

Before the Independent Commissioner Hearing Panel

Under the Resource Management Act 1991 (**RMA**)

In the matter of an application by **Dunedin City Council** to develop a landfill at Smooth Hill, Dunedin.

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**Statement of evidence of Anthony Dixon**

29 April 2022

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**Applicant's solicitors:**

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**anderson  
lloyd.**

## Qualifications and experience

- 1 My name is **Anthony Dixon**.
- 2 I am a Technical Director and the Business Group Manager for Waste Management in GHD's Sydney office.
- 3 I have a Bachelor degree in Chemical Engineering (Honours) from the University of New South Wales (graduating in 1991), a Master of Environmental Engineering from the University of Sydney (graduating in 1992) and a Master of Engineering in Groundwater Management from the University of Technology Sydney (graduating in 2003).
- 4 Since 1992, I have worked on landfill related projects in New South Wales (NSW) and Queensland in Australia, and in New Zealand. I have regulatory experience gained through a previous role as the Principal Technical Advisor – Waste Disposal at the New South Wales Environment Protection Authority (NSW EPA) where I led a team which advised on environmental performance, engineering and licensing of waste projects in NSW.
- 5 While working for the NSW EPA, for one project I reviewed the complaints made to the EPA about rural landfills in NSW. This identified a high proportion of complaints were due to fires and associated smoke. Since then, I have provided expert advice on several projects relating to landfill fires. This included:
  - (a) Expert advice on investigation of a fire at a waste storage and processing facility in Chester Hill for the NSW EPA;
  - (b) Review of possible causes and advice on methods to extinguish and prevent fires in landfills for two confidential clients operating landfills in NSW; and
  - (c) Review of the possible operational and response factors that may have exacerbated the spread and extent of a landfill fire for a confidential client operating a landfill in the North Island of New Zealand.
- 6 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

## **Scope of evidence**

- 7 I have been asked to prepare evidence in relation to landfill fire risks. This includes:
- (a) Comments on the Otago Regional Council (ORC) peer review;
  - (b) Comments on the section 42A report;
  - (c) Response to matters raised in submission as it relates to landfill fire risk; and
  - (d) Any other issues that I deem relevant to the frequency, extent, monitoring and mitigation of landfill fires.

## **Executive summary**

- 8 The proposed landfill site will accept waste materials that present fire risks to on-site staff, equipment and infrastructure; and off-site vegetated land and residents, if not appropriately managed.
- 9 I have undertaken an assessment of the project to enable me to advise on fire control measures proposed in the application.
- 10 As part of my assessment of the project, I have reviewed:
- (a) the existing and proposed site layout, design, operational plan and topography to identify key fire risk areas
  - (b) relevant literature guidance for the management of landfill fires.
- 11 I have also considered the types of fires that can occur at a landfill, with these being surface and subsurface fires and the typical sources of landfill fires, along with the findings in relation to recent records of landfill fires that have occurred at the current Dunedin landfill (Green Island Facility).
- 12 Based on my review and investigations I have recommended several design, monitoring and operational changes to the project which are reflected in the evidence of Richard Coombe and in my evidence herein. The justification for some of the changes to the project with respect to fire risks are also detailed in the evidence of Paul de Mar and Rhys Girvan, with Matt Welsh advising on additional monitoring requirements with respect to landfill gas.
- 13 The primary control to reduce the risk of a surface fire is to have a small active tipping area, which is under observation, with plant and equipment readily available to suitably trained staff to quickly extinguish surface fires.

All other areas should be covered with inert cover materials which are available throughout the life of the landfill. The risk of subsurface fires can be significantly reduced by carefully ensuring all surface fires are extinguished before placing more waste (or cover) over the fire impacted waste and by managing and monitoring the gas extraction system to reduce the ingress of air.

- 14 While appropriate fire control measures are proposed to be applied at the site, it is not practicable to fully eliminate potential fire sources. Accordingly, early fire detection measures, and on-site fire suppression capability will be applied to address the residual risk that the fire control measures are not able to eliminate.
- 15 I consider that with the control and early fire detection measures and on-site fire suppression capability proposed in the application, fire risks arising from the development can be managed to acceptable levels, consistent with industry practice.

## **Introduction**

- 16 The Dunedin City Council (DCC) has proposed development of a new Class 1 landfill site as part of the Waste Futures Project to replace the current Green Island Landfill which is scheduled to close around 2028. The Smooth Hill landfill site(the Site) is located off Big Stone Road in south west Dunedin. An assessment of Environmental Effects for Updated Design was prepared by Boffa Miskell Limited in May 2021. This assessment is based on the updated Smooth Hill landfill design documented in GHD's May 2021, Landfill Concept Design Report and operational measures contained in GHD's June 2021, Draft Landfill Management Plan.
- 17 Following my review of fire related issues some aspects of the landfill concept design have been refined. These refinements are included on attachments to Richard Coombe's design evidence and Rhys Girvan's landscape evidence, which in turn takes into account the evidence of Paul de Mar. Relevant project elements related to fire management are summarised in Attachment 1.
- 18 An overview of the potential sources of landfill fires and key risk pathways has been provided below to provide context for the response to submissions.
- 19 I have identified the key themes of the submissions relating to landfill fire concerns. In response to the submissions, I have analysed the controls already proposed for the project and put forward some additional measures which are reflected in the evidence referenced above and Attachment 1.

## What are the potential sources of landfill fires?

- 20 Landfill fires are not uncommon at an operational landfill site. Therefore, the key issue is how they can be minimised and best contained so that small regular fires are promptly identified and extinguished at the source and do not become a large catastrophic fire.
- 21 There are two main types of fires that occur at landfills. Surface fires at a landfill can occur in recently placed and/or exposed waste. Subsurface fires are caused by exothermic reactions that occur below the surface of the landfill or from a surface fire not being extinguished and extending into the waste. Subsurface fires tend to travel more slowly than surface fires and would be limited to the extent of the landfill.
- 22 As part of the development of this evidence, GHD engaged with relevant organisations that have expertise in the area of landfill fires and sought additional information in relation to the occurrences and causes of landfill fires in New Zealand. This engagement is summarised in Table 1 2.

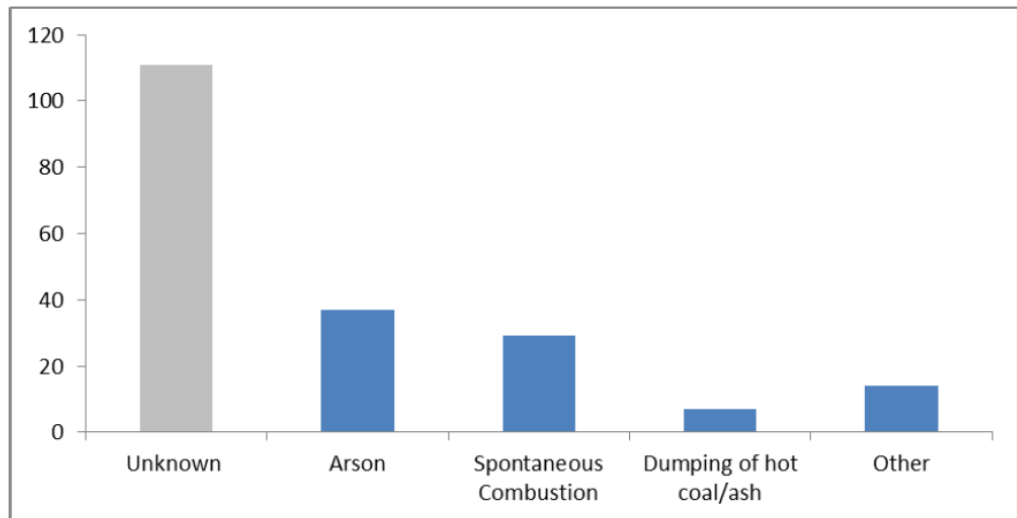
*Table 1 Summary of consultation activities*

Agency	Timing	Description
Environmental Protection Agency (EPA)	February 2022	The EPA was contacted through their information services line regarding local landfills and fire management. GHD were notified that the landfills were managed on a local level and individual councils should be contacted for further information.
WasteMINZ	February 2022	WasteMINZ provided the following reference documents via email for landfill fire prevention and design and reporting requirements: <ul style="list-style-type: none"> <li>– WasteMINZ, 2018, Technical Guidelines for Disposal to Land, WasteMINZ, Auckland</li> <li>– H&amp;S Guidelines for the Solid Waste and Resource Recovery Sector – parts one, two, three, four and five</li> </ul> WasteMINZ were not aware of any specific technical guidance or guidelines around landfill fires.
Fire and Emergency New Zealand (FENZ)	February 2022	FENZ were contacted via email regarding the incidence of fires in the Brighton area. A response letter was received on 9 March 2022 that identified three wildfires that had occurred in Brighton, Dunedin between 2014 and 2018 that required assistance from FENZ.
Dunedin City Council (DCC)	February 2022	In email correspondence DCC noted that any incidences of fire at the Green Island Facility are reported to DCC and FENZ (if required).
Waste Management NZ Ltd	February 2022	GHD received a record of landfill fires reported to DCC at the Green Island Facility between August 2017 and April 2022 from the Green Island Facility operator. The Green Island Facility includes waste transfer station, landfill and composting activities, noting that the Smooth Hill application is proposing a landfill operation only.

- 23 Based on review of the information provided from the Green Island Facility, the following findings were identified:
- (a) Twelve landfill fires were reported at the Green Island Facility between August 2017 and April 2022. All of these fires were classified as either minor or insignificant;
  - (b) Three fires occurred in composting windrows due to insufficient turning of the windrows resulting from limited access to the clay compost pad during wet weather;
  - (c) Two fires occurred at the transfer station within the hooklift bins due to the presence of batteries;
  - (d) Seven fires occurred at the landfill active filling area and were identified to be caused by:
    - (i) Chemical reaction from hydrated lime delivered to the landfill
    - (ii) Three battery fires
    - (iii) Hot loads received at the landfill on two occasions
    - (iv) Fire started by heated debris that had built up under the axle guard of the compactor
  - (e) Majority of the fires were detected by visual observation of smoke
  - (f) The fires at the compost pad and in the transfer station were extinguished using water.
- 24 The fires detected at the tipping face were extinguished by digging out of the hot spot, extinguishing with water and placement and compaction of clay material. In two out of the seven landfill fires, FENZ was called to assist in controlling the fire.
- 25 Based on a review of the site setting, typical causes of landfill fires identified in literature, and the records of landfill fires reported at Green Island Facility between August 2017 and April 2022; in addition to my own experience, the following potential causes of landfill fires (surface and subsurface) have been identified.
- (a) Dumping of hot materials;
  - (b) Pilot ignition from vehicles;
  - (c) Deliberate ignition from arson or mixing of reactive materials;

- (d) Extreme weather conditions such as extended dry and hot weather;
- (e) Large area of exposed waste at the surface of the landfill;
- (f) Over extraction of landfill gas;
- (g) Air ingress into landfilled waste other than due to landfill gas collection systems operations;
- (h) Poorly designed leachate re-circulation system;
- (i) Embers from another fire;
- (j) Hot works;
- (k) Lightning;
- (l) Poorly maintained equipment or faulty electrical wiring;
- (m) Spontaneous combustion of materials;
- (n) Combustion of lithium ion batteries;
- (o) Burying of surface fires; or
- (p) A combination of the above.

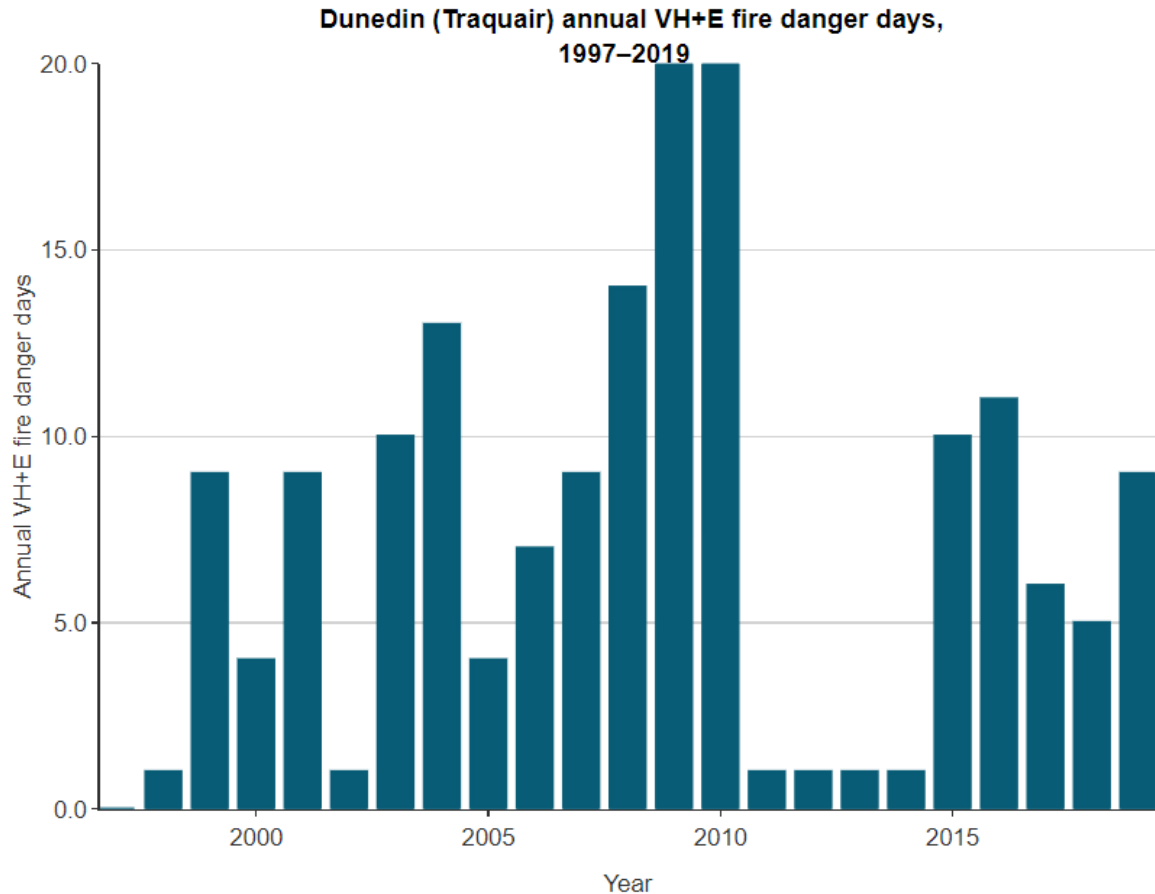
26 However, quite often the cause of a landfill fire whether it be a surface fire or hot spot below the landfill surface is unknown. The review by ISF 2016 from data provided by the NSW EPA for landfill fires between the start of 2014 and April 2016 indicated that the cause for the majority of these fires in NSW Australia was recorded as unknown (refer **Figure 1**). This is also supported by international studies by FEMA (2002) that concluded more than half of fires at landfills have no known cause.



**Figure 1 Causes of fires in New South Wales (ISF, 2016)**

- 27 Similarly, the UK Environment Agency (2007) reviewed 78 incidents at landfills to identify the main causes and contributing factors for hot spots which in some cases can cause a surface fire. Air ingress to the waste as a result of active gas extraction system management was suspected to be the primary contributing factor for the majority of sites (62%). An active landfill gas extraction system is proposed to be installed at the Smooth Hill site. Details on the management of this system are provided in the evidence of Matt Welsh.
- 28 I consider that the risk of arson causing a fire at the site is low as waste will not be delivered to the site by the general public and the site will be fenced and gated to control entry.
- 29 The site is surrounded by pine plantation forest which is combustible. There are 3000 to 4000 wildfires in New Zealand each year (Statistics New Zealand 2020). **Figure 2** shows that the Very High and Extreme (VH+E) fire danger days are likely increasing across 1997 to 2019.





**Figure 2 VH+E fire dangers days – Dunedin (Traquair) (Stats NZ, 2020)**

- 30 In the last 5 years or so, waste fires identified as being due to lithium-ion batteries have started to become more widely reported by the waste industry and internationally. It is expected that a similar trend exists in New Zealand as supported by data from the Green Island Facility. An article published by Stuff on 17 October 2021 indicated that there had been 20 landfill fires caused by batteries at the Nelson Landfill over a 12 month period. Data published by FENZ (2020) identifies a number of incidents involving lithium ion batteries over recent years, supporting the theory that this is a growing trend.
- 31 Based on the information above, I believe that the most likely source of fires that will need to be managed for the Site will be:
- (a) Dumping of hot materials;
  - (b) Mixing of reactive materials;
  - (c) Over extraction of landfill gas collection systems;
  - (d) Air ingress into landfilled waste other than due to landfill gas collection systems operations;

- (e) Embers from another wildfire from the local pine plantations;
  - (f) Combustion of lithium ion batteries; or
  - (g) A combination of the above.
- 32 Furthermore, and in my experience the most effective way to reduce the risk of a landfill fire from escalating and being difficult to extinguish is if either or both the extent of uncovered waste is large or cover materials are not inert (i.e. are combustible). Therefore, it is important to ensure that a ready supply of inert (non-combustible) cover material is available throughout the operational life of the landfill.

### **Fire mitigation**

- 33 I have listed in Attachment 1 the measures that will be adopted to address the risk of landfill fires occurring at the site; how to limit their extent and frequency; monitoring and extinguishment of such fires. The table in Attachment 1 also references those measures recommended by Matt Welsh and Paul de Mar which are further detailed in their evidence.
- 34 I consider that these measures address the sensible comments received from the public regarding fire risks presented by the proposed landfill.
- 35 The measures cover:
- (a) limiting the frequency and extent of a fire at the site;
  - (b) monitoring of the site to rapidly detect a fire (or provide early identification of increased fire risks so that the risk of fire (or risk of a large fire) can be reduced); and
  - (c) mitigating the fire risk through implementing risk control measures to reduce the extent and/or intensity of any fire that may ignite, and which enable response phased measures to be undertaken to control and extinguish a fire.
- 36 The primary control to reduce the risk of a surface fire is to have a small active tipping area, which is under observation, with plant and equipment readily available for operators trained in fire management to quickly extinguish surface fires. All other areas should be covered with inert cover materials which are non-combustible and limit the extent of vegetation over the landfill footprint (until when operations cease). The risk of subsurface fires can be significantly reduced by carefully ensuring all surface fires are extinguished before placing more waste (or cover) over the fire impacted

waste; compacting and covering waste; and by managing and monitoring the gas extraction system to reduce the ingress of air.

- 37 While appropriate fire prevention measures are proposed to be applied, it is not practicable to fully eliminate potential fire sources. Accordingly, early fire detection measures, and on-site fire suppression capability is proposed to address the residual risk that the fire prevention measures are not able to eliminate.

#### **Response to issues in ORC peer review**

- 38 No issues of relevance to landfill fire were identified.

#### **Response to any issues in section 42A report**

- 39 No issues of relevance to landfill fire were identified, other than as identified in the submissions.

#### **Response to matters raised in submissions**

- 40 Key themes for fire risk concerns were identified in the submissions. These are identified as follows and grouped by theme.

<b>Key concerns</b>	<b>Respondent</b>	<b>Where addressed</b>
Batteries ignition risk	Saddle Hill Community Board (via Chairperson Scott Weatherall) South Coast Neighbourhood Society Inc (SCNS) (incorporated society registered by Sarah Ramsay on 14 May 2021) M Sydor (2 Bennett Road, Dunedin)	Refer paragraph 41
Inadequate monitoring measures for fires on site	A & M Granger – 731 Big Stone Road (opposite application site) Saddle Hill Community Board (via Chairperson Scott Weatherall)	Refer paragraph 42
Insufficient fire water supply	E J Munro GJ Bennett Saddle Hill Community Board (via Chairperson Scott Weatherall) Scott, Justine, Thomas and George Weatherall S W Bennett	Refer paragraph 43
Fire risk due to overhead power lines through forestry	A & M Granger – 731 Big Stone Road (opposite application site)	Refer paragraph 44
Fire service response time	Big Stone Forest Ltd, S & A Ramsey – 689 Big Stone Road (opposite application site) E Velenski – 261 Big Stone Road	Refer paragraph 45 for limitation of risk through

Key concerns	Respondent	Where addressed
	<p>S &amp; B Judd – 389 Big Stone Road (1.5 km east of application site)</p> <p>South Coast Neighbourhood Society Inc (SCNS) (incorporated society registered by Sarah Ramsay on 14 May 2021)</p>	<p>prevention, monitoring, mitigation measures</p> <p>Refer evidence of Paul de Mar for information on first response and training</p>
<p>Fire spreading off the site and evacuation routes for neighbours</p>	<p>A and K Lucking – 60 Big Stone Road</p> <p>Big Stone Forest Ltd, S &amp; A Ramsey – 689 Big Stone Road (opposite application site)</p> <p>A &amp; M Granger – 731 Big Stone Road (opposite application site)</p> <p>E J Munro</p> <p>GJ Bennett</p> <p>GL &amp; EG McLeod Family Trust</p> <p>JAR McLeod, PA McLeod – 68 Big Stone Road</p> <p>RJ King</p> <p>S &amp; B Judd – 389 Big Stone Road (1.5 km east of application site)</p> <p>South Coast Neighbourhood Society Inc (SCNS) (incorporated society registered by Sarah Ramsay on 14 May 2021)</p> <p>Scott, Justine, Thomas and George Weatherall</p> <p>S W Bennett</p>	<p>Refer evidence of Paul de Mar for information on access and fire breaks</p> <p>Refer paragraph 46 for operational mitigation measures</p>
<p>Requirement for a fire management plan</p>	<p>JW Hancock</p> <p>S &amp; B Judd – 389 Big Stone Road (1.5 km east of application site)</p> <p>Saddle Hill Community Board (via Chairperson Scott Weatherall)</p> <p>South Coast Neighbourhood Society Inc (SCNS) (incorporated society registered by Sarah Ramsay on 14 May 2021)</p> <p>M Sydor (2 Bennett Road, Dunedin)</p> <p>Vianney Santagati</p>	<p>Refer evidence of Paul de Mar</p>
<p>Screening vegetation ignition risk</p>	<p>Big Stone Forest Ltd, S &amp; A Ramsey – 689 Big Stone Road (opposite application site)</p>	<p>Refer evidence of Paul de Mar</p>
<p>Fire risk due to landfill gas</p>	<p>A H McMillan - 291 Big Stone Road</p> <p>Big Stone Forest Ltd, S &amp; A Ramsey – 689 Big Stone Road (opposite application site)</p> <p>P Early</p> <p>W Early</p>	<p>Refer evidence of Matthew Welsh</p>

Key concerns	Respondent	Where addressed
	Saddle Hill Community Board (via Chairperson Scott Weatherall) SC Hart – 291 Big Stone Road M Sydor (2 Bennett Road, Dunedin)	

### **Batteries ignition risk**

- 41 In relation to the statements made concerning the risk of fires caused by batteries, the following comments are made:
- (a) Batteries are a potential fire ignition source for the landfill;
  - (b) In recognition of this situation a number of measures are proposed for to address the battery fire risks;
  - (c) DCC has a collection program for residents to drop off household batteries to the rummage store for free. The waste batteries are then recycled via Cargill Enterprises. DCC aims to educate both businesses and residents on the importance of diverting waste batteries from landfill and increasing awareness of battery recycling schemes;
  - (d) The New Zealand Battery Stewardship Research project released a proposal in April 2021 that outlined a scheme for circular product stewardship for large batteries that includes diversion of batteries from landfill; and
  - (e) I recognise it would not be practical to ensure that all batteries are not landfilled at the Site. Given this reality, a number of measures will be implemented to reduce the frequency and extent of any fire caused by batteries (or other ignition sources). This includes having the active filling area under constant observation and trained staff and equipment available to promptly extinguish a fire.

### **Inadequate monitoring measures for fires on site**

- 42 In relation to the statements made concerning the monitoring and detection of fires at the site, I consider that the following monitoring measures satisfactorily address concerns regarding adequate detection of potential landfill fires:
- (a) Operational staff will undergo training in the detection of landfill fires in order to detect any hot or smouldering loads during placement of waste material and incompatible material that may combust. Roles, responsibilities and procedures for visual monitoring will be detailed

in the Fire Preparedness and Response Plan to be prepared and included in the Landfill Management Plan for the site. Further clarification of the content for this plan is provided in the evidence of Paul de Mar;

- (b) During filling operations (when the active area is not covered) it will be attended by site staff and under observation for signs of fire and smoke. Should fire or smoke be observed the area will be isolated, the fire extinguished as rapidly as possible before it spreads (e.g. by water or cover or both), the material exhumed, and confirmation received that the fire was extinguished before applying more waste and / or daily cover. A handheld heat sensing camera will be utilised to confirm that the fire has been extinguished;
- (c) Thermal imagery of the active filling area (if not under constant observation by site staff) will be recorded. Thermal imagery involves the infrared measurement of surface temperatures. Based on the proposed staging plan, an infrared camera surveillance system if utilised will need to be mobile to allow for progressive filling of the landfill cells. The camera will be set up to provide automated notifications such that any surface fires that develop are detected in a timely manner. The system should provide full coverage of the surface of the active filling area (exposed waste) and be regularly tested to confirm that it is operating as intended;
- (d) Regular monitoring of landfill gas in the collection and treatment system can provide an indication of the potential for and/or existence of sub-surface fires in the waste mass. Monitoring measures to detect subsurface fires are further addressed in the evidence of Matt Welsh; and
- (e) A weekly review should be undertaken to ensure that the only exposed waste materials over the landfill footprint are in the active landfill area and that this area is generally less than 300 m<sup>2</sup> in area during operations. No flammable waste materials should be exposed over the landfill footprint outside of operational hours.

### **Insufficient fire water supply**

43 In relation to the statements made concerning the on-site water supply for the purpose of firefighting activities, I offer the following comments:

- (a) The proposed site will have supplies of firefighting water on site for fire response, and any attending fire appliances will be able to replenish without departing the site. The landfill project initially

identified that a dedicated firefighting water supply tank of a minimum 100,000 L and a dedicated 5-10m<sup>3</sup> tracked water tanker (with a spray canon) would be provided;

- (b) The proposed firewater supply meets the minimum requirement of the Victorian EPA Best Practice Environmental Guidelines for siting, design, operation and rehabilitation of landfills<sup>1</sup> of 50,000L of water available for combating small fires;
- (c) The fire water supply is now proposed to be 400,000L. A 200,000 litre supply will be located near the main entrance to the site and 200,000 litres. at the southern emergency entrance to the site such that they will be accessible to the site's tracked water tanker and if required the fire services appliances. The locations of these tanks are depicted in Drawing Ref. C102 attached to Richard Coombe's evidence and repeated here in my evidence. Furthermore, each year the volume of water used for fire suppression should be measured to assess and determine if any additional fire water supply should be provided at the site;
- (d) In addition to a fire water supply, another key resource for extinguishing fires on site is inert cover material/soil. The proposed arrangement for access and storage of cover materials is considered to be satisfactory. Ready access to a supply of inert cover material/soil in the near vicinity of active landfilling operation area will be maintained. At a minimum, this stockpile should be approximately 1,500 cubic metres;
- (e) It is proposed that ready access to an additional bulk supply of inert material for smothering operations as contingency for ready-use supply being exhausted will also be provided. This will be sited at the Western earth stockpile area. The Landfill Management Plan should include measures to ensure adequate and continuous supply and availability of inert cover material. The volume of this stockpile should be sufficient to allow for continuity of landfill cover operations and progressive capping and will vary in size with landfill staging;
- (f) Suitable earthmoving machinery and mobile equipment for applying large water volumes will be provided on-site to facilitate fire control. Plant and equipment proposed for use on site includes two

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<sup>1</sup> Victoria Environment Protection Authority (2015) Victorian EPA Best Practice Environmental Guidelines for Siting, design, operation and rehabilitation of landfills, EPA Publication 788.3

excavators, a bulldozer, compactor and a track mounted water tanker; and

- (g) Earthmoving machinery (and operators) and the track mounted water tanker (and drivers/operators) need to be available near the active landfilling area and ready on-site to affect such operations. Such fire suppression techniques are successful in extinguishing most landfill fires if fires are detected and responded to early while they are small. As stated above the active landfill area is recommended to be under constant observation during filling operations and until such time as the waste is covered (with inert material) at the end of each day's operations.

### **Fire risk due to overhead powerlines through forestry**

44 In relation to the statements made concerning the fire risk associated with construction of new overhead powerlines, I offer the following comments:

- (a) It is noted that the power connection has not yet been designed. Any transmission lines will be designed in accordance with the requirements of the power regulator and Electricity (Hazards from Trees) Regulations 2003 including minimum easement and clearance distances and requirements around flammable vegetation.

### **Fire service response time**

45 In relation to the statements made concerning the response time for fire services, I offer the following comments:

- (a) The first response to fires on site will be undertaken by trained and equipped site staff and is discussed in the evidence of Paul de Mar; and
- (b) Furthermore, the monitoring and mitigation measures have been developed with consideration to the fire service response. A number of operational measures will be implemented to reduce the frequency and extent of fires, of landfill fires occurring at the site including:
  - (i) Limitation of the active tipping area (where a surface fire could occur) to generally 300 m<sup>2</sup> and no greater than this area during very high and extreme fire danger days;
  - (ii) Specification of cover materials that do not comprise combustible materials and meets the objectives and guidance in the WasteMINZ, 2018, Technical Guidelines for Disposal to Land. It is recommended that daily cover is limited to site won



or received soils and crushed rocks and other alternative cover materials are only utilised if inert and are not combustible; and

- (iii) Compaction of waste and placement of cover materials in accordance with the landfill management plan.

### **Fire spreading off the site and evacuation routes for neighbours**

46 In relation to the statements made concerning preventing fire spreading off site, the following comments are made specific to landfill operations: (These should be read in conjunction with the evidence of Paul de Mar (who addresses site access and fire breaks) and Matt Welsh (who addresses LFG risks))

- (a) The risk of fire spreading off site is discussed in the evidence of Paul de Mar. The primary boundary of concern is the south east boundary between the landfill and Big Stone Road and the plantation vegetation to the south of the site;
- (b) Operational measures have been proposed to limit the risk of fires spreading off the site;
- (c) Non-active landfill areas will be covered with inert material to limit surface fire spread within the site if fire ignition and spread initiates in active areas;
- (d) Where there is hydroseed/vegetation of the intermediate cover, or existing vegetated areas over the landfill's footprint or final cap, these areas should be set back (cleared of vegetation) at least 10 m from any active landfilling area;
- (e) The entire landfill footprint at the commencement of construction activities at the site will be cleared and only grasses planted and maintained to reduce the fuel load, particularly between the initial stages of the landfill and the site's south eastern boundary;
- (f) A protocol will be developed for managing any fire in a truck caused by waste en route to site. The protocol will be developed and documented in the Fire Preparedness and Response Plan to be adopted by DCC and commercial operators using the site;
- (g) Access within the site and between the screening vegetation will be provided as depicted in Drawing Ref. C102 to enable access for the site's tracked mounted water tanker to attend to any fire nearby the landfill's perimeter; and

- (h) Electrical infrastructure at the landfill will be designed, installed and operated in accordance with AS/NZS 60079.11:2011: Explosive atmospheres - Part 11: Equipment protection by intrinsic safety 'i' to ensure that it is intrinsically safe and does not spark a fire. And the site's plant will have fire suppression equipment installed and be operational, if needed.

## Conclusion

- 47 The proposed landfill site will accept waste materials that present fire risks to on-site staff, infrastructure and equipment and off-site vegetated land and residents if not appropriately managed.
- 48 The primary control to reduce the risk of a surface fire is to have a small active tipping area, which is under observation and plant and equipment is readily available to suitably trained staff to quickly extinguish surface fires. All other areas should be covered with inert cover materials which are made available throughout the life of the landfill. The risk of a subsurface fires can be significantly reduced by carefully ensuring all surface fires are extinguished before placing more waste (or cover) over the fire impacted waste and by managing and monitoring the gas extraction system to reduce the ingress of air.
- 49 While appropriate fire control measures are proposed to be applied, it is not practicable to fully eliminate potential fire sources. Accordingly, early fire detection measures, and on-site fire suppression capability is proposed to be applied to address the residual risk that the firecontrol measures are not able to eliminate.
- 50 I have identified a number of possible sources for fires at the site. The most likely sources in my opinion are:
  - (a) Dumping of hot materials;
  - (b) Mixing of reactive materials;
  - (c) Over extraction of landfill gas collection systems;
  - (d) Air ingress into landfilled waste other than due to landfill gas collection systems operations;
  - (e) Embers from another wildfire from pine plantations;
  - (f) Combustion of lithium ion batteries; or
  - (g) A combination of the above.

- 51 There are a number of potential receptors at and around the site. In recognition of the importance of preventing a fire from escaping off site, additional measures are proposed including targeted and larger clearings and screening vegetation types to reduce their ability to combust and transfer a fire off-site. This is described in the evidence of Paul de Mar and reflected in the evidence Richard Coombe and Rhys Girvan.
- 52 Noting the submissions raised regarding fire risk, I consider that with the control measures proposed in the application, fire risks arising from the development can be managed to acceptable levels that are consistent with industry practice.

A handwritten signature in blue ink that reads "A. Dixon". The signature is written in a cursive style with a large initial 'A'.

**Anthony Dixon**

29 April 2022

## References

The following documents have been considered in this assessment:

- Boffa Mickell Limited, May 2021, Smooth Hill Landfill Assessment of Environmental Effects for Updated Design
- C&P Environmental Ltd, Biffa, Infinis Limited, Sita UK, Viridor Waste Management, Waste Recycling Group, 2008, Industry Code of Practice Management and Prevention of Sub-surface fire, United Kingdom, 1<sup>st</sup> Ed.
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## Attachment 1 – Fire frequency reduction and extent, monitoring and mitigation measures

Measure	Implementation
<b>Reduction of fire frequency and extent</b>	
Removing batteries from waste	DCC has a collection program for residents to drop off household batteries to the rummage store for free. The waste batteries are then recycled via Cargill Enterprises.  The New Zealand Battery Stewardship Research project released a proposal in April 2021 that outlined a scheme for circular product stewardship for large batteries that includes diversion of batteries from landfill.
Screening of incoming waste loads for combustible materials	Incoming waste loads will be received from known sources and operators and visually inspected during placement to identify any combustible materials such as pool chemicals, gas bottles, and hot / smouldering loads
Maintain a compact active tipping area (with all over surfaces covered with either daily, intermediate or final cover)	The active tipped area will generally be limited in area to no greater than 300 m <sup>2</sup> and will not extend beyond 1,000 m <sup>2</sup> . During filling operations (when the active area is not covered) it will be under constant observation for signs of fire and smoke.
Active tipping area during very high and extreme fire danger days	If the fire danger rating is very high or extreme the active tipping face will be limited to no greater than 300 m <sup>2</sup> .
Specification of cover materials that do not comprise combustible materials	150 mm daily cover or equivalent alternative cover will be placed over the waste at the end of each day, it is noted that contaminated soils received at the site that meet the landfill waste acceptance criteria or construction and demolition waste were proposed to be used as cover material. However daily cover will be limited to site won or received soils and crushed rocks and other inert materials are only utilised if not combustible (and meets the objectives and guidance in the WasteMINZ, 2018, Technical Guidelines for Disposal to Land).  The alternative cover materials will not comprise combustible material ie mulches  300 mm intermediate cover with hydroseed applied will be placed over daily cover areas that will not be overlaid for more than 3 months. The intermediate cover will comprise site won loess (or other equivalent inert material) and any areas where there is hydroseed/vegetation it should be set back at least 10 m from any active landfilling area.
Appropriately managing the landfill gas extraction and leachate management systems so that they do not result in sub-surface or surface fires due to ingress of oxygen	Monitoring will be undertaken to reduce the risk of the active gas extraction system causing the intrusion of air into the landfilled waste. See the evidence of Mr Matt Welsh.
Filling practices that limit the ingress of oxygen into the waste mass	The active tipping area will be limited to generally 300 m <sup>2</sup> . Waste would be placed in lifts and compacted using purpose built compaction equipment.
Stockpiling of combustible materials	Combustible materials will not be stockpiled over the landfill area
Final capping revegetation during filling operations	The final capping areas during site operations will not be revegetated within 10 m of the active landfilling area.

Measure	Implementation
Clearing and replacing vegetation over the entire planned landfill footprint at the commencement of construction	The area to be landfilled includes a range of vegetation included recently planted pine trees. Most of this area will be cleared and replaced with vegetation which reduces the ability of this vegetation to act as a mechanism to transfer a fire to the site boundaries. For further information see the evidence of Paul de Mar.
Other measures	No smoking at the site (unless in designated areas off the landfill surface), no burning of waste at the site, no hot works (unless procedures developed and implemented on a case by case basis to prevent fire), no placing mulch (or any other combustible material) over the liners as temporary cover, staff training and resources to extinguish fires quickly, maintenance of fire fighting equipment, supervised unloading of material, water supply for fire fighting, maintaining access roads and tracks and a 5 -10 m <sup>3</sup> tracked water tanker with high pressure hose/cannon that can spray up to 100 m.
<b>Monitoring</b>	
Operational staff training in fire detection	Operational staff will undergo training in the detection of landfill fires in order to detect any hot or smouldering loads during placement of waste material and incompatible materials.  Roles, responsibilities and procedures for visual monitoring will be detailed in the Fire Preparedness and Response Plan to be prepared for the site. For the details on this Plan see the evidence of Paul de Mar.
Surveillance of the active tipping area	During filling operations (when the active area is not covered) it will be attended by site staff and under observation for signs of fire and smoke. Should fire or smoke be observed the area will be isolated, the fire extinguished as rapidly as possible before it spreads (eg by water or covered), the material exhumed and confirmed the fire was extinguished before applying daily cover. A hand held heat sensing camera will be utilised to confirm that the fire has been extinguished.
Thermal imagery of the active filling area (if not under constant observation by site staff)	Thermal imagery involves the infrared mapping of surface temperatures. According to the Environment Agency (2007), this approach allows for a non intrusive method. However it does not allow for the depth of a hot spot to be determined. Based on the proposed staging plan, an infrared camera surveillance system will need to be mobile to allow for progressive filling of the landfill cells. The camera will be set up to provide automated notifications such that any surface fires that develop are detected in a timely manner.  The system should provide full coverage of the surface of the active filling area (exposed waste) and be regularly tested to confirm that it is operating as intended in a timely manner
Landfill gas monitoring (collection and treatment system)	Regular monitoring of landfill gas in the collection and treatment system will provide an indication of the potential for and/or existence of sub-surface fires in the waste mass. For further details see the evidence of Matt Welsh.
Weekly review of landfill surface for combustible material	A weekly review will be undertaken to ensure that the only exposed flammable material (waste) over the landfill footprint is the active landfill area and that this area is at mostly times less than 300 m <sup>2</sup> in area during operations. No exposed flammable materials (waste) will be exposed over the landfill footprint outside of operational hours.

Measure	Implementation
<b>Mitigation measures</b>	
Develop a protocol for managing a fire in a truck caused by waste en route to site	The protocol will be developed and documented in the Fire Preparedness and Response Plan to be adopted by DCC and commercial operators using the site
Providing road and track access within the site to potential fire ignition areas for access for implementation of mitigation measures	<p>Proposed haul routes within the site are shown in the general arrangement plan (Drawing ref C102). This shows the site access, access to site amenities and maintenance, stockpiling areas and landfilling area. The internal access routes within the landfill area will be subject to the status of filling and the staging plan.</p> <p>Internal access roads will be maintained to ensure access for plant and water cart in the event of a landfill fire.</p>
Providing ready access to a supply of inert cover material/soil in the near vicinity of active landfilling operation area	<p>The stockpiling areas are sited in lower lying flat areas of the site which limit visual impact and optimise bulk earthworks for establishment of the stockpiling area. However based on the contours there is limited access to the eastern earth stockpile area which allows for only one access road. The western earth stockpile area may be accessed from two separate locations.</p> <p>Fire ignition risk in earth stockpile areas is low. Other than providing for machinery access around the base of the earth stockpiles, the only other prudent fire risk mitigation measure is recurrent weed control to ensure that pine regeneration, gorse and other flammable vegetation does not become established on the stockpiles.</p>
Providing ready access to additional bulk supply of inert material for smothering operations as contingency for ready-use supply being exhausted	<p>There is a deficit in the material balance for the site that may be supplemented by waste soils that are suitable for use as cover material. The material deficit should it occur will not happen for many years after site operations commence. A cover and capping material management plan will be developed that monitors cover usage and assesses whether there will be a sufficient supply of material available to cover and cap the landfill and for use in firefighting as required. At all times there will be a stockpile of inert cover material available adjacent to the operational stage to cater for at least 1 months of operational needs (or approximately 1,500 m<sup>3</sup>).</p> <p>There is an opportunity to develop a borrow area at the site if required.</p>
Ensuring non-active landfill areas are covered with inert material to limit surface fire spread within the site if fire ignition and spread initiates in active areas	<p>All non-operational areas of the landfill will be covered with non-combustible cover/capping materials.</p> <p>All areas over the landfill footprint will be regularly maintained such that the vegetation (fuel load) is reduced as much as practicable. For further details see the evidence of Mr Paul de Mar.</p>
Providing a trafficable perimeter fire break around the landfill area and low flammability and pruned screening vegetation	<p>A 5m wide perimeter 4WD road is proposed to be constructed with each stage of the landfill around the landfilling stage boundary. The road will be trafficable by maintenance vehicles and if needed the tracked water tanker – see Figure 1 in Richard Coombes evidence.</p> <p>In addition, for the purpose of fire risk mitigation, the screen planting along the eastern, south-eastern and southern boundary of the landfill (adjacent to Big Stone Road) should allow for a 10 metre wide fire break which is created at the site establishment phase (as depicted in Drawing Ref. C102) between the landfill footprint and the strip planting,</p>



Measure	Implementation
	<p>and that plant species used be low flammability species (typically soft-leaved plant types with low leaf oil content) and pruned pines. The drainage swale which is constructed at the commencement of site establishment will be maintained by slashing and keeping the vegetation low to the ground. For further details on the screening vegetation see the evidence of Paul de Mar and Rhys Girvan.</p> <p>Further, the trafficable perimeter road along the eastern, southeastern and southern boundaries will be between 5-10 metres wide and trafficable by AWD and tracked vehicles (prior to placement of the final landform on these areas). This is depicted in Drawing ref C102.</p>
<p>Having supplies of firefighting water on site for fire response, and enabling any attending fire appliances to replenish without departing the site</p>	<p>A fire water supply of 400,000 litres be made available at the site. It will be located at near the emergency entrance/exit and the site entrance, and at each of these locations a 200,000 litre supply will be placed. This is depicted in Figure 1 attached to Richard Coombe's evidence. An annual review of water used for fire fighting will be undertaken to assess whether additional water sources are required to be implemented.</p>
<p>Having suitable earthmoving machinery on-site to facilitate fire control</p>	<p>Plant and equipment proposed for use on site includes two excavators, a bulldozer, and a tracked water tanker.</p> <p>Earthmoving machinery (and operators) and a mobile water truck and (and driver/operator) need to be available and ready on-site during site operations (and when any waste is exposed) to affect such operations. Such fire suppression techniques are successful in extinguishing most landfill fires if fires are detected and responded to early while they are small.</p>
<p>Containment of any firefighting water</p>	<p>The active filling area should at all times be surrounded by a small (approx 200 mm high) earthen bund to contain within the waste mass any water used to extinguish a fire.</p>
<p>Having in place suitable mobile equipment for applying large water volumes to extinguish burning material</p>	<p>Equip the site's tracked water truck with a fire water hose dispersion system which can project the water at least 100 metres in distance from the truck.</p>
<p>Appropriately designing, installing, operating and maintaining electrical infrastructure (so that it is intrinsically safe and does not spark a fire) Fire suppression equipment of mobile plant.</p>	<p>Electrical infrastructure at the landfill will be designed, installed and operated in accordance with AS/NZS 60079.11:2011 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety 'i'.</p> <p>Fire suppression equipment will be installed and maintained on mobile plant that is operating on the landfill.</p>