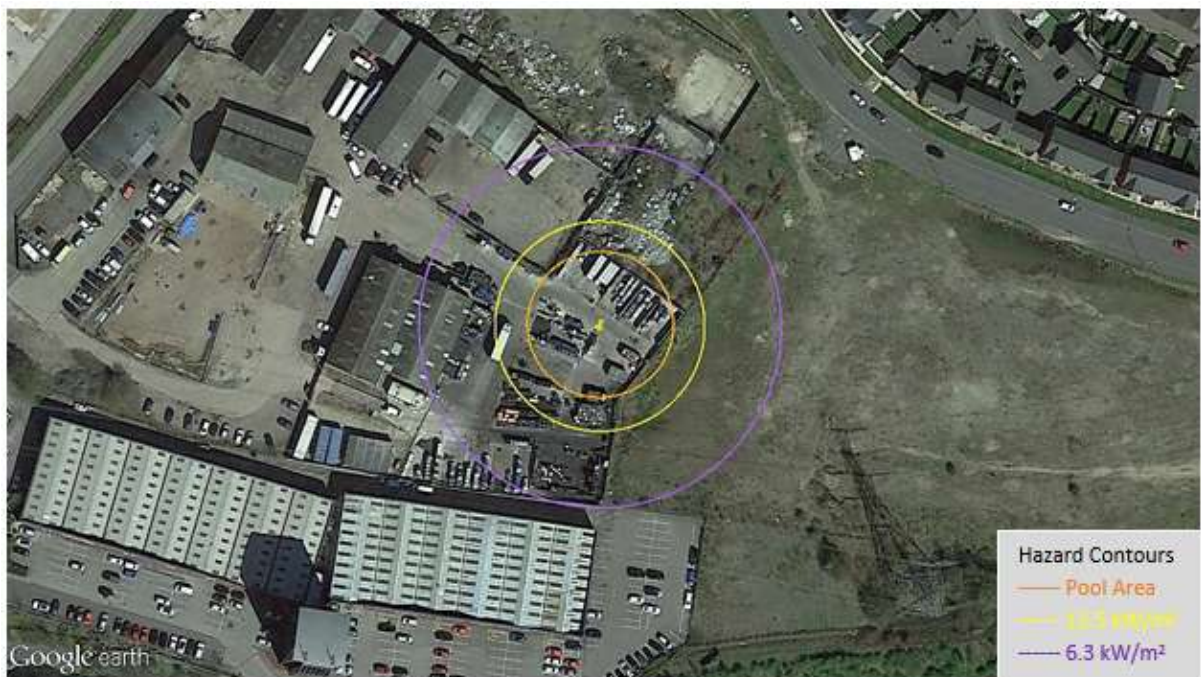


Figure 8 Pentane Pool Fire Thermal Radiation Contours – F2 Weather

Thermal radiation contours have also been produced for substances which are defined as having a ‘general’ flame flag and are neither smoky nor luminous, in order to convey the impact the flag has on the contours.

Table 8 General substance results

Substance	37.5 kW/m <sup>2</sup>	24 kW/m <sup>2</sup>	12.5 kW/m <sup>2</sup>	6.3 kW/m <sup>2</sup>
<b>D5 Weather</b>				
Ethanol	37	44	55	68
Methanol	24	33	41	50
<b>F2 Weather</b>				
Ethanol	32	40	51	66
Methanol	23	29	38	48

Of the two general substances chosen, **Ethanol** produced slightly further hazard contours.

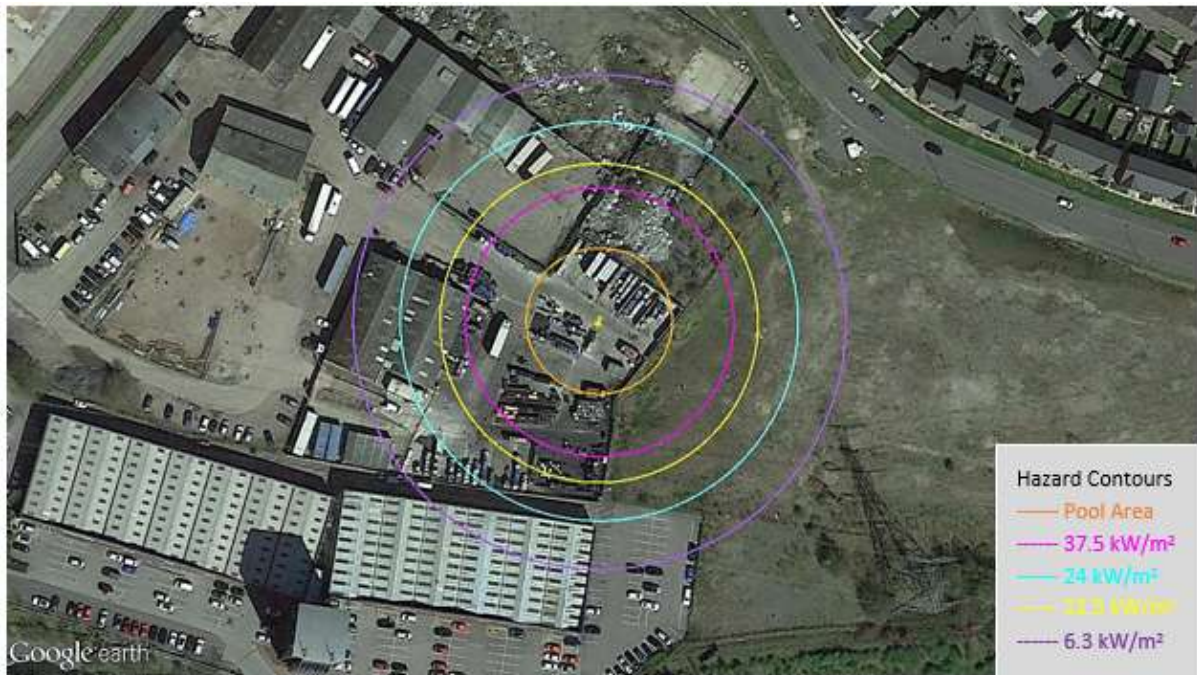


Figure 9 Ethanol Pool Fire Thermal Radiation Contours - D5 Weather



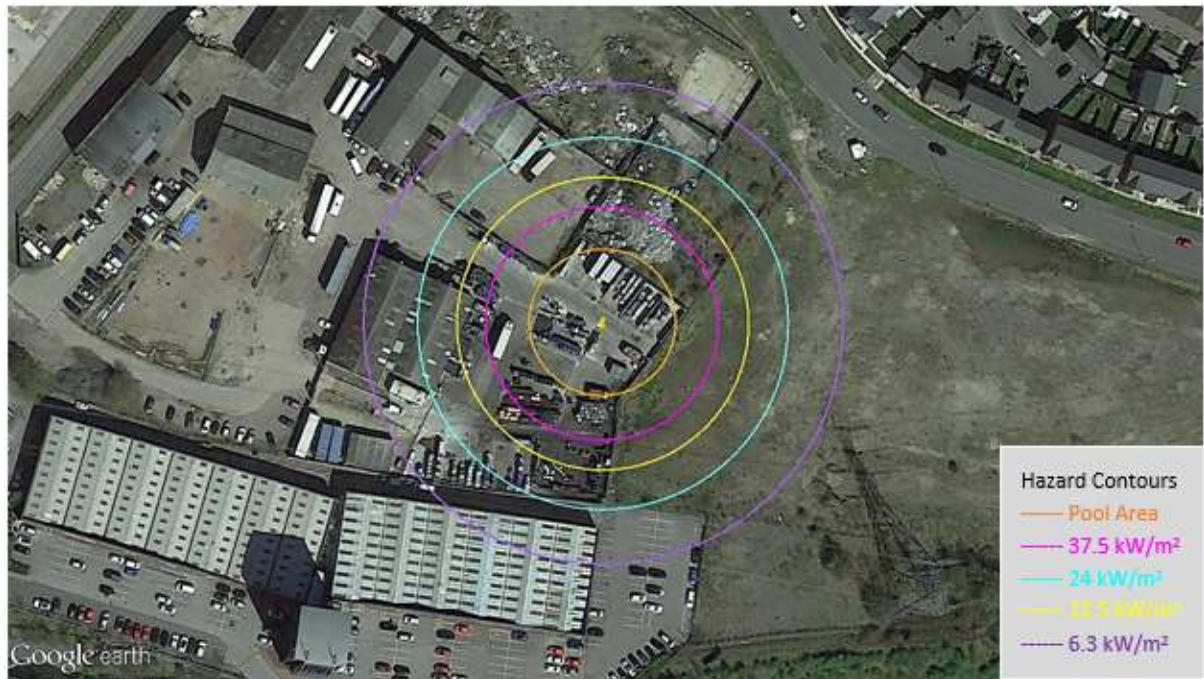


Figure 10 Ethanol Pool Fire Thermal Radiation Contours – F2 Weather

## ADMS Modelling – Toxic release

Modelling has been carried out in ADMS 5.1 to assess the extent of toxic fumes of Hydrogen Cyanide (HCN) that could be produced when cyanide waste is emptied into an IBC onsite, over a release duration of 5 minutes.

### Modelling inputs

The table below details specific modelling inputs for the scenario. All other inputs are left as model defaults.

**Table 1 ADMS Modelling Inputs**

Input parameter		Units	note
Material to model	HCN	ppm	
Discharge velocity	15.6	m/s	
Height of release point	1	m	
Diameter of release point	0.1	m	
Temperature of fire plume	24.85	deg. C	
Duration of discharge	Short Term		1 hour average
Weather conditions	D5 and F2		
Elevation	1	m	
Emission rate	137.8	g/s	
Grid reference (x/y coordinates)	397887, 308245		

The following table details the parameters used for the meteorological data input:

**Table 2 Meteorological Inputs**

Input parameter	D5	F2
Wind Speed (m/s)	5	2
Wind Angle (°)	270	270
Year	2016	2016
Julian Day Number	90	90
Local time (hours)	12	4
Cloud cover (oktas)	8	0
Boundary layer height (m)	800	100

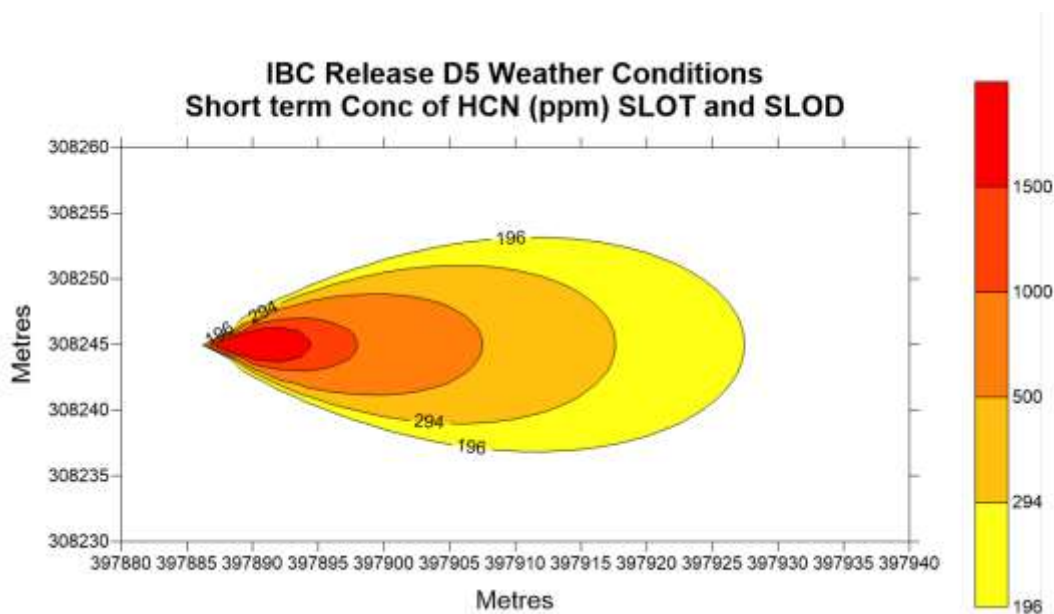
## Results

The short-term concentrations of HCN have been modelled under both D5 and F2 conditions at the release height of 1 m. The distances to the 5 minute (release duration) SLOT and SLOD are displayed in the table below:

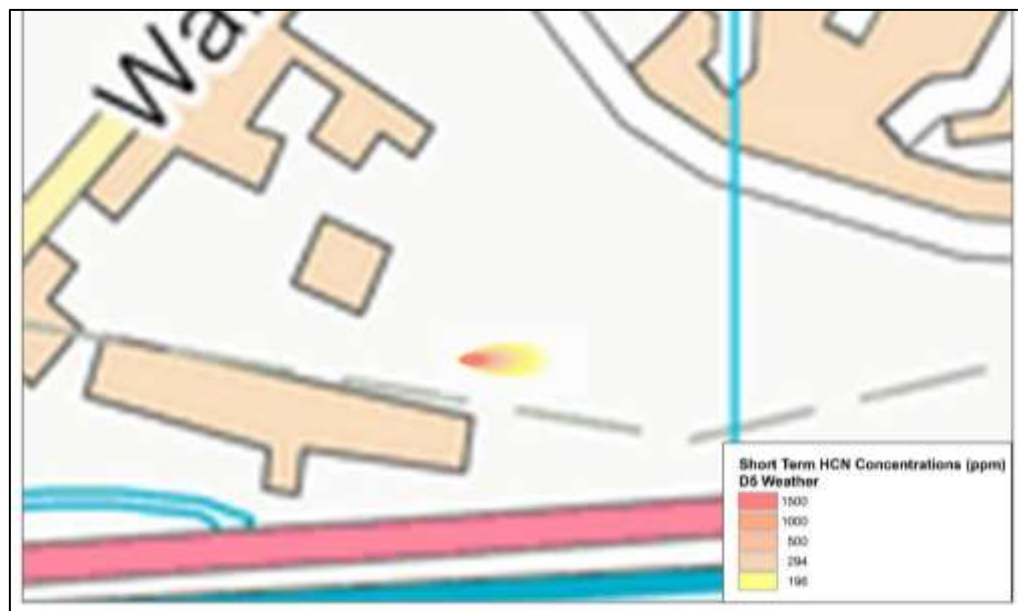
**Table 3 Distances to dangerous toxic loads**

	D5	F2
5 min SLOT (m)	40	80
5 min SLOD (m)	30	Not reached

The contour plots for total concentrations and distances to the 5 minute SLOT and SLOD produced in ADMS are displayed below. They have also been plotted onto an OS map.



**Figure 1 ADMS Contour Plot SLOT and SLOD – D5 Weather**



**Figure 2 ADMS Contour Plot and OS Map - D5 Weather**

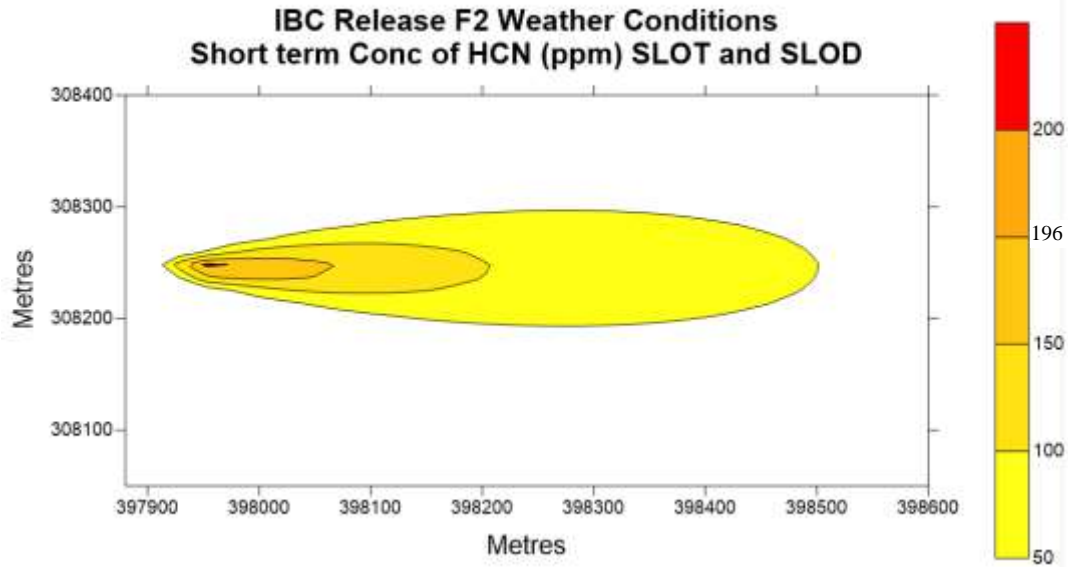


Figure 3 ADMS Contour Plot SLOT and SLOD – F2 Weather

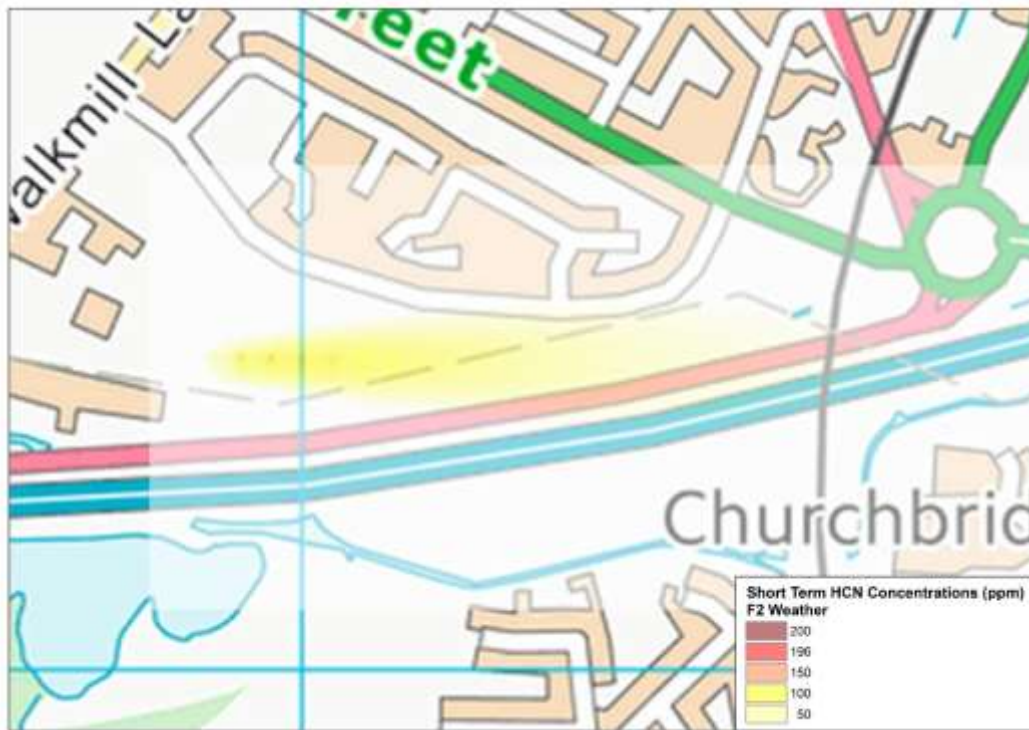


Figure 4 ADMS Contour Plot and OS Map – F2 Weather

# McPhelan Fire Consultancy Limited

**James.**

**I hope you are well.**

Below, as requested, are my observations of Staffordshire Fire and Rescue Service (SFRS) considerations of mitigation of risk options to the domestic dwellings bordering Augean Plc. I have also offered my views on the Fire Risk Assessment and PHAST report provided by Augean; also SSRI and 7.2. (d) by SFRS.

**Mitigation-Option to be considered. (SFRS)**

- **Fire Suppression Systems**

It is my opinion that all new build domestic dwellings in the United Kingdom should be fitted with suppression systems (Low pressure misting systems) however, until the UK Government conclude the full review of approved document B volume 2, following the Grenfell fire tragedy, it is only a requirement in Scotland and Welsh building Regulation. To fit sprinklers within new build domestic dwellings. It should be noted that SFRS could have requested "Consideration" of installation of suppression at planning stage, in view of their current concerns.

In view of the installation of suppression systems within domestic dwellings, it should be pointed out that they do not prevent fires from occurring, but contribute to extinguishing or certainly the development of fires within homes.

Retro fitting suppression systems is a viable option for the houses in closest proximity to the boundary fence of the site, but further research using SFRS domestic dwelling fire statistics (past 5-10 years data) should be considered to support the cost benefits of installation. It is my opinion that the conclusion of the current building regulations review will recommend installation of suppression within domestic dwellings will become a Regulatory requirement, especially within social housing projects, and therefore recommend a policy review be considered.

In view of the risk of fire spread from units in close proximity to Augean, I consider the risk from existing premises, statistically, may also pose a risk of fire spread and further research using SFRS commercial building fire statistics (5-10 years) should be used to support this concern. (Written assessment not provided at the point of writing).

It is my opinion that the consideration of installation of suppression within the risk critical areas of Augean has more cost benefits than the installation of suppression within the domestic property development or a "Deluge system" fitted to surrounding residential properties (External sprinklers).

This should be supported with the findings of the latest Risk Assessment and PHAST report, commissioned by Augean (In view of their current concerns for the safety of the residents of the new development, hence a “significant change” would initiate a review) and should also incorporate a review of storage and management in movement and quantities of all the risk products on site within the same Risk Assessment, and particular reference to the hazard contour explained within the PHAST report.

### **Legal considerations (WHS)**

In reference to the Social housing apartment element of the development, the Fire Safety Order applies to the “Common areas” only and it is recommended that the tenancy agreement for potential tenants would be subject to strict maintenance of the “Sterile” design of the common areas. The actual apartments are legislated by the Housing Act 2004 and the Housing Association can utilise this Act and the Legislation within to secure “Reasonable” behaviour habitability of these premises. (Strict Tenancy agreement on “Do’s and Don’ts)

It is also recommended to review the AFD within the apartments (LD2 BS 5839 Category A is recommended) should be linked to all apartments (Heat detectors) and the common areas and Sounders provided to ensure all tenants can be alerted in the case of a fire

Walsall housing should also consider “Full disclosure” of the current situation (H&S at work Act etc.) regarding “Tolerable risk” of the Augean Plc. Site and provide particular reference to the contents and outcomes of this document.

Augean and SFRS should consider a site emergency exercise (Planned and cancelled in 2017) to fully consider all aspects and changes to risk to environment, site staff, the housing estate residents, the southern and western perimeter neighbours and Firefighter safety.

It is also recommended that the Apartments are subject to an annual Fire Risk Assessment from an external independent assessor to avoid any potential conflict of interest, which should include the internal condition of apartments, fire detection, passive and active protection functionality etc.

It is also recommended that SFRS provide “Home Risk Checks” as per their “Fire Service Community fire safety” policy to all homes within the development on an annual reviewed basis (This would also include the safe management of domestic cooking, smoking, barbeques and Fireworks during the festive and or bonfire period) and also supported by SFRS Fire Enforcement department to audit all commercial premises neighbouring the Augean site (If they haven’t already been done) to assess their emergency action policies in the event of an incident on site (As they fall within the hazard contour identified within the PHAST report).

- **Physical barrier**

The consideration of an earth bank to form a physical barrier between Augean and residential units is worthy of consideration; however, to support this consideration, the Risk Assessment of the site, again is required to provide a subjective “Probabilistic” reasoning and cost benefit analysis of such a consideration.

The elements of consideration would include;

- (1). Seasonal weather conditions (Wind direction) in the event of a hypothetical incident involving a residential unit or an incident occurring

within the Augean site, and speed and weight of attendance from site firefighting teams and SFRS (Pre-determined attendance to site)

(2). Risk management of Augean site (Fire Risk Assessment significant findings and action plan recommendations)

(3). Practicality of height and footprint of such a barrier.

An acoustic fence has been provided to address any potential noise pollution from the Augean site, however, I am not convinced that enough research has been carried out to support the cost benefit of this construction and recommend all considerations discussed be made prior to any further "Additional" barrier is agreed to justify any future costing's can be. The consideration of constructing a 4 metre high boundary wall between the Augean site and the property development would also be subject to further research regarding cost benefits of such a project. The emphasis on cost benefits, it must be stressed, is not to save money but to maximise the cost benefits and safety of the community site personnel, and firefighters.

- **Increase height of storage bays adjacent to residential Units**

The option of increasing the height of bays close to or upon the boundary of the housing development, in my view is a viable option. However, again this must be subject to the Risk Assessment of the Augean site.

The heightening of the bays, in conjunction with the potential re-arrangement of the storage and processes of the site risk licensed materials (Risk assessment findings) would also benefit the installation of a fire resistant and vented (Clerestory) roof (will support the mitigation/reduction of potential burning embers from surrounding fires, fireworks etc. landing on top of containers holding flammable materials/liquids) and the installation of a suppression systems were this reviewed methodology of risk management is deemed appropriate.

Installation of heightened bays and vented roofs within the Augean site will also improve the view from the residential premises and reduce risk of fire within site.

- **Alternative location for Augean site**

In view of the of the consideration of Augean to move to an alternative location is the choice of Augean Plc. And the process and cost will be the responsibility of Augean Plc entirely.

- **Augean Fire Risk Assessment November 2017**

In relation to the FRA commissioned by Augean and presented to WHG, my initial findings are as follows;

- It has been almost 2 years between the most recent Fire Risk Assessments. November 2017 being provided by Augean (Should be every 12 months or whenever a significant event happens (When for example outlining planning and planning permission is granted, confirmed and certainly when site construction begins etc.)
- The name and qualifications of the assessor is shown (I believe the report has been written by a Health & Safety Assessor, not necessarily a Fire Safety Assessor, which are two important but "Different" skill sets).

- The Fire Risk Assessor does not denote what level of Fire Risk Assessment this is. I believe it is of the simplest compliant level 1.
  - The assessment makes reference to a 4m block wall building planning application but makes no assessment, action plan or recommendation
  - The assessor makes reference to the planning permission for a 4m “Timber acoustic wall/fence, the build-up of flammable debris and “Opportunist” arsonist but offers no action plan or recommendations. The timber fence approved under the planning permission is also not 4m in height.
  - The assessor makes reference to “Smokers” throwing cigarettes over the boundary wall” but offers no findings or recommendations
  - The Assessor makes reference to the PHAST modelling (Consequence assessment) based on quantities of hazardous risks on site but again makes no recommendations or reviews to mitigate or reduce the PHAST findings.
  - It is also my understanding that the figures used for the PHAST modelling report are based on the “Licensed quantities” of hazardous waste permissible and not the actual, practicable quantities used on a regular basis, which I believe, in my experience, would be considerably less than those stated within the report and consequently impact reduction on the “Radiated risk radius” indicated, again makes no recommendations, action plan or reviews to mitigate or reduce the PHAST findings.
- **PHAST** (Hudson Pool Review carried out by Risk and Hazard Management October 2016).
  - In reference to the outcomes of the PHAST report, I would request confirmation of the following observations:
    - Section 1.1.** References a site bay containing 60 tonnes of mixed solvents,
      - (1). Is this (60 tonnes) the actual volume generally contained within the site or is this the “Licenced” permissible quantities?
      - (2). Has Augean reviewed the quantities storage location and quantity management since the surrounding risk has significantly changed?
      - (3). Has Augean considered relocation of the storage within site?
      - (4). Will Augean consider any of the risk management options suggested within this report, which we feel will reduce risk and minimise the outcomes set out within the PHIST report?
    - Section 1.1.2.**
      - Table 2** sets out figures in Kilowatt values based on “Maximum full fire conditions” assuming with the maximum licenced quantities under 2 measured and controlled weather conditions D2 and F2.
        - (1). Has Augean made any considerations to reduce the volumes indicated to reduce the hazard contours set out within the report?
        - (2). Again, will Augean consider any of the risk mitigation options suggested within this report?
        - (3). In reference to the hazard contours set out within the report, the site neighbours are equally affected by the same hazards indicated within the report; will Augean include this information within their recent Fire Risk Assessment and has there been an “Impact



assessment” carried out to consider actions and management to reduce and or mitigate the hazard contours identified within the report to reduce impact on the neighbours South and West to the site?

**Table 3.**

This table indicates the hazard contours showing two chosen luminous substances (Heptane and Pentane).

The table indicates hazard contours of thermal radiation under D2 and F2 weather conditions.

(1). Will Augean consider reduction of materials processed or limited the specific quantities to suitably reduce the radiated heat hazard contours?

(2). The weather conditions measured are restricted under stringent laboratory conditions and are subjective to extensive diversification of real time weather and seasonal affects. It should be noted that the PHAST report offers no solutions or recommendations to reduce the hazard contours and provides no details regarding quantities of hazard. We therefore should assume that the “Worst case scenario” of maximum licensed tolerances of waste materials are measured. This indeed lends itself to consider reducing the quantities and locations of the epicentre of the risk (Hazard contour).

- **Number of House fires within 500m of site in 10 years.** (SFRS statistics). I consider this figure considerably high for a small radius of 500m from the site. However, the figures offer no supporting evidence such as “Occupancy” cause of fire, damage, and fire spread etc. or what “Community education assistance was provided by SFRS post incidents to reduce these incidents. In my 30 year career as a Rider Station Officer/First responder, it was extremely unusual to attend a fire which spread from its “room of origin” or indeed spread beyond the property affected by fire.
- **Two hazardous incidents in 10 years on-site.** The two incidents have been provided but are not supported by the findings of any hazardous/fire incident investigation by the Health & Safety, Environmental Agency or Fire Service.

In particular, what actions were recommended, reviewed, revised and what “Corporate” policies were implemented following such recommendations from the Enforcing Authorities and internal safety policies subject to the stringent requirements of the permissible handling license.

- **Site Specific Risk Information** (SFRS) (Statutory) This information is gathered and should be shared by SFRS Operational fire crews, SFRS Health & Safety Departments, SFRS Fire Safety Legislation Departments, SFRS operation intelligence, and other emergency services and potentially neighbouring partner emergency services (Depending on predetermined attendance, available resources and “Interoperability” arrangements). This information is confidential and must not be shared by SFRS outside the required fields set out above. This information and contents vary from Fire Service to Fire Service, but generally

follow the template of the attached example. The Augean site management is entitled to share the information with interested parties (Based on the need for commercially sensitive security and competitive business continuity, they may choose not to share) to establish mutually beneficial safety action measures and reduce or mitigate potential risk, and to pre-plan actions in the event of an incident.

- **Section 7.2. (d) Fire Services Act 2004 (SFRS)**

This section of the Fire Service Act obliges (Statute) the local and neighbouring Operational FRS Crews to visit the premises/site to “Familiarise” themselves with such things as;

What are the general risks?

How do we gain access?

What surrounds the risk?

What should be our initial actions?

Again, this information should be shared and support the data set out in the site Fire risk assessment, SSRI, and the PHAST report. It is confidential, but again can be shared by the Augean site. (Augean can request a copy of the SSRI)

**Other legal considerations which may affect occupation of residential units.**  
(Partial reference document provided)

**1.2.** WHG are acting on the full understanding of its responsibilities under the H&S Act 1974 and its duties therein, and are actively seeking all reasonable options to resolve the safety concern issues raised by both SFRS and Augean which are identified within this report.

**1.3.** WHG are on notice of a known risk in relation to fire and its potential impact to the development. WHG is taking steps to consider all available options for consideration within this and preceding reports to mitigate this/these risks. It must also be stated that Augean, in my opinion, vicariously, are also on notice of the “Significant change” to their risk to the environment, due to the planning, construction and completion phases of this development and should have or are taking measures to mitigate the potential impact of the development, particularly those areas identified in their recent risk assessment. In the interest of safety, I would suggest the current status of Augean Risk Assessment be made available, especially following the incident in Paisley (Findings and recommended actions)

**1.5.** WHG are aware of their responsibilities within the H&S Act, Housing Act 2004 and Fire Safety Order 2005 and are considering all reasonable options to mitigate and or reduce risk, expanding their normal measures to support the safety of their residents, the community, firefighter safety and the environment within the report above (Legal considerations). It is in my opinion, important that Augean co-operate fully with WHG and consider all areas discussed within this and other reports to reasonably address all issues of potential and perceived risk.

**1.7.** WHG are aware of their legal obligation under the Housing Act 2004 and all its Articles including Fire prevention (Seeded to the local Authority to enforce) and are

considering additional protection options not required within the Approved Document B Volume 2 (Sprinklers and or drenchers to the closest housing stock to site)

**1.8.** The construction of all the premises units within the development comply with all current Building Regulations (Approved Document B Volume 1) however, WHG in conjunction with Galliford are considering all reasonable improvements which support the safety of the safety of their residents, the community, firefighter safety and the environment within the report above (Section 1, 2 & 3). It is also recommended that consideration be given to planting of "Mature" trees as in the construction of motorway intersection junctions to "Absorb" sounds, odours and exhaust gases, along the boundary separating the site and housing development

**1.9.** It is my understanding the original outlining planning application (2015) and full planning application met with some sensitive objections from all the concerning parties listed above. WHG are recommended within this report to periodically review the residential site, the management and occupancy controls (Stringent tenancy agreements based on full disclosure of risk prior to occupancy) and risk assessments. This should include periodic communications/meetings with Augean safety management representatives.

**1.10** WHG would ask the Deputy Chief Fire Officer to provide supportive evidence to suggest why the onus of fire prevention and management is exclusively the responsibility of WHG. It is a fact that the changes surrounding the Augean site (Planning permission granted) has impacted upon their daily routine and processes, in particular reference is drawn to the Notice of variation and consolidation with introductory note The Environmental Permitting (England & Wales) Regulations 2010 and the potential need to amend this documentation.

Also, in relation to the suggestion that the residential development will "Force" SFRS to alter their firefighting strategy may be somewhat misleading. In view of the National Operational Guidelines dealing with incidents involving Chemicals and Hazardous materials (Provided); general fire risk assessment deals with incidents in the following methodology;

(1). **Dynamic risk assessment** is the practice of formally and mentally observing, assessing and analysing an environment while we work, to identify and remove risk. The process allows individuals to identify a hazard on the spot and make quick decisions in regards to their own and others safety. Utilising existing known data such as existing weather conditions, processes, local knowledge, and Familiarisation inspections (7.2. (d) (Fire Service Act 2004), Site Specific Risk Information data [SSRI] (Fire Services Act 2004)

(2). **Analytical risk assessment** (Dynamic) allows for supporting the emergency services Incident Commander at the scene in the managing of risks, called dynamic Analytical Risk Assessment due to the fact that the method reacts dynamically to the changing at the emergency scene and is detailed enough to be considered an analytical risk assessment. Which takes the above availability of information, combining it with information received from various sources such as public emergency calls, data from SFRS Mobilisation centre and visual evidence etc.

(3). **Strategic risk assessment** involves a practiced process performed by incident management for identifying, assessing and managing risk and

uncertainties, affected by internal and external events, scenario's and risk that could impede incident management's ability to achieve its strategic and organisational objectives. This will also include information including weather conditions, changing wind direction and speed, what is on fire, what extinguishing media to use and what to avoid (SSRI) where is the fire, flammability, explosive capability, Hazard contours, access availability, surrounding life risk, persons reported etc.

The knowledge of the close proximity of residential development and the publicly occupied commercial premises to the opposite boundary of the Augean site will be significant in all 3 levels of assessment above and will determine actions utilising the "Decision making model" for considerations used by the emergency services rather than "Force" actions intimated by the Deputy Chief Fire Officer SFRS.

In this report, my observations are not conclusive, but offer opportunities to further discuss all "Reasonable" options or variation of options for consideration. The primary objective for WHG and Galliford is to provide suitable mitigation actions or suggestions of risk to the residents of the development before and during occupation.

It is my opinion, based on the information provided, that WHG are actively seeking resolution to this issue and are willing to contribute to the mitigation of risk and improvement of relations with Augean. It is also my opinion, based on the evidence I have been provided with, that the majority of efforts to resolve this issue are being initiated and actioned by WHG and Galliford. The site risk management have a legal responsibility to identify risk and to implement policies to identify, reduce or mitigate known risks. The current situation, in my opinion is that the Augean site have commissioned a Fire risk assessment and PHAST report, but have not indicated as to what actions they have applied or intend to apply to reduce risks identified within their commissioned reports.

With the information supplied, I consider that Augean have failed to:

- (1). Offer solutions to identified risks within FRA and PHAST reports
- (2). Identify the publicly occupied risks already located to the south and West of the site and all sit within the same Hazard Contours set out within the PHAST report, or offer any solutions to reduce the identified risks

I am happy to discuss in further detail any of the points I have made, however, without a copy of the most recent SFRS SSRI and 7.2(d). Augean site, it will be difficult to conclude this report and discuss an agreeable compromise.

However, I do believe there is enough evidence to suggest that WHG are acting in a reasonable manner to identify and reduce or mitigate risks.

Kind regards

Ged Phelan

07904692848



**COVER NOTE TO THE DRAFT REPORT OF THE DEPUTY CHIEF FIRE OFFICER  
REGARDING LAKESIDE BOULEVARD**

This report was requested in October 2017 by the Chief Executive of Cannock Chase District Council. This was in order to guide conversations at internal stakeholder meetings regarding possible mitigation of potential risks of fire at the hazardous waste treatment site located in Cannock referred to as ‘the Augean site’ (as operated by Augean Integrated Services Plc (Augean)).

This report was prepared by Staffordshire Fire and Rescue Service’s (SFRS) fire engineer Stuart Ruckledge on behalf of the Deputy Chief Fire Officer and its contents summarised details contained within a report prepared by Hudson Consultants Ltd dated 7 November 2016 (the Hudson Report) which had been obtained by Augean. The information within the Hudson Report was not checked or tested by SFRS - it was simply a summary of health and safety concerns regarding the proximity of the residential development on Lakeside Boulevard to the Augean site. And the basis for options and recommendations suggested by SFRS for further mitigation measures to reduce the likelihood and consequence of a fire occurring at the Augean site.

The Regulatory Reform (Fire Safety) Order 2005 (the Order) is the primary fire safety legislation in England and Wales designed to provide a minimum fire safety standard in all non-domestic premises. It is SFRS duty to enforce the Order. As a workplace, the Order firmly applies to Augean. In addition to duties under other legislation, such as the Health and Safety at Work Act 1974, the Order requires Augean to take general fire precautions to ensure the safety of its employees.

Since the Order does not apply to domestic premises, SFRS can only make recommendations on fire safety standards directly relating to the nearby flats or houses. However, the Order does require Augean to take general fire precautions to protect relevant persons who are not employees. The definition of relevant persons includes any person in the immediate vicinity of the premises who is at risk from a fire on the premises. It is therefore the responsibility of Augean to carry out fire risk assessments that consider the risk a fire on their premises could have on neighbouring premises.

**Dated January 2019**  
**Rob Barber MBA, MIFireE**  
**Deputy Chief Fire Officer Deputy Chief Executive**  
**Staffordshire Fire and Rescue Service HQ**

# Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5

## BACKGROUND

Augean Integrated Services Plc operates the Cannock Hazardous Waste Treatment Site and hold Permit Number EPR/BP3737SG. This permit was issued by the Environment Agency (EA) on 5<sup>th</sup> May 2006. The site has permissions that allow a wide range of processes to be carried out including; hazardous chemical processing, radioactive waste storage and processing, stabilisation, waste transfer, storage, bulking and shredding. The site is permitted to treat and manage flammable, toxic, eco-toxic, acid and alkali and radioactive wastes handling up to 100,000 tonnes per annum 24 hours a day. The site has been classified by the Health and Safety Executive (HSE) as a sub-Control of Major Accident Hazards (sub-COMAH) site.

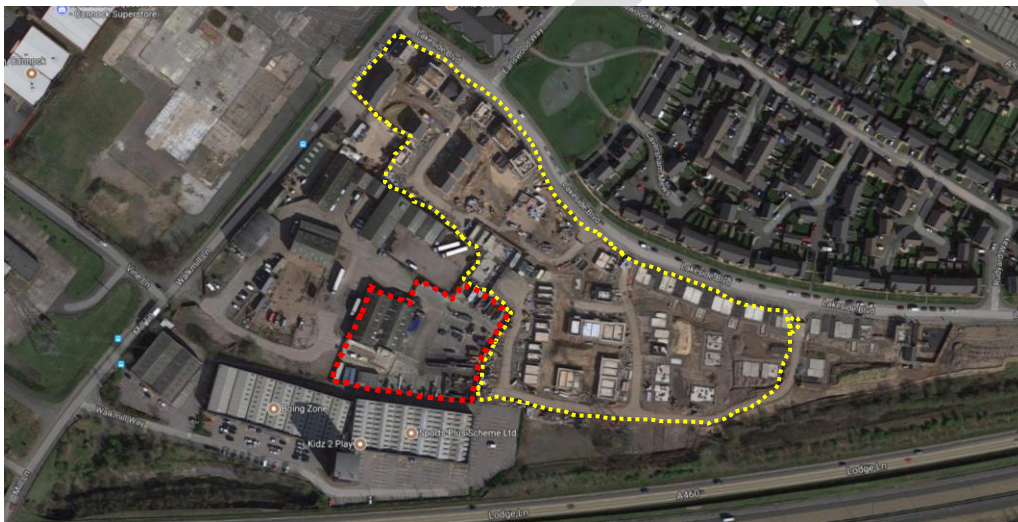


Figure 1 - The boundaries of Lakeside Development (yellow) and the Augean site (red).

A Building Regulations consultation was made in September 2016 for 93 houses and 18 flats to be built on brown field land adjacent to the Augean site. The development would provide a mixture of privately owned properties and social housing. The social housing is to be operated by Walsall Housing Group (WHG).

On Thursday 5<sup>th</sup> October 2017 at 13:00 a meeting at Augean Plc, Unit 15 Cannock Industrial Centre, Walkmill Lane, Cannock, Staffordshire, WS11 0LN. Attending the meeting were representatives from Augean Plc, Cannock Chase District Council (CCDC), Staffordshire Fire and Rescue Service (SFRS), WHG and Galliford Try Partnerships (GTP). The purpose of the meeting was to collaboratively discuss Health and Safety concerns regarding the proximity of the residential development on Lakeside Boulevard and the Augean site.

# **Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5**

In addition on Friday 20th October 2017 at 13:30 a site visit was made to the Riverside Boulevard residential development, to look at the proximity of the houses in relation to the Augean site. There were representatives from SFRS, CCDC, WHG and GTP.

Following three events the specific concerns have been identified by SFRS which are;

1. The effects of fire/chemical incidents within the Augean site on the Lakeside Boulevard housing development
2. The effects of fire incidents within the Lakeside Boulevard housing development on the Augean site
3. Being forced to change the firefighting tactics from defensive to offensive

## **SIGNIFICANT FINDINGS**

Although the EA and SFRS have had no issues with the site management and permit compliance in the past, the effects of fire or chemical incidents within the Augean site on the Lakeside Boulevard housing development could be devastating. It is important to note that had the Augean site been classified as a lower or upper tier COMAH site the housing development would not have been permitted. Although the processes, chemicals and materials are exactly the same as a COMAH site the reason for classifying as a sub-COMAH is purely down to the quantities.



# Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5



Figure 2 - The plan show the direct boundary between Augean and the houses

The block of flats can be seen in Figure 1 identified by the number 57-62 and the blue arrow. These will be three storeys in height and will overlook the Augean site and are directly adjacent to the two most dangerous bays of the chemicals on the Augean site, which can be seen below.

As can be seen in Figures 3 – 5 the boundary distance between the chemicals and flammable materials is no more than 3m.



Figure 3 - View from Augean to the block of flats which is still to have a third floor added



Figure 4 - Shows the distance between the boundary of Augean and the flats



Figure 5 - the view of Augean from the second floor of the flats

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The boundary to the houses, road and parking bays is also close with a minimum distance of approximately 11m. Figures 6 and 7 below show the distance of the Augean site from the frontages of the houses. Details of the plans can be seen in Figure 2, a road and 4 car parking bays are proposed along with buffer planting. These houses are directly down wind of the Augean site which is identified a report by Hudson Consultants Ltd dated 7<sup>th</sup> November.



Figure 6 - the approach road to the rest of the housing estate. This will have the road and 4 parking bays



Figure 7 - View from the second floor of the flats showing the Augean site in relation to the houses and road

The report by Hudson Consultants Ltd details the results of consequence modelling that carried out to assess the potential impact of the flammable and toxic substances stored on site. The conclusions identify that both fire and toxic gas release scenarios could potentially result in significant onsite and offsite consequences, including potential fatalities.

The HSE define the Specified Level of Toxicity (SLOT) as leading to the following effects:

- Severe distress to almost everyone in the area
- A substantial fraction of the exposed population requiring medical attention
- Some people being seriously injured, requiring prolonged treatment
- Highly susceptible people possibly being killed

The concentration, for a given substance to give a Dangerous Toxic Load (DTL) corresponding to the SLOT can be therefore calculated which gives an approximate 1-5% chance of fatality in the region affected, if the individual is exposed outdoors for the related duration.

## Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5

A similar procedure is followed to derive a toxic load equation to predict exposure conditions for a DTL relating to the mortality of 50% of an exposed population, a specified level known as SLOD DTL (Significant Likelihood of Death – Dangerous Toxic Load)

The resultant radiant heat flux from a fire could threaten anyone in the vicinity. The following criteria are used when carrying out modelling.

- 100% lethality is assumed for any duration of exposure to  $24\text{kW/m}^2$
- Distances to  $12.5\text{kW/m}^2$  are shown for the potential impact on building and structures
- $6.5\text{kW/m}^2$  is the level above escape may be impaired

With these figures in mind it would be likely that in the case of a fire at the Augean site different chemicals range in severity. Different scenarios have been modelled using day and night weather conditions and fire incidents contained within a single bay and involving the entire site.

It is suggested that the worst case scenario within the site would be that of a fire contained within a bay involving Butane with the weather conditions that are typically experienced in the day. This could produce a 100% lethality distance of 33m and the affected area can be seen using a hazard contour (found in appendix 1) placed over an image of the Lakeside Boulevard area. However a fire contained within a bay involving Methanol experienced with weather conditions typically experienced at night would produce a 100% lethality distance of 7.9m and again the affected area can be seen using a hazard contour placed over an image of the area (Appendix 1).

Furthermore a fire which escalates to entire site would involving Butane experiencing typical daytime weather conditions would create a 100% lethality distance of 92m, the affected area can be seen using a hazard contour placed over an image of the Lakeside Boulevard area. (Appendix 2).

If a fire which escalates to entire site involving Methanol in the weather conditions typically experienced at the night. This could produce a 100% lethality distance of 29m and again the

## **Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5**

affected area can be seen using a hazard contour placed over an image of the area.  
(Appendix 2).

These hazard contours have been taken from the Hudson Report and placed over a updated map, so are therefore not as accurate as the modelling in the Hudson report but will give a good indication of the areas of the housing development which could be affected. It is important to note that the PHAST modelling should be repeated for a more accurate data as the existing Hudson report identifies the modelling done prior to any housing being built. The houses and buildings will affect the pattern of any affected areas.

Being forced to change the firefighting tactics from defensive to offensive due to the close proximity of the residential properties would significantly increase the risk to fire fighters as there would now be a need for an evacuation of the properties. This would place Fire Service personnel into the risk zone, increasing the risk for firefighting personnel.

The fire incidents within the Lakeside Boulevard housing development affecting the Augean site are more likely. The activities within the residential site are not managed as they would be within a business. The main concerns are that property fires or vehicle fires close to the boundary could radiate heat or cause embers pass to the chemicals and flammable substances within the Augean compound causing them to become unstable or ignite. Any domestic activities such as BBQs fireworks or even discarded smoking materials could introduce an ignition source to the Augean site.

The Augean site is well managed however due to the risks that are outside of the control of Augean the risk to the public and the site will now increase and therefore further mitigation measures need to be considered.

### **OPTIONS**

1. Do nothing and carry on. This option does not mitigate any of the risks identified above and is therefore not a viable option and should be discounted.

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2. Increase the height of the current acoustic fence between the residential development and Augean. The height should be such that deliberate breaching of ignition sources can be reduced such as smoking materials. It is also important that it is constructed of appropriate fire resisting material which would also prevent radiated heat transferring from a fire on the Augean site. However this would not eliminate the risk from fireworks or embers from property fires bonfires and vehicle fires. Currently the gap between the new acoustic fence and the existing concrete barrier acts as a trap for combustible material, this needs to be prevented.



Figure 8 - The gap between the acoustic fence and the concrete barrier

3. Increase the height of the bays on the Augean site. Again the height should be such that deliberate breaching of ignition sources can be reduced such as smoking materials. This option would reduce the transfer of radiant heat from a single bay on the Augean site, but not eliminate the risk from fireworks or embers from property fires, vehicle fires and bonfires transferring to the Augean site.
4. Cover over the bays on the Augean site. By introducing a fire resisting roof/cover over each of the bays would reduce the risk from fireworks and other airborne ignition sources from entering the Augean site and causing a fire. This would also protect the housing, preventing radiated heat transferring from a fire on the Augean site. The fire would not spread to other bays, although the fire would be more severe as the heat would not be able to escape as quickly due to the bay being covered over.
5. Provide a tree lined earth mound along the perimeter between the residential dwellings and the Augean site boundary. This will act as a sound and visual barrier

## **Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5**

minimising the complaints made by residents. The mound will also act as a barrier protecting against radiant heat transfer in the event of a fire. The trees could also act as a barrier for chemical vapour as the leaves would absorb particles reducing odours and particulates.

6. Install sprinklers to the houses that have been built on the boundary. This would ensure that any fire in a flat or house would remain within the compartment of origin and would be prevent a fully developed fire. This would reduce the risk of property fires posing an ignition source to the Augean site. The sprinklers would offer little protection to dwellings should fire spread from the Augean site as they would only activate if fire penetrated into the dwelling, through the eaves, window or door openings. Sprinklers systems for the average 2 bedroom domestic dwellings when fitted at new build stage cost approximately £2000. If retro fitted this cost increases to approximately £4000 - £4500. However if houses are fitted with sprinklers in a group, such as a row of terraces it is possible to share water supplies and pumps which reduces the costs. When fitting sprinklers to a block of flats such as those on the Lakeside development them an approximate cost of £1500 per flat can be assumed.
7. Install a drencher system to the external wall of the block of flats adjacent to the Augean site. A Drencher system is one that is designed to work on the outside of a building rather than the inside. It is used most commonly in situations where one building is closely adjacent to the protected building and the transfer of fire from one to the other is a possibility. A drencher system discharges water over the outside, over windows and any other wall opening which may allow fire to get inside the building and continue to spread. The Drencher system heads can be either sealed or open, depending upon how the design works along with additional systems inside the building. Sealed heads operate in the same manner as sprinkler heads and work as an extension of an existing sprinkler installation. Open heads can be used as a separate system, which would then be activated manually or automatically through a separate detection system. The difficulty with drencher systems is that there is not British Standard available, although they use all the components used in sprinklers systems. They use a large amount of water, an approximation for protecting the gable end of the flats is 300l/m requiring a tank of 10,000l and costing

## Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5

just under £20,000. This would ensure that any fire in the Augean compound was prevented from spreading to the housing as it would act as boundary cooling to the walls. However the drencher system would only protect the flats from external fires and not from a fire in a flat. This option would not reduce the risk of property fires posing an ignition source to the Augean site.

8. Install a flooding system to the Augean site covering the bays. This would ensure that any fire in the Augean compound would be prevented from spreading to the housing. The fire would be suppressed or even extinguished.
9. Prohibit the use of the nearest houses for members of the public. Use the houses nearest to the site as office accommodation for Augean Plc. This would ensure that the housing closest to the Augean perimeter are managed and occupied by people who understand the chemicals and the facility operations.
10. Demolish the houses and flats near to the boundary of Augean Plc which would reduce the risk of property fires posing an ignition source to the Augean site.
11. Relocate the Augean facility to a more remote site. Moving the site would remove the risks completely, allowing the housing development to increase in size offering more housing. Augean would be able to develop their business and fully utilise their permit allowances.

### CONCLUSIONS

Regulation 3(2) of the Housing Health and Safety Rating System (England) Regulations 2005 prescribes that the risk of harm arising from hazard may be at a dwelling or house in multiple occupation (HMO), or “in any building or land in the vicinity of the dwelling or HMO”. This implies that risk identified from land (Augean) in the vicinity of the dwelling (Lakeside Boulevard) needs to be addressed and reduced as far as reasonably practicable.

In order for this to be read in context the full document can be found using the link below;

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/9425/150940.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9425/150940.pdf)

## **Report of the Deputy Chief Fire Officer Augean v Lakeside Boulevard ver5**

The hazard contour maps within the Hudson Report showed the distances from the site where the toxic levels are sufficient to cause injury or death. All persons inside the boundary are at risk of toxic exposure and potential death.

When any of the options from 1 to 10 above are implemented these would purely provide mitigation only, and a number of options will be needed to work in partnership. However care should be taken when choosing several options as they can have opposing influences. Only option 11 will remove all the risks.

### **RECOMMENDATIONS**

Having looked at the perceived hazards and possible scenarios, using a selection of options will mitigate some of the hazards. Only option 11 will remove the risk of the toxic gases to the residents of domestic properties, and will remove all the risks, encouraging both the Lakeside Development and Augean Plc to grow their respective businesses.

Relocating the Augean facility to a more remote site would remove the risks completely. The housing development could increase in size offering more housing options within the current Augean site. Augean would be able to develop their business and fully utilise their permit allowances moving to a more suitable site locally.



**Report  
for  
Eversheds  
Sutherland  
(International)  
LLP**

**ASSESSMENT OF RISK OF EXTERNAL FIRE SPREAD  
AT  
LAKESIDE BOULEVARD, CANNOCK**



*Fire Safety Consultants*

**April 2018**

**ASSESSMENT OF RISK OF EXTERNAL FIRE SPREAD  
AT  
LAKESIDE BOULEVARD, CANNOCK**

Report by:

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April 2018

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N/A	23 <sup>rd</sup> March 2018	First issue
1	April 2018	Amendments following request from client
2	April 2018	Report altered to reflect confirmation of fire hydrants

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## 1. INTRODUCTION

- 1.1 This report has been prepared on the email instruction of Mr R. Buxton of Eversheds Sutherland (International) LLP (“Eversheds”), on behalf of the Walsall Housing Group (“client”), to C.S. Todd & Associates Ltd (“CSTA”), dated 9<sup>th</sup> February 2018, to assess the risk of a fire at the residential development on Lakeside Boulevard, Cannock, Staffordshire WS11 (“the residential development”) impacting the neighbouring third-party waste treatment site, Augean Integrated Services, 15 Cannock Industrial Centre, Walkmill Ln, Cannock WS11 0LN (“the waste site”).
- 1.2 This report is not intended to consider the risk of a fire or any other event at the waste site affecting the residential development. The waste site operations are subject to their own risk management controls in accordance with applicable legislation that applies to the employer or person having control of the waste site. Any advice offered to reduce the likelihood of, or mitigate, such an event is offered only as gratuitous advice, and should not be considered as an implication that any particular risk has been fully addressed.
- 1.3 The residential development was visited on 13<sup>th</sup> March 2018. Prior to the visit the Client provided the following documents:
  - Report for Deputy Chief Fire Officer – Augean v Lakeside Boulevard
  - Drawings:
    - Proposed Site layout, Project No 15128, Drawing No. P03, Rev -.
    - Proposed Site layout, Project No 15128, Drawing No. P04, Rev -.
    - Proposed Site layout, Project No 15128, Drawing No. P05, Rev -.
    - Proposed Site layout, Project No 15128, Drawing No. P07, Rev -.
    - Proposed Site layout, Project No 15128, Drawing No. P08, Rev -.
    - Proposed Site layout, Project No 15128, Drawing No. P100(Co), Rev -.
- 1.4 Access was not provided to the waste site, so the only information that has been provided to CSTA in relation to the waste site is the information provided in the document “*Report for Deputy Chief Fire Officer – Augean v Lakeside Boulevard*”, listed above.
- 1.5 The following section of this report contains a summary of the findings. In Section 3, the details of the site are provided, together with relevant plans, including information on the nature and proximity of the waste site, and details of the access and water supplies for the fire and rescue service. The risk of fire spread by various means is discussed in Section 4, and Section 5 details the conclusions of the analysis and recommendations.
- 1.6 The submission of this report constitutes neither a warranty of future results by C.S. Todd & Associates Ltd, nor an assurance against risk. The report represents only the best judgement of the consultant involved, and is based, in

part, on information provided by others. No liability whatsoever is accepted for the accuracy of such information.

## **2. EXECUTIVE SUMMARY**

- 2.1 The results of the analysis indicate that the risk of fire spread, via radiated heat, from a fire originating in the three-storey apartment building or the nearest semi-detached house is very low.
- 2.2 It is also considered that as the domestic houses' gardens are on the opposite elevation of the domestic houses to the boundary to the waste site, the risk of fire caused by domestic activities, such as barbeques and bonfires, is also very low.
- 2.3 It is not the intention of this report to address the potential risks presented by a fire at the waste site to the residential development and its occupants. However, it is noted that any such risks should be effectively controlled by the relevant legislation that applies to the employer or person having control of the waste site.

### 3. DESCRIPTION OF THE SITE

#### Site details

3.1 The proposed site plan, showing the layout of the residential development and the locality of the waste site, is provided below.





### **The waste site**

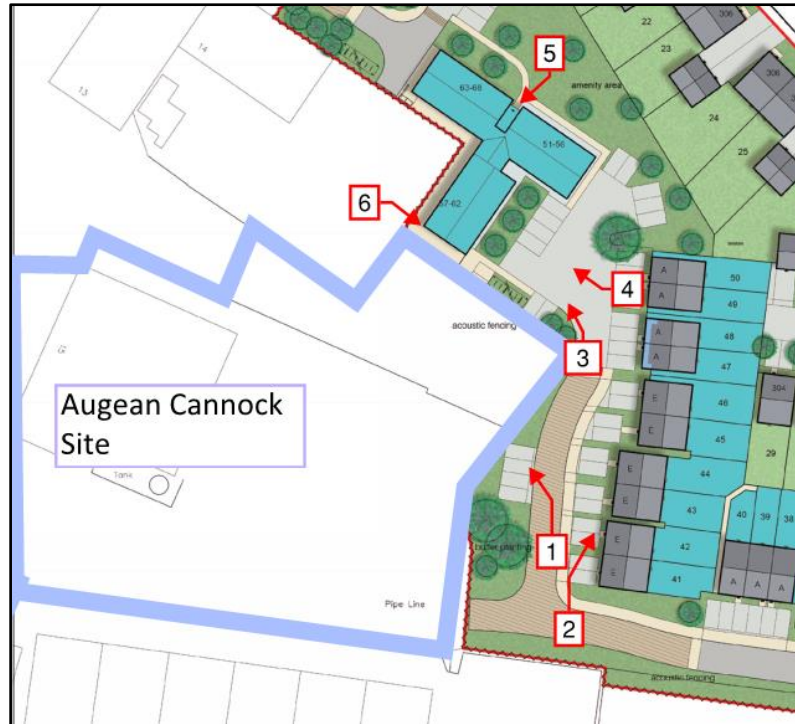
- 3.2 The waste site is a hazardous waste treatment site, managed by Augean Integrated Services PLC, operating under a permit issued by the Environment Agency. A wide range of processes are carried out, including:
- Hazardous chemical processing.
  - Radioactive waste storage and processing.
  - Stabilization.
  - Waste transfer.
  - Storage.
  - Bulking.
  - Shredding.
- 3.3 The site is classified by the Health and Safety Executive as a “sub-COMAH<sup>1</sup>” site, and is permitted to treat and manage flammable, toxic, eco-toxic, acid and radioactive waste.

### **The residential development**

- 3.4 Several digital images were taken during the site visit, some of which are provided below. The following diagram clearly shows the approximate location from where the images were taken and the approximate orientation.

---

<sup>1</sup> This definition is from the document “*Report for Deputy Chief Fire Officer – Augean v Lakeside Boulevard*”.



**Diagram of image location and direction**

The image below is taken from a road between the residential development and the waste site, looking north-west, and shows the acoustic fence between the two areas. The three-storey apartment building that is part of the residential development can be seen in the background.



**Image 1**

The image below is taken from a similar location to Image 1, but looking north-east, and shows the residential premises that are the nearest to the waste site's boundary. The white premises seen in the distance are the closest to the waste site's boundary.



**Image 2**

The image below is taken from the south-east of the apartment building and shows the three-storey apartment building.



**Image 3**

The image below is taken from a similar location to Image 3 but shows the timber fence that is on the boundary of the site, to the left of the image. There is a concrete acoustic wall on the other side of the fence.



**Image 4**

The image below shows the construction within the three-storey apartment building. As can be seen, the internal construction is blockwork.



**Image 5**

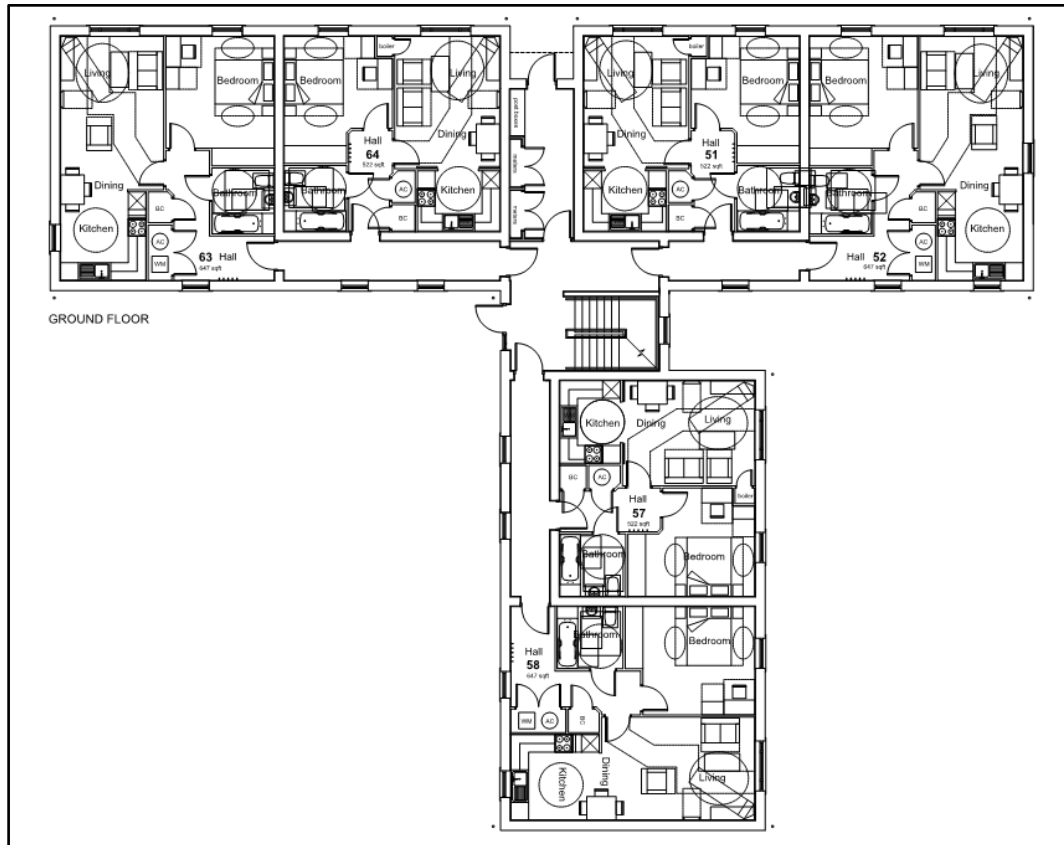
The image below shows the proximity of the south-western elevation of the three-storey apartment building to the boundary. The imperforate brick wall of the three-storey apartment building can be clearly seen.



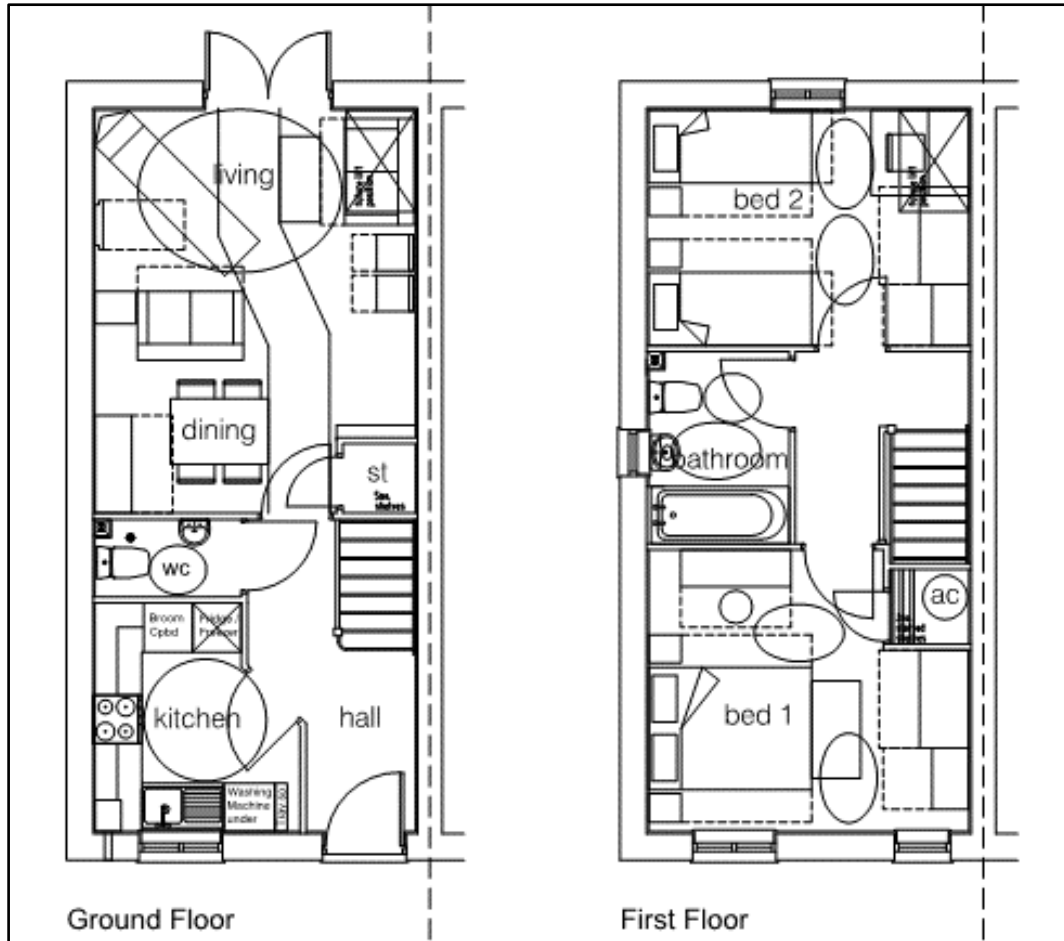
**Image 6**

## Proposed floor plans

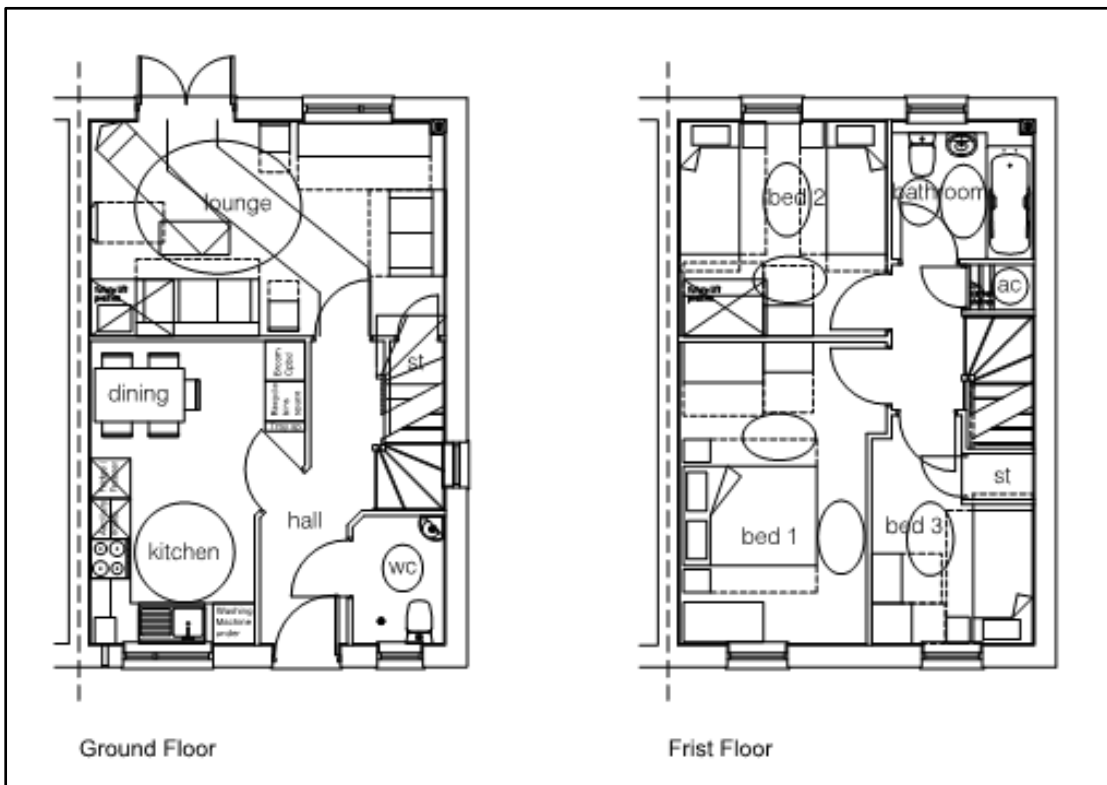
3.5 The diagrams below show typical floor plans for the residential buildings.



**Three-storey apartment building – typical floor plan**



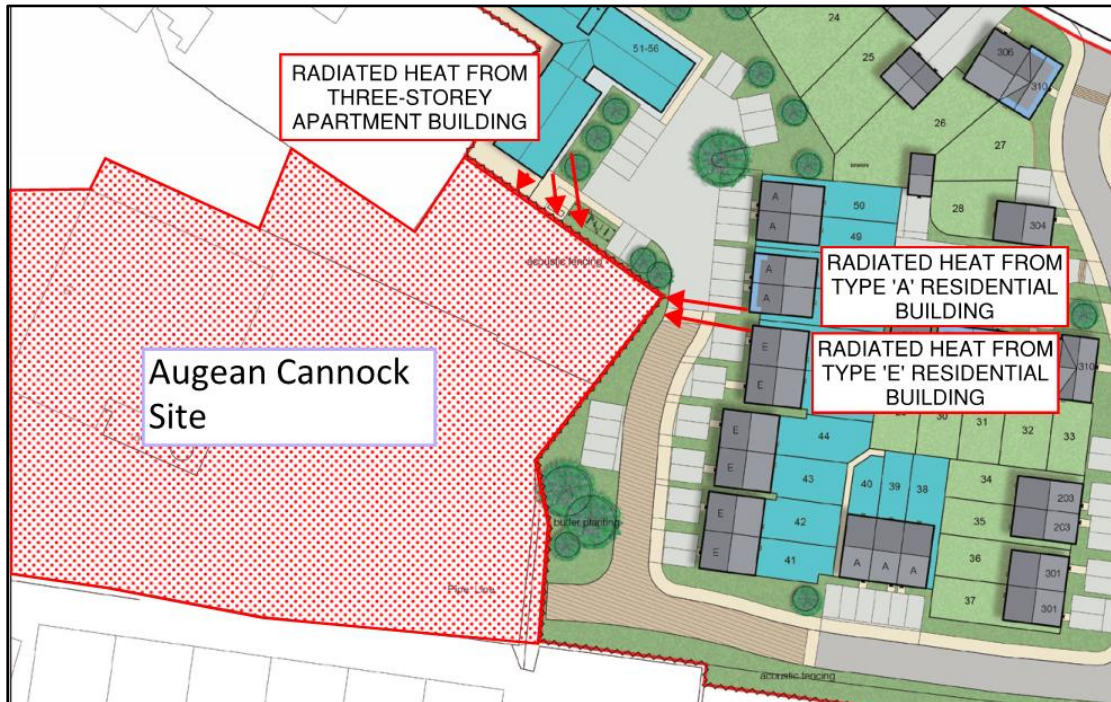
House Type 'A' – typical floor plan



House Type 'E' – Typical floor plan

### Areas of concern

- 3.6 The main reported areas of concern are the proximity of the three-storey apartment building, and the proximity of the residential buildings, to the waste site, as shown on the diagram below:



- 3.7 The three-storey apartment building is constructed from 100mm blockwork with a 100mm cavity, with 100mm of brickwork on the external elevations. The elevation of the three-storey apartment building that faces the waste site is of imperforate construction.
- 3.8 The residential buildings to the east of the waste site are also of brick and block construction. The residential buildings nearest the site boundary are facing the site, but appear to be a reasonable distance away. However, the risk will still be fully assessed.
- 3.9 The residential buildings to the east are of two main types, Type 'A' and Type 'E'. Although the Type 'A' dwelling is the closest to the site boundary, it is noted that the Type 'E' dwelling is slightly larger and has more window openings in the relevant elevation. Therefore, it is considered prudent to assess both types of dwelling.

### Fire and rescue service access and water supplies

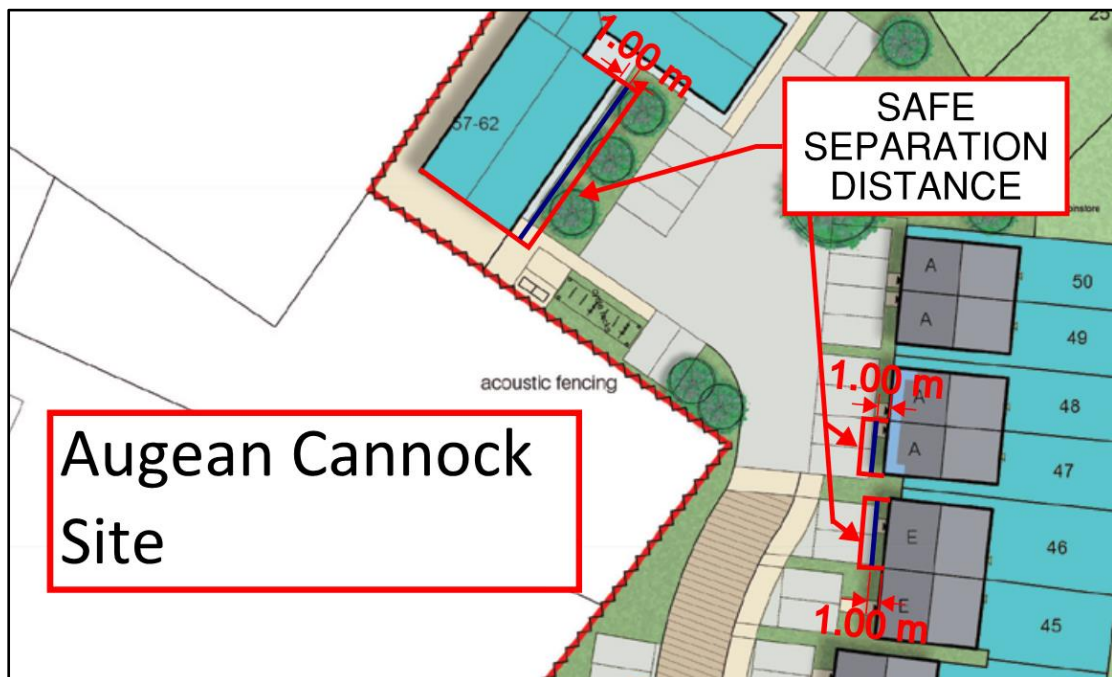
- 3.10 Access to the development for fire appliances is by means of the roads around the development.
- 3.11 A dry-rising main is provided in the three-storey apartment building, and a fire hydrant is located within close proximity to the three-storey apartment building.



## 4. RISK OF FIRE SPREAD

### Risk of fire spread via radiated heat

- 4.1 Where new premises are being constructed, the risk of fire spread between the premises being constructed and neighbouring buildings is controlled under Requirement B4 of Schedule 2 of the Building Regulations. Any new premises being constructed should not unduly affect any premises located outside the site boundary.
- 4.2 Accordingly, an analysis of fire spread via radiated heat was carried out (see Appendix A). That analysis provides a safe separation distance between the premises being constructed and any off-site risks.
- 4.3 The calculated "first limiting position", applying the guidelines of BR 187<sup>2</sup>, is shown on the plans below, in blue. The "first limiting position" is the minimum distance calculated as being necessary between an elevation of a building and the site boundary. This is calculated using the tables in BR 187, which take into account the building's use and the size of any unprotected areas of the largest fire-resisting compartment in the building, such as window and door openings. The premises under consideration should not be built any closer to the site boundary than the minimum distance specified as the first limiting position, to reduce the risk of fire spreading across this boundary to a theoretical identical building located at the same distance from the boundary. The red line shows what is considered to be the safe separation distance between any two opposing buildings and is based on twice the distance calculated for the first limiting position.



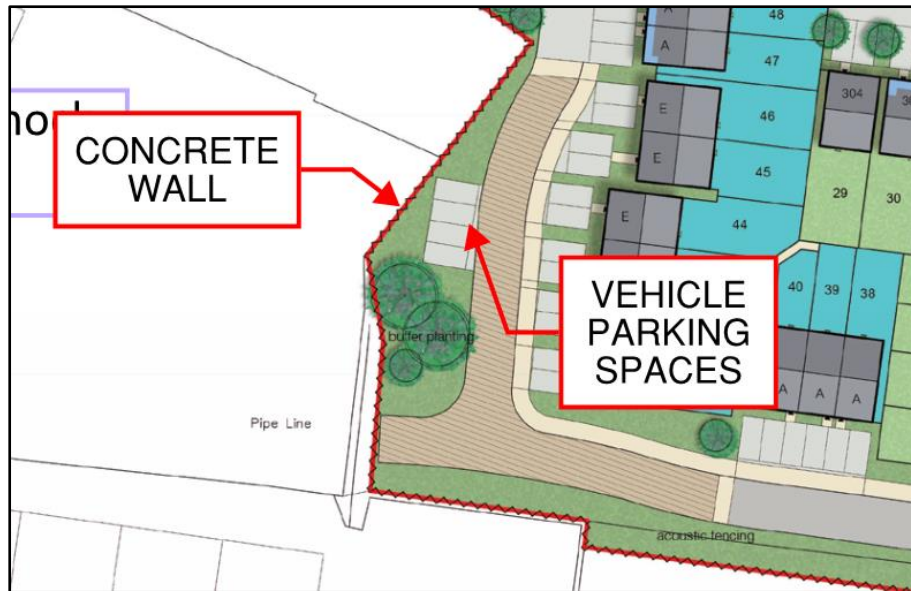
<sup>2</sup> BR 187 (2<sup>nd</sup> edition 2014): *External fire spread: building separation and boundary distances*. BRE.

#### **Calculated first limiting position and safe separation distance**

- 4.4 As can be seen, the waste site boundary is a significant distance beyond the safe separation distance from the houses and is also an acceptable distance from the safe separation distance of the three-storey apartment building.
- 4.5 For reference, the actual level of heat received at the boundary has been assessed using the thermal radiation software 'TRad' (see Appendix B, which includes an explanation of the TRad program).
- 4.6 The 'TRad' analysis confirmed that the site boundary is subject to a maximum heat flux of just 2.22kW/m<sup>2</sup>, which is significantly below the 12.56kW/m<sup>2</sup> threshold value for piloted ignition.

#### **Document review**

- 4.7 The document '*Report for Deputy Chief Fire Officer – Augean v Lakeside Boulevard*' ("the document") raises the following concerns, in specific relation to fires or risks origination in the residential development:
- Property or vehicle fires close to the boundary.
  - Domestic activities, such as barbeques and bonfires.
  - Fireworks.
  - Discarded smoking materials.
- 4.8 The risk presented by a property fire would generally be a risk caused by radiated heat, which has been considered as part of this report. This is not considered to present a significant risk.
- 4.9 The risk presented to the waste site by vehicle fires on the residential development close to the boundary is likely to be less, on a probability basis, than the risk presented by electrical forklifts and other site vehicles that would routinely be present on the waste site. However, it is noted that, as with the site operations generally, the waste site's vehicles will be subject to safety controls which should mitigate any fire risk.
- 4.10 Notwithstanding the abovementioned probability, it is noted that there are some vehicle parking spaces directly adjacent to the site boundary, as shown on the diagram below. However, the concrete acoustic fence, located on the site boundary, is of a height whereby the waste site would be significantly shielded from any radiated heat emitted from a car fire in that area.
- 4.11 The height of the acoustic fence could be increased, with a view to reducing further what is considered to be the limited risk of a vehicle fire spreading to the waste site from the residential development. Such a decision should take into account that the waste site will be required by applicable health and safety legislation to introduce measures to manage any potential risks the site presents, and such measures would certainly reduce the risk appropriately in the opposite direction. Given this, increasing the height may, therefore, not be required.



**Concrete acoustic fence near vehicle parking spaces**

- 4.12 From the site plans provided, it is clear that the residents' gardens are on the opposite side of the houses to the waste site. Therefore, the risk presented by barbeques and bonfires is considered to be minimal. In addition to this, the size of each of these gardens is not considered to be conducive to any significant size of bonfire.
- 4.13 The risk of discarded smoking materials igniting combustible waste on the site is considered to be slim. It is assumed that the waste site operator would have a suitable and sufficient fire risk assessment, which would be expected to

identify that accumulations of combustible waste, on a site where dangerous substances are stored and used, would be a matter that would require appropriate ongoing management to minimize that risk.

- 4.14 The risk of fireworks landing within the boundary of the waste site would be assumed to exist regardless of whether the residential development was directly next to the waste site or whether it was quite a distance away. As stated in 4.11, it would be expected that the amount of combustible waste within the site would be minimal, particularly in areas where flammable liquids and gases are stored.
- 4.15 Notwithstanding the remit of this report, if there is a risk to persons that is caused by the activities of the waste site, or caused by the storage of dangerous substances on the waste site, then this is likely to be addressed, primarily, by one, or more of, the following pieces of legislation:
- The Regulatory Reform (Fire Safety) Order 2005.
  - The Health and Safety at Work etc Act 1974.
  - The Dangerous Substances and Explosive Atmospheres Regulations 2002.
- 4.16 In each case, the responsibility would fall upon the employer at the waste site, or the person having control, to ensure that any risks are reduced, so far as is reasonably practicable, to an acceptable level.

#### **Comments on the mitigation options presented in the document**

- 4.17 The document contains a total of 11 mitigation options; only four of these relate to options which could be taken at the residential development. We have considered each of these in turn:

##### Increasing the height of the acoustic fence

- 4.18 As noted in 4.10 above, the current height of the fence is of a sufficient height to minimize, as far as is reasonably practicable, the risk of any vehicle fire spreading to from the residential development to the waste site.

##### Provide a tree-lined mound along the site perimeter

- 4.19 The risk of a fire spreading from the residential site to the waste site has been shown to be acceptable. Consequently, it is not considered necessary to provide a tree-lined mound along the site perimeter in order to avoid a fire spreading from the residential site to the waste site.

##### Installation sprinklers to the houses located nearest the site boundary

- 4.20 As above, the risk of a fire spreading from the residential site to the waste site has been shown to be acceptable. The provision of automatic sprinkler systems in the houses would offer no benefit in relation to this risk. It is also noted that there is no requirement within current Building Regulations for domestic houses to be provided with automatic sprinkler systems.

Installation of a drencher system to the block of flats nearest the site boundary

- 4.21 The elevation of the block of flats that is facing the waste site is an imperforate masonry wall and, in addition to this, the risk of a fire spreading from the elevation that is perpendicular to the waste site has also been shown to be well within acceptable limits. As such, there is no reasonably foreseeable risk of a fire in the block of flats spreading to the waste site. Therefore, a drencher system would offer no benefit.

## 5. CONCLUSIONS

### Conclusions

- 5.1 The results of the analysis indicate that the risk of fire spread via radiated heat from a fire originating in the three-storey apartment building or the nearest semi-detached house is very low. The TRad analysis demonstrates that the site boundary is subject to a maximum heat flux of 2.22kW/m<sup>2</sup>, which is significantly below the 12.56kW/m<sup>2</sup> threshold value for piloted ignition. It is noted that the heat flux of 2.22kW/m<sup>2</sup> is also below the recommended tenability levels for persons on escape routes. That is to say that, aside from there being no risk of fire spread to the waste site via radiated heat, the heat at the site boundary is at a level whereby persons escaping along that area would not be subject to unacceptable levels of heat.
- 5.2 It is also considered that as the domestic houses' gardens are on the opposite elevation of the domestic houses to the boundary to the waste site, the risk of fire caused by domestic activities, such as barbeques and bonfires, is also low.
- 5.3 The height of the acoustic fence could be increased, with a view to further reducing what is considered to be the limited risk of a vehicle fire spreading to the waste site from the residential development. Such a decision should take into account that the waste site will be required by applicable health and safety legislation to introduce measures to manage any potential risks the site presents, and such measures would certainly appropriately reduce the risk in the opposite direction. Given this, increasing the height may, therefore, not be required.
- 5.4 Of the 11 mitigation options presented in the document '*Report for Deputy Chief Fire Officer – Augean v Lakeside Boulevard*', only four are considered to relate to measures that can be taken within the residential development, viz:
- Increasing height of the acoustic fence
  - Provide a tree lined mound along the site perimeter
  - Installation sprinklers to the houses located nearest the site boundary
  - Installation of a drencher system to the block of flats nearest the site boundary

As discussed in Section 4, as the risk of a fire spreading from the residential development is within acceptable limits, none of these measures are considered necessary in specific relation to the risk of a fire spreading from the residential development to the waste site.

- 5.5 It is not the intention of this report to address the risk presented by the waste site to the residential development, but it is noted that any such risks should be effectively controlled by the relevant legislation that applies to the employer, or person having control, of the waste site. The relevant legislation that is

applicable would require that the risks are removed or reduced so far as is reasonably practicable, and that, where risk remains, appropriate protective measures are provided, so far as is reasonably practicable. Assuming that the legislative obligations of the employer/person having control of the waste site are met, the risk to the residential site should be able to be assumed as being within acceptable limits.

- 5.6 Taking all of the above findings into account, the design of the residential development is not considered to present any significant risk to the waste site.

### **Recommendations**

- 5.7 In relation to any ongoing risk presented by the activities within the construction site, further information in relation to fire safety within construction site is contained in the documents listed below:
- *Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation*, published by the Construction Confederation and The Fire Protection Association.
  - *HSG168 Fire Safety in Construction*, published by the HSE.

## **APPENDIX A - BR 187 ANALYSIS**

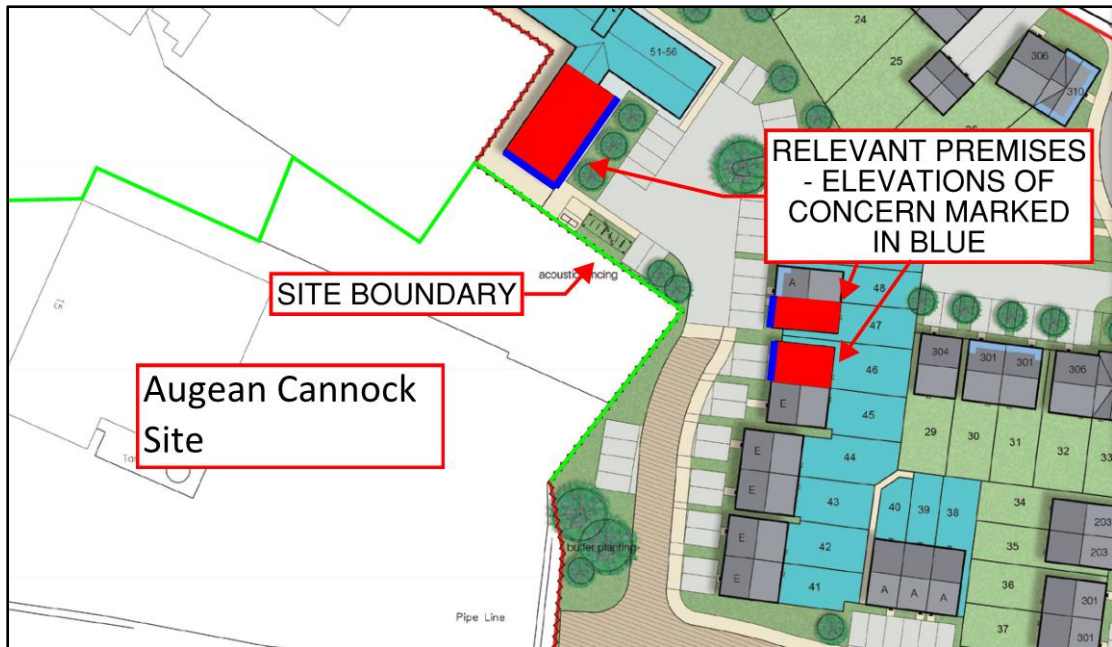


## **1. INTRODUCTION**

- A1.1 Guidance for the calculation of possible fire spread has been taken from BR 187. This document describes different methods of calculating adequate space separation between buildings. It has been prepared in support of ADB in relation to the Building Regulations' functional requirement B4 and is directed towards achieving suitable distances between adjacent buildings to minimise the risk of external fire spread.
- A1.2 The method of analysis used in this report is the Enclosing Rectangles (Geometric Method).
- A1.3 In this method, the elevation is viewed, and a rectangle drawn around the unprotected areas; a table (see BR 187) then gives the minimum boundary distance for this size of rectangle and this proportion of unprotected area. The process is repeated for all relevant elevations of the building so that a trace on plan is obtained. If the site boundary falls outside the trace, then further calculation is not usually necessary.
- A1.4 In BR 187, two sets of tabulated data are provided to represent the different amounts of fire load likely to be present in different building types. For example, shops are generally considered to have a higher fire load per unit of floor area than residential buildings.

## **2. RELEVANT SITE BOUNDARIES**

- A2.1 To apply the method of enclosing rectangles, it is necessary to identify appropriate boundaries as a basis for analysis. The use of the distance to a boundary rather than to another building, in measuring the separation distance, makes it possible to calculate the allowable proportion of unprotected areas, regardless of whether there is a building on an adjacent site, and regardless of the location of that building, or the extent of any unprotected areas it might have.
- A2.2 In this case, the boundary is the clearly defined site boundary between the residential development and the waste site, as shown by the green line on the diagram below. The relevant elevations of the residential buildings are marked on the diagram below.



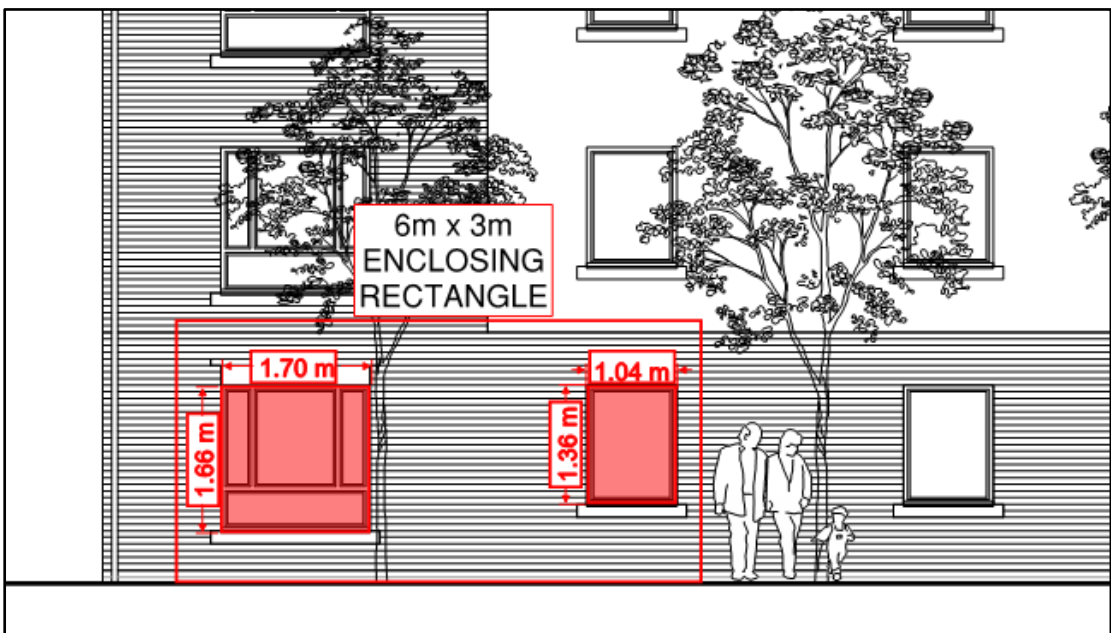
### 3. ASSESSMENT OF THE BUILDING ELEVATIONS

- A3.1 This is not intended to be a full appraisal of compliance with the relevant functional requirements set out in Requirement B4 of Schedule 2 of the Building Regulation, as only the relevant elevations of concern are being considered.
- A3.2 The only buildings being considered are the buildings that are the closest to the boundary, as if the risk of fire spread from the closest relevant premises is acceptable then any premises that are a greater distance away from the site boundary would also clearly be acceptable.
- A3.3 The buildings nearest to the site boundary are all constructed from standard brick and block construction. Therefore, the unprotected areas requiring consideration will be any window and door openings only.
- A3.4 It is only necessary to consider the heat being emitted from the largest compartment on the relevant elevation. In the case of a semi-detached house, the largest compartment would be one dwelling, and in the case of the three-storey apartment building the largest compartment could be one flat.
- A3.5 The dimensions for the building elevations were taken from plans provided by the Client.

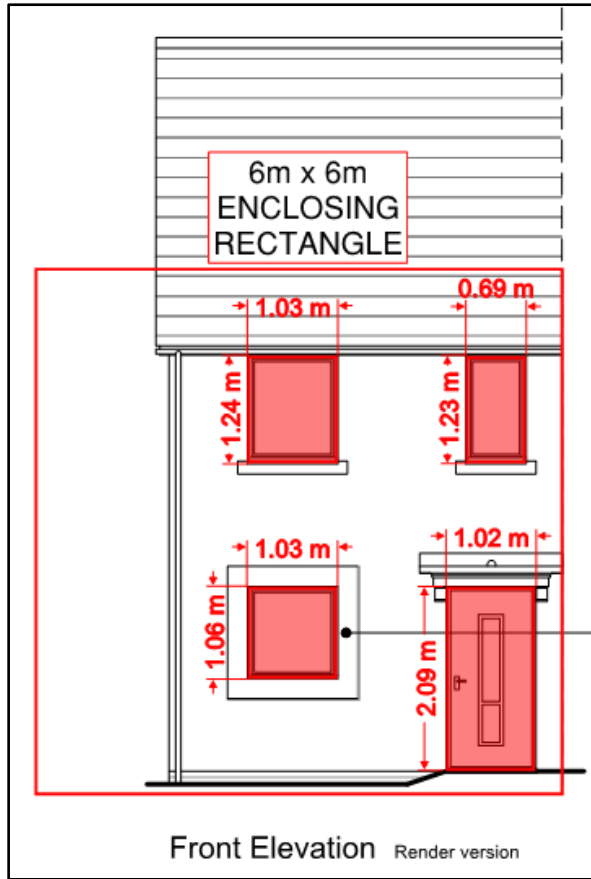
### Plans showing elevations and enclosing rectangles applied



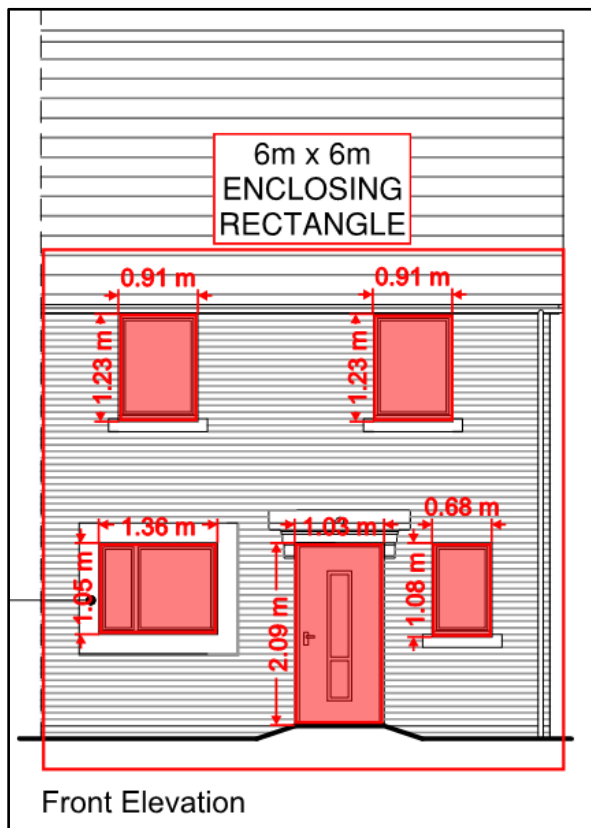
Three-storey apartment building – south-west elevation  
(no unprotected areas on the relevant part of the elevation)



Three-storey apartment building – south-east elevation



House Type 'A' – west elevation



House Type 'E' – west elevation

A3.6 The enclosing rectangles marked on the plans above are selected to approximate the radiating plane of the building. The unprotected areas are expressed as a percentage of the area of the enclosing rectangle provided in the tabulated data in BR 187 and are rounded up to the nearest 5% to add an additional factor of safety.

**Assessment of the south-east elevation of the three-storey apartment building**

A3.7 The following criteria have been applied:

- Enclosing rectangle BR 187 of 3m height.
- Enclosing rectangle BR 187 of 6m width.
- 25% unprotected openings applied.
- Boundary calculated at 50% of distance for received radiant heat flux of 12.56kW/m<sup>2</sup>.
- Radiator emitting at the theoretical maximum of 83.6kW/m<sup>2</sup>.

Calculated limiting position = 1m

**Assessment of the west elevation of house type 'A'**

A3.8 The following criteria have been applied:

- Enclosing rectangle BR 187 of 6m height.
- Enclosing rectangle BR 187 of 6m width.
- 15% unprotected openings applied.
- Boundary calculated at 50% of distance for received radiant heat flux of 12.56kW/m<sup>2</sup>.
- Radiator emitting at the theoretical maximum of 83.6kW/m<sup>2</sup>.

Calculated limiting position = 1m

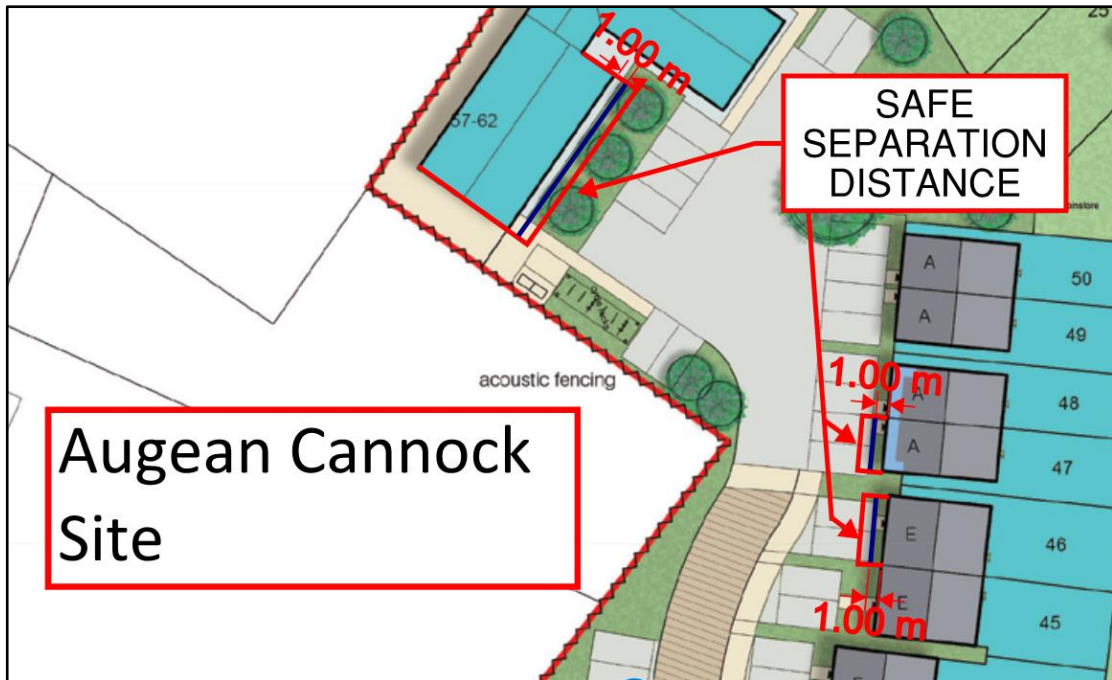
**Assessment of the west elevation of house type 'E'**

A3.9 The following criteria have been applied:

- Enclosing rectangle BR 187 of 6m height.
- Enclosing rectangle BR 187 of 6m width.
- 20% unprotected openings applied.
- Boundary calculated at 50% of distance for received radiant heat flux of 12.56kW/m<sup>2</sup>.
- Radiator emitting at the theoretical maximum of 83.6kW/m<sup>2</sup>.

Calculated limiting position = 1m

A3.10 The calculated first limiting positions for the relevant premises are shown on the plan below. The highlighting in blue on the plan shows the calculated first limiting position for the relevant premises, applying the guidelines of BR 187.



**Calculated first limiting position and safe separation distance using BR 187**

- A3.11 It should be noted that the first limiting position is not intended to represent a distance whereby the risk of fire spread is deemed to be acceptable; the limiting position represents a boundary, whereby an identical building could be built that same distance away, on the opposite site of that boundary, and the risk of fire spread between both those two buildings would be deemed acceptable.
- A3.12 The red highlighting on the plan above shows the boundary at a distance equal to twice the first limiting position. This is considered to be the safe separation distance.
- A3.13 As can be seen, all of the relevant premises are a suitable distance away from the site boundary for the risk of fire spread through radiated heat to be of practically no concern, in accordance with the recommendations of BR 187. However, to ascertain the actual level of heat received at the boundary, further analysis has been undertaken (see Appendix B).

## **APPENDIX B - 'TRad' ANALYSIS**

## 'TRad' thermal radiation model

### 1. INTRODUCTION

B1.1 Additional analysis of the risk of external fire spread has been completed using the thermal radiation software, 'TRad'. 'TRad' provides a flexible and versatile tool to compute the radiation distribution received on exposed walls (receivers) due to thermal radiation from any number of unprotected areas (radiators).

B1.2 The radiation intensity calculation is based on the fundamental inverse square law, as shown in accordance with the equation below. The normal radiation intensity received at point P on the receiver can be expressed as:

$$I_P = \int I_E \frac{\cos \alpha_1 \cos \alpha_2}{\pi R^2} dA$$

in which  $\alpha_1$  and  $\alpha_2$  are the normal angles of the radiator plane and the receiver plane respectively, as shown below. The received radiation depends on the radiation intensity distribution  $I_E$  from the emitting point, the distance  $R$  between the emitting point and the point P, and the relative orientations  $\alpha_1, \alpha_2$  ( $<90^\circ$ ) between the emitter and the receiver, as illustrated in Figure 1 below. The integration is carried out numerically over the entire area  $A_E$  of the radiator.

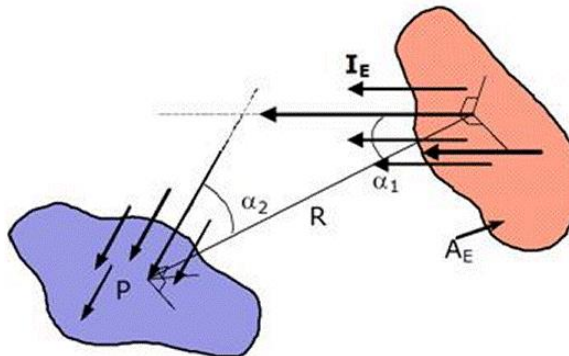


Figure 1

B1.3 The emitter intensity for each relevant elevation has been calculated for input into the 'TRad' model, using the equation below.

$$P = T_f^4 \varepsilon_f \sigma$$

Where: P is the radiative heat flux from the emitter ( $\text{kW}/\text{m}^2$ ).

$\sigma$  is the Stefan-Boltzmann constant ( $5.67 \times 10^{-11}$ ).

$T_f$  is the flame temperature at the emitter surface in Kelvin.

$\varepsilon_f$  is the emissivity of the flames.



### Emitter variables

B1.4 The following variables have been applied:

Emitter flame surface temperature:	1000°C <sup>3</sup>
Emissivity:	1
Flame height:	Height of opening + 20%

B2.1 Based on the above variables, the intensity of radiation from the emitter has been calculated as approximately 148.9kW/m<sup>2</sup>. It is noted that this level of radiation is far in excess of the assumption of 83.6kW/m<sup>2</sup>, made in BR 187 in relation to residential premises. Therefore, any results obtained are considered to incorporate a significant factor of safety.

## **2. MODEL DETAILS**

B2.2 Screenshots from the 'TRad' model are shown below. The model was created to demonstrate the radiation received at the site boundary in the event of a fire in any of the premises of concern. As opposed to running three separate models, all of the relevant premises of concern have been included in the same model and are all modelled as emitting heat at the same time.

B2.3 All unprotected openings have been included as emitters on each elevation.

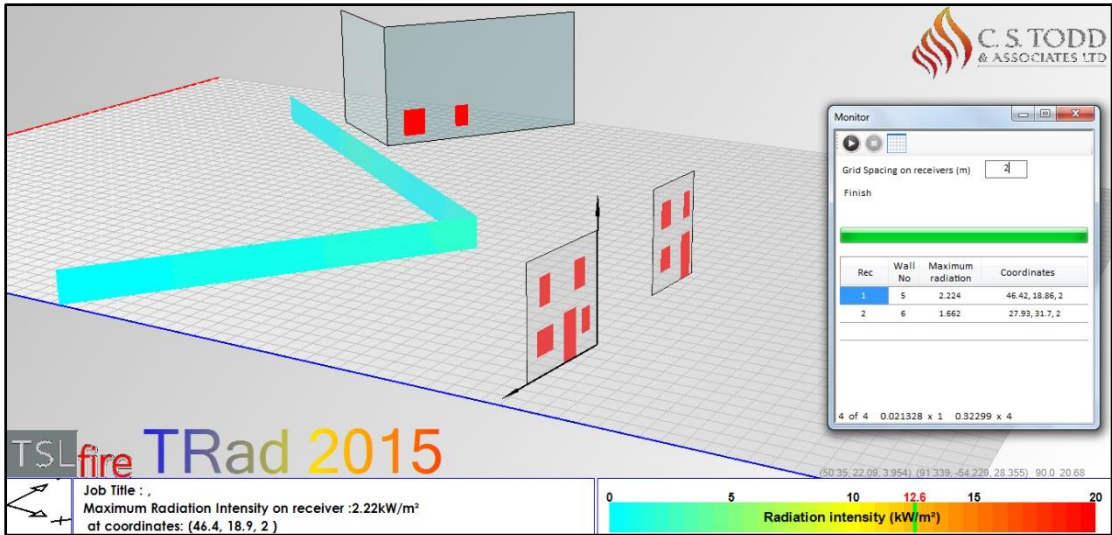
## **3. MODEL RESULTS**

B3.1 The model demonstrates that the site boundary is subject to a maximum heat flux of 2.22kW/m<sup>2</sup>, which is significantly below the 12.56kW/m<sup>2</sup> threshold value for piloted ignition.

B3.2 It is noted that the heat flux of 2.22kW/m<sup>2</sup> is also below the recommended tenability levels for persons on escape routes. That is to say that, aside from there being no risk of fire spread via radiated heat, the heat at the site boundary is at a level whereby persons escaping along that area would not be subject to unacceptable levels of heat.

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<sup>3</sup> Utilizing a value of 1000°C for the emitter flame surface temperature is considered to include a significant factor of safety. It is noted that testing carried out by the Structural Timber Association, involving unprotected timber frames, recorded a heat output that equated to a temperature of 850°C.

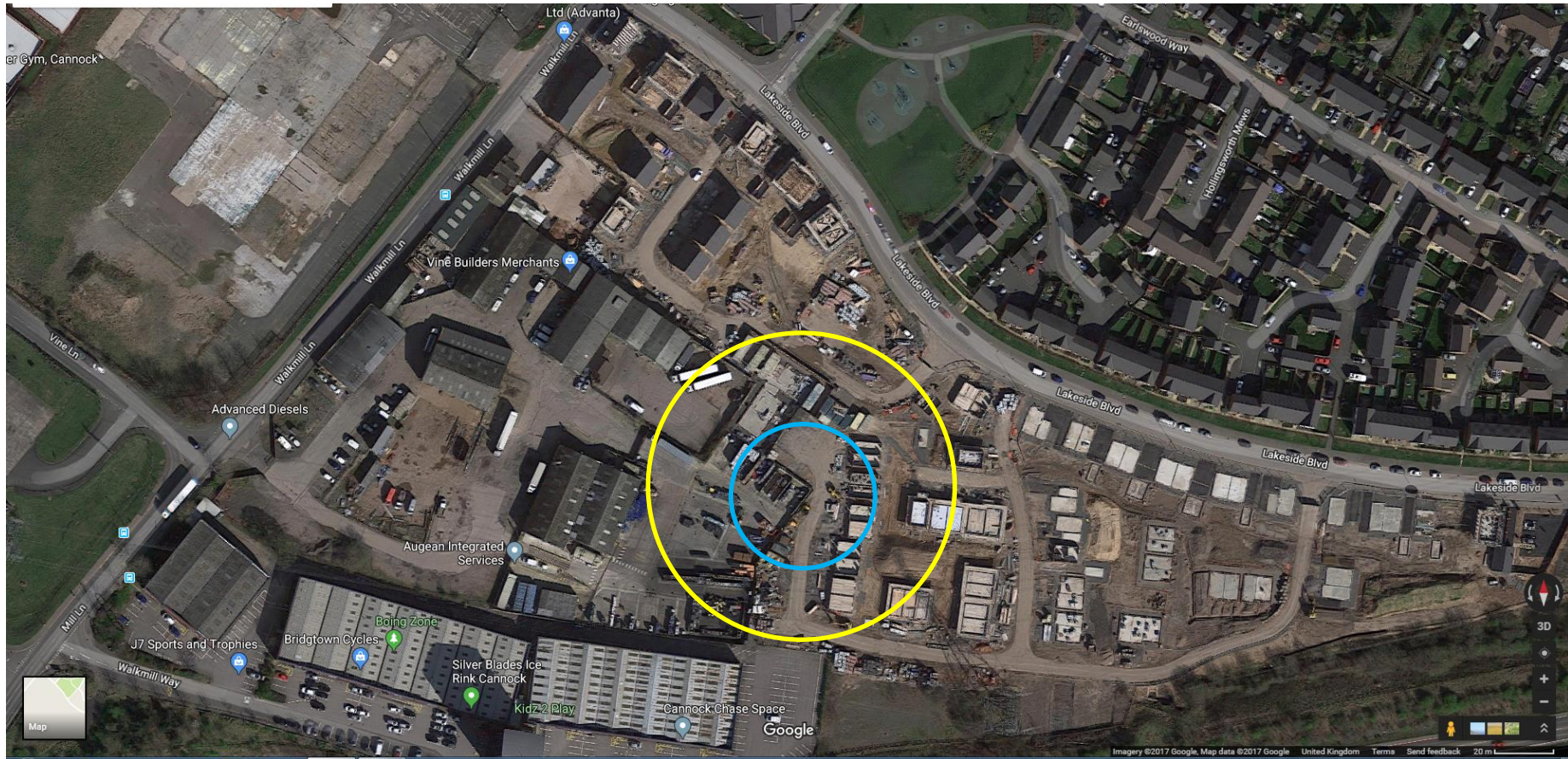


**Heat received at the site boundary**

Rec	Wall No	Maximum radiation	Coordinates
1	5	2.224	46.42, 18.86, 2
2	6	1.662	27.93, 31.7, 2

**Detail of maximum radiation on the boundary**

## Appendix 1

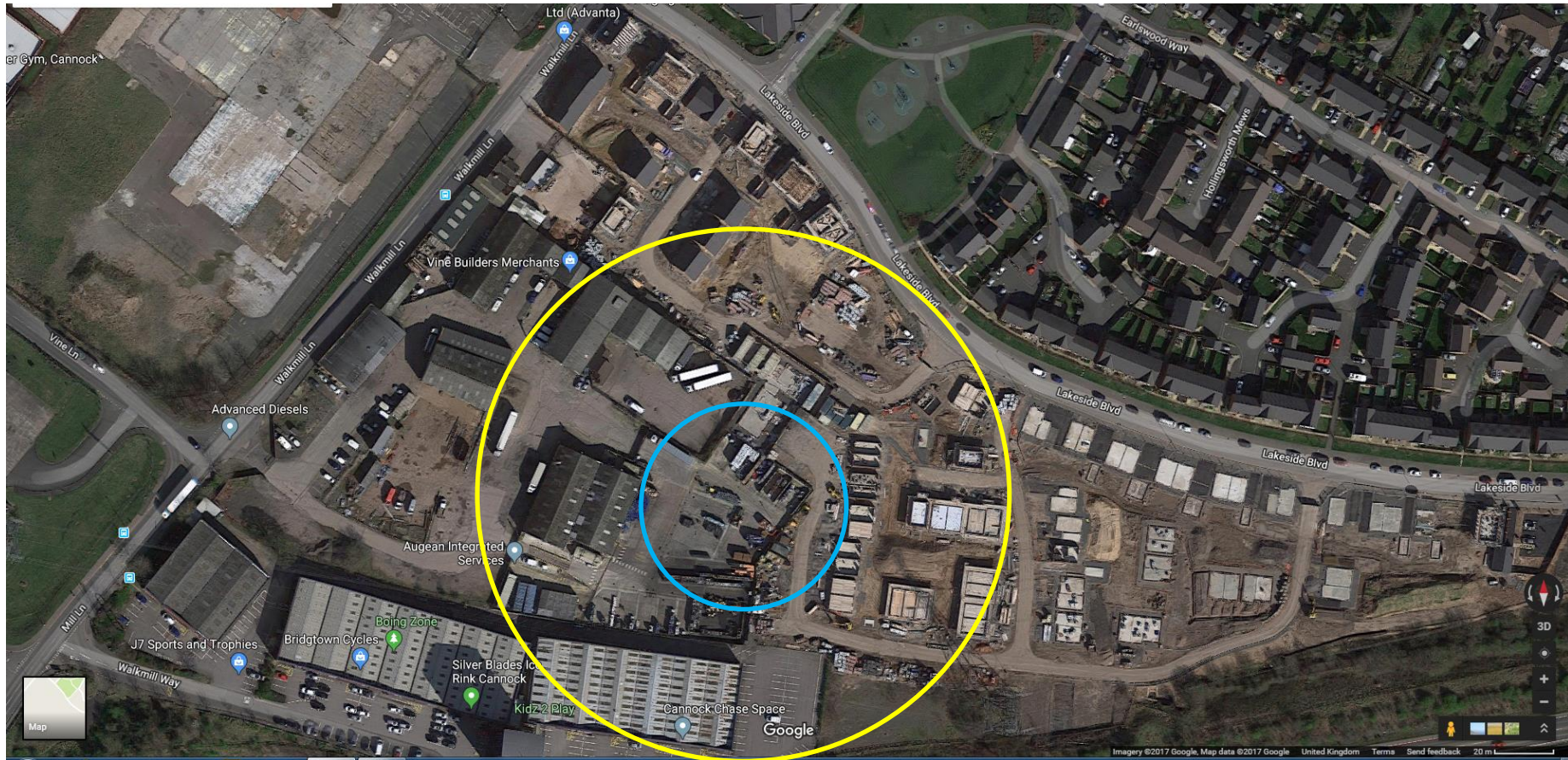


Methanol bay fire during the night 7.9m – 24kW/m<sup>2</sup> resulting in 100% lethality



Butane bay fire during the day 33m – 24kW/m<sup>2</sup> resulting in 100% lethality

## Appendix 2



Methanol fire entire site during the night 29m – 24kW/m<sup>2</sup> resulting in 100% lethality (no contour shown in by Hudson)



Butane fire entire site during the day 92m – 24kW/m<sup>2</sup> resulting in 100% lethality