

ATTACHMENT A FOR THE EVIDENCE OF WALTER STARKE



AB Lime Limited

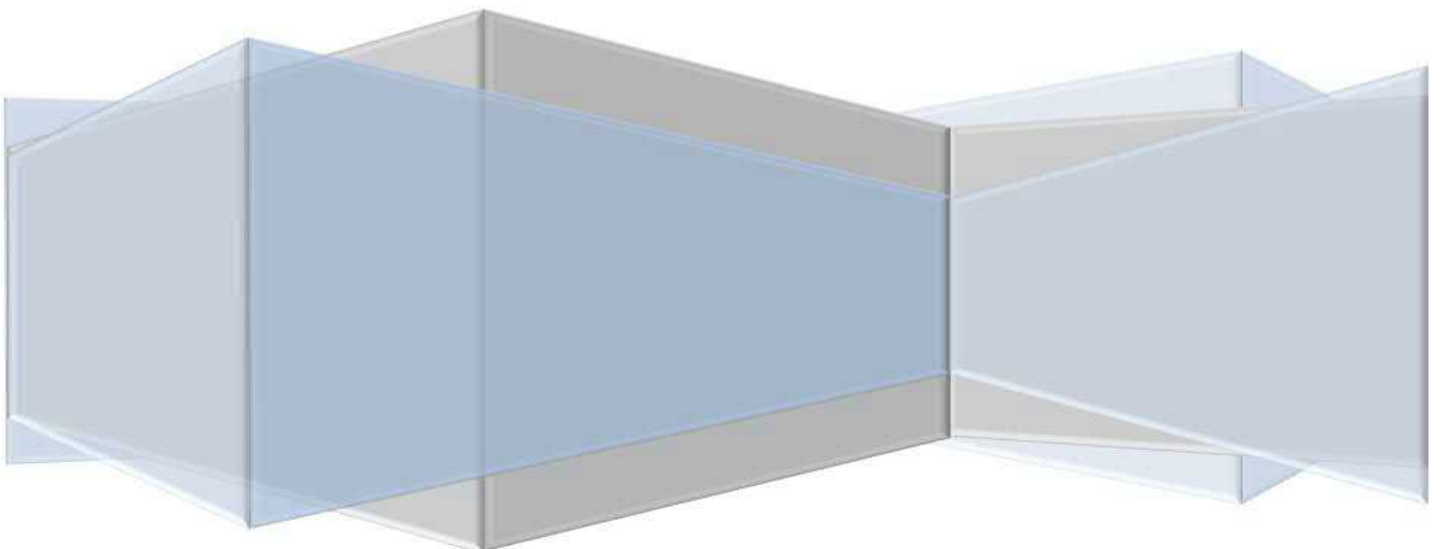
AB Lime Ltd Landfill Operations Management Plan

IZ000400-LFC-NG-RPT-0003 | 4

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AB Lime Ltd

Draft for Consenting Purposes



AB Lime Limited

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Document history and status

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Abbreviations

- AB Lime: AB Lime Limited
- ~~ADW: Aluminium Dross Waste~~
- ANZECC: Australian and New Zealand Environment and Conservation Council
- cm²: centimetre squared
- COD: Chemical Oxygen Demand
- ELVs: End-of-Life Vehicles (shredding of waste from ELVs may be auto shredder residue)
- EMP: Environmental Management Plan
- EPA: Environmental Protection Agency
- ES: Environment Southland, i.e. Southland Regional Council
- GCL: Geocomposite Clay Liner
- g/m³: grams per cubic metre
- h: horizontal
- HDPE: High Density Polyethylene
- HSNO: Hazardous Substances and New Organisms Act 1996
- H&S: Health and Safety
- IPR: Independent Peer Reviewer
- Jacobs: Jacobs New Zealand Limited
- k: permeability
- LOMP: Landfill Operations Management Plan
- MPI: Ministry for Primary Industries
- m³: cubic metre
- NESCS: Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
- NZS: New Zealand Standard
- PCBU: Person Conducting a Business or Undertaking
- PCBs: Polychlorinated biphenyls
- POPs: Persistent organic pollutants
- PPE: Personal Protective Equipment
- ppm: parts per million
- SDC: Southland District Council
- SKM: Sinclair Knight Merz Limited, now part of Jacobs
- SRC: Southland Regional Council, i.e. Environment Southland
- SVOCs: Semi Volatile Organic Compounds
- TBC: To be confirmed
- TCLP: Toxic Characteristic Leaching Procedure
- USEPA: United States Environmental Protection Agency

- v: vertical
- VOCs: Volatile Organic Compounds
- μg : micro gram, i.e. 0.000001 gram

Important note about this report

This report has been prepared by Jacobs New Zealand Limited (Jacobs) for AB Lime Limited (the Client) for the purposes of a Landfill Operations Management Plan guiding the operations of the AB Lime landfill. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report (or any part of it) for any other purpose.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report may also describe specific limitations and/or uncertainties which qualify its findings. Accordingly, this report should be read in full and no excerpts are to be taken as representative of the findings unless any such excerpt and the context in which it is intended to be used have been approved by Jacobs in writing.

1. Introduction

1.1 Purpose/Objective of the Landfill Operations Management Plan

The purpose of the AB Lime Ltd Landfill Operations Management Plan is to manage key operational aspects of the landfill in accordance with the corresponding legislative requirements outlined below in Section 2, in particular the resource consents granted by Environment Southland, and Southland District Council, and in accordance the New Zealand good practice landfill guidelines; such as the Technical Guidelines for Disposal to Land prepared by WasteMINZ (2018).

The Landfill Operations Management Plan has the following objectives relevant to resource consents held with the Southland District Council:

Nuisance Control:

- i. To maintain a clean and tidy site
- ii. To maintain screen and litter fences and ensure litter does not accumulate on the screens and litter fences
- iii. To minimise wind-blown litter outside the site boundaries

Noise:

- iv. To operate the landfill within the notional boundary noise limits
- v. To keep all site machinery well maintained and hold all necessary compliance certification

Facilities and Maintenance:

- vi. To minimise the establishment of vermin, insect and bird populations through effective management of the refuse disposal and process area
- vii. To implement pest management strategies as required

Contaminated Land Procedures:

- viii. To appropriately assess and manage contaminants in the soil to protect human health
- ix. To appropriately identify procedures for asbestos management on site.

The Landfill Operations Management Plan has the following objectives relevant to resource consents held with Environment Southland:

- i. To utilise an effective cover system to maintain quality site rehabilitation, while minimising long term leachate generation
- ii. To limit face access, thus enabling the size of the active area to be minimised.
- iii. To minimise stockpiling, both within and outside the footprint.
- iv. To outline Waste Acceptance Criteria and Procedures:
 - To protect the receiving environment;
 - To protect the health and safety of people;
 - To maintain that all waste received is compatible with the land filling operation;
 - To maintain that all waste landfilled complies with 'Waste Acceptance Criteria' outlined in the relevant consent conditions.
- v. To outline crisis response and emergency waste acceptance procedures:
 - To manage the identification of all special waste;
 - To pre-arrange the disposal of special waste;

- To have in place measures and appropriate provisions for disposal of each special waste load are in place before the waste arrives at the landfill.
- vi. The placing of refuse and daily cover:
 - To achieve a minimum in-situ refuse density of 0.8;
 - To maintain a working face that is as small as possible;
 - To cover all refuse daily;
 - To manage special waste planning;
 - To record the location of special waste by survey;
- vii. The effective capping of the landfill:
 - To minimise ingress of rainwater into the landfill;
 - To minimise erosion and cracking of the cap through design, planting and maintenance

1.1.1 Management Plan Structure

The operation of AB Lime landfill and quarry requires a suite of environmental management and mitigation plans to operate the site. The Environmental Management Plan (EMP) sets the overall framework for the operation of the site and is supported by a series of sub management plans focusing on specialist environmental areas to effectively run the landfill and quarry. The Landfill Operations Management Plan is a sub management plan under this framework that manages key day to day operations and processes of the landfill. Figure 1 below illustrates the relationship between the Landfill Operations Management Plan and the remainder of the AB Lime management plan framework.

This plan has been prepared in accordance with the certification and submission process outlined in section 1 of the AB Lime Environmental Management Plan.

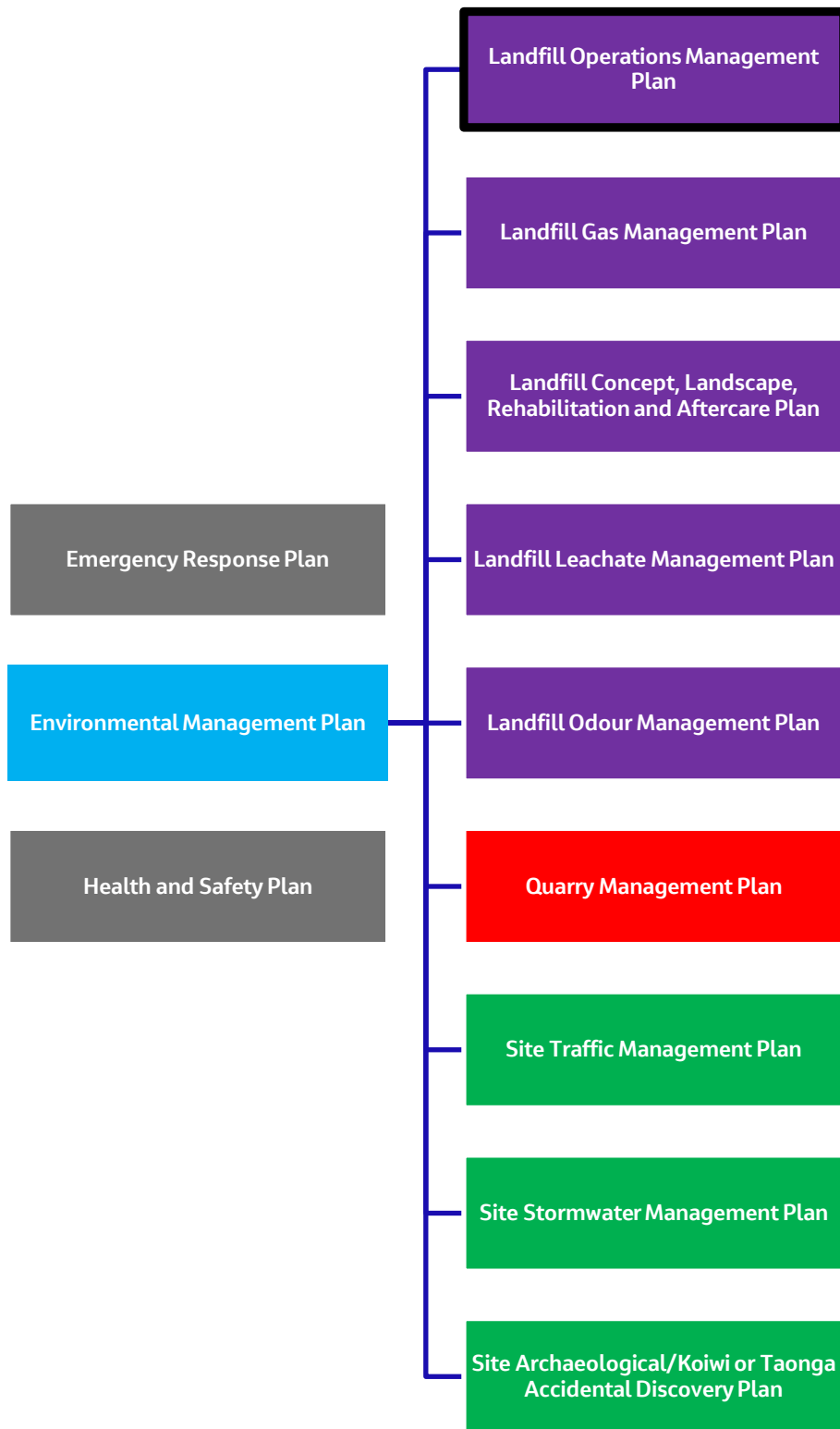


Figure 1 AB Lime Limited Management Plan Structure

Key:



2. Legislative Requirements

The legislative requirements of this Landfill Operations Management Plan outline the consent conditions that this plan is designed to assist with implementing.

2.1 Resource Consent Requirements

Table 1 Relevant Conditions for Consents related to the Landfill Operations Management Plan

Condition Number	Condition	Reference
Land Use Consent		
2.16	The consent holder shall prepare and maintain a Landfill Operations Management Plan (LOMP) for certification by the Council. The LOMP shall describe the operations of the landfill, including demonstrating how compliance with the relevant conditions of this consent will be achieved. The plan shall also achieve the following objectives:	
	Nuisance Control:	Section 8
	i. To maintain a clean and tidy site	
	ii. To maintain screen and litter fences and ensure litter does not accumulate on the screens and litter fences	Section 8
	iii. To avoid wind-blown litter outside the site boundaries	Section 8
	Noise:	Section 8.3
	iv. To operate the landfill within the site boundary noise limits	
	v. To ensure all site machinery is well maintained and hold all necessary compliance certification	Section 8.3
	Facilities and Maintenance:	Section 8.5
vi. To avoid the establishment of vermin, insect and bird populations through effective management of the refuse disposal and process area		
vii. To implement pest management strategies as required	Section 8.5	
Contaminated Land Procedures:	Section 12	
viii. To appropriately assess and manage contaminants in the soil to protect human health:		
ix. To appropriately identify procedures for asbestos management on site	Section 5.5.4	
2.22	Noise: That all activities associated with the construction and operation of the solid waste disposal facility and associated operations including, but not limited to any recontouring and earthworks associated with solid waste disposal activity shall comply with the following:	Section 8.3

Condition Number	Condition	Reference
	<p>The consent holder shall ensure that all activities on the site to which this consent applies are managed and carried out so that the rating level measured at the notional boundary of any residential, hospitality, tourist, educational or health activity excluding property owned, or covenanted by the consent holder does not exceed the following levels:</p> <p>Monday - Saturday, 7.00 am - 10.00 pm 50 dBA Leq</p> <p>All other times including public holidays 40 dBA Leq</p> <p>Daily, 10.00 pm - 7.00 am the following day 70 dBA Lmax</p> <p>“Notional boundary” means a line 20 metres from the façade of the building in question of the nearest residential boundary, excluding property owned, or covenanted by the consent holder, or this legal boundary on which the building is located where the boundary is closer to the building than 20 metres.</p> <p>Sound levels shall be measured in accordance with the provisions of NZS 6801:2008 Acoustics - Measurement of Environmental Sound, and assessed in accordance with the provisions of NZS 6802:2008 Acoustics - Assessment of Environmental Noise.</p>	
2.25	<p>That all exterior lighting shall be directed away from adjacent residences not owned or covenanted by the consent holder, so as to minimise the potential for adverse effects from light spill on adjacent residents, and so as to achieve compliance with Rule Rural.7 of the Operative Southland District Plan 2018.</p>	Section 8.7
2.26	<p>That the consent holder shall take all practicable steps to minimise the potential for litter spillage on to roads and adjacent properties not owned, or covenanted by the consent holder. The consent holder shall be responsible for the removal, as soon as practicable, of any litter spillage resulting from the site operations on to public roads, and wind-blown litter on to adjacent properties not owned, or covenanted by the consent holder at the request of any such adjacent landowner(s), to the satisfaction of the Southland District Council.</p>	Section 8.4
<p>Schedule 1 – General Conditions 201346, 201347, 201348, 201349, 201350 and 201351</p>		
22.	<p>The consent holder shall prepare and maintain a Landfill Operations Management Plan (LOMP). The LOMP shall describe the operations of the landfill, including demonstrating how compliance with the relevant conditions of this consent will be achieved. The plan shall also achieve the following objectives:</p> <ul style="list-style-type: none"> <li data-bbox="435 1865 1230 1928">i. To utilise an effective cover system to maintain quality site rehabilitation, while minimising long term leachate generation <li data-bbox="435 2000 1230 2063">ii. To limit face access, thus enabling the size of the active area to be minimised. 	<p>Section 10</p> <p>Section 7.4.3</p>

	<p>i. To minimise stockpiling, both within and outside the footprint.</p>	Section 8.5
	<p>ii. To outline Waste Acceptance Criteria and Procedures:</p> <ul style="list-style-type: none"> ▪ To protect the receiving environment; ▪ To protect the health and safety of people; ▪ To maintain that all waste received is compatible with the land filling operation; ▪ To maintain that all waste landfilled complies with 'Waste Acceptance Criteria' outlined in the relevant consent conditions. 	Section 4
	<p>iii. To outline crisis response and emergency waste acceptance procedures:</p> <ul style="list-style-type: none"> ▪ To manage the identification of all special waste; ▪ To pre-arrange the disposal of special waste; ▪ To have in place measures and appropriate provisions for disposal of each special waste load are in place before the waste arrives at the landfill. 	Section 6
	<p>iv. The placing of refuse and daily cover:</p> <ul style="list-style-type: none"> ▪ To achieve a minimum in-situ refuse density of 0.8; ▪ To maintain a working face that is as small as possible; ▪ To cover all refuse daily; ▪ To manage special waste planning; ▪ To record the location of special waste by survey; 	Section 10.1
	<p>v. The effective capping of the landfill:</p> <ul style="list-style-type: none"> ▪ To minimise ingress of rainwater into the landfill ▪ To minimise erosion and cracking of the cap through design, planting and maintenance 	Section 10.4
30.	A geological map of the base grade of the landfill shall be prepared and upgraded from time to time as the base grade is exposed. The geological mapping shall include detailed logging of the location, extent and nature of fractures, fracture zones, Karst features and other defects.	Section 11
31.	As-built drawings shall be forwarded to the Southland Regional Council following completion of works and structures, for acceptance in writing, prior to the disposal of refuse in each newly constructed stage. These drawings shall include 0.25 metre contours for the liner base, final elevations of the HDPE or compacted clay liner prior to placement of the leachate drainage layer sufficient to monitor future movement of the base.	Section 11

32.	All investigations, design, supervision of construction, operation, monitoring and after-care shall be undertaken by suitably qualified personnel experienced in such works, or works of a similar nature, and to the satisfaction of the Southland Regional Council.	Section 12
36.	All water quality sample analyses required shall be undertaken using standard methods as detailed in the "Standard Methods For The Examination Of Water And Waste Water, 1998" 20th edition by A.P.H.A. and A.W.W.A. and W.E.F or by some other method approved in advance in writing by the Southland Regional Council.	Section 13
Discharge Permit AUTH-201346-V3		
2.	The discharge of waste is authorised only on the areas of the site identified as the landfill footprint, as shown on drawing number IZ000400-1000-NG-DRG-1002 attached to this consent.	Section 3 Attachment 1
6.	<p>a) The leachate containment and leachate collection system for the base of the landfill, and any side slopes with a slope less than 2H:1V, shall consist of the following as a minimum, from bottom to top:</p> <ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 600 millimetres of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-9} metres per second; ▪ a 1.5 millimetre high density polyethylene (HDPE) flexible membrane liner; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material. <p style="text-align: center;">or</p> <ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 300 millimetres of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-9} metres per second; ▪ a geosynthetic clay liner (GCL), with a minimum thickness of 5 millimetres, a permeability coefficient (k) not exceeding 5×10^{-11} metres per second; ▪ a 1.5 millimetre high density polyethylene (HDPE) flexible membrane liner; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material. <p style="text-align: center;">or</p> <ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 600 millimetres of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-8} metres per second; ▪ a geosynthetic clay liner (GCL), with a minimum thickness of 5 millimetres, a permeability coefficient (k) not exceeding 5×10^{-11} metres per second; ▪ a 1.5 millimetre high density polyethylene (HDPE) flexible membrane liner; 	Section 11.9

	<ul style="list-style-type: none"> ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material. <p>b) An alternative to the above minimum specifications may be proposed and included in the Landfill Operations Management Plan subject to Independent Peer Review approval and subsequent council certification.</p>	
7.	<p>a) The leachate containment system for the side slopes of the landfill, with a slope of 2H:1V or greater, shall consist of the following as a minimum, from bottom to top:</p> <ul style="list-style-type: none"> ▪ a groundwater underdrainage system where required; ▪ a geosynthetic clay liner, with a minimum thickness of 5 millimetres, a permeability coefficient (k) not exceeding 5×10^{-11} metres per second and sufficient internal shear strength to maintain a stable configuration on slopes; ▪ a 2.0 millimetre HDPE flexible membrane liner; and ▪ a 300 millimetre minimum liner protection layer of soil or clay or granular material. <p>b) An alternative to the above minimum specifications may be proposed and included in the Landfill Operations Management Plan subject to Independent Peer Review approval and subsequent council certification.</p>	Section 11.9
8.	<p>The consent holder shall prepare landfill side slopes, to ensure a smooth surface appropriate for the placement of geosynthetic liner materials. This shall include the smoothing of rough surfaces, sealing of solution features or compaction of slopes to an appropriate bearing capacity.</p>	Section 11
9.	<p>The leachate collection system shall be designed to maintain a leachate head of less than 300 millimetres on the base liner and side liner, as demonstrated by design calculations, to the satisfaction of the Southland Regional Council, based on the expected leachate impingement rate due to rainfall and any leachate recirculation and expected clogging of the leachate collection system.</p>	Section 11.9
12.	<p>The HDPE component of composite lining systems may be replaced with an alternative material, following acceptance in writing by the Southland Regional Council, where an alternative material is demonstrated to provide equivalent, or superior, performance in terms of</p> <ul style="list-style-type: none"> ▪ puncture resistance ▪ resistance to chemical degradation; ▪ hydraulic containment; ▪ physical strength and deformation characteristics under service and seismic loads; ▪ welding and general installation; 	Section 11.7

	expected service life.	
13.	Liner components comprising synthetic or geo-synthetic materials shall be constructed in accordance with the manufacturer’s recommended quality assurance/quality control procedures.	Section 11
14.	The landfill gas collection and leachate recirculation systems shall be designed to prevent puncture of the landfill liner by system components. In particular, any vertical wells or pipes installed for the collection of landfill gas, or re-injection of leachate into the landfill, shall terminate at a height above the base or side liner that will ensure that pipes, or wells, will not puncture the liner as a result of refuse settlement, or incorporate other appropriate design features that allow for expected settlement, to the satisfaction of the Southland Regional Council.	Section 11
16.	No bulk liquid waste shall be accepted for disposal. The definition of liquid waste shall be any waste that contains free liquid on arrival at the landfill, or has a solids content of less than 20 percent, except such waste that passes the USEPA Paint Filter Liquids Test (EPA Method 9095A).	Section 4.4.1
17.	Medical wastes shall be accepted only in accordance with NZS 4304:2002 “ Health Care Waste Management” or subsequent amendments.	Section 5.5.4
18.	Asbestos wastes shall be accepted only in accordance with the Health and Safety at Work (Asbestos) Regulations 2016, or subsequent amendments.	Section 5.5.4
19.	<p>Where, during landfill operations, the Consent Holder is required to accept waste by a Government Agency as a crisis or emergency response, the following protocol shall apply:</p> <ul style="list-style-type: none"> a) All crisis response waste acceptance shall trigger the protocol identified in the Crisis/Emergency Response chapter of the Landfill Operations Management Plan b) The consent holder shall notify the Southland Regional Council Compliance Manager of this waste acceptance within 24 hours. c) A management response in line with the criteria identified within the Crisis/Emergency Response chapter of the Landfill Operations Management Plan shall be made available to the Southland Regional Council within 3 days of notification of condition (xx)(b), above. d) All likely affected neighbours are to be notified of the crisis/emergency waste stream prior to acceptance on site, or as soon as practicable. <p>Mitigation measures for crisis/emergency waste shall follow the guidelines identified in the Crisis/Emergency Response chapter of the Landfill Operations Management Plan.</p> <p>Advice Note: <i>There may be instances when the consent holder is required to accept waste under the direction of a Government Agency. Where this is the case, despite the conditions of consent that ordinarily apply to the landfill, it is accepted that there may be effects associated with the waste that are beyond the control of the consent holder. This shall be taken into consideration by the Southland Regional Council when discharging its duties to monitor the conditions of consent.</i></p>	Section 6

<p>20.</p>	<p>For other than minor amounts of offal, the consent holder shall:</p> <ul style="list-style-type: none"> ▪ require all offal to be disposed of to be pre-booked by the waste generator or transporter, and only be accepted in discrete loads; ▪ record information on the source of the offal, including the origin of the animals; ▪ record information on the cause of death of the animals from which the offal is sourced; ▪ dispose of the offal in pits specifically excavated in the landfill for each discrete load of offal; ▪ cover each load of offal immediately following deposition; and record the location of each pit used for the disposal of offal. 	<p>Sections 4.3 & 5.2.1</p>
<p>21.</p>	<p>Material contaminated with methamphetamine and/or chemicals associated with the manufacture of methamphetamine may be accepted into the landfill provided that the level of contamination does not exceed 100 µgm/cm², based on an average by weight per individual household lot. The material that may be accepted includes wall linings (including gib board), soft furnishing (e.g. Curtains, carpets), furniture, bedding, clothing and whiteware. Actual stocks of chemicals used in, or leftover from, methamphetamine manufacture are also excluded from this condition.</p> <p>The consent holder shall:</p> <ol style="list-style-type: none"> i. Record the date, source, volume and nature of the material received; ii. Keep a record of monitoring data that confirms the contamination level of the material; and iii. Record the location where the material is placed within the landfill in 3 dimensions. 	<p>Sections 4.2 and 5.2.2</p>
<p>22.</p>	<p>Aluminium dross waste (AWD) and material contaminated with this waste may be accepted into the landfill provided that the concentrations of aluminium and fluoride do not exceed the leachability limits or screening concentrations set out in Table 1 of "Module 2: Hazardous Waste Guidelines, Landfill Waste Acceptance Criteria and Landfill classification, May 2004". The leachability limits shall be established using SPLP testing, with concentrations not to exceed a SPLP test result of 40g/m³ of Aluminium and 200 g/m³ of Fluoride. The material that may be accepted includes gravels and soils that have been contaminated with dross.</p> <p>The consent holder shall:</p> <ol style="list-style-type: none"> i. Record the date, source, volume and nature of the material received; ii. Notify the Southland Regional Council within 7 days of the material being accepted, and provide details of the source and volume of the material; iii. Keep a record of monitoring data that confirms the contamination level of the material; and 	<p>Sections 4.2 and 5.2.3</p>

	<ul style="list-style-type: none"> random inspections of incoming loads, for the presence of hazardous waste, shall be undertaken, at the average rate of at least one inspection per 50 loads. 	
28.	The consent holder shall install new downgradient groundwater monitoring wells, if deemed necessary by the consent holder. The final locations shall be agreed in writing by the Southland Regional Council.	Section 13
34.	If any groundwater monitoring well is destroyed the consent holder shall replace it with a new well, in the same general location, to the satisfaction of the Southland Regional Council.	Section 13
Water Permit 201348		
2.	The taking of groundwater is authorised only from the groundwater underdrainage systems beneath the landfill footprint and leachate storage pond, as shown on drawing IZ000400-1000-NG-DRG-1008 attached to this consent.	Section 13 Attachment 1
Air Discharge Permit 201351		
6.	The lateral extent of the landfill working face shall be kept to a practical minimum. The extent of the area between load tipping and load spreading shall be minimised at all times.	Sections 7.4.3, and 7.4.6
7.	All refuse placed in the working face area shall be covered with soil or equivalent material. Cover shall be applied at the end of each day to a depth of approximately 150 millimetres in accordance with the Landfill Operations Management Plan.	Section 7.5

2.2 Monitoring and Reporting the performance of the Landfill Operations Management Plan

Table 2 Monitoring and Reporting Requirements Related to the Landfill Operations Management Plan

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
Land Use Consent 60/3/02/138/1					
2.33	An annual noise monitoring survey shall be carried out for the duration of the consent in order to ensure that the consent holder is operating in compliance with Condition 2.23.	Southland District Council	Annual Recording		
Schedule 1 – General Conditions 201346, 201347, 201348, 201349, 201350 and 201351					
29.	The EMP and sub-management plans (where applicable) shall include monitoring with respect to surface water, groundwater, leachate, landfill gas and nuisance. Each monitoring element shall include:	Southland Regional Council	All Monitoring parameters are referred to in various	N/A	Environmental Manager

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	<ul style="list-style-type: none"> i. Monitoring locations; ii. Monitoring parameters; iii. Monitoring frequency; iv. Detection limits; v. Reporting; vi. Trigger levels (for each monitoring location) for implementing contingency/remedial actions 		consent conditions		
34.	<p>The consent holder shall retain an appropriately experienced person to supervise the operation of the landfill. That person shall compile an annual report on the operation of the landfill, including:</p> <ul style="list-style-type: none"> ▪ the status of landfilling operations on the site and work completed during the preceding year; ▪ the results of environmental monitoring; ▪ any difficulties which have arisen in the preceding year and measures taken to address those difficulties; and ▪ activities proposed for the next year of the landfill operation. <p>This report shall be forwarded to the Southland Regional Council by 1 May, unless otherwise agreed in writing with the Southland Regional Council.</p>	Southland Regional Council	Annually	1 May	Environmental Manager
Discharge Permit AUTH-201346-V3					
24.	<p>The consent holder shall maintain, to the satisfaction of the Southland Regional Council, a record of the quantities and types of waste accepted at the landfill, including the location (in three dimensions) of:</p> <ul style="list-style-type: none"> ▪ treated hazardous wastes; and 	Southland Regional Council	Annually	1 May	Environmental Manager

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	<ul style="list-style-type: none"> specials wastes (as listed in the landfill management plan). <p>A copy of this record shall be forwarded to the Southland Regional Council by 4 August 1 May each year, unless otherwise agreed in writing by the Southland Regional Council.</p>				
25.	The consent holder shall immediately notify the Southland Regional Council if any vehicle(s) is turned away from the landfill with waste that does not comply with the waste acceptance criteria detailed in conditions 18, 19, 20, 21 and 22. This notification shall include the vehicle registration number and source of the waste (if known).	Southland Regional Council	As required	N/A	Environmental Manager
29.	The consent holder shall conduct a rising head test, or other test(s) as agreed in writing by the Southland Regional Council (within 3 months), to demonstrate that any new groundwater monitoring well is working and assess the hydraulic conductivity of the in-situ ground. A water sample shall be taken from the well and tested for turbidity to determine whether the well is clean enough to provide samples of dissolved constituents. The results of these tests shall be forwarded to the Southland Regional Council with the first set of monitoring results from the well.	Southland Regional Council	Within 3 months of any new well	N/A	Environmental Manager
30.	<p>The consent holder shall monitor water quality in existing downgradient groundwater monitoring wells SKM104, SKM201, SKM202, SKM203 and SKM204, as indicated on drawing number IZ000400-1000-NG-DRG-1008 attached to this consent; to the satisfaction of the Southland Regional Council.</p> <p>To this end the consent holder shall monitor water level every month, and water quality for the following parameters four times a year:</p>	Southland Regional Council	Existing groundwater wells - monthly		Environmental Manager

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	<p>pH (field and laboratory) Conductivity (field and laboratory) Turbidity Chloride Total Ammoniacal Nitrogen COD Soluble Iron Soluble Manganese Soluble Aluminium Soluble Arsenic Soluble Cadmium Soluble Chromium Soluble Copper Soluble Nickel Soluble Lead Soluble Zinc Total hardness Alkalinity Potassium Sulphate Sodium Magnesium Calcium Bicarbonate Total Phenols Volatile Acids Dissolved Reactive Phosphorus Total Organic Carbon Total Kjeldahl Nitrogen Nitrate Nitrogen</p> <p>The consent holder shall monitor for the following parameters once every year, to coincide with summer groundwater minimum:</p> <p>Volatile Organic Compounds Semi-volatile Organic Compounds</p> <p>Sampling shall be undertaken under protocols approved in writing by the</p>		<p>Water quality – quarterly</p> <p>Specialist compounds -annually</p>		

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	<p>Southland Regional Council, including on site filtration and preservation of samples for soluble metals analysis. An ion balance to APHA criteria shall be provided for the anions and cations.</p> <p>The results of such monitoring shall be reported in writing to the Southland Regional Council within two months of sampling.</p>				
31.	<p>The consent holder shall establish baseline groundwater quality for each new groundwater monitoring well, monitored in accordance with condition 28 and condition 31 of this consent, after a minimum of four groundwater sampling events. Following the establishment of baseline groundwater quality, to the satisfaction of the Southland Regional Council, the consent holder may reduce the frequency of monitoring for those parameters requiring monitoring from four times a year to twice a year, (to coincide with expected groundwater level maximum and minimum).</p>	Southland Regional Council	Quarterly reduced to biannually		Environmental Manager
32.	<p>The consent holder shall, monitor water quality in any new downgradient groundwater monitoring well(s), installed in accordance with condition 30 of this consent, to the satisfaction of the Southland Regional Council.</p> <p>To this end the consent holder shall monitor water level every month, and water quality for the following parameters four times a year:</p> <p>pH (field and laboratory) Conductivity (field and laboratory) Turbidity Chloride Total Ammoniacal Nitrogen COD Soluble Iron</p>	Southland Regional Council	Water Quality – quarterly Water level - monthly Specialist compounds - biannually		Environmental Manager

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	<p>Soluble Manganese Soluble Aluminium Soluble Arsenic Soluble Cadmium Soluble Chromium Soluble Copper Soluble Nickel Soluble Lead Soluble Zinc Total hardness Alkalinity Potassium Sulphate Sodium Magnesium Calcium Bicarbonate Total Phenols Volatile Acids Dissolved Reactive Phosphorus Total Organic Carbon Total Kjeldahl Nitrogen Nitrate Nitrogen</p> <p>The consent holder shall monitor for the following parameters once every year, to coincide with summer groundwater minimum:</p> <p>Volatile Organic Compounds Semi-volatile Organic Compounds</p> <p>Sampling shall be undertaken under protocols approved in writing by the Southland Regional Council, including on site filtration and preservation of samples for soluble metals analysis. An ion balance to APHA criteria shall be provided for the anions and cations.</p> <p>The results of such monitoring shall be reported in writing to the Southland</p>				

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
	Regional Council within two months of sampling.				
33.	The consent holder shall develop trigger levels for each parameter within each new groundwater monitoring well downgradient of the landfill, to identify, to the satisfaction of the Southland Regional Council, any significant change in background groundwater quality for these wells. The consent holder shall within six months of the completion of each such well submit interim trigger levels to the Southland Regional Council. Trigger levels shall be finalised after a minimum of four sampling rounds over at least one year. The consent holder shall notify the Southland Regional Council in writing within one month of the identification of any significant change in groundwater quality.	Southland Regional Council	Within 6 months of completion of each well		Environmental Manager
35.	<p>The consent holder shall undertake a formal inspection of the landfill cap following significant storm events (greater than 50 percent AEP at a duration of less than one day), but at least every six months. The inspection shall check for:</p> <ul style="list-style-type: none"> Vegetation die-off; Cracking of the cap surface; Subsidence and erosion; Leachate break-out through the cap; Refuse protruding through the cap. <p>Any defects noticed during the inspection shall be remedied immediately.</p> <p>A report on the inspection, and details of any remedial actions undertaken as a result, shall be forwarded to the Southland Regional Council within two months of each inspection.</p>	Southland Regional Council	As required but at least bi-annually		Environmental Manager
Water Permit 201348					

Condition	Requirement	Relevant Regulatory Authority	Frequency	Date	Responsibility
3.	The consent holder shall monitor the quantity of groundwater taken from the groundwater underdrainage system to the satisfaction of the Southland Regional Council. The volume of groundwater taken shall be recorded at monthly intervals. The volume of groundwater taken shall be reported in writing to the Southland Regional Council by 1 May every year.	Southland Regional Council	Monthly recording, Annual reporting	1 May	Environmental Manager
Water Permit 201350					
2.	The consent holder shall maintain a record of the daily pumping hours (the actual number and period of hours over which water was taken) and daily water usage (total daily volume), which shall be made available to the Southland Regional Council at all reasonable times. These records shall be forwarded to the Southland Regional Council by 1 May each year.	Southland Regional Council	Daily recording Annual reporting NB: Information always available on request of SRC	1 May	Environmental Manager

2.2.1 Interaction Between Legislative Requirements and the Landfill Operations Management Plan

If there is a conflict between the management plan and the corresponding legislative requirements, including consent conditions, then the legislative requirements must prevail.

3. Landfill Facilities and Site Development

3.1 Landfill Area and Void Volume

The total landfill area is 37.15 ha and the total approximate void volume is 20 million m³ (Mm³).

Refuse deposition commenced in 2004 in the lowest part of the quarry (i.e. southern part of the quarry) and has been gradually progressing to the north.

In the period 2004 to March 2020 the total amount of waste accepted at the landfill is approximately 855,000 tonnes.

The final contours are shown on drawing IZ000400-1000-NG-DRG-1003 in Attachment 1.

3.2 Site Development

The landfill is being developed in a series of cells/areas as shown on drawing IZ000400-1000-NG-DRG-1003 in Attachment 1.

In April 2020 waste is being placed in Area 14 and Area 15 is being developed to accept refuse from mid-2020.

The layout and phases are developed to fit into the quarry development plans. This allows the detailed planning and design to progress logically and achieve the following:

- Progressive use of the landfill area such that some parts of the site are capped, or being capped, an area is being prepared to receive waste and a small area is being actively filled with waste;
- Effective planning for and the use of materials for liner, cover and cap;
- Enable progressive restoration;
- Minimise leachate production by keeping the active area to a minimum;
- Coordinate haul and access roads; and
- Segregate clean surface water runoff.

Each area is developed in the construction season (late summer) prior to placement of waste in that area. The liner is in place for up to 6 to 12 months prior to waste placement. Each area will be brought up to as close to finished contours that access will allow, before starting in the next area. Where the area can be brought up to final levels, capping is progressively carried out. The detailed design for each area will be undertaken and approved progressively. The concept designs for all future phases are considered many years before they are needed.

3.3 Design Principles

Principal components of the landfill site development are:

- Access facilities, site office and access road development;
- Landfill formation;
- Leachate management system;
- Surface water management system;
- Landfill gas management system;
- Groundwater underdrain management system;
- Landscaping and screen planting; and

- Site fencing.

The design principles are:

- To place waste within the landfill footprint using modern landfill techniques and good industry practice;
- To generally maintain surface water run-off paths within the AB Lime property by realigning these around the landfill footprint in stages during the course of the landfill development;
- To collect and divert clean stormwater within the landfill footprint via a 1200 mm diameter stormwater pipe discharging the stormwater to an on-site stormwater pond;
- To collect and contain leachate by maintaining a leachate collection system discharging to the landfill leachate tank;
- To dispose of collected leachate off-site to the Wastewater Treatment Plant in Clifton that is operated by Invercargill City Council;
- To control the ingress of precipitation by a staged placement of landfill cover (daily, temporary, intermediate and final) and landfill capping;
- To manage the uncontrolled release of landfill gas via active gas extraction wells connected via a gas header pipe system to a principal flare that treats the gas prior to discharge to the atmosphere; and
- To collect any groundwater below the landfill base liner in a groundwater underdrainage system prior to discharge to the site stormwater pond.

3.4 Construction Activities

Construction activities will include the construction and establishment works as follows:

- Excavation and general earthworks;
- Subgrade preparation;
- Stormwater system construction and maintenance including maintenance of stormwater pond;
- Managed wetland maintenance;
- Groundwater underdrainage construction;
- Landfill base and sidewall liner construction;
- Leachate collection disposal system construction and maintenance of leachate tank;
- Construction of vertical and horizontal gas wells, reticulation gas header pipes and gas condensate traps;
- Placement of intermediate cover;
- Placement of temporary and final capping; and
- Remediation works.

Construction activities do not include operation works. Operational works are defined as works directly related to the placement of refuse and include the following:

- Removal of daily cover at the start of each working day;
- Tipping refuse or Special Waste;
- Placing and compacting refuse; and
- Placing daily cover at the end of each working day on the active tipping face.

4. Waste Acceptance Criteria

4.1 General

This section sets out the procedures relating to waste acceptance criteria and includes an application and approval processes described as the Landfill Users Access Agreement.

All landfill users and waste carriers are required to complete a formal application form for waste acceptance and sign a Landfill Users access agreement to authorise landfill loads/users and document waste acceptance.

Waste is only delivered to the site in vehicles dedicated specifically for the transport of solid waste, and which have been given prior authorisation to access the site by AB Lime.

A notice is clearly positioned at the landfill entrance to identify the hazardous wastes which are unacceptable at the landfill.

The landfill is NOT open to the general public for the disposal of waste.

An additional approval process applies to waste types that cannot be freely accepted for disposal and are restricted because of their nature, properties or composition. These wastes are referred to as "Special Waste" and are discussed in Section 5.

4.2 Acceptable Waste Types

Solid wastes will be accepted for disposal provided it complies with the acceptance criteria set out in this plan.

The types of waste that can be accepted at the AB Lime landfill include:

- Domestic;
- Industrial;
- Commercial;
- Clean fill;
- Medical waste only in accordance with NZS 4304:2002 "Health Care Waste Management";
- Special Waste subject to the criteria set out in Section 5;
- Asbestos in accordance with the Health and Safety at Work (Asbestos) Regulations 2016 (see also Section 5.5.4);
- Methamphetamine contaminated household wastes that have an average contamination of below 100ug/100cm² (see Section 5.2.2);
- Difficult wastes that require special handling e.g. cess pit sludge, offal, bulky items in minor quantities; and
- ~~Acceptable Aluminium Dross Waste (see Section 5.2.3).~~

Staff working at the tip face are trained in the waste acceptance procedures and in identifying non-conforming loads. Disposal at the working face is always supervised to ensure that unacceptable wastes are not being placed.

4.3 Acceptable Offal Waste

Acceptable offal waste is discussed in Section 5.2.1.

4.4 Waste Types Not Accepted

Wastes that are excluded from the landfill include:

- Bulk liquid waste;
- Hazardous medical wastes;
- Hazardous wastes; and
- Sludges.

A notice is clearly positioned at the landfill entrance that identifies the wastes that are not accepted at the landfill.

4.4.1 Bulk Liquid Waste

Liquid waste is defined as being any waste that contains free liquid on arrival at the landfill or has a solids content of less than 20% except such waste that passes the USEPA Paint Filter Liquids Test (USEPA Method 90905A).

Liquids in small containers forming part of domestic waste that are impractical to be emptied and that do not contain hazardous characteristics are considered acceptable waste.

4.4.2 Sludges

Sludges have a consistency of a viscous liquid and pour and behave like a liquid. Sludges will be defined as having less than 20% solids (as sewage sludge typically has a higher content and may be accepted under the Special Waste Category).

Sludges will not be accepted unless the sludge can be, or has been, treated/stabilised in such a way that it does not behave like a liquid.

4.4.3 Hazardous Waste

Except for asbestos waste, medical waste and ~~Aluminium Dross Waste (ADW)~~ (see Section 5.2), no hazardous waste is accepted for disposal at the landfill.

The definition of "hazardous waste" is:

- Wastes which are defined as either radioactive, explosive, flammable, oxidising, or corrosive in terms of the HSNO Classification regulations, or capable, by any means after disposal, of yielding another material, for example leachate which possess any of the above characteristics.
- Wastes which exhibit the characteristics of toxicity and eco-toxicity, which following testing using the USEPA Toxicity Characteristic Leaching Procedure (TCLP) result in leachable concentrations of contaminants in excess of the leachable concentration limits listed in Schedule 2 (see Consent 210346, Attachment 2).
- Waste that exhibit the characteristics of toxicity and eco-toxicity with total concentrations in excess of the total concentration limits listed in Schedule 2 (see Attachment 2).

The definition of 'hazardous waste' does not include small quantities of waste products containing potentially hazardous components that are likely to have adverse effects on the environment, such as can be expected to be contained in the municipal waste stream.

4.5 New Contaminants

The process for assessing and developing assessment criteria for new contaminants is seen below:

4.5.1 Emerging Contaminants

It is possible within the lifetime of the consent, that a contaminant or group of contaminants may become a concern typically due to improvements over time in scientific knowledge about its effects and distribution. Additional Waste Acceptance Criteria may be needed in due course and is to be reviewed using the following methodology:

review of the Waste Acceptance Criteria will be conducted every 10 years during the lifetime of the landfill. The aim of the review will be to consider amendment to any existing Waste Acceptance Criteria

The objectives of the review are as follows:

- 1) To consider the addition of any new Waste Acceptance Criteria to manage potential environmental harm or human health risk associated with emerging contaminants;
- 2) With regard to any contaminant that does not already have Waste Acceptance criteria within this management plan, the characteristics that may trigger its inclusion in a review are:
 - i. Evidence of greater potential harm presented in recent publications;
 - ii. Known presence in a regional context; and
 - iii. More frequent instances of special waste disposal applications requiring assessment on a case-by-case basis.
- 3) The review steps for emerging contaminants will be:
 - a) Identify the contaminant and review the reasons for it to be a candidate for imposition of special waste acceptance criteria;
 - b) Review New Zealand and international regulations and good practice guidelines to look for any existing WAC for the contaminant at other landfills within New Zealand;
 - c) If there are existing waste acceptance criteria, then compare the management of these emerging contaminants against the AB Lime landfill context and determine whether existing criteria can be adopted for the AB Lime site;
 - d) If there are no existing waste acceptance criteria, or if the existing criteria are not site specific, then AB Lime develop landfill specific criteria;
 - e) In developing site-specific criteria for a contaminant AB Lime shall have regard to its mobility, persistence, degradation products, pathway to any receptor and published evidence of harm;
 - f) Measure or estimate the concentration and total mass of the contaminant in raw leachate, raw landfill gas, treated leachate, treated landfill gas and waste mass wherever relevant;
 - g) Consider the potential discharges from the landfill in the long term;
 - h) Recommend whether or not new waste acceptance criteria are justified (and if so, then reasonable parameter limits);
 - i) Recommend any worthwhile additional and/or alternative related monitoring;
 - j) Summarise the assumptions and findings of the review; and
 - k) If new waste acceptance or monitoring parameters are proposed, then follow the procedure for revision of the Landfill Operations Management Plan.

4.6 Random Load Inspections of Incoming Waste

Random inspections of incoming loads for the presence of not accepted wastes are undertaken at the average rate of at least one inspection per 50 loads (approximately once a week) at the site entrance.

The results of these inspections are recorded on the Waste Inspection Sheets.

If, during random inspections, waste that is not accepted at the landfill is discovered, the material is reloaded onto the delivery vehicle for return and a copy of the Inspection Sheet is sent to Environment Southland within 48 hours, along with a description of the action taken, including:

- The date and time at which the vehicle was turned away;
- The registration number of the vehicle;
- The identity of the carrier;
- The size and type of the load;
- The source of the load; and
- The category of the hazard.

In the event that not accepted waste is discovered during tipping the following contingency responses will apply:

- Safety first;
- Notify the Landfill Site Supervisor and co-workers;
- Cordon off the hazardous waste;
- Track down the customer who delivered it;
- Refuse any further deliveries from that customer until satisfactory resolution;
- Instruct the customer to remove the not accepted waste;
- If removal will occur promptly, then assist the customer with removal;
- If the response from the customer is slow, then consult with a specialist advisor and the regulator about alternative methods to address the hazardous waste;
- Remove and/or treat as required;
- Contact hazardous waste/not accepted waste removal contractor for removal to their hazardous/ not accepted waste treatment facility if required;
- Survey any burials;
- Review the pre-acceptance process, the customer's systems, and the source before recommencing deliveries;
- Ensure that the clean-up is satisfactory for worker safety and environmental containment; and
- The incident is to be recorded in accordance with incident reporting.

5. Special Waste Acceptance

5.1 Special Waste Application Form

The generator of special waste or the cartage contractor will be required to make an application for the disposal and supply the following details:

- Nature and source of the waste stream;
- Details of the process generating the waste;
- Estimates of the quantities and expected frequency of disposal;
- Substances (i.e. 'contaminants') present in the waste including contaminant testing and TCLP results; and
- Relevant supporting analytical information.

An application form is provided in Attachment 3.

If the special waste does not contain contaminants then the only restriction on the waste is its physical nature (e.g. large objects such as wire rope, bulky objectives or demolition waste), then in these cases, arrangements for disposal can be made with the Environmental Manager.

5.2 Special Waste Application Appraisal

Information on the special waste will be appraised for completeness.

The appraisal process will consider the protection of human health and safety, protection of the environment and compatibility with the operation of the landfill. This can only be done by either:

- using the listed waste acceptance criteria, or
- considering a disposal application as special waste.

5.2.1 Acceptable Offal Waste

For other than minor amounts of offal, AB Lime requires that Offal Waste is classified as a Special Waste subject to the following procedures:

- All offal to be disposed of is to be pre-booked by the waste generator or transporter, and will be only be accepted in discrete loads;
- Information on the source of the offal, including the origin of the animals is recorded;
- Information on the cause of death of the animal from which the offal is sourced is recorded;
- Age of the offal and any treatment applied to stabilise offal (note: old offal may be odorous and will be assessed as described in the Landfill Odour Management Plan);
- Disposal of the offal into pits specifically excavated in the landfill for each discreet load of offal;
- Each load of offal is immediately covered following deposition; and
- The location of each pit used for the disposal of offal is record.

5.2.2 Acceptable Methamphetamine Contaminated Waste

Material contaminated with methamphetamine and/or chemicals associated with the manufacture of methamphetamine may be accepted into the landfill provided that the level of contamination does not exceed 100 µgm/cm², based on an average by weight per individual household lot.

The material that may be accepted includes wall linings (including gib board), soft furnishing (e.g. curtains, carpets), furniture, bedding, clothing and whiteware. Actual stocks of chemicals used in, or leftover from, methamphetamine manufacture is excluded from this condition.

For Methamphetamine Contaminated Waste AB Lime will:

- Record the date, source, volume and nature of the material received;
- Keep a record of monitoring data that confirms the contamination level of the material; and
- Record the location where the material is placed within the landfill in 3 dimensions.

5.2.3 — Acceptable Aluminium Dross Waste

~~Aluminium dross waste and material contaminated with this waste may be accepted into the landfill provided that the concentrations of aluminium and fluoride do not exceed the leachability limits or screening concentrations set out in Table 1 of "Module 2: Hazardous Waste Guidelines, Landfill Waste Acceptance Criteria and Landfill Classification, May 2004".~~

~~The leachability limits shall be established using Synthetic Precipitation Leaching Procedure (SPLP) testing, with concentrations not to exceed a SPLP test result of:~~

- ~~▪ 40 g/m³ of Aluminium and~~
- ~~▪ 200 g/m³ of Fluoride.~~

~~The material that may be accepted includes gravels and soils that have been contaminated with dross.~~

~~For aluminium dross waste AB Lime will:~~

- ~~▪ Record the date, source, volume and nature of the material received;~~
- ~~▪ Notify the SRC within 7 days of the material being accepted, and provide details of the source and volume of the material;~~
- ~~▪ Keep a record of monitoring data that confirms the contamination level of the material; and~~
- ~~▪ Record the location where the material is placed within the landfill.~~

~~The information recorded will be made available to Environment Southland or its representative on request.~~

5.3 Special Waste Acceptance Criteria

The criteria outlined below and defined in 2 indicate whether a special waste is acceptable for disposal in the landfill.

As wastes are usually mixtures of a range of substances the most stringent criteria that relates to a component applies. As such a waste may be treated to remove its prohibited properties so that it can be accepted as a special waste.

If no criteria is listed then the waste is accepted for disposal unless the waste is defined as a hazardous substance in terms of the HSNO regulations (Hazardous Substances and New Organisms (HSNO) Act 1996).

If it is defined as a hazardous substance then the waste is only accepted if a risk assessment (see Section 5.5.4) shows that it is able to be landfilled without adverse effects on human health or safety, the environment and it is compatible with the operations of the landfill.

5.3.1 Hazardous Characteristics

Any waste with a characteristic defined in Table A in Attachment 4 is not acceptable for disposal. If there is any doubt in the interpretation of this list, then reference is made to the HSNO definition.

5.3.2 Nature and Composition of Waste

Criteria relation to the nature and composition of wastes are listed in Attachment 2.

These tables include:

- elutriation criteria;
- maximum allowable concentrations acceptable with the requirement to undertake an elutriation test; and
- maximum concentrations.

5.3.3 Elutriation Criteria

The elutriation criteria are based on the USEPA Toxicity Characteristic Leaching Procedure (TCLP), USEPA Method 1311. The TCLP is designed to determine the mobility of both organic and inorganic analytes present in the liquid, solids and multiphase wastes.

It is recommended that the elutriation criteria are the lesser of:

- 100 times the NZ drinking water criteria, to consider carcinogenicity or development/reproductive toxicity of compounds to humans, or
- Criteria specified within the most recent Hazardous Substance (Storage and Disposal of Persistent Organic Pollutants) Notice, or

Total Concentration of contaminants in a waste without Elutriation Tests

Wastes with total concentrations of all chemical parameters less than those listed are accepted without the need for a TCLP test.

The listed value is 20 times the TCLP criteria, because the TCLP test included a 20 times dilution.

Maximum Concentration

This is the maximum concentration at which disposal is allowed. If no value is included, then the waste is able to be landfilled regardless of the concentration provided the other criteria are satisfied.

5.3.4 Physical Nature

Criteria relating to the physical characteristics of a waste a listed in Table B in Attachment 4. The only restriction on these wastes is their physical nature. In these cases, special arrangements for disposal are made with the Environmental Manager.

5.4 Special Case Procedure- Special Waste Acceptance

An alternative to using the criteria outlined in Section 5.3 is to assess an application as a Special Case- Special Waste Acceptance. This involves the use of a risk assessment process and may allow the disposal of wastes that exceed the listed criteria.

This approach is not available for all substances. Those for which this option is not available are marked with an asterisk in the lists and must comply with the listed values.

An inventory of the individual Special Case- Special Waste Acceptance documentation will be kept on file for reference by the Environmental Manager.

5.4.1 Risk Assessment Process- Special Case Procedure- Special Waste Acceptance

The leachate generated by a waste can be estimate on a pro-rata basis. The potential increase of a substance in the leachate discharge can be estimated by:

(Daily tonnes of a special waste/daily total tonnage) x TCLP concentration = substance increase in leachate conc.

This approach does not allow for attenuation and assumes that the waste will be in contact with extreme acidic conditions, i.e. TCLP concentration will be achieved in the leachate out of the specific waste. For example, for metallic analyte determinations the sample must be acidified with nitric acid to a pH < 2, and such a low pH-value is rarely observed in municipal solid waste landfills.

An example would be 10 tonnes/day of copper foundry waste with a TCLP concentration of 20 mg/L. If the total refuse tonnage were 1000 tonnes, then the maximum increase in leachate concentration would be:

$$(10/1010) \times 20 \text{ mg/L} = 0.2 \text{ mg/L is possible increase in copper concentration.}$$

With comparison of the leachate copper concentration and trade waste limits ($10 \text{ g/m}^3 = 10 \text{ mg/L}$), acceptance of this waste stream would be acceptable.

On the other hand, for the disposal of 200 tonnes/day of the same waste, the copper concentration would be:

$$(200/1200) \times 20 \text{ mg/L} = 3.3 \text{ mg/L is possible increase in copper concentration.}$$

Then if the existing leachate copper concentration is 5 mg/L, then the additional 3.3 mg/L would be very close to the trade waste limit of 10 mg/L, and in that instance, it would not be recommended to accept the special waste.

5.5 Disposal Method for Special Waste

5.5.1 Location of Special Waste Disposal

Special waste approved for disposal under Sections 5.1-5.4 will be disposed of as follows;

- a) Either at the working face where it will be covered with refuse prior to compaction, or
- b) Placed into pits/excavations in mature refuse to minimise exposure to acidic conditions such as arise in leachate generated in the early stages of refuse decomposition.

Waste approved for disposal under Section 5.4 (Special Case Waste) must be only be disposed of under item b) above.

5.5.2 Special Holes for Special Waste Disposal

Waste that is potentially a health hazard or visually distressful or landfill staff such as fine dust, autoclaved medical waste and sewage effluent screenings will be deposited into a special hole in a mature area of the landfill where practicable.

A minimum of Temporary Capping (see Section 12.3) shall be applied immediately to the Special Waste requiring disposal under Section 5.5.1-b), and the cover application operation must be supervised by the Landfill Supervisor.

5.5.3 Buffer Distance to Liner System for Special Waste Disposal

A 3 m buffer to the liner system is required to ensure that the excavation of special holes in the landfill do not compromise the base and sidewall liner system and are separate from the leachate collection system, no special wastes requiring special disposal will be accepted for disposal until the Environmental Manager has certified that sufficient waste has been placed to allow construction of special holes whereby the distance between the base of the special hole and the liner will be greater than 3 metres.

5.5.4 Disposal of Asbestos Waste and Medical Waste

Asbestos and medical related waste will be handled in accordance with AB Lime's document 4.30 Policy & Procedure Name: Approved Hazardous Waste 4.30. A copy of this document is contained in Attachment 5.

5.5.5 Surveying Location of Special Waste Disposal

The Landfill Supervisor is responsible for setting out and surveying the special holes.

5.6 Special Waste Tracking

If AB Lime decides, using the acceptance criteria of this plan, that the Special Waste can be disposed of at the landfill, then a permit will be issued to the special waste generator and/or contractor transporting the special waste. A copy of an example permit is contained in Attachment 6.

The permit must be carried by the transporter of the Special Waste and presented to the weighbridge operator to gain entry into the landfill.

The permit will have details of:

- A description of the approved special waste;
- The estimate of quantities to be disposed of;
- Customer details and permit expiry date;
- A permit number;
- The waste classification code; and
- The area for disposal.

The Weighbridge Operator will enter the permit number and waste classification code from the permit into the computer, together with the weigh details when the transporter leaves the landfill again, via the weighbridge.

All details associated with the waste will be able to be accessed by reference to the permit number.

5.7 Record Keeping- Special Waste

A full record will be kept for all Special Waste accepted at the landfill. For wastes approved under the category Special Case Procedure- Special Waste Acceptance a database of specific substances will be maintained to track any possible cumulative effect of that substance on leachate quality.

6. Crisis/Emergency Response Waste Acceptance

6.1 Waste Acceptance Criteria in Response to an Emergency and Government Agency Instruction

In the instance of a local, regional or national biosecurity emergency or disaster, AB Lime may be required to accept a substantial volume of waste over a relatively short period of time.

Due to the organic nature of some of these wastes, their acceptance at the landfill site is likely to cause a heightened loss of amenity or increased nuisance associated with odour.

AB Lime should ensure the following is completed:

- Environment Southland are notified within 24 hours prior to the acceptance of the waste. The notification is to include the following:
 - A copy of the disposal authorisation/directive from the relevant Government Agency;
 - Proof of notification to neighbours;
 - The nature of the waste;
 - The volume of the waste;
 - Expected number of loads and the duration over which they will be accepted;
 - The generator or source of the waste;
 - The potential impacts associated with accepting the waste;
 - The conditions of the consent that will potentially be breached;
 - The request that a Council Officer be made available to oversee the disposal; and
 - A waste treatment or disposal procedure outlining the management controls and mitigation measures that will be employed.

AB Lime will require acknowledgement of receipt of the notification and authorisation from Environment Southland before they are permitted to accept the waste.

6.2 Mitigation Measures when Accepting Crisis/Emergency Response Waste

In these circumstances, the following provisions and management measures are to be employed to mitigate the potential impacts associated with the acceptance and handling of the waste:

- a) The Environmental Manager will manage the entire disposal process associated with the emergency waste.
- b) Trained operational staff are to be briefed on the procedure, advised of the health and safety risks and provided with the respective PPE.
- c) A special area is to be designated and available to accept emergency waste.
- d) An Environment Southland officer is to be present on site for the duration of the disposal procedure to ensure the management controls and mitigation measures are implemented as far as is possible.
- e) The existing controls for odorous loads as per Landfill Odour Management Plan are to be employed along with the following additional controls:
 - All waste to be disposed of under full-time supervision of the Environmental Manager;

- Waste is to be treated with additional lime at a ratio of 2:1, where it is considered safe to do so;
 - Deep burial to a minimum of 2 metres;
 - Application of lime with the biosecurity waste being disposed of; and
 - Trench and cover immediately to Temporary Capping criteria (see Section 12.3).
- f) Before exiting the landfill, all vehicles are to be disinfected as follows:
- Vehicle to first be water blasted in the washbay;
 - Vehicle is then to be disinfected using a Ministry of Primary Industries approved disinfectant that is to be applied as per the manufacturer's instructions; and
 - The disinfectant may need to be left on for 10-20 minutes to have full effect.

Upon completion of disposal but within 1 month, AB Lime are to provide Environment Southland with a report outlining the following:

- Confirmation of volume of waste received;
- Confirmation of number of loads received;
- Confirmation of duration of disposal process;
- Number of complaints received over the duration of the disposal process and how they were handled; and
- Lessons learnt and recommendations on how the process could be better managed in future.

7. Landfilling Operations

7.1 Site Control and Management

7.1.1 General Operations

All processes on site shall be undertaken in accordance with the Environmental Management Plan so that odours, noise, litter and other effects from the site operations are minimised.

7.1.2 Emergency Operating Hours

In an emergency, refuse may be delivered to the landfill outside the operating hours, provided that:

- Environment Southland are informed within 24 hours of the AB Lime Landfill being notified of the upcoming emergency waste acceptance event in terms of:
 - a) The nature of the emergency; and
 - b) The time/times of delivery and number of vehicles involved.
- The emergency is no more than one truck-load.

The information of the emergency event shall be made available to the Community Liaison Ground upon request.

For emergency waste that involves more than one truckload the procedures under Section 6 must be followed.

7.2 Weighbridge: Incoming Waste

All loads of waste will be weighed and inspected prior to entering the site and on leaving the site. The Weighbridge Operator:

- Will be present at the weighbridge office at all times the landfill is open to accept waste. The Weighbridge Operator duties will be shared with other qualified staff during breaks;
- Ensures that all vehicles entering the site will go over the weighbridge and be weighed on entry (gross weight- tonnes) and again on exit from the site (net weight- tonnes);
- Will check that any customer/transporter disposing of Special Waste has a valid Disposal Permit and that all Permit conditions have been complied with;
- Checks that waste transporters arriving at the landfill have their loads securely covered with no loose litter, dust or liquid leaking from the vehicle. Loads that do not meet these criteria will be refused entry;
- Will instruct a Pointsman to conduct the load inspection to ensure compliance with the Waste Acceptance Criteria for the landfill;
- Will provide the waste transporter with the location and directions to safely travel to the working face;
- Manages the weighbridge computer system that automatically records weights;
- Collects all forms required to be accompanied with the waste; and
- Records waste classifications and vehicle/transporters numbers.

7.3 Offloading Waste

The Pointsman:

- Will direct vehicles/transporters of waste to the appropriate location to offload;

- Instruct the vehicles to reverse to the offloading area where it is safe to do so, and discharge their load;
- Visually inspect load as they are offloaded to ensure compliance with Waste Acceptance Criteria; and
- Check for odorous loads and if found to be odours during tipping, the load shall be covered immediately with other waste or clean soil reserved for daily cover.

Any load that is found to contain waste that is not accepted at the landfill under the full-time supervision of the Landfill Supervisor will be pushed to one side for immediate reloading, on the waste transporter/vehicle and removed from the landfill.

The Landfill Supervisor will inform the Environmental Manager of the incident who will discuss with the transporter and/or transporter's client and/or generator of the waste, the reason for the waste being removed from the landfill.

A record will be kept by the Environmental Manager of all incidences related to waste not accepted at the landfill entering the landfill. This information will be reported to Environment Southland.

7.4 Placement & Compaction of Waste

7.4.1 Filling Programme

The landfill will be filled in a series of areas, i.e. cells. In April 2020 fifteen (15) areas have been filled as shown on drawing IZ000400-1000-NG-DRG-1003 in Attachment 1.

The future filling programme for areas 15 to Area 20 and Future Area's 1, 2 and 3 is shown on drawing IZ0004000-1000-NG-DRG-1002 in Attachment 1.

The design of the filling programme has been carried out in collaboration between AB Lime and Jacobs, so as to safely manage leachate, stormwater and landfill gas management associated with the landfilling operations and to accommodate the quarry operations that occur in close proximity to the landfilling operations. Please refer to landfill design documents for more detail.

7.4.2 First Placement of Refuse

- Loosely placed a 1 m minimum thick protection layer (selected waste) over the geogrid covering the leachate drainage material.
- The 1 m thick selected waste layer may consist of bagged domestic, selected refuse or other appropriate waste. The 1 m thick layer must not include any sawdust, sludge, bulky steel and other material which may damage the flexible membrane liner and reduce disturbance or cause clogging of the leachate collection blanket and pipework.
- No sludges or Special Waste pits will be disposed of within a 3 m zone above the drainage layer.
- The 1 m thick layer will be lightly compacted by a bulldozer or similar size and weight equipment, i.e. not a landfill compactor.
- The loose refuse on the perimeter of the lightly compacted refuse is tamped with the excavator bucket and covered with soil.
- Once sufficient area of the liner has been covered with the 1 m protection layer, refuse may be placed in 300 mm thick layers and subject to the usual refuse compaction by the landfill compactor to achieve a minimum compaction rate of 0.8 ton/m³.

7.4.3 Working Face

The working face, also known as the open face or operating face, is the area where the waste is tipped, spread and compacted.

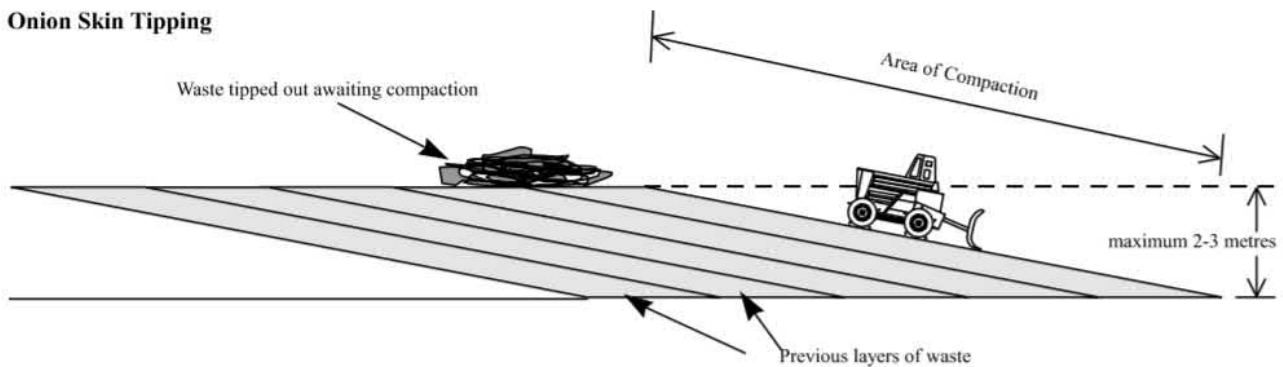
The area of the working face, i.e. exposed refuse, shall be kept to a practical minimum having given consideration to the quantity of waste entering the site, maintenance of optimum compaction and health & safety requirements.

The working face will not exceed 1000 m².

A schematic diagram showing the placement and compaction of waste at the working face, using the “face tipping” method or the “onion skin tipping” method is presented in **Figure 2**.

The Pointsman, Refuse Bulldozer Operator and Refuse Compactor Operator must maintain continuous contact via radio and/or visual contact, to assess the placement of each load on the working face.

Onion Skin Tipping



Face Tipping

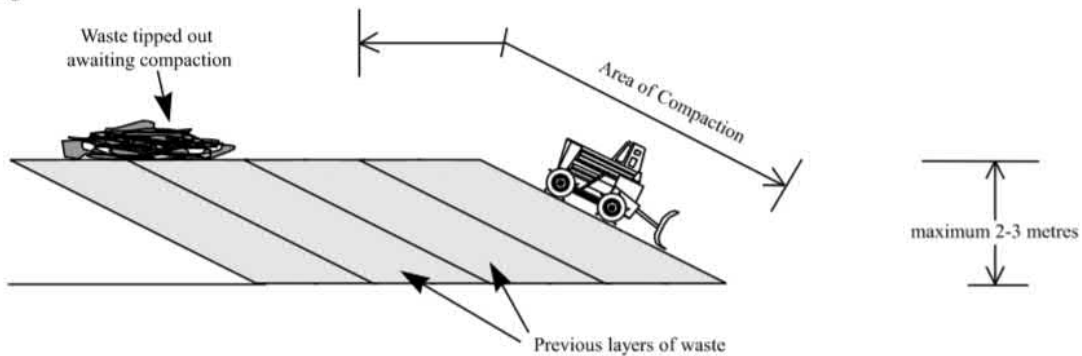


Figure 2 Two options for Working Face Refuse Tipping Methods (source; Fig 4 of EPA, Landfill Manuals, Landfill Operational Practices, Ireland, 1997)

7.4.4 Refuse Bulldozer Operator

The Refuse Bulldozer Operator:

- Will strip/blade the daily cover and stockpile it along the perimeter of the working area for re-use at the commencement of each working day;
- Ensure that sufficient daily cover is removed, to enable free drainage of leachate to the leachate collection system;
- Carry out the stripping of daily cover in tandem with the placement of fresh refuse to minimise the discharge of odour;
- Blade the waste from the off-load area to the working face area;
- Spread the waste in a 300 mm to 500 mm thick layer at the working face area as indicated by the Refuse Compactor Operator; and
- Track-roll the waste prior to the placement of daily cover at the end of each working day.

7.4.5 Refuse Compactor Operator

The Refuse Compactor Operator:

- Compacts the waste by a minimum of three to five passes (one pass is 'there-and-back');
- Instructs the Refuse Bulldozer Operator where each layer of waste is placed; and
- Liaises with the Refuse Bulldozer Operator that the waste is spread in 300 mm to 500 mm thick layers.

The compactor used at AB Lime is a BOMAG BC 772 RB-2 which is a 36-ton compactor.

It is envisaged that a minimum target refuse density of 0.8 tonnes/m³ will be achieved if the refuse is placed in 300-500 mm loose lift layers and compacted using a minimum of 3-5 passes.

7.4.6 Temporary Access Road to Working Face

A temporary all-weather access road for the transporter of waste to travel to or near the working face (<50 m) and allow for the unloading of the waste, is essential for efficient operation of the landfill.

The temporary roads should allow for an approximate area of 4 m width per truck for unloading of waste, and for sufficient room for trucks to turn around.

This temporary access road is by its nature is always formed on waste. Forward planning by the Environmental Manager and Landfill Supervisor of operational areas will be carried out so that maximum use and minimum maintenance of these temporary access roads is achieved.

The temporary access roads and unloading areas will be constructed as to provide adequate traction for vehicles accessing the working face in all weather conditions.

7.4.7 Special Waste Disposal

The special waste disposal is described in Section 5.5.

The construction of special holes, limitations where special holes shot not be dug (with 3 m of base and sidewall landfill liner) and surveying of special holes is also presented in Section 5.5.

7.5 Daily Covering of Waste

7.5.1 Daily Cover

The main objectives of daily cover at the landfill include:

- Reduction of odour and landfill gas emissions;
- Prevention of wind-blown litter;
- Deterrence of scavenging by birds or other animals;
- Prevention of fly infestations;
- Reduction of dust nuisance;
- Deterrence of vermin such as rats;
- Reduction of the risk of fire; and
- Improvement of the visual appearance.

At the end of each working day the waste will be covered by a 'daily cover' layer that may comprise:

- A minimum 150 mm thick cover of suitable soil such as quarry overburden.

- a) Note, this is a 150 mm thick layer after compaction so the loose lift layer thickness should be around 200 mm to 250 mm, to achieve a minimum 150 mm compacted thickness of daily cover soil.
- b) The reason for a 200 mm to 250 mm loose lift layer thickness is that soil may drop into open spaces of the compacted waste.
- c) For this reason, proper compaction of the refuse at the end of each working day is recommended as this reduces the risk of 'losing' soil in the underlying waste and thus, minimises the loose lift layer thickness of daily cover soil.

Alternative daily covers that can be used include:

- Sludge (lime dust and coal ash slurry) from the mill/kiln scrubbers;
- ConCover ProGaurd 11B (pulp and paper spray); and
- Other suitable alternatives that may be present in the waste stream.

7.5.2 Unsuitable Daily Cover

Unsuitable daily cover includes auto-shredder residue, also referred to as fragmentised waste, frag or fluff, or car-flock. The waste is generated from the shredding of end-of-life vehicles (ELVs) after the removal of hazardous and certain recyclable materials. The shredder residue is now not considered to be suitable as daily or intermediate cover at landfills.

The shredder residue has the potential to contain high levels of contaminants such as heavy metals, oils, and persistent organic pollutants (POPs) including certain brominated flame retardants and polychlorinated biphenyls (PCBs). It also presents a fire hazard, can be visually unattractive and can cause dust and litter concerns, depending on the composition of the material.

7.5.3 Daily Cover Odour Mitigation

If there is odour at the working face the alternative daily cover should not be used. Instead a soil cover of at least 150 mm thick should be used.

7.5.4 Removal of Daily Cover

- The next working day the daily cover will be removed as much as reasonably practical to allow leachate to migrate downwards rather than sideways, before it is covered with waste
- Any remaining daily cover will be scarified to facilitate vertical drainage
- During wet periods when it is difficult to remove daily cover material, trenches will be dug in the daily cover to expose the underlying refuse to facilitate leachate migration into the landfill

Further details about daily cover, intermediate cover, temporary capping and permanent capping are presented in Section 12.

7.5.5 Supply of Daily Cover

7.5.5.1 Excavated Cover

Excavation of soil for daily cover such as quarry overburden should be made available from areas of the site identified with agreement from both Landfill Supervisor and the Quarry Manager.

The Landfill Supervisor shall ensure that:

- The daily cover soil/material should be placed in reasonably close and practical proximity to working face, so that there is no risk of the daily cover not being applied at the end of each working day due to limited day-light hours to apply the daily cover, or because 'the working shift is over'; and
- All personnel and equipment required to apply the daily cover are available to apply the daily cover.

7.5.5.2 Imported Cover

Imported cover is soil or other approved alternative cover material that has been brought to the landfill. Material such as clean fill, dirt and small pieces of rubble may be used as cover for refuse.

Imported materials such as asphalt grindings and broken concrete should be used for building roads and for surfacing wet weather areas (e.g. waste transporter access to unloading area near working face).

Various types of imported fill material may be stockpiled in areas designated by the Landfill Supervisor.

7.5.6 Placement of Daily Cover

The placement of daily cover is by a combination of bulldozer and compactor (see Section 7.4) for soil-type daily covers.

7.5.7 Special Waste Cover including Asbestos Waste

Where it is deemed necessary to excavate pits to bury Special Waste, the type of cover must comprise at least Temporary Capping (see Section 5.5).

AB Lime has special procedures for handling and disposal of Asbestos Waste, and these are contained in Attachment 5.

7.5.8 Bulky Waste Items

The Landfill Supervisor will ensure that all bulky items (with a solid dimension in excess of 1 m) are NOT placed within 3 m of the base or sidewall of the landfill, or within 3 m of the final landfill cap.

7.5.9 Placement of Intermediate Cover, Temporary Capping and Final Capping

For placement of Intermediate Cover, Temporary Capping and Final/Permanent Capping, see Section 11.

7.6 Cleanfill

The AB Lime Landfill is consented to take cleanfill but under the agreement that is in place with Wastenet all Southland cleanfill is to be taken to other cleanfill sites.

Cleanfill is material that when discharged to the environment will have no adverse effect on people of the environment, and includes natural materials such as clay, soil and rock, and other materials, such as concert, brick or demolition products, that are free of:

- Combustible, putrescible, degradable or leachable components;
- Hazardous substances or materials (such as municipal solid waste) likely to create leachate by means of biological breakdown;
- Any products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices;
- Materials such as medical and veterinary waste, asbestos;
- Radioactive substances that may present a risk to human health; and

- Contaminated soil and other contaminated materials.

Suitable cleanfill material that arrives at the landfill in discreet loads can be used for:

- Access routes within the landfill (hardfill);
- Temporary drainage systems within the landfill, for example leachate recirculation entry points (hardfill);
- Soil/subsoil as daily cover and screening bunds on landfill; and
- Topsoil restoration work.

All other material that may be considered suitable for a cleanfill activity is placed within the landfill containment area.

8. Nuisance Control

8.1 Odour Control

Please refer to Landfill Odour Management Plan.

8.2 Dust Control

Please refer to the Landfill Air Quality Management Plan.

8.3 Noise Control

All activities on the site are managed and carried out so that the rating level measured at the notional boundary of any neighbouring property does not exceed the following levels.

Table 3 Noise Limits

Monday – Saturday, 7.00 am – 10.00 pm	50 dBA L_{eq}
All other times including public holidays	40 dBA L_{eq}
Daily, 10.00 pm – 7.00 am the following day	70 dBA L_{max}

“Notional boundary” means a line 20 metre from the façade of the building in question or the legal boundary of the site on which the building is located where the boundary is closer to the building than 20 metres.

Sound levels are those as measured in accordance with the provision of NZS 6801:2008 Acoustics – Measurement of Environment Sound and assessed in accordance with the provision of NZS 6802:2008 Acoustics – Assessment of Environmental Noise.

Measurement of Environment Sound and assessed in accordance with the provision of NZS 6802:2008 Acoustics – Assessment of Environmental Noise.

An annual noise monitoring survey shall be carried out for the duration of the consent in order to ensure that the consent holder is operating in compliance with condition 2.22.

8.4 Litter Control

Uncontrolled litter can contribute significantly to the loss of amenity experienced at a landfill site. The location of AB Lime is in a general rural area with many trees around the landfill boundary providing a degree of screening.

AB Lime will implement the following controls to prevent and manage nuisance from wind-blown litter.

8.4.1 Secure Loads

A condition of entry is that all trucks/transporters of waste must have secured loads to prevent the escape of litter.

The covers are not to be removed until the trucks reach the off-loading area near the working face. The Weighbridge Operator will remind the drivers of the trucks of this requirement when they enter the landfill.

Should the waste transporter experience litter falling or blowing from the truck when driving to the working face, the driver must inform the Pointsman immediately who in turn will advise the Landfill Supervisor who will be responsible for arranging a clean-up of litter as soon as reasonably practical.

8.4.2 Tipping Areas

Ensure that vehicles are only unloaded within the active cell and in the vicinity of the working face.

Ensure adequate plant is available on site for the placement, compaction and covering of waste.

Ensure an adequate supply of daily cover materials is available on site and that cover is placed over the waste as soon as practical but no later than the end of the day.

During dry and windy conditions, the active working face is to be kept damp by watering. In high winds it may be necessary to suspend disposal activities for a short period.

8.4.3 Litter Nets

Litter control nets will be erected around the perimeter of the operational area which will be an appropriate set back from the working face in order for the bulldozer and compactor to work safely and efficiently.

The litter nets will be generally 6 m high constructed of tandalised timber poles from which 75 mm mesh netting is hung.

Additional relocatable litter nets will be placed immediately adjacent to the working face on an as-required basis as determined by the Landfill Supervisor.

8.4.4 On-Site Litter Checks

The Landfill Supervisor shall ensure that checks of the site for litter including all litter nets and areas outside the landfill footprint are undertaken. Any litter found must be removed the same day.

8.4.5 Litter on Adjacent Properties

If any complaints are received from adjacent landowners in relation to windblown litter from the landfill, the Landfill Supervisor shall inform the Environmental Manager, who will carry out an investigation into the origin of the litter immediately and ensure that the litter is collected as soon as practicable. If the nuisance is of an on-going nature as deemed from the receipt of repeated valid complaints, take steps to ensure any identified impacts are addressed.

Litter complaint reporting is to be undertaken in accordance with the Environmental Management Plan Complaints Register.

8.5 Vermin Control

Vermin can spread disease, cause property destruction or contaminate food; however, vermin are generally not present at a properly operated and maintained sanitary landfill.

Rat and cat populations occur because they are brought to the site in incoming waste loads or migrate to the landfill. Effective site management is the best way to counter rat or cat infestation.

Local feral cats can cause a wild cat population problem in the landfill and surrounding area. Regular trapping of cats in humane cages is undertaken during autumn and spring. Captured cats are humanely shot, neutered/spayed or in the case of kittens rehomed if possible.

The Landfill Supervisor is responsible that the following vermin controls are undertaken:

- Ensuring that the waste arriving on site is promptly unloaded and compacted, i.e. no stockpiling of waste unless an emergency;
- Applying cover on the working face daily (delegate responsibility to Landfill Supervisor and Pointsman);

- Check that there is sufficient thickness and appropriate daily cover in those areas that will require re-filling with refuse within one month;
- Check that there is sufficient intermediate cover in those areas that will not require re-filling with waste within one month;
- Regular mowing of grassed areas to prevent nest establishment and seeding;
- Keeping equipment, storage and leisure/office areas free of debris and food waste to prevent vermin from establishing residence in or near areas where employees or support personnel work, eat and drink;
- Arranging poisoning by a pest controller, if appropriate; and
- Reject incoming loads if vermin is present.

8.5.1 Vermin Surveys

An independent pest controller, such as Allpests Southland Pest Control, is engaged to carry out a vermin survey on a monthly basis. They report to AB Lime monthly on rodent activity and bait placement. These reports are available for Environment Southland, upon request.

If increased vermin levels are detected the Landfill Supervisor shall take immediate action to reduce the vermin numbers.

8.5.2 Fly Control

Flies may become a problem over the summer months and are capable of transmitting diseases such as salmonella and other food-borne diseases.

The Landfill Supervisor is responsible for undertaking the following controls:

- Ensure that all the waste arriving on-site is promptly compacted;
- Daily covering of the working face;
- Burying odorous loads inadvertently accepted immediately;
- Rejecting maggot infested load; and
- Arranging the application of insecticide by a pest controller if required.

8.6 Bird Control

Bird control at the site will focus on ensuring that minimal numbers of gulls are attracted to the landfill and the bird nuisance effects are minimised. Bird control practices to be used on site are outlined below.

8.6.1 Covering the Refuse and Controlling the Tipping

The methods described in this section are used to limit the access to food and will have the greatest effect on controlling the likelihood of a bird problem occurring on site. The techniques here include:

- No public access;
- All refuse loads arriving at the site will be covered;
- The working face will be kept to a practical minimum (<1000 m²);
- Continuous movement of machinery over the working face; and
- Daily covering of exposed refuse.

8.6.2 Bird Dispersal Techniques

Bird dispersal involves harassing or frightening birds away from the refuse so that they ultimately leave. Methods of bird dispersal include auditory or visual scaring devices and chemical repellents.

A gas cannon (gas operated scare-gun) will be used on-site if required, and uses a loud noise to scare the birds. These cannons can be effective until birds become 'habituated' to the device. To prevent habituation the location of the gas cannon will be regularly moved, and it will fire at irregular intervals with varying number of shots together.

8.6.3 Bird Obstruction/Shooting/Poison Techniques

Wires with metallic flagging tape will be placed randomly near the working face to assist in preventing birds gaining access to the working face.

The culling of birds, only those listed in Schedule 5 of the Wildlife Act 1953, by shooting shall be done under the instruction of the Environmental Manager. Only persons with a firearms licence issued by the New Zealand Police shall operate a firearm on the landfill.

Earmuffs and safety glasses shall be worn at all times when shooting. A clear unobstructed line of sight is required before any shot is taken. A normal firearms safety procedure must be adhered to. The firearm shall be discharged at an angle not exceeding 20 degrees from the vertical. At no stage shall a firearm be discharged horizontally on the landfill.

Poisoning birds with alpha chloralosed paste is a last resort method. This poison is best used in cold conditions and works by slowing the metabolism of the birds down. Non-target species can be revived by warming them up. If it were deemed necessary to use poison a suitably qualified contractor would be engaged by AB Lime. Prior to implementing the programme, the contractor would need to develop a plan to be approved by the Environmental Manager to ensure the effective use of the poison, that only target species are killed and no birds die off-site from the landfill.

The number of birds culled will be recorded by the Environmental Manager. All carcasses will be removed to the working face and buried under the direction of the Landfill Supervisor.

8.7 Exterior Lighting Control

All activities on the site are managed so that all exterior lighting shall be directed away from adjacent residences not owned by the consent holder, so as to minimise the potential for adverse effects from light spill on adjacent residents, and so as to achieve compliance with Rule Rural.7 of the Operative Southland District Plan 2018.

9. Slope Stability

9.1 Soil or Rock Landfill Side Slopes (Pre-Landfilling)

The side slopes of the landfill are either limestone or soil side slopes. Limestone side slopes are excavated from the existing limestone rock and the soil side slopes are constructed from structural fill. **It is recommended that any karst features are identified and removed during the limestone quarrying.**

The side slope liner design is specified for slopes of 2H:1V or greater in proposed consent conditions and is shown in drawing IZ000400-1000-NG-DRG-1018 in Attachment 1. The side slope liner includes the following components:

- A groundwater underdrainage system where required;
- 5 mm GCL with a maximum permeability of 5×10^{-11} m/s;
- 2.0 mm HDPE;
- A liner protection layer of geotextile;
- A 300 mm of granular material; and
- A 1 m select waste layer.

Further details on the side slope liner design and construction are provided in the Technical Specification and Quality Assurance & Quality Control Standard documents, the latest of which are for Area 15. The GCL, HDPE and select waste layer are discussed in Section 12.

9.1.1 Subgrade Preparation

The proposed consent conditions state that the landfill side slopes will be prepared to ensure a smooth surface appropriate for the placement of geosynthetic liner materials. This shall include the smoothing of rough surfaces, sealing of karstic solution features or compaction of slopes to an appropriate bearing capacity. **During this process, especially the sealing of solution features, observations will be noted, and any features will be logged and shown on an as-built.**

9.1.2 Groundwater Underdrainage System

For the side slope liner, a groundwater underdrainage system is only constructed where groundwater is observed on the exposed limestone surface. This varies from the base liner design, where the groundwater underdrainage layer is continued across the entire landfill base. The limestone side slope surface is clearly exposed, and superficial obstructions are disposed of and the face is checked for the presence of groundwater and karstic features. There is no requirement for a groundwater underdrainage system for soil side slopes if no groundwater or karstic features are identified.

The groundwater underdrainage system for the limestone side slopes involves a separate design for outflow and inflow karstic cavities. Outflow cavities (i.e. cavities orientated approximately downslope) are backfilled and sealed to form a smooth surface. There are several sealing techniques, such as grouting or using a flexible filler. Inflow cavities (i.e. cavities orientated approximately upslope) are drained using a drainage strip, such as CORDRAIN, which is connected to the groundwater underdrainage system under the base liner. This side slope groundwater underdrainage system is described in the Technical Specification, the most recent of which is Area 15 Technical Specification.

9.1.3 Anchor Trenches

At the top of the slope the GCL and the HDPE is placed in an anchor trench on all edges as shown in drawing IZ000400-1000-NG-DRG-1018. Structural fill is backfilled and compacted in the anchor trench to provide resistance against pull out. Further details are provided in the ELCOSEAL Installation Guidelines.

9.1.4 Slope Stability

The soil or rock landfill side slopes have been designed with a typical slope of 1(v):2(h), since:

- AB Lime has quarried the site for many years and has a significant amount of slope stability experience from the quarrying operations
- The quarrying operations are relatively steep slopes with a height of 5 m and 5 m wide benches
- In the past 15 years the landfill design has successfully used a typical slope of 1(v):2(h) as this is considered a maximum slope where specialist contractors can safely carry out the in-situ welding operations of the HDPE liner.
- The landfill footprint and cell/area layout shows that a 1(v):2(h) provides a good compromise between maximising landfill airspace (which favours a steep slope) and the practicality of installing the HDPE liner system.
- Geotechnical observations have proven that the slope of 1(v):2(h) contains an appropriate factor of safety against slope instability
- The slope of 1(v):2(h) has been allowed for in the resource consent conditions.

9.2 Waste Slopes- Working Face

The refuse filling operations are typically carried out in 300 mm to 500 mm thick lift on a near horizontal surface (in the longitudinal direction) with a shallow lateral slope into the waste.

The shallow slope into the waste will be no greater than a slope of 1(v):3(h), although the slope may be a lot shallower if the 'onion skin tipping' method is used Section 7.4.3).

The height of the working face slope will be no greater than 2-3 m so there is no risk of working face slope instability (Section 7.4.3).

9.3 Internal Temporary Slope

For the internal temporary slopes, the design criteria are a slope of 1(v):4(h), and this slope should provide the Landfill Bulldozer Operator and Landfill Compactor Operator will a reasonable slope angle to place and compact the intermediate cover or temporary capping (see Sections 12.2 and 12.3).

At the discretion of the Environmental Manager, after consultation and agreement with the Landfill Supervisor, Landfill Dozer Operator and Landfill Compactor Operator, the internal temporary slope of 1(v):4(h) may be increased to a slope of 1(v):3(h), provided that the intermediate cover or temporary capping layer can be safely and appropriately compacted on the 1(v):3(h) slope.

A diagram of the internal temporary slope of 1(v):3(h) is presented in **Figure 3** for 'overlying phases' and in **Figure 4** for a 'typical filling sequence'.

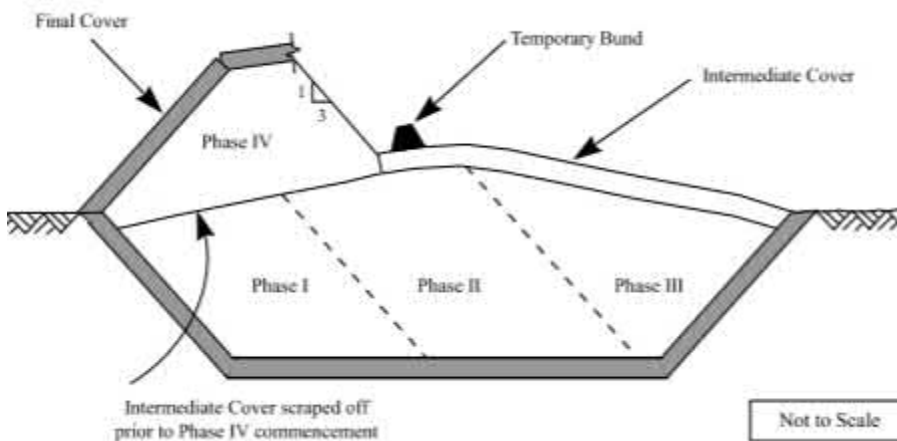


Figure 3 Internal Temporary Slope of 1(v):3(h) for Overlying Phases (source; Fig 8 of EPA, Landfill Manuals, Landfill Operational Practices, Ireland, 1997)

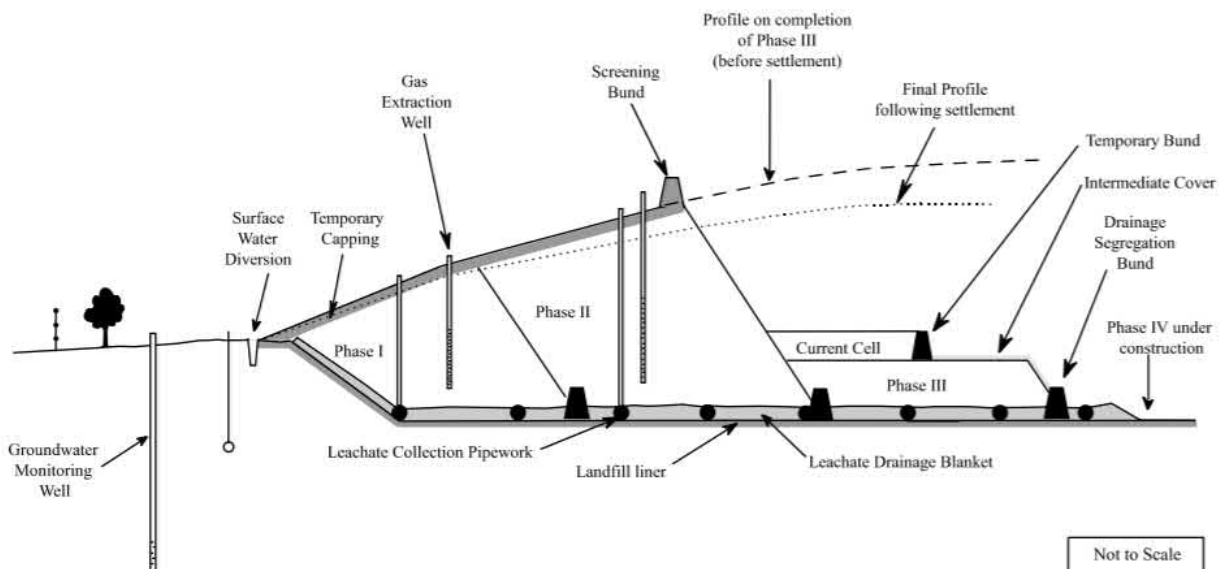


Figure 4 Internal Temporary Slope of 1(v):3(h) for Typical Landfill Filling Sequence (source; Fig 7 of EPA, Landfill Manuals, Landfill Operational Practices, Ireland, 1997)

9.4 Improvement of Existing Temporary Capping on Steep Slopes

There are currently several relatively large steep temporary slopes at the landfill where the thickness and type capping soil does not meet the temporary capping criteria (see Section 10.3).

Since these relatively large steep slopes do not have appropriate capping there are potential hazards for:

- Odour and landfill gas emissions, due to the relatively thin and not-compacted capping layer;
- Air ingress through the thin capping layer into the gas extraction wells, resulting in a lower than optimal vacuum that otherwise could be applied to the gas wells, thus not maximising gas extraction and inefficient use of the gas plant;
- Oxygen infiltration through the temporary cap also increases the risk of underground fires;
- Leachate generation, due to rainfall and surface water infiltration through the thin cover layer; and
- Slope in-stability, due to a combination of the size and steepness of the slopes and potential for water/leachate to build up within the steep slopes.

It is proposed to mitigate these potential hazards by providing an improved temporary capping layer covering the top/flat area of the steep slope and the slope itself. The improved temporary capping layer will be a minimum thickness of 600 mm and meeting the Temporary Capping criteria.

The mitigation measures to improve the temporary capping on the steep slopes are shown diagrammatically on an east-west trending ground profile cross section covering Area 14 and Area 15, see drawing **IZ000400-1000-NG-DRG-1014** in Attachment 1.

The ground profile cross section shows the following sequence of construction events (see cross section in drawing **IZ000400-1000-NG-DRG-1014** in Attachment 1:

- Construct a 600 mm minimum thickness intermediate cover on the relatively flat area on Area 14;
- The cover should be placed in no less than four layers, each layer comprising a loose lift layer thickness of no less than 200 mm so that the compacted total cover thickness is at least 600 mm thick;
- The slope of the newly place cover should be placed so that the surface water run-off is guided away from the Area 14/15 steep slope;
- Install a leachate collection pipe, leachate gravel surrounding the pipe covered with a geotextile in the existing buffer zone between the base of the existing Area 14-15 stormwater bund and the base of the existing Area 14 slope. Connect the leachate pipe to the existing leachate system;
- Place and compact waste between the Area 14/15 bund and the base of the existing slope Area 14 slope to a height 0.5 m below the existing height of the existing Area 14/15 bund;
- Construct a low permeability soil bund on top of the recently placed waste but off-set to the east from the existing Area 14/15 bund;
- The new bund dimensions will be approximately as follows: crest 2 m, height 3 m, side slopes 1(v):1(h), base 8 m wide;
- Place and compact waste as per item d) above;
- Construct another bund as per item e) above;
- Repeat process until the top of the existing slope at Area 14 has been reached; and
- At the top of the Area 14 slope provide an additional banded area to guide stormwater away from the newly constructed benched bunds between Area 14/15.

The low permeability soil bund can be progressively stripped back when waste placement occurs in Area 15, where it is considered safe to do so by the Environmental Manager.

Area 15 will be filled using the maximum slope criteria described in Sections 11.2 and 11.3, so that future large steep slope faces are avoided.

9.5 External Permanent Slope- Landfill Permanent Capping Slope

The external permanent landfill capping slope will be **placed at a maximum pre-settlement slope of 1(V):3(H) with an expected post-settlement slope of 1(V):4(H)**. This is further discussed in Section 12 below.

10. Landfill Cover and Capping

The terms landfill cover and landfill capping can be distinguished by the material type and when they are applied during the landfill operation, see Table 4 below.

A site plan showing the part of the landfill that have permanent capping, temporary capping, intermediate cover and the working face (as of April 2020) is presented in drawing IZ000400-1000-NG-DRG-1012 in Attachment 1.

Table 4 Summary of Cover and Capping Types for the AB Lime Landfill, Thickness and Material Type

Cover/Capping Type	When used	Material type (typical) and thickness	Section of LOMP
Daily cover	Each day	150 mm minimum thick soil	Section 7.5.1
Intermediate cover	>7 days	300 mm minimum thick low permeability soil	10.2
Temporary capping	>3 months	600 mm minimum thick low permeability soil	10.3
Permanent capping	As required	See consent conditions	10.4

10.1 Daily Cover

The objectives and types of daily cover are presented in Section 7.5.1

10.2 Intermediate Cover

Intermediate cover refers to the placement of suitable, adequate and stable material (minimum 300 mm if soil is used) over deposited waste for a period of time prior to temporary capping or prior to further disposal of waste in that area.

The 300 mm minimum compacted thickness should be applied in at least two loose lift layer thicknesses of no more than 200 mm to 250 mm per layer.

Daily cover should generally be replaced by intermediate cover in any area of an active cell where a new covering lift of waste is not planned within the next seven days, although the precise timeframe may vary according to prevailing conditions.

Intermediate cover has the same objectives as daily cover, i.e. to control nuisances such as litter, odour and vermin, but in addition, intermediate cover should reduce the infiltration of rainfall, help prevent the escape of leachate and landfill gas, and be functional over a prolonged period of time (e.g. weeks or months).

Where odour control is an issue and/or active landfill gas extraction is warranted, the intermediate cover may need to be replaced by a temporary capping (see Section 10.3).

Not all materials used as daily cover may be suitable for use as intermediate cover. Intermediate cover needs to be robust and to provide greater long-term protection to the landfill surface until such time as capping takes place or waste placement in that area recommences.

Soils that are not free-draining are more suitable for use as intermediate cover than daily cover, because they will help prevent the ingress of rain and lessen fugitive landfill gas emissions and leachate break-outs. Areas with intermediate cover should be regularly inspected by site staff, and any eroded cover materials should be replenished.

10.3 Temporary Capping

Temporary capping will be used for all parts of the landfill where the intermediate capping has been in place for more than 3 months.

Temporary capping at the AB Lime landfill may be present for months to years and as such, the soil thickness and soil type should be compatible with minimising landfill gas surface emissions, minimising rainfall/surface water infiltration, and maximising landfill gas extraction from the gas extraction wells.

The AB Lime temporary capping will be constructed of low permeability soil with a minimum compacted thickness of 600 mm, constructed in a minimum of four layers where each layer has a minimum loose lift layer thickness of 200 mm to 250 mm.

Alternatives to the low permeability soil layer such as a Geocomposite Clay Liner (GCL), in conjunction with another soil layers (e.g. AB Lime knaprock or quarry overburden), may be considered but only with prior discussion and approval from the Independent Peer Reviewer.

Temporary capping will be used in all areas of the landfill where increased landfill gas extraction from vertical wells is required (e.g. for odour control and/or to minimise landfill gas surface emissions).

10.4 Final Capping

The objectives of the final cover and capping applied to landfills are outlined by the Technical Guidelines for the Disposal to Land by Waste Management Institute New Zealand (WasteMINZ, 2018) as follows:

- Provide a barrier to surface water infiltration into the waste;
- Control discharges of landfill gas and leachate; and
- Rehabilitate the site surface.

The Technical Guidelines for Disposal to Land (WasteMINZ, 2018) states that a simple final cover system should include the following elements from bottom to top:

- Intermediate soil cover;
- A low permeability layer; and
- A topsoil layer.

Final capping that was constructed prior to April 2020 adhered to Condition 10 of Consent AUTH-201346-V3, which is presented below:

“Final cover and capping shall be constructed to the following minimum specification, from bottom to top, as each stage of the landfill is completed:

- 300 millimetres intermediate cover/regulating layer of compacted quarry overburden;
- 600 millimetres of compacted clay, overburden or soil material, with a permeability coefficient (k) of not more than 1×10^{-7} metres per second;

- 150 millimetres of growing medium.”

Final capping that is constructed post April 2020 will adhere to the proposed consent conditions. The updated consent condition includes two capping design options, which both adhere to WasteMINZ guidelines.

10.4.1 Final Capping Design

AB Lime’s landfill final capping design details of the edge extent of the final capping layer is shown in drawing IZ000400-1000-NG-DRG-1017 in Attachment 1. It meets the minimum specification of Option Two of the proposed consent conditions. The final capping design also includes additional layers to improve its effectiveness in managing effects. The components of the final capping system, from bottom to top, are as follows:

- The first three layers meet consent requirement for a minimum 300 mm thick intermediate cover/regulating layer:
 - 100 to 200 mm thick intermediate layer (knap rock);
 - 200 to 300 mm of quarry rock;
 - 600 mm of compacted knap rock;
- A geosynthetic clay liner (GCL) with a permeability coefficient (k) not exceeding 1×10^{-7} metres per second;
- 300 mm of compacted knap rock (growth layer); and
- 150 mm of topsoil.

The final capping surface cover has a minimum gradient requirement of 1(V):20(H) to promote effective shedding of surface water. The WasteMINZ guidelines recommend a maximum gradient of 1(V):3(H) for capping (WasteMINZ, 2018). The current maximum gradient for AB Lime Landfill’s final surface pre-settlement is 1(V):3(H). This provides an acceptable factor of safety for waste stability and aids to minimise erosion and post-closure care issues; it is also appropriate for after use as it can be traversed by agricultural machinery.

Permanent stakes, or similar are installed in the ground at existing ground level and immediately outside the anchor trench, at 20 m centres, to clearly mark the lateral extent of the landfill capping layer. The stakes protect the capping layer from unnecessary plant and equipment driving over it.

Further details on the components of the proposed final capping layer, from bottom to top, are presented from Section 10.4.1.1 to 10.4.1.6.

10.4.1.1 Intermediate Layer

On top of the landfill waste a 100–200 mm thick intermediate layer is placed. The intermediate layer is constructed from knap rock material and is deposited in one lift. The intermediate layer is compacted to hold waste in place, minimise odour, and to provide a uniform platform for the remaining capping material to be built upon. There are no specific compaction requirements associated with the intermediate layer.

10.4.1.2 Quarry Rock

A 200–300 mm quarry rock layer is placed on top of the intermediate layer and is deposited in one lift. The quarry rock is compacted to provide a firm base to allow ease of compaction of the lower knap rock layer. The quarry rock layer has the following specifications:

- The maximum particle size is a diameter of 150 mm;
- Compaction plant will be managed so that during spreading, compaction and subsequent trafficking, weaving and rutting of the compacted fill surface is avoided; and

- During compaction the maximum tolerable temporary weave will be a temporary deflection of 50 mm and a permanent deflection of 20 mm under the passage of a fully laden earthmoving plant or compactor, measured from the surface level of the compacted layer.

10.4.1.3 Lower Knap Rock

The lower knap rock is deposited on top of the quarry rock in **one two lifts**. The minimum thickness of the compacted knap rock layer is **600** mm. The knap rock is compacted to provide a smooth surface for the GCL to be laid on and acts as an additional contaminant barrier. The lower knap rock layer has the following specifications:

- It will contain only screened, well graded sands and gravels with a maximum particle size of 32 mm diameter. In addition, d_{60} will be less than 5 mm and d_{20} will be less than 0.15 mm (as per manufactures recommendations). These materials should bind and have good bearing capacity when compacted/rolled;
- The lower knap rock layer shall have a minimum relative compaction of 90%, where minimum relative compaction refers to the Maximum Dry Density (MDD) Ratio at Standard Compaction. The testing requirements for the lower knap rock layer are outlined in Table 5 and Table 6.;
- The lower knap rock layer will be proof rolled with a smooth drum roller immediately prior to deployments of the GCL to ensure a smooth, flat surface with no visible rutting or deformation; and
- The finished surface of the knap rock will be free of foreign matter, free standing water or loose stones. To protect the GCL layer from damage, no stones protruding out of the subgrade by more than 10 mm will be allowed (as per manufactures recommendations).

10.4.1.4 GCL

The GCL layer provides a hydraulic and gas barrier and is the main component of the final capping system that reduces infiltration into the waste material. **The GCL is the X1000 or X2000, which has a permeability of between 1.8 to 2.8×10^{-11} m/s.** Therefore, the GCL meets the consent requirement to have a maximum permeability of 1×10^{-7} m/s.

The principal advantage of using a GCL is the ease of the construction and quality assurance process of the capping construction. In addition, this capping arrangement is superior to the previous capping design (pre-March 2020) due to the lower permeability of the GCL and its ability to handle 15%-50% (product dependant) of elongation that will allow for differential settlement. **The GCL will be joined from cell to cell using the methodology for longitudinal and transverse overlaps as described in Attachment 9.**

Further details of this recommendation are discussed in the Landfill Capping Concept Design Memo. The attachments from the Landfill Capping Concept Design Memo should be referred to for further information regarding the construction requirements and installation guidelines.

Should leachate recirculation plumbing be required to penetrate through the GCL, a design similar to that described in the Elcoseal Installation Guide (Attachment 9) will be used.

10.4.1.5 Upper Knap Rock (Growth Layer)

The upper knap rock layer is placed immediately above the GCL in one lift. It provides a buffer layer between the vegetation and the GCL, which protects the GCL from root growth. The minimum thickness of the compacted knap rock layer is 300 mm. The upper knap rock layer has the following specifications:

- It will contain only screened, well graded material with a maximum particle size of 32 mm diameter and a uniformity coefficient greater than 5 (as per manufactures recommendations);
- The upper knap rock layer will be track rolled but does not need to be rolled smooth. The knap rock receives minimal compaction, which assists with its stability, but avoids creating a hard, low permeability layer beneath the topsoil; and

- Prior to placing the topsoil, the surface of the knap rock layer is scarified to increase its permeability and roughen the surface to assist with retention of topsoil.

10.4.1.6 Topsoil

A topsoil layer of 150 mm thickness is placed over the upper knap rock layer. The growing season is taken into consideration when timing the placement of the topsoil. Therefore, topsoil placement might be delayed until autumn or spring. Vegetation is limited to grasses; no large trees or deep rooting shrubbery.

10.4.2 Final Capping Connection Details

10.4.2.1 Clay and GCL Capping Layers Connection

The GCL is partially inserted into the clay capping layer. To achieve this 300 mm of the compacted clay layer is excavated from the clay capping layer for a minimum length of 1 m adjacent to the GCL capping layer. The GCL is then laid atop of the compacted clay, and backfilled with 65% knap rock and 35% bentonite (further details provided in Section 10.4.2.3). Between the clay and GCL capping design, the GCL shall be placed vertically and then laid on top of the lower knap rock layer of the GCL capping layer. The horizontal connection detail to tie the GCL capping layer (new design) into the clay capping layer (original design) is shown in drawing IZ000400-1000-NG-DRG-1016 in Attachment 1.

10.4.2.2 Gas Well and Capping Layer Connection

Within a 1 m radius around the gas well a bentonite and knap rock seal (further details provided in Section 11.4.2.3) is placed, that extends from the bottom of the intermediate layer to the top of the upper knap rock layer. The GCL is partially inserted into the gas well seal. The bentonite and knap rock mixture allows for settlement of the waste and capping layer surrounding the gas well, while still maintaining a tight seal. The connection detail for gas wells that penetrate through the GCL capping layer is shown in drawing IZ000400-1000-NG-DRG-1015 in Attachment 1.

10.4.2.3 Bentonite and Knap Rock Mixture

The backfill mixture for the capping connection details shall be composed of 65% knap rock and 35% bentonite by weight. The bentonite and knap rock shall be mechanically blended with the appropriate amount of water to form a homogenous mix with suitable consistency. It is also necessary to ensure that the knap rock is well graded. Based on findings in literature, the 65% knap rock and 35% bentonite mixture is expected to have a permeability lower than 1×10^{-7} m/s. However, one permeability test will need to be performed in order to confirm that it meets requirements.

10.4.3 Final Capping Quality Control

The lower knap rock layer is the only layer within the final capping system that requires testing. Testing requirements to confirm the achieved compaction of the lower knap rock layer is summarised in Table 10.2.

Table 5 Testing Requirements for Lower Knap Rock Layer

Parameter	Test	Standard	Capping
Minimum Relative Compaction ¹	Nuclear Densometer (NDM)	NZS 4407:2015 Test 4.2	90%
Notes:			
1. Minimum relative compaction refers to the Maximum Dry Density (MDD) Ratio at Standard Compaction.			

The minimum frequency of testing required is summarised in Table 10.3. The actual amount of testing carried out will depend on the size and shape of areas being worked and the consistency of operations and materials on site.

Table 6 Frequency of Testing Required for Lower Knap Rock Layer

Parameter	Test	Standard	Frequency
MDD and OMC	Standard Compaction Test (5-point laboratory test)	NZS 4402:1986 Test 4.1.2	1 test per 10,000 m ³ sampled from each stockpile. Additional tests shall be performed if the stockpile is visually variable.
Relative Compaction (% of MDD) and Moisture Content	Nuclear Densometer (field test)	NZS 4407:2015 Test 4.2	1 set (1 NDM test and 1 moisture content test) per 500 m ² of compacted material for each layer for the first 1,000 m ³ ; thereafter 1 set per 1,000 m ² of compacted material for each layer. A minimum of 2 sets per day shall be taken during knap rock placement.

10.4.4 Final Capping Trial Pad

A trial pad is to be constructed to observe whether the GCL capping design and construction methodology is suitable. The trial pad will be a minimum size of 20 m by 20 m and will be constructed adjacent to the current capping layer. The trial pad will be constructed atop of the landfill waste and shall tie-in with the slope of the current capping layer at 1(V):3(H).

The gas well connection detail and the clay and GCL horizontal capping connection detail as described in Section 10.4.2 and shown in drawing IZ000400-1000-NG-DRG-1015 and drawing IZ0004000-1000-NG-DRG-1016 respectively, found in Attachment 1 and will both be constructed as part of the trial pad.

Upon the completion of the capping trial pad, testing for landfill gas surface emissions will be carried out. This should be completed once a week for the first month and then monthly for up to 6 months. The testing should be carried out when the wind speed is less than 5 km/hr and at least two rounds of testing should be completed during falling and low (<1000 mbar) barometric pressure. An Internal Trigger Level (TL-1) of 0.05%, as specified in the Landfill Gas Management Plan, will be applied.

Following completion of the capping trial pad the final capping design will be finalised and the Final Capping Specification and Quality Control Standard will be issued for approval to the Independent Peer Reviewer and Environment Southland. The Landfill Operations Management Plan will then be updated to refer to the Final Capping Specification and Quality Control Standard document for design and construction details.

Effective design improvements to the capping design are suggested below:

- The requirement of the knap rock below the GCL capping liner to meet a required permeability;
- Drainage layer above the GCL;
- Slope stability analysis
- Anchor trench detail improvements; and
- GCL penetration detail

10.4.5 Final Capping Management

10.4.5.1 Inspections of Final and Temporary Capping Areas

Inspections of the permanent and temporary capping areas are carried out at least once every six months and following significant storm events (greater than 50% AEP at a duration of less than one day). This formal inspection requirement is outlined in Condition 36 of Consent AUTH-201346-V3.

The inspection criteria are listed below:

- Vegetation die-off;
- Cracking of the cap surface;
- Subsidence and erosion;
- Leachate break-out through the cap; and
- Refuse protruding through the cap.

AB Lime typically carries out weekly landfill cap inspections, and a summary of the inspections are provided annually in the Environmental Monitoring Report. Any defects that are noticed are remedied immediately and a report of the inspection and actions taken are forwarded to SRC within two months of each inspection, or as agreed with Environment Southland.

10.4.5.2 Management of Final Cap Settlement

There is a requirement for long term management of the landfill cap and its settlement to ensure it remains effective at managing effects. Differential settlement can cause cracking of the capping layer and issues with drainage, which results in landfill gas discharging to the atmosphere, ponding of water and increased quantities of leachate.

Technical Guidelines for Disposal to Land Appendices (WasteMINZ, 2018) state that waste will typically undergo total settlement of approximately 25% of the waste depth. About half of settlement occurs during waste placement and, following completion of waste filling, it is expected that 10 to 12.5% long-term settlement will occur due to secondary compression and waste degradation. It should be noted that the settlement rate may increase at leachate recirculation injection points due to accelerated breakdown of wastes in these areas. However, currently AB Lime does not utilise leachate recirculation.

As of March 2020, the capping inspections have indicated no major cracks in the final capping layer. However, if in the future, severe settlement and cracking of the clay capping layer occurs then the following steps will be taken:

- The topsoil and knap rock growth layer will be removed (scrape from the surface and temporarily stockpiled);
- The clay layer will then either be excavated, reworked, and compacted back into place, or
- If cracking is well defined, cracks will be locally filled with bentonite pellets;
- Finally, the knap rock and topsoil layer will be reinstated.

Care will be taken to overlay the in-situ clay with the re-compacted clay to create a smooth transition between the existing cap and reworked areas. This is to reduce the tendency for cracks to reappear at the boundaries of the reworked areas. Clay will be placed back up to the original level before settlement, resulting in a localised thickening in the area of settlement.

There are minimal concerns regarding detrimental effects on the GCL when subject to total and differential settlements. The X800/X1000 GCL product is able to elongate in excess of 15% prior to failure, and the X2000

GCL product is able to elongate in excess of 50% before failure. However, if, severe settlement and cracking of the GCL capping layer occurs then the following steps will be taken:

- The topsoil and upper knap rock layer will be removed (scrape from the surface and temporarily stockpiled);
- Place another layer of GCL over the defective area and glue to the original GCL following installation guidelines; and
- Finally, the knap rock and topsoil layer will be reinstated.

If settlement is minor and does not affect the integrity of clay or GCL capping layers, then it will be sufficient to remove the topsoil layer and top up settled areas with compacted knap rock to maintain drainage gradients of the cap and prevent ponding of surface water. Topsoil will then be replaced over the knap rock. Further details on management of the final cap settlement are included in the Landfill Concept, Landscape, Rehabilitation and Aftercare Plan.

11. Base Liner System

11.1 Introduction

The objectives of the base liner system are outlined by the Technical Guidelines for the Disposal to Land by Waste Management Institute New Zealand (WasteMINZ, 2018) as follows:

- Contain leachate; and
- Control the ingress of groundwater.

Area 1 to Area 15 of the landfill have base liner systems that adhere to, or have been approved as being equivalent to, Condition 6 of Consent AUTH-201346-V3, which are presented in Table 7.

Table 7 Description of Base Liner Systems Allowed for in Consent AUTH-201346-V3.

Type	Base Liner System Description (from bottom to top)
1	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 1000 millimetres of compacted clay with a permeability coefficient (k) of not more than 1×10^{-9} metres per second; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material with a permeability coefficient (k) of not less than 1×10^{-3} metres per second;
2	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 600 millimetres of compacted clay with a permeability coefficient (k) of not more than 1×10^{-9} metres per second; ▪ a 1.5 millimetre HDPE flexible membrane liner; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material with a permeability coefficient (k) of not less than 1×10^{-3} metres per second;
3	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 300 millimetres of compacted clay with a permeability coefficient (k) of not more than 1×10^{-9} metres per second; ▪ a geosynthetic clay liner, with a minimum thickness of 5 millimetres, a permeability coefficient (k) of not less than 5×10^{-11} metres per second and sufficient internal shear strength to maintain a stable configuration on slopes; ▪ a 1.5 millimetre HDPE flexible membrane liner; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material with a permeability coefficient (k) of not less than 1×10^{-3} metres per second."
4 (approved as equivalent to Type 1)	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 300 millimetre of compacted knap rock with a permeability coefficient (k) of not more than 1×10^{-8} metres per second; ▪ a geosynthetic clay liner, with a minimum thickness of 5 millimetres, a permeability coefficient (k) of not less than 5×10^{-11} metres per second and sufficient internal shear strength to maintain a stable configuration on slopes ▪ a 1.5 millimetre thick HDPE flexible membrane liner; ▪ a 300 millimetre minimum liner protection/leachate collection layer of granular material with a permeability coefficient (k) of not less than 1×10^{-3} metres per second."

New Zealand’s landfill guidelines have been updated since AB Lime’s consent (Consent AUTH-201346) was granted, and therefore, the original consented base liner systems are no longer all recommended systems.

The base liner system for Area 16 and future areas will adhere to proposed consent conditions, which has been updated to reflect the latest Technical Guidelines for the Disposal to Land (WasteMINZ, 2018). It includes the three base liner system options recommended by WasteMINZ, including a groundwater underdrainage system underneath, and a leachate collection system on top. The three options for minimum base liner designs are detailed in Table 8.

Table 8 Description of Base Liner Systems Recommended by WasteMINZ (2018) and Allowed for in the Proposed Consent Conditions.

Type	Base Liner System Description (from bottom to top)
1	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 600 mm of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-9} m/s; ▪ a 1.5 mm high density polyethylene (HDPE) flexible membrane liner; ▪ a 300 mm minimum liner protection/leachate collection layer of granular material.
2	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 300 mm of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-9} m/s; ▪ a GCL, with a minimum thickness of 5 mm, a permeability coefficient (k) not exceeding 5×10^{-11} m/s; ▪ a 1.5 mm HDPE flexible membrane liner; ▪ a 300 mm minimum liner protection/leachate collection layer of granular material.
3	<ul style="list-style-type: none"> ▪ a groundwater underdrainage system; ▪ a minimum of 600 mm of compacted soil with a permeability coefficient (k) not exceeding 1×10^{-8} m/s ▪ a GCL, with a minimum thickness of 5 mm, a permeability coefficient (k) not exceeding 5×10^{-11} m/s; ▪ a 1.5 mm HDPE flexible membrane liner; ▪ a 300 mm minimum liner protection/leachate collection layer of granular material.

11.2 Base Liner System Design

A Type 3 Base Liner System is the approach AB Lime will take for Area 16 and future areas, with some additional elements included to improve the performance of the base liner. Overall, the base liner system is comprised of the following, from bottom to top:

- Groundwater underdrainage system composed of:
 - Groundwater collection trenches;
 - Geotextile; and
 - Blinding layer;
- 600 mm compacted knap rock layer with a maximum permeability of 1×10^{-8} m/s;
- A 5 mm GCL with a maximum permeability of 5×10^{-11} m/s;
- A 1.5 mm HDPE;
- Geotextile;
- 300 mm leachate collection layer; and
- Confining stress layer.

Further details on each component of the base liner system is provided in the Technical Specification and Quality Assurance & Quality Control (QA/QC) documents, the latest of which is for Area 15.

11.3 Subgrade Preparation

Site preparation includes clearance and disposal of vegetation, topsoil and any superficial obstructions, such as removal of any boulders in the footprint of the landfill. After site preparation, the landfill base shall be over-excavated to show a limestone surface. The consent conditions require a geological map of the base grade of the landfill to be prepared and upgraded from time to time as the base grade is exposed. The geological mapping shall include detailed logging of the location, extent and nature of fractures, fracture zones, Karst features and other defects. In addition, it shall be confirmed that the landfill base has a minimum slope of 2% gradient.

11.4 Groundwater Underdrainage System

11.4.1 Groundwater Collection Trenches

The groundwater underdrainage system comprises of minimum 300 mm by 300 mm trenches filled with gravel with a minimum permeability of 1×10^{-3} m/s. The trenches are excavated at 20 m centres and are laid perpendicular to the fall of the landfill floor. Laid in the gravel trench is a 110 mm diameter Marley Drainflo, or similar approved perforated pipes wrapped in a filter sock.

11.4.2 Geotextile

A geotextile separation layer is placed over the gravel layer. The geotextile is a A19 Bidim, or similar as approved by the engineer and as meets the requirements of Type B, Class 3 as defined in Transit NZ Specification for Geotextiles, TNZ F/7, 2003.

11.4.3 Blinding Layer

A minimum of 50 mm of knap rock is laid and compacted over the excavated limestone surface. This forms the blinding layer. The maximum particle size shall be 75% of the loose layer thickness. This will form the blinding layer for the landfill liner system and will extend over the full width and length of the liner. The blinding layer shall be compacted to the requirements of structural fill.

The finished groundwater collection trenches shall be completed free of potholes, gullies and depressions where water may accumulate. In addition, haul trucks and earth moving plant will not operate or drive on top of the geotextile separation layer without a minimum of 150 mm cover being placed above.

The groundwater collection trench design is shown in drawing IZ000400-1000-NG-DRG-1019 found in Attachment 1. Further details on the material specification and construction methodology are provided in the Technical Specification documents, the latest of which is Area 15 Technical Specification.

11.5 Compacted Knap Rock Layer

Knap rock is weathered limestone and is classified as a sandy GRAVEL with some silt and minor clay. The knap rock is mined from the in-situ limestone and is screened to produce a well graded material with a maximum particle size of 40 mm. As the knap rock is mined it is placed in temporary stock piles, which are constructed to be free draining and shaped to prevent ponding and erosion of the material.

In order to assess the compaction, water content and permeability properties of the knap rock a field trial and laboratory testing of the knap rock material was undertaken in 2014. The methodology and results of the field and laboratory testing are presented in the Proposed Alternative Basal Liner Report (AE03541.16-E SG-RP-001). Since the report was issued in August 2014, further compaction, water content and permeability testing of the knap rock material has been completed. Based on all the testing that has been completed on the knap rock material, a relationship between permeability, relative compaction and water content was found.

It is a consent requirement that the knap rock has a permeability no greater than 1×10^{-8} m/s. Since an undisturbed knap rock sample cannot be collected, relative compaction and water content parameters of knap

rock are used to determine permeability. Therefore, it is anticipated that the permeability requirement is achieved if the criteria in Table 9 is achieved.

Table 9 Relative Compaction & Water Content Requirements

Scenario	Relative Compaction (measured as minimum % of MDD)	Water Content
1	95%	+3% to +6% wet of OWC
2	98%	+0% to +3% wet of OWC

Where:
MDD is the maximum dry density and OWC is the optimum water content as determined from a Heavy Compaction Test (NZS 4402 - Test 4.1.2).

Based on the above findings the following testing methodology was established:

- A knap rock sample is taken from the temporary stockpile and undergoes a laboratory heavy compaction test. This determines the material's maximum dry density (MDD) and optimum water content (OWC) parameters;
- Another knap rock sample is taken from the temporary stockpile and undergoes a laboratory permeability test targeting either of the scenarios in Table 9, using the heavy compaction test results from Step 1 as the reference;
- The proposed consent conditions require the knap rock to have a permeability no greater than 1×10^{-8} m/s. If the permeability test results are $\leq 1 \times 10^{-8}$ m/s, and the target relative compaction and water content are achieved then the stockpile is appropriate to use for the compacted knap rock layer;
- The knap rock is laid and compacted in 150 mm layers until the minimum thickness of 600 mm is constructed.
- Once a 300 mm knap rock layer has been laid and compacted, then nuclear densometer (NDM) and water content laboratory testing is completed. This determines the knap rock's in-situ relative compaction and water content;
- If the NDM and water content test results meet the requirements shown in Table 9, of either scenario one or two, the compacted knap rock layer has achieved the permeability consent requirement.

The compacted knap rock layer has a minimum thickness of 600 mm. The Technical Guidelines for the Disposal to Land recommend that the knap rock material is deposited and compacted in layers a maximum of 150 mm thick (WasteMINZ, 2018). Testing is required twice, firstly after 300 mm has been placed and compacted, and secondly after 600 mm has been placed and compacted. The testing type and frequency required for the compacted knap rock layer is outlined in Table 10. AB Lime is to provide Jacobs with all test results on the compacted knap rock layer.

Table 10 Testing Type and Frequency for the Compacted Knap Rock Layer.

Parameter	Test	Standard	Test Frequency
Relative Compaction ¹	Nuclear Densometer - NDM (Field)	NZS 4407:2015 Test 4.2	1 set (1 NDM test and 1 moisture content test) per 500 m ² of compacted material on each layer for the first 1,000 m ³ ; thereafter 1 set per 1,000 m ² of compacted material on each layer. A minimum of 2 sets per day shall be taken during knap rock placement.
MDD & OMC	Heavy Compaction Test (Laboratory)	NZS 4402:1986 Test 4.1.2	1 test per 10,000 m ³ sampled from each stockpile. Additional tests shall be performed if the stockpile is visually variable.
Minimum Clegg Impact Value	Clegg Impact Hammer - 4.5 kg (Field)	ASTM D5874-16 2016	1 set per 500 m ² of compacted material on each layer. No Clegg impact hammer tests needed if NDM tests are undertaken.
Maximum Permeability	Constant Head (Laboratory)	BS 1377 1990	1 test per 3,000 m ² of compacted material or 1 test per week (whichever is the greater number of tests).
Water Content ²	Water Content (Laboratory)	NZS 4402:1986 Test 2.1	1 test per NDM test.
<p>Notes:</p> <ol style="list-style-type: none"> 1. Relative compaction refers to the MDD ratio at heavy compaction. 2. Moisture content refers to the percentage variation from the OMC as determined from the heavy compaction test. 			

There are two hold points for construction of the compacted knap rock layer that require input and approval by Jacobs, and there are as follows:

- Approval of the knap rock stockpile – needs to meet the permeability requirement; and
- Approval of the compacted knap rock layer – needs to meet relative compaction and water content requirements.

11.6 GCL

The installation of the GCL shall only commence once the compacted knap rock layer is approved by the Engineer. The construction of the GCL shall only be started if the HDPE, leachate collection layer, and 500 mm confining gravel layer can be deployed within the working day. This is to ensure that the confining stress requirements of the GCL are met.

The GCL shall be stored and installed in accordance with ELCOSEAL Installation Guidelines, unless stated otherwise in this specification or by the Engineer in writing. An X1000 or equivalent GCL should be used with a minimum bentonite mass of 4 kg/m².

There are several points that should be taken into consideration to ensure best management practices are adhered to during placement of the GCL panels:

- Vehicles of any kind are not to drive or operate on the GCL;
- The GCL is not damaged by handling, movement of vehicles or other site activities;

- GCL shall be deployed only if it can be covered at the end of the working day with a minimum cover of 300 mm of soil, a geomembrane or a temporary waterproof tarpaulin (as per the ELCOSEAL Installation Guidelines);
- The completed GCL panel shall be protected from wind by putting temporary load on the GCL;
- The GCL shall not be left uncovered overnight;
- If partial hydration of the GCL occurs, the operating considerations outlined in the ELCOSEAL Installation Guidelines shall be adhered to.

At the top of the slope the GCL shall be placed in an anchor trench on all edges. The backfill should be placed in the anchor trench to provide resistance against pull out.

11.7 HDPE

The installation of the 1.5 mm High Density Polyethylene (HDPE) will commence within the same working day following placement of the GCL.

The HDPE shall be stored and installed in accordance with manufacturer's requirements. There are several points that should be taken into consideration to ensure best management practices are adhered to during placement of the HDPE panels:

- The HDPE shall not be installed when the ambient air temperature is below 0°C or above 40°C, during precipitation, heavy fog conditions, high humidity, in areas of ponded water, or in windy conditions;
- Vehicles of any kind are not to drive or operate on the HDPE liner;
- The HDPE is not damaged by handling, movement of vehicles or other site activities; and
- The completed HDPE panel is suitably protected from damage and wind by putting a temporary load on the HDPE.

At the top of the slope the HDPE shall be placed in an anchor trench on all edges. The backfill should be placed in the anchor trench to provide resistance against pull out. The details of the anchor trenches are indicated on the drawings and further details are provided in the ELCOSEAL Installation Guidelines.

11.8 Geotextile

Geotextile is placed over the HDPE in order to protect the liner from damage during placement of the leachate drainage layer. The geotextile is A14 Bidim or a similar product approved by the Engineer that is nonwoven and needle punched and that meets the requirements of Type A, Class 3 as defined in Transit NZ Specification for Geotextiles, TNZ F/7, 2003. In addition, the geotextile shall be installed in accordance with this Transit NZ specification.

11.9 Leachate Collection Layer

The leachate collection system is a 300 mm gravel layer and an array of 150 mm diameter perforated pipes at 20 m spacing, which drain to 300 mm diameter solid pipes at 80 m spacing. The leachate collection layer should be at a minimum slope of 2% gradient.

The leachate collection layer is placed over the HDPE liner without damaging the HDPE or creating squeezing within the GCL. General construction traffic is not be permitted on the installed leachate collection layer at any time. End tipping of gravel directly on to the HDPE liner is not permitted.

Leachate collection pipes for the future stages shall be completely sealed, non-perforated, within the cell boundary and shall be laid at the same level or above the leachate collection pipes for this stage of the landfill development.

The leachate collection system has been designed such that the direction of flow is towards the leachate collection tank and the maximum drainage path is 20 m to reach a collection pipe. A minimum of 1.5% fall will be maintained for all the pipes.

A biaxial geogrid shall be placed over the leachate collection layer and the confining gravel layer to avoid 'thinning-out' of the gravel layer during placement of the confining stress layer.

11.10 Confining Stress Layer

The GCL needs to be covered after installation to provide the necessary confining stress to avoid cation exchange. Once the leachate collection system is constructed, a 500 mm thick layer of gravel is placed over the leachate collection layer (a total thickness of 800 mm) in order to meet the confining requirements of the GCL. This confining gravel layer extends across the entire area. When waste is ready to be placed in the area then the 500 mm of gravel is excavated, and geogrid is placed over the leachate collection layer. A 1 m thick layer of select waste is then be placed over the geogrid. The excavation of the gravel can be completed in parts as the waste placement in the area progresses.

The select waste (fluff layer) shall preclude items such as angular rock fragments, sharp objects or other deleterious material which could adversely affect the performance of the leachate collection layer or any of the underlying layers. Where it is not possible to source such fill, shredded tyres or similar material shall be used.

11.11 Hold Points

The proposed consent conditions state that as-built drawings shall be forwarded to SRC following completion of works and structures, for acceptance in writing, prior to the disposal of refuse in each newly constructed stage. These drawings shall include 0.25 metre contours for the liner base, and final elevations of the HDPE liner.

The hold points indicate the portions of work which, prior to proceeding, need approval from the Engineer. These are listed in Table 11.

Table 11 Hold Points for AB Lime Landfill Area Construction

Item	Description of Work
1	Completion of subgrade preparation for landfill platform (geological mapping and photography of base)
2	Confirm that the landfill floor has a minimum gradient of 2%
3	Completion of groundwater collection trenches installation
4	Completion of geotextile separation layer installation
5	Completion of compacted knap rock for landfill liner
7	Completion of stormwater bunds
8	Completion of GCL, HDPE & geotextile installation
9	Completion of leachate collection layer installation
10	Installation and excavation of confining gravel layer
11	Installation of geogrid
12	Completion of the placement of select waste

12. Contaminated Land Procedures

The contaminated land procedures to appropriately assess and manage contaminants in the soil to protect human health are as follows.

- Contaminated soil will be assessed as a Special Waste and disposed of following the Special Waste Acceptance procedures (see Section 5)
- Random load inspections of incoming waste will be carried out (see Section 4.5)
- At the working face the Pointsman is responsible for managing odorous waste including contaminated soil (see Section 7.2.2)
- Odorous contaminated soil procedures are covered in the Landfill Air Quality Management Plan.

12.1 NESCS

The objective of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS) is to ensure that land affected/potentially affected by contaminants in soil which may have an adverse effect on human health, is appropriately identified and assessed when soil disturbance and/or a change in land use occurs. This includes, where appropriate, the requirement that contaminants are contained, or the land remediated to make the land safe for human use.

The NESCS applies to specific activities on HAIL sites including sampling, investigating, remediating or disturbing a *piece of land* and changing the use of a *piece of land*.

12.1.1 Pre-Landfilling Areas

Preliminary Site Investigations, undertaken in general accordance with the most recent version of the MfE Contaminated Land Management Guidelines (CLMG) No. 1 – Reporting on Contaminated Sites in New Zealand and CLMG No.5 - Site Investigation and Analysis of Soils, are required prior to the development of future Areas of the landfill to determine whether the *piece of land* for development has been subject to an activity or industry that could result in soil contamination and whether resource consent under the NESCS is required.

12.1.2 Post-Landfilling Areas

Once a cell has been filled with refuse and once the whole landfill is complete, the NESCS does apply, under HAIL Category G3 "*Landfill sites*".

The requirement for resource consent under the NESCS to carry out an activity such as "soil disturbance" on those existing landfilled areas will be discussed and agreed with Environment Southland, on a case by case basis.

13. Groundwater Monitoring

Groundwater monitoring is required as part of a range of environmental monitoring activities that are conducted to assess how the landfill is performing with the design, operational practices and regulatory requirements.

Trigger levels are a set of standards used to gauge the effects on the environment from the operation of the landfill. The Environmental Manager will compare all monitoring data with the trigger levels for groundwater monitoring. Exceedance of a trigger level requires investigation and reporting and may require immediate remedial action.

Trigger levels are set at two levels, namely Trigger Level 1 (a lower response limit / warning level) and Trigger Level 2 (upper response limit / alarm level).

Exceedance of TL1 warns of potential adverse effects, and potential future non-compliance with the resource consent conditions and results in a review of landfill management practices to identify and remedy the cause of the exceedance.

Exceedance of a TL2 is a strong indication that significant adverse effects and breaches of consent conditions may already be occurring, or could have occurred, or are about to occur. Exceedance of TL2 will necessitate one or more of the following actions:

- Urgent mitigative actions;
- Notifications of the authorities - Environment Southland;
- Calling of a specialist adviser (a qualified person or consultancy with experience in environmental management);
- Prompt instigation of investigations; and
- Remedies.

Extreme exceedance of TL2 might require reference to the site Emergency Response Plan.

13.1 Groundwater Trigger Levels

TL1 levels are based on probable worst-case statistics (median plus or minus two times the standard deviation value) of background water quality data for each site. The median has been implemented rather than the mean as it places less emphasis on extreme values.

TL2 levels are based primarily on ANZECC (2000) or USEPA (1999) guidelines where available, with a focus on the protection of aquatic life. Drinking water guidelines are not considered relevant as there are no downgradient users of the water for potable supply purposes. Where no regulatory standards are defined for a parameter or where background levels exceed regulatory standards, the TL2 is defined as the median background concentration plus or minus three standard deviations.

The ANZECC (2000) and USEPA (1999) water quality guidelines for metals are based on analysis of the dissolved metal fraction (i.e. metals occurring naturally in solution) and as such dissolved metals will be specified to the laboratory. Dissolved metal concentrations are hardness dependant. The guideline for dissolved metals will be corrected to the median background hardness obtained from baseline monitoring. The methodology for this calculation is detailed in the ANZECC (2000) Guidelines.

The following approaches will be used to assess compliance of groundwater quality trigger levels:

- For continuous monitoring (i.e. 2.5-minute measurements) compliance with trigger levels will be assessed using running means calculated over 6 successive measurements (i.e. 15-minute averages). Only the running means will be stored to the datalogger.

- For grab samples or monthly, quarterly or annual monitoring, compliance with trigger levels will be assessed using individual data points.

13.2 Groundwater Monitoring Parameters

For groundwater the following parameters in Table 12 will be monitored at the landfill.

Table 12 Groundwater Monitoring Parameters

Parameter	Details
Major Elements	Major elements including calcium, magnesium, sodium and chloride are common constituents of surface water and groundwater. By monitoring these parameters prior to landfill development, a distinction can be made between the effects of the landfill activities and background levels.
Electrical Conductivity	Conductivity is the ability of the water to conduct electricity and is based on the quantity of charged ions (i.e. sodium, potassium, calcium, chloride and carbonates) in the water. Conductivity measurements can be used as a quick indicator of potential water quality problems associated with increased ion concentrations.
Suspended Solids and Turbidity	Suspended solids and turbidity are measures of the amount of particulate suspended matter in a water body. High sediment concentrations can inhibit plant growth by reducing the amount of light in the water column and smothering organisms. Suspended solids in surface water may be of concern particularly where earthworks are an essential part of operation, as in the case of a landfill. Suspended solid and turbidity concentrations can change rapidly over time, particularly during storm events when surface runoff from the catchment may be high. Turbidity will be monitored continuously in surface water at the landfill as it is a quicker method than measuring total suspended solids, which is usually determined by filtering and drying a water sample. An empirical relationship between turbidity and suspended solids will be developed in order to estimate suspended solid concentrations from turbidity levels.
Dissolved Oxygen	Fish and other aquatic organism require dissolved oxygen for respiration. The amount of dissolved oxygen is dependent on the water temperature, quantity of sediment, presence of decaying and respiring organisms, stream flow and aeration. Depletion of dissolved oxygen can encourage the microbial reduction of nitrate to nitrite and sulphate to sulphide, giving rise to odour problems. Maintenance of high dissolved oxygen levels in the leachate pond is an effective method of odour control at the landfill.
Nutrients and Bacteria	The presence of excessive nutrients (e.g. nitrogen and phosphorus) and microorganisms (bacteria) in surface water can indicate possible contamination from the landfill or other sources.
Organic compounds, COD, TOC	Leachate contains a wide variety of organic compounds that are typically associated with organic decomposition processes. They can provide a measure of the strength and age of the leachate. Total organic carbon (TOC) and chemical oxygen demand (COD) are measured to provide an indication of contamination by organic compounds. Individual species such as volatile acids and total phenols are also often measured as indicator species. A more comprehensive organic compound analysis including volatile and semi-volatile compounds may be conducted at less frequent intervals.
Trace Metals	Leachate contains a variety of trace metals (i.e. lead, cadmium etc.) many of which are toxic at low concentrations.

13.3 Monitoring Network

Drawing IZ000400-1000-NG-DRG-1008 (Attachment 1), **Figure 5** and Table 13.2 outline the groundwater monitoring network. Attachment 7 contains copies of the construction logs for all bores.

Groundwater abstraction and quality is monitored at Site 13 (landfill underdrainage system). Groundwater quality from Site 17 (leachate pond underdrainage system) is also monitored.

Site 17 is a manhole with an open grate. It is located at a low point in the topography into which surface water from around the leachate pond will drain. This means that the manhole will gradually fill up with sediment and

the collected water will comprise of both surface water and groundwater. The manhole will be regularly pumped clean of sediments to allow fresh groundwater to flow in for sampling. The contingency plan for site 17 (see section 13.3.2.1) refers to the action.

Table 13 Groundwater Monitoring Network

Site	Parameter	Location
SKM104	Groundwater level, water quality	Along ridge line up-gradient of the landfill
SKM106	Groundwater level, water quality	Along ridge line up-gradient of the landfill
SKM108	Groundwater level, water quality	Down gradient of the landfill near site boundary
SKM201	Groundwater level, water quality	Along the southern boundary of the landfill footprint
SKM202	Groundwater level, water quality	Along the southern boundary of the landfill footprint
SKM203	Groundwater level, water quality	Along the southern boundary of the landfill footprint
SKM204	Groundwater level, water quality	Along the southern boundary of the landfill footprint
Site 13	Flow/abstraction, water quality	Landfill underdrainage pipe manhole
Site 17	Water quality	Leachate pond underdrainage pipe manhole

13.3.1 Groundwater Levels

Groundwater levels are measured and recorded at monthly intervals as outlined in Table 14. The water levels are measured from the top of the casing and recorded to the nearest 0.01m in accordance with appropriate sampling and analysis procedures (see Attachment 8.). Flow from the groundwater underdrainage system (site 13) is measured continuously with a flow meter.

Table 14 Groundwater Level Monitoring Plan

Site	Parameter	Detection Limit	Trigger Level		Monitoring Frequency	Report
			TL1	TL2		
All Bores	Groundwater Level	0.01 mAMSL	Variable	N/A	Monthly	Report 1 & 3
Site 13	Flow/abstraction		N/A	40 m ³ /day	Monthly	Report 1 & 3

13.3.1.1 Contingency Plan

The following contingency measures in Table 15 shall be used as appropriate.

Table 15 Contingency Measures for Groundwater Levels

Contingency Triggering Event	Contingency Action
Abstraction from Site 13 exceeds the maximum levels specified in the resource consent	Operational records to be reviewed to determine the reason for the exceedance

13.3.2 Groundwater Quality

Groundwater sampling from the monitoring bores are undertaken at biannual intervals as agreed by Environment Southland in 2012. Table 16 shows the range of parameters that are analysed. Volatile and semi-volatile organic compounds are sampled annually.

Groundwater quality monitoring from the groundwater underdrainage systems (Site 13 & 17) comprises sampling for a small suite of leachate indicator parameters at monthly intervals. If it is detected that leachate is present a more comprehensive sampling round will be conducted. Baseline water quality is to be established at Site 13 and Site 17 prior to each stage of landfill development by monitoring for the list of parameters given in Table 16. An ion balance to APHA criteria will be achieved and a quality control program is to be implemented for each sampling round.

Groundwater Monitoring Bores are monitored biannually and reported on in Reports 1 & 3.

Table 16 Groundwater Monitoring Plan

Parameter	Detection Limit	T2 Levels	Upper T1 Trigger Levels for Each Bore						
			104	106	108	201	202	203	204
Alkalinity	1 mg/L	20	337	515	320	643	403	337	310
Bicarbonate	1 mg/L		419	620	399	791	482	416	377
Calcium	0.05 mg/L		141.5	173	115	245	211	126	125
Chloride	0.5 mg/L	230	31.1	37	71.2	47	46	34	27.7
COD	6 mg/L		170.1	9	6	4.1-9.2	8	6	6
Conductivity (field & laboratory)	0.1 m/Sm		73.4	70.2	77.6	124.3	105.0	66.5	60.6
Dissolved Aluminium	0.003 mg/L	0.055	0.003	0.003	0.003	0.003	0.008	0.003	0.004
Dissolved Arsenic	0.001 mg/L	0.024	0.001	0.001	0.0053	0.001	0.0011	0.001	0.001
Dissolved Boron	0.005 mg/L		0.005						
Dissolved Cadmium	0.00005 mg/L	0.00155	0.00005	0.0004	0.00005	0.00005	0.00005	0.00005	0.00005
Dissolved Chromium	0.0005 mg/L	0.0218	0.006	0.002	0.0005	0.00554	0.0006	0.0005	0.0005
Dissolved Copper	0.0005 mg/L	0.0099	0.0034	0.002	0.0020	0.00560	0.0012	0.0012	0.0012
Dissolved Iron	0.02 mg/L	0.3	0.25	0.02	0.51	0.67	0.02	0.02	0.02
Dissolved Lead	0.0001 mg/L	0.0633	0.002	0.001	0.0001	0.0001	0.00011	0.00023	0.0002
Dissolved Manganese	0.0005 mg/L	1.7	0.0142	0.0016	21.7	1.225	0.0005	0.0005	0.0005
Dissolved Nickel	0.0005 mg/L	0.0779	0.0012	0.002	0.0005	0.006	0.0089	0.0005	0.0005
Dissolved Reactive Phosphorus	0.004 mg/L	0.01	0.004	0.051	0.022	0.01	0.035	0.035	0.01
Dissolved Zinc	0.001 mg/L	0.057	0.0391	0.051	0.0244	0.0185	0.0116	0.015	0.0181
Magnesium	0.02 mg/L		3.3	4.5	21.7	14.9	8.2	3.9	3.9
Nitrate-Nitrogen	0.002 mg/L	0.16	2.2	3	0.064	2.04	3.54	3.8	3.7
pH (field & laboratory)	0.1 pH units	7.2-7.8	7.6	6.5-8.2	7.1-7.8	6.7-7.3	6.9-7.3	7.1-7.5	7.1-7.6
Potassium	0.05 mg/L		1.6	2.38	2.4	1.52	1.58	1.04	0.92
Sodium	0.02 mg/L		19.2	23.4	41.3	37.2	25	19.4	19.4
Sulphate	0.5 mg/L		14.4	10.4	7.7	84	152	6.3	7.6
Total Ammoniacal Nitrogen	0.01 mg/L		3.7	0.018	0.023	0.431	1.18	0.025	0.01
Total Hardness	1 mg/L		372	447	382	668	561	332	330
Total Kjeldahl Nitrogen	0.1 mg/L		3.3	0.84	0.2	0.85	0.30	0.19	0.37
NPOC (Organic Carbon)	0.5 mg/L		20.8	1.8	1.6	5.47	2.9	1.3	1.7
Total Phenols	0.002 mg/L	0.32	0.0143	0.024	0.003	0.0036	0.005	0.00	0.004
Turbidity	0.05 NTU		26.7	29.4	28.8	12.17	20.3	62	5.0
Volatile Acids	5 mg/L	5	5	5	5	5	5	5	5
Semi-volatile Organic Compounds	0.003 mg/L								
Volatile Organic Compounds	0.004 mg/L								

Underdrainage groundwater is monitored monthly and reported in Reports 1 and 3 as per Table 17.

Table 17 Groundwater Monitoring Plan

Site	Parameter	Detection Limit	Trigger Level		Monitoring frequency	Reporting Frequency
			TL1	TL2		
13	Conductivity (field & laboratory)	0.1 mS/m	13.2-126.1		Monthly	Reports 1 & 3
	Total Ammoniacal Nitrogen	0.01 mg/L	0.00-0.11		Monthly	Reports 1 & 3
	pH (field & laboratory)	0.1 pH units	6.8-8.2		Monthly	Reports 1 & 3
	Chloride	0.5 mg/L	4.4-77.5		Monthly	Reports 1 & 3
17	Conductivity (field & laboratory)	0.1 mS/m			Monthly	Reports 1 & 3
	Total Ammoniacal Nitrogen	0.01 mg/L			Monthly	Reports 1 & 3
	pH (field & laboratory)	0.1 pH units			Monthly	Reports 1 & 3
	Chloride	0.5 mg/L			Monthly	Reports 1 & 3

13.3.2.1 Contingency Plan

Site 13

Figure 5 shows a schematic outline of the contingency plan for the monthly monitoring at Site 13. The contingency measures in Table 18 will be used as appropriate for site 13.

Table 18 Site 13 Monitoring Contingency Measures

Contingency Triggering Event	Contingency Action
Indicator parameters at Site 13 exceed their respective TL1 trigger levels	<ul style="list-style-type: none"> A grab sample will be taken from the site as soon as practical and analysed for the parameters specified in Table 13.8. A preliminary review of operations will be undertaken. Both the results of the preliminary review and the analytical results from the grab samples are to be reviewed by the Environmental Manager.
Water quality parameters measured in the grab sample exceed the respective TL2 trigger level	<ul style="list-style-type: none"> The groundwater is to be treated and/or disposed of as leachate and Environment Southland will be advised within one month of sampling. If identified as necessary by Environment Southland, further monitoring and/or mitigation measures will be undertaken.

Table 19 Groundwater Quality Grab Sample Parameter List

Parameter	Detection Limit
pH (field & laboratory)	0.1 pH units
Conductivity (field & laboratory)	0.1 mS/m
Alkalinity	1 mg/L
Chloride	0.5 mg/L
Potassium	0.05 mg/L
Suspended Solids	3 mg/L
Total Ammoniacal Nitrogen	0.01 mg/L
Total Boron	0.005 mg/L
Total Iron	0.02 mg/L
Total Organic Carbon	0.5 mg/L
Total Zinc	0.001 mg/L

Site 17

The following contingency measures in Table 20 will be followed for Site 17.

Table 20 Site 17 Monitoring Contingency Measures

Contingency Triggering Event	Contingency Action
	<ul style="list-style-type: none"> The leachate pond underdrainage manhole is to be pumped out regularly (approximately every 6 months). This is to remove accumulated sediments and allow fresh groundwater to flow into the manhole.
The indicator parameter exceeds the respective TL1 trigger levels	<ul style="list-style-type: none"> The manhole is to be pumped out again as soon as practical and a grab sample taken for analysis. The grab sample parameters to be analysed are the same as Site 13 as specified A review of operations is to be undertaken. The Environmental Manager is to evaluate both the results of the sampling and the operational review.
TL2 trigger levels are not required by consent condition for Site 17. However, if grab sample parameters indicate that groundwater from the leachate pond underdrainage system is contaminated	<ul style="list-style-type: none"> The groundwater shall be treated and/or disposed of as leachate. The grab sample results will be compared against the TL2's for Site 13. Contingency process is similar to that described for Site 13 except that the manhole is required to be pumped immediately prior to taking a grab sample and there are no specified trigger levels in the resource consent conditions.

All Sites

The following contingency measures in Table 21 will be followed for all sites.

Table 21 Contingency Measures to be Followed at all Sites

Contingency Triggering Event	Contingency Action
Baseline monitoring confirms that SKM108 is not the most appropriate downgradient position	<ul style="list-style-type: none"> An appropriately constructed groundwater monitoring bore is to be installed in a better location and added to the monitoring schedule.
A bore is destroyed	<ul style="list-style-type: none"> A new bore is to be drilled in the same general location A rising head test is to be conducted on any new bore to demonstrate that the bore is working and assess the hydraulic conductivity of the <i>in-situ</i> ground
Parameters from quarterly or annual monitoring exceed their respective TL1	<ul style="list-style-type: none"> the Environmental Manager is to conduct a preliminary review of operations. If the parameter exceeds the TL1 on a regular basis, changes to the landfill management practice are to be implemented to remedy the cause of the exceedance.
Parameters exceed their respective TL2	<ul style="list-style-type: none"> Environment Southland will be notified. Immediate steps will be taken to prevent further leachate contamination.

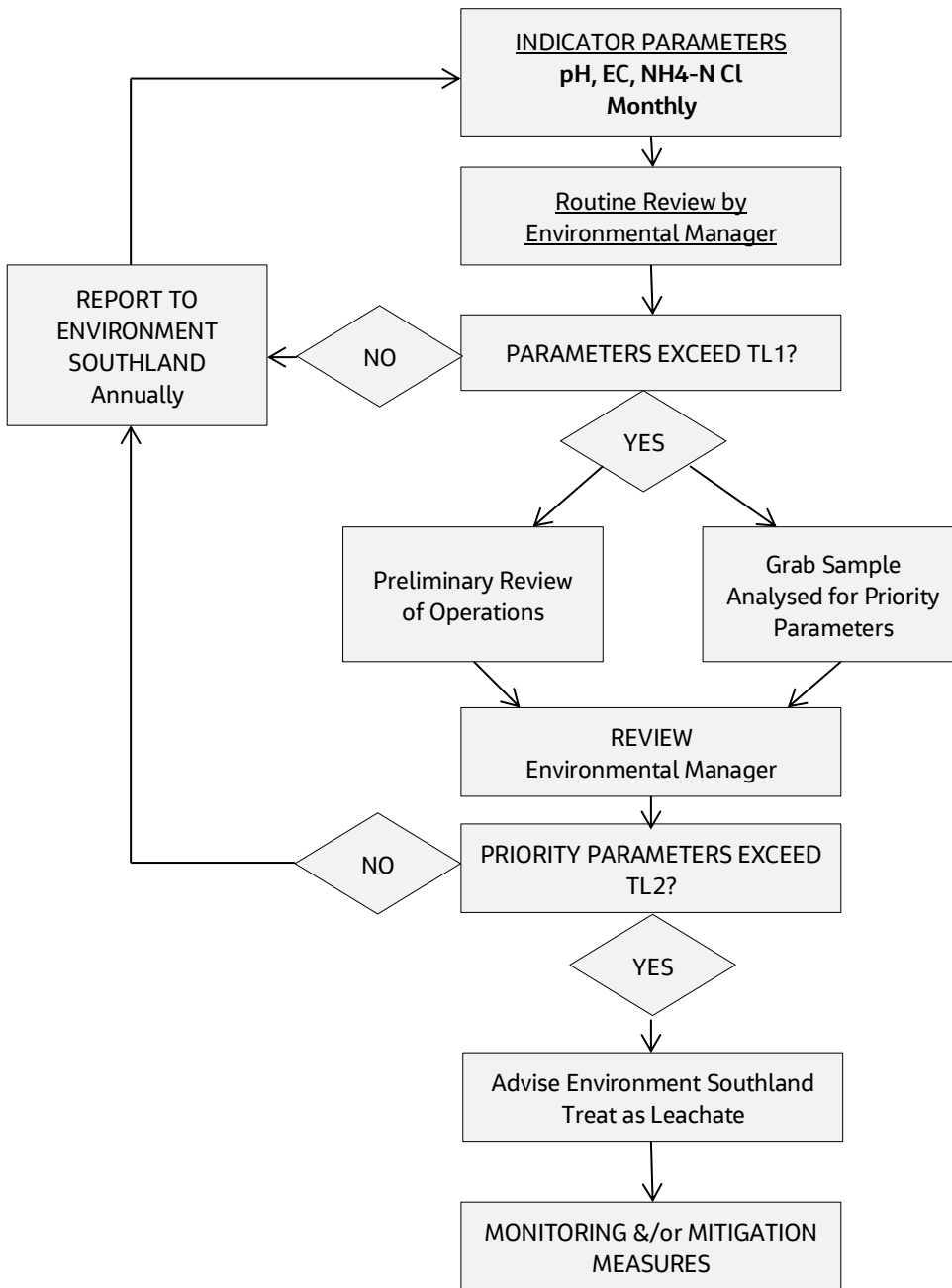


Figure 5 Groundwater Monitoring Contingency Plan: Site 13

13.3.3 Groundwater Contamination Remediation Plan

Contamination remediation plans are to be developed on an individual basis dependent on the nature and degree of contamination detected.

- The general approach to a remediation plan would be as follows:
- Identification of the type of contamination;
- Assessment of the potential environmental impact;
- Isolation of the source of the contamination and redirection of the flow of leachate storage ponds if possible;
- Assessment and implementation of appropriate treatment for the contamination;
- Further monitoring to identify the source of the contaminations this may include the expansion of the existing monitoring programme to include more locations, more parameters and more often; and
- Implement corrective measures to rectify the source of contamination.

Specific contingency plans and reporting activities are not necessary until the uncontrolled release of pollutants have been identified. Reporting will be necessary to demonstrate to Environment Southland that the situation is under control. Additionally, management plans may require amending.

Potential Corrective Measures for contamination are as follows:

Landfill

- Cease placing waste and re-circulating leachate in the area of concern;
- Assess whether liner repairs can be undertaken, providing it will not risk further damage to the intact lining system;
- Isolate and cap the area of concern to prevent further water ingress;
- Increase the leachate extraction from the cell; and
- Re-assess the risks with Environment Southland and discuss specific remediation measures of the monitored natural attenuation is considered inappropriate i.e. pump and treat.

Leachate Tank

- Empty the leachate pond by pumping leachate back to the landfill or tankering all leachate off-site;
- Repair / replace the liner system in accordance with the adopted specification;
- Confirm the installation / repair of the lining system with a leak location survey; and
- Re-assess the risks with Environment Southland and discuss any further remediation measures required.

13.4 Installation of Groundwater Monitoring Wells

The consent holder shall install new downgradient groundwater monitoring wells, if deemed necessary by the consent holder. The final locations shall be agreed in writing by the Southland Regional Council. If any groundwater monitoring well is destroyed AB Lime will discuss the requirement for replacing the well with Environment Southland, and where required by Environment Southland to do so, replace it with a new well, in the same general location, to the satisfaction of Environment Southland.

13.5 Taking of Groundwater

AB Lime will only take groundwater from the groundwater underdrainage systems beneath the landfill footprint and leachate storage pond, as shown on drawing IZ0004000-1000-NG-DRG-1008 found in Attachment 1.

13.6 Maximum Allowable Surface Water Take

AB Lime will not take more surface water than 500 cubic metres in any 24-hour period.

14. Area 15 Concept Filling Plan

14.1 Location

Area 15 is located west of Area 14 and north of Areas 11 and 12, see Drawing IZ000400-1000-NG-DRG-6000-1008.

In plan-view the Area 15 base-liner footprint is approximately 150 m long (east-west) and 100 m wide (north-south).

14.2 Phased Filling of Area 15

Area 15 will be filled in three phases as shown conceptually on the recent aerial photographs (taken Aug 2020) contained in Attachment 10.

For the concept filling plan for Area 15 we have assumed a base-liner footprint filling of 120 m long (east-west) and 90 m wide. This allows for sufficient room for the construction of the temporary access track to each of the three phases. The location of the temporary access track is located in the western part of Area 15, see Attachment 10.

It is envisaged that the remaining area of the base-liner footprint of Area 15 (i.e. 30 m east-west and 10 m north-south), will be filled during the Area 16 filling.

The three filling phases can be summarised as follows:

- a) Phase 1: the southern part of Area 15, approximately 120 m long 30 m wide. The aerial photograph shows that the selected waste layer (fluff layer) is being placed.
- b) Phase 2: the middle part of Area 15, approximately 120 m long and 30 m wide. This area has an additional 500 mm confining gravel layer placed on top of the leachate collection layer and geogrid. The 500 mm gravel layer will be removed and 1 m of select waste will be placed once Phase 1 has been filled.
- c) Phase 3: the northern part of Area 15, approximately 120 m long and 30 m wide. This area has an additional 500 mm confining gravel layer placed on top of the leachate collection layer and geogrid.

14.3 Filling via Cells and Typical Working Face Area

Each phase will be filled via a series of cells that constitute the Working Face. Each cell has a plan-view area of up to 30 m long and 25 m wide, so that the average Working Face area is 750 m².

The average 750 m² Working Face is below the maximum 1000 m² Working Face area (see Section 7.4.3), thereby allowing AB Lime to operate a second Working Face of up to 250 m² elsewhere within Area 15 as a contingency.

14.4 Cell Filling Sequence within each Phase

A concept filling sequence for each of the three phases is presented on two cross sections contained within Attachment 10:

- a) Cross Section 1: this is a North-South cross section showing the filling sequence against the overstep northern slopes of Areas 11 and 12. The North-South cross-section shows that during and after Area 15 filling the northern waste slopes have reduced from approximately 1(v):2(h) to 1(v):3(h).

- b) Cross Section 2: this is an East-West cross section showing the filling sequence against the oversteep western slope of Area 14. The East-West section also shows that during and after Area 15 filling the western waste slopes have reduced from approximately 1(v):2(h) to 1(v):3(h).

Based on 5 m filling height per cell the concept filling sequence will be as follows:

- a) Phase 1: 19 cells, start: Cell 15-1A, finish: Cell 15-1S.
- b) Phase 2: 27 cells, start: Cell 15-2A, finish: Cell 15-2AA.
- c) Phase 3: 27 cells, start: Cell 15-3A, finish: Cell 15-3AA.

The 5 m filling height is considered the maximum filling height per cell. The 5 m height may be reduced to 2 m or 3 m if AB Lime considers a lower filling height more practical.

14.5 Airspace Volume of Area 15

An estimate of the airspace volume of Area 15 has been based on filling sequence shown on the North-South and East-West cross sections contained in Attachment 10.

A summary of the estimated airspace volume for each of the three phases of filling Area 15 is presented in Table 14.1 below.

Table 14.1: Summary of Estimated Airspace Volume for each of the Three Phases of Filling Area 15

Phase	Number of cells (1)	Identification of cells (1)	Airspace Volume, estimate (m ³) (2)
1	19	15-1A - 15-1S	25,000
2	27	15-2A - 15-2AA	70,000
3	27	15-3A - 15-3AA	88,000
TOTAL	73		183,000

Notes:

- 1) Number of cells and location of cells based on North-South and East-West cross sections contained in Attachment 10.
- 2) Both North-South and East-West cross sections show that the waste filling occurs to a height of approximately '30 m', i.e. level with the assumed existing (Aug 2020) waste level of Areas 11, 12 and 14. This is a conservative fill height since additional fill can be placed in Area 15 with a slope of 1(v):3(h) to the east (i.e. towards Area 14) and the same slope to the south (i.e. towards Areas 11 and 12).

Similarly, the waste truck access located on the western part of Area 15 has not been included as it is conservatively assumed that this access track will be required during the construction of Area 16, which is located west and adjacent to Area 15, see Drawing IZ000400-1000-NG-DRG-6000-1008.

14.6 Time Estimate to fill Area 15

A broad time estimate to fill Area 15 is presented in Table 14.2 below and is based on the following assumptions:

- a) Waste acceptance rate of 100,000 tons/year.
- b) Landfill operating 52 weeks/year, 6 days/week, i.e. waste acceptance rate is 321 ton/day.
- c) Assume compacted waste density is 0.85 ton/m³, i.e. waste acceptance rate is 273 m³/day.
- d) Allow for 15% of Daily Cover, Temporary Cover and Intermediate Capping, i.e. 0.15 x 273 = 41 m³/day.
- e) Volume of waste + Daily Cover, etc = 273 + 41 = 314 m³/day.
- f) Use 314 m³/day for each of the airspace volumes in Table 14.1.

Table 14.2: Summary of Time Estimate to Fill Area 15

Phase	Airspace Volume, estimate (m ³) (1)	Broad Time Estimate (2)		
		days	weeks	years
1	25,000	80	13	
2	70,000	223	37	
3	88,000	280	47	
TOTAL	183,000		97	1.9

Notes:

- 1) See Table 14.1.
- 2) These are broad time estimates only, and should not be relied upon for detailed planning of Area 15 filling duration.

14.7 Waste Truck Access to Area 15

Access to Area 15 will be via a temporary road on the western side of Area 11, see location on background of recent aerial photograph in Attachment 10.

The aerial photographs shows that there is an existing access road to Area 15. The existing access road is used by the AB Lime to transport waste from the top of the slope, down the access track, to Area 15.

The existing access road is will be upgraded with gravel/hardfill. This will enable AB Lime waste trucks (Huka Trucks) to bring the waste in bins from the top of the slope to Area 15.

14.8 Waste Drop-Off Areas for Incoming Waste Trucks

For the filling of Area 15 waste truck entering the landfill via the weighbridge will transport the waste to one of the three areas as shown on the aerial photograph contained in Attachment 10.

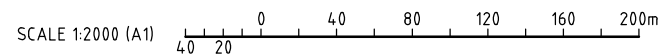
The AB Lime Huka Truck will transport the waste to the Working Face.

Attachment 1. Drawings



NOTES

1. THE HORIZONTAL COORDINATE SYSTEM FOR THE SITE IS NEW ZEALAND MAP GRID 1949.
2. THE LATEST SURVEY FOR THE SITE WAS PERFORMED BY DRONE SURVEY, FLOWN ON 12/03/2020.



LEGEND

- CONSENTED LANDFILL FOOTPRINT
- - - CELL DEVELOPMENT OF LANDFILL
- - - CELL DEVELOPMENT OF FUTURE LANDFILL
- CADASTRAL BOUNDARY
- BUILDING
- ☁ TREE

CONSENT ISSUE

REV	DATE	APP'D	REVISION
0	19.03.21	VP	CONSENT ISSUE - FOR HEARING
A	29.05.20	VP	CONSENT ISSUE

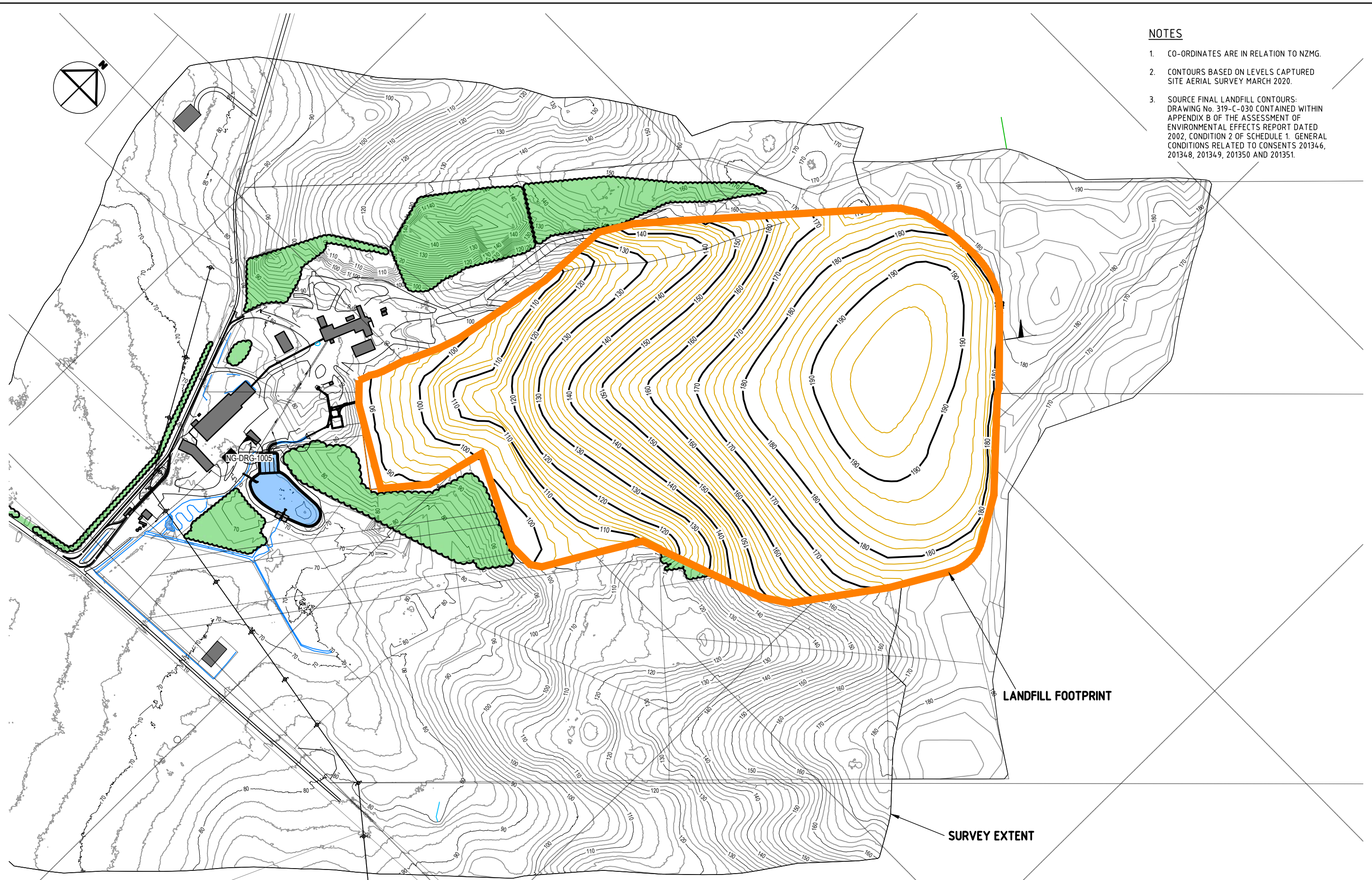
SCALES AT A1



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CLIENT AB LIME LTD.		TITLE LANDFILL FOOTPRINT AND SITE INFRASTRUCTURE	
PROJECT LANDFILL INVESTIGATION KING'S BEND SITE		SCALE 1:10000 (A1)	
DRAWN MH	DRAWING CHECK JK	REVIEWED CW	APPROVED VP
DESIGNED KJ	DESIGN REVIEW LJ	DATE 19.03.2021	DATE 19.03.2021

DRAWING No	REV
IZ000400-1000-NG-DRG-1002	0



- NOTES**
1. CO-ORDINATES ARE IN RELATION TO NZMG.
 2. CONTOURS BASED ON LEVELS CAPTURED SITE AERIAL SURVEY MARCH 2020.
 3. SOURCE FINAL LANDFILL CONTOURS: DRAWING No. 319-C-030 CONTAINED WITHIN APPENDIX B OF THE ASSESSMENT OF ENVIRONMENTAL EFFECTS REPORT DATED 2002, CONDITION 2 OF SCHEDULE 1. GENERAL CONDITIONS RELATED TO CONSENTS 201346, 201348, 201349, 201350 AND 201351.

LANDFILL FOOTPRINT

SURVEY EXTENT

CONSENT ISSUE

REV	DATE	APPD	REVISION
A	29.05.20	VP	CONSENT ISSUE

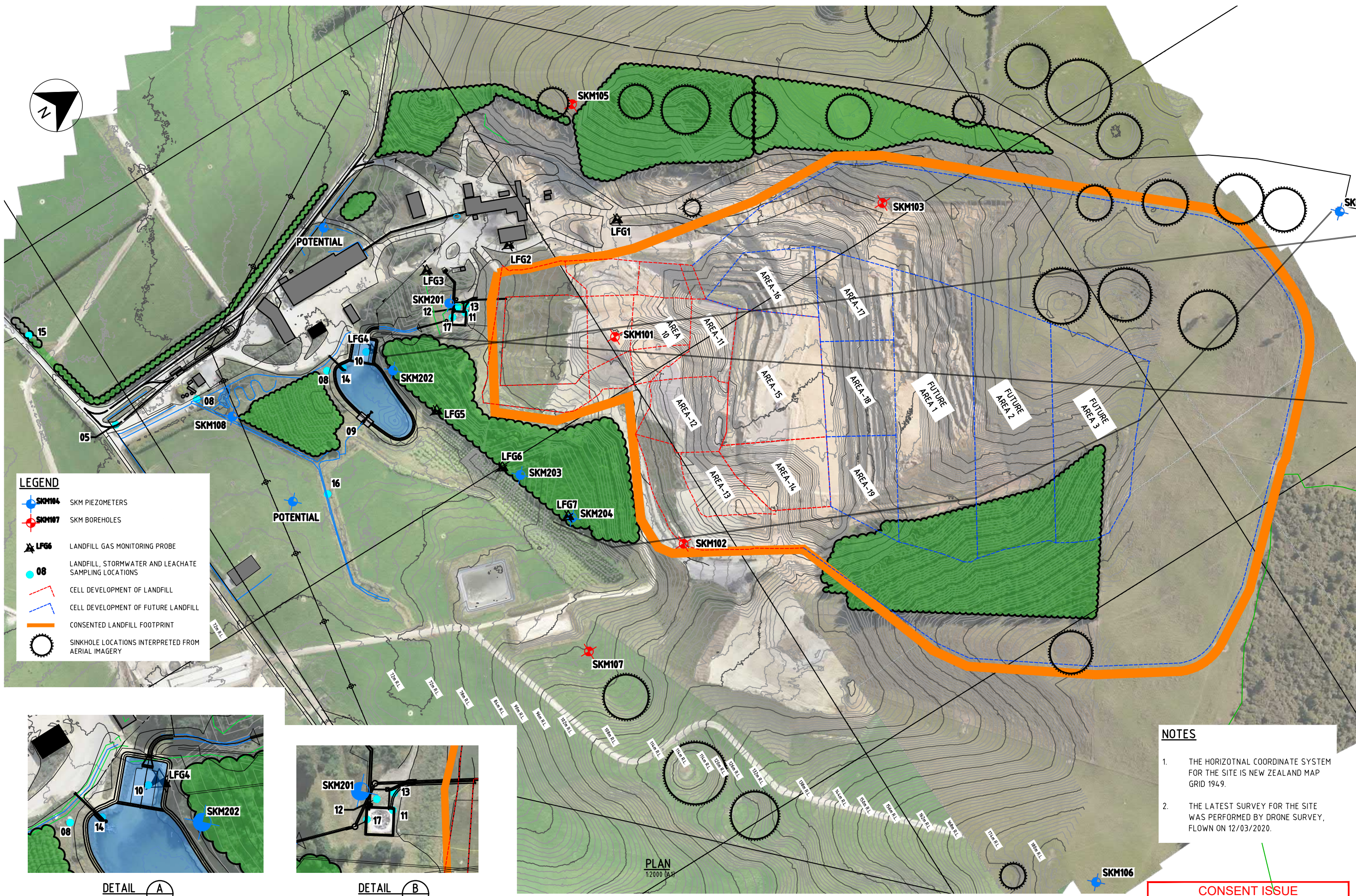
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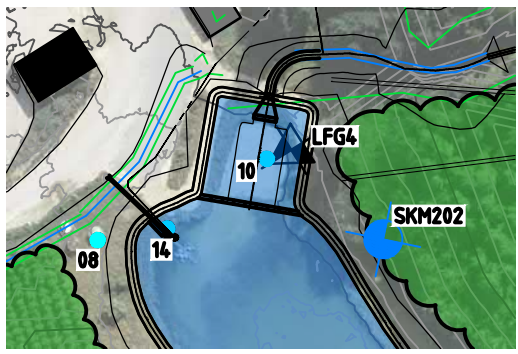
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DESIGNED KJ	DESIGN REVIEW LJ	DATE 29.05.20	DATE 29.05.20

DRAWING No. IZ000400-1000-NG-DRG-1003	REV A
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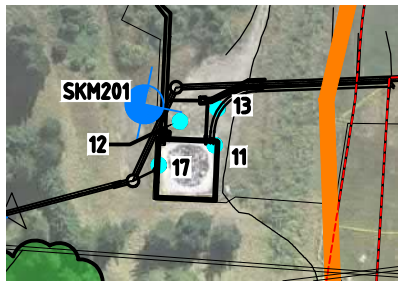


LEGEND

- SKM104 SKM PIEZOMETERS
- SKM107 SKM BOREHOLES
- LFG6 LANDFILL GAS MONITORING PROBE
- LANDFILL, STORMWATER AND LEACHATE SAMPLING LOCATIONS
- CELL DEVELOPMENT OF LANDFILL
- CELL DEVELOPMENT OF FUTURE LANDFILL
- CONSENTED LANDFILL FOOTPRINT
- SINKHOLE LOCATIONS INTERPRETED FROM AERIAL IMAGERY



DETAIL A
1:1000



DETAIL B
1:1000

- NOTES**
1. THE HORIZONTAL COORDINATE SYSTEM FOR THE SITE IS NEW ZEALAND MAP GRID 1949.
 2. THE LATEST SURVEY FOR THE SITE WAS PERFORMED BY DRONE SURVEY, FLOWN ON 12/03/2020.

CONSENT ISSUE

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A	29.05.20	VP	CONSENT ISSUE

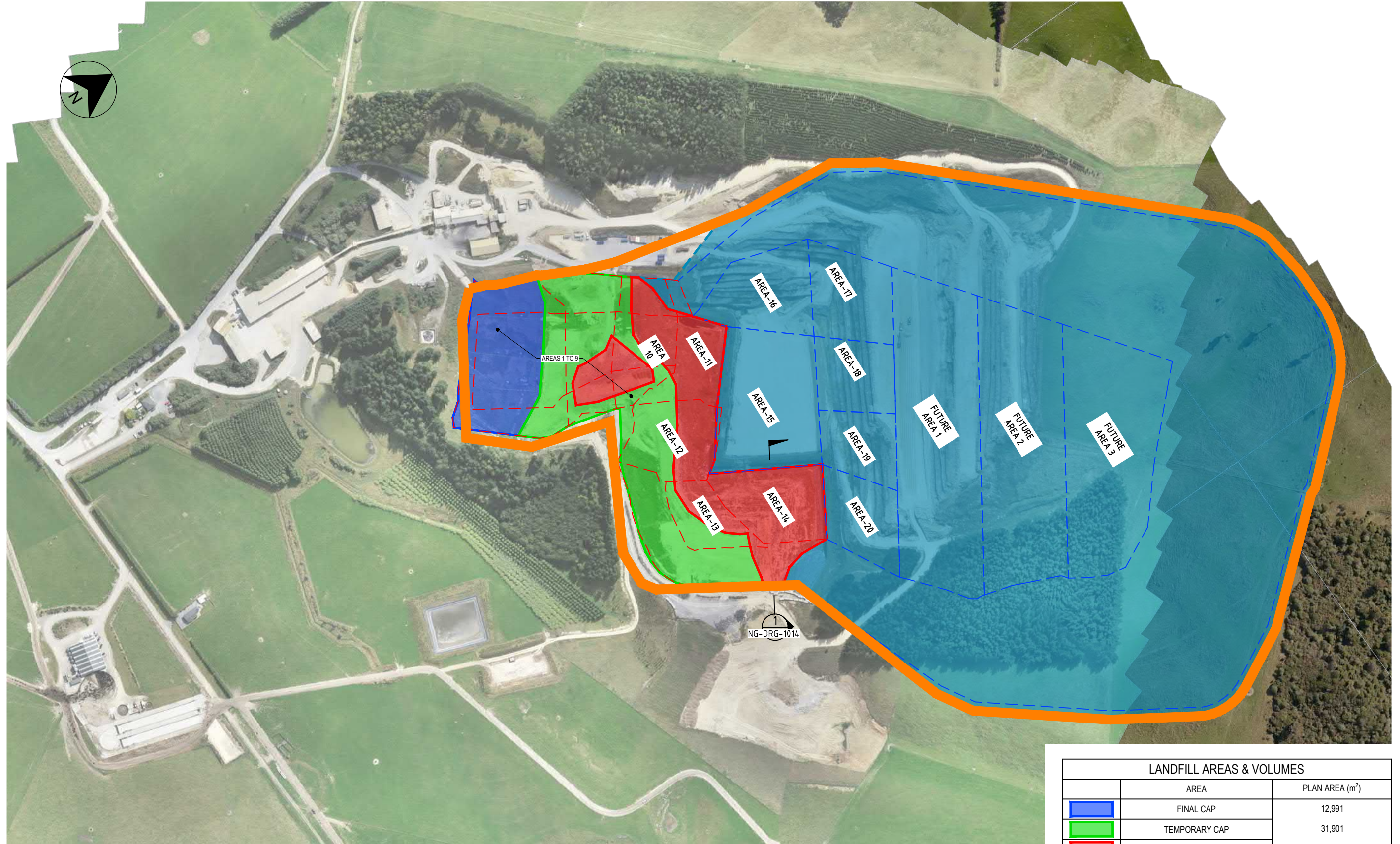
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CLIENT	AB LIME LTD.
PROJECT	LANDFILL INVESTIGATION
DRAWN	NBL
DESIGNED	LJ
DRAWING CHECK	KJ
DESIGN REVIEW	CW
REVIEWED	CW
DATE	19.03.2021
APPROVED	VP
DATE	19.03.2021

TITLE		GROUNDWATER, STORMWATER & GAS BOREHOLE LOCATIONS
PLAN		
SCALE	AS SHOWN	
DRAWING No	IZ000400-1000-NG-DRG-1008	
REV	0	



LANDFILL AREAS & VOLUMES		
	AREA	PLAN AREA (m ²)
	FINAL CAP	12,991
	TEMPORARY CAP	31,901
	WORKING AREA \ DAILY COVER	27,060
	AREA 15 TO FUTURE LANDFILL	310,654

CONSENT ISSUE

REV	DATE	APP'D	REVISION
A	29.05.20	VP	CONSENT ISSUE

SCALES AT A1



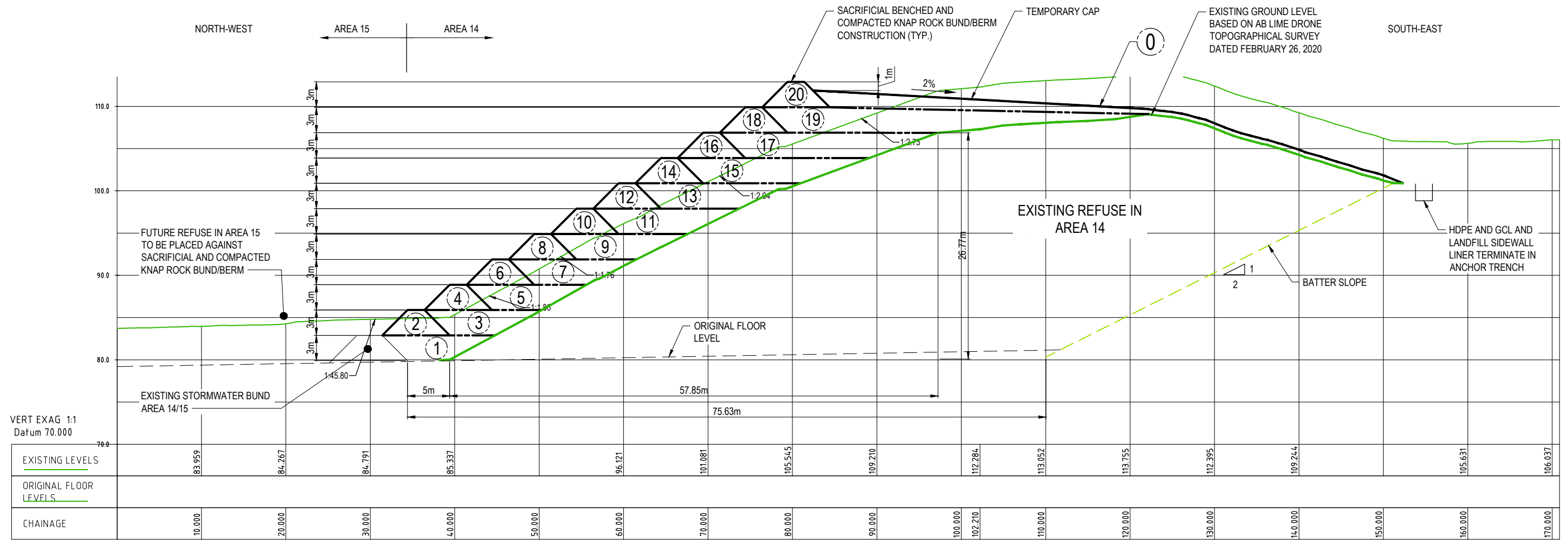
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CLIENT AB LIME LTD.		DESIGNED WS	
PROJECT LANDFILL INVESTIGATION		DRAWING CHECK KJ	
REVIEWED CW	APPROVED VP	DATE 29.05.20	DATE 29.05.20

TITLE LANDFILL CAPPING STATUS AS OF APRIL 2020 PLAN		SCALE 1:2000 (A1)	DRAWING No IZ000400-1000-NG-DRG-1012	REV A
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BUND INSTALLATION NOTES

- 0 INSTALL TEMPORARY COVER 0.6m THICK COMPACTED LOW PERMEABILITY SOIL, MINIMISE RAINFALL INFILTRATION AND REDUCE LANDFILL GAS EMISSIONS THROUGH CAP
- 1 PLACE WASTE 0.5m THICK LAYER LOOSE LIFT THICKNESS, COMPACT WITH MINIMUM 3 PASSES (1 PASS = THERE AND BACK), COMPACT REFUSE TO 3m HEIGHT
- 2 CONSTRUCT KNAP ROCK BUND, 3m HEIGHT, 1(V):1(H) SLOPE, 2m CREST, 8m BUND, OFFSET FROM EXISTING SW BUND
- 3 REPEAT STEP 1
- 4 REPEAT STEP 2
- 5 REPEAT STEP 3
- 6 REPEAT STEP 4
- ETC.



SECTION 1
 SCALE 1:250 IZ000400-1000-NG-DRG-1002

NOTE

- 1 CONSTRUCT A SERIES OF COMPACTED LOW-PERMEABILITY SOIL BUNDS, MEETING THE TEMPORARY COVER CRITERIA

CONSENT ISSUE

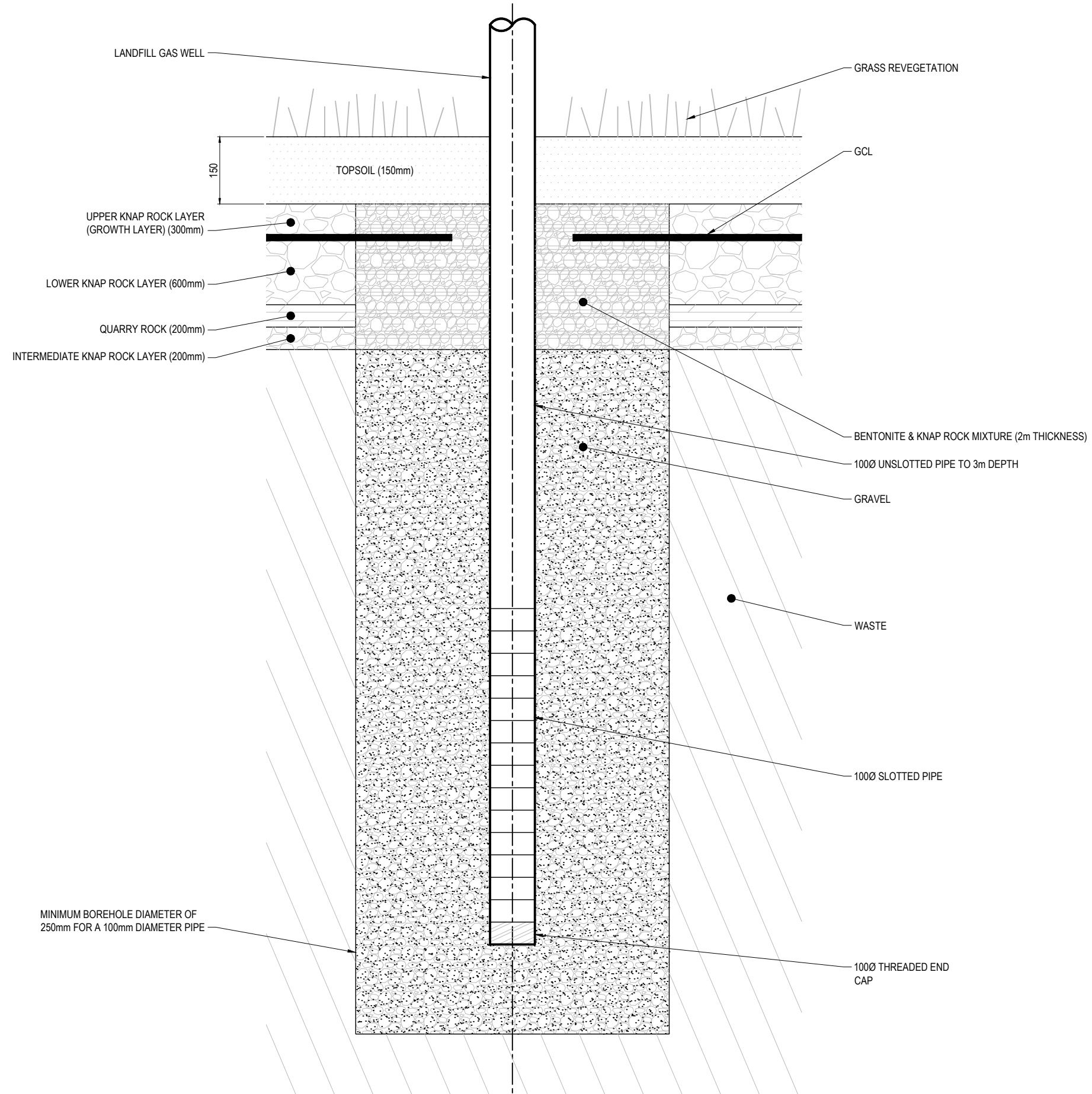
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A	29.05.20	VP	CONSENT ISSUE

SCALES AT A1



CLIENT AB LIME LTD.		PROJECT LANDFILL INVESTIGATION	
DRAWN NBL	DRAWING CHECK KJ	REVIEWED CW	APPROVED VP
DESIGNED WS	DESIGN REVIEW BC	DATE 29.05.20	DATE 29.05.20

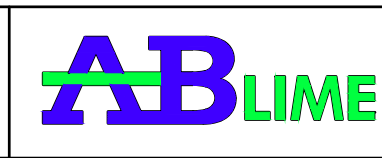
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SCALE AS SHOWN	DRAWING No IZ000400-1000-NG-DRG-1014
REV A	



CONSENT ISSUE

REV	DATE	APPD	REVISION
A	29.05.20	VP	CONSENT ISSUE

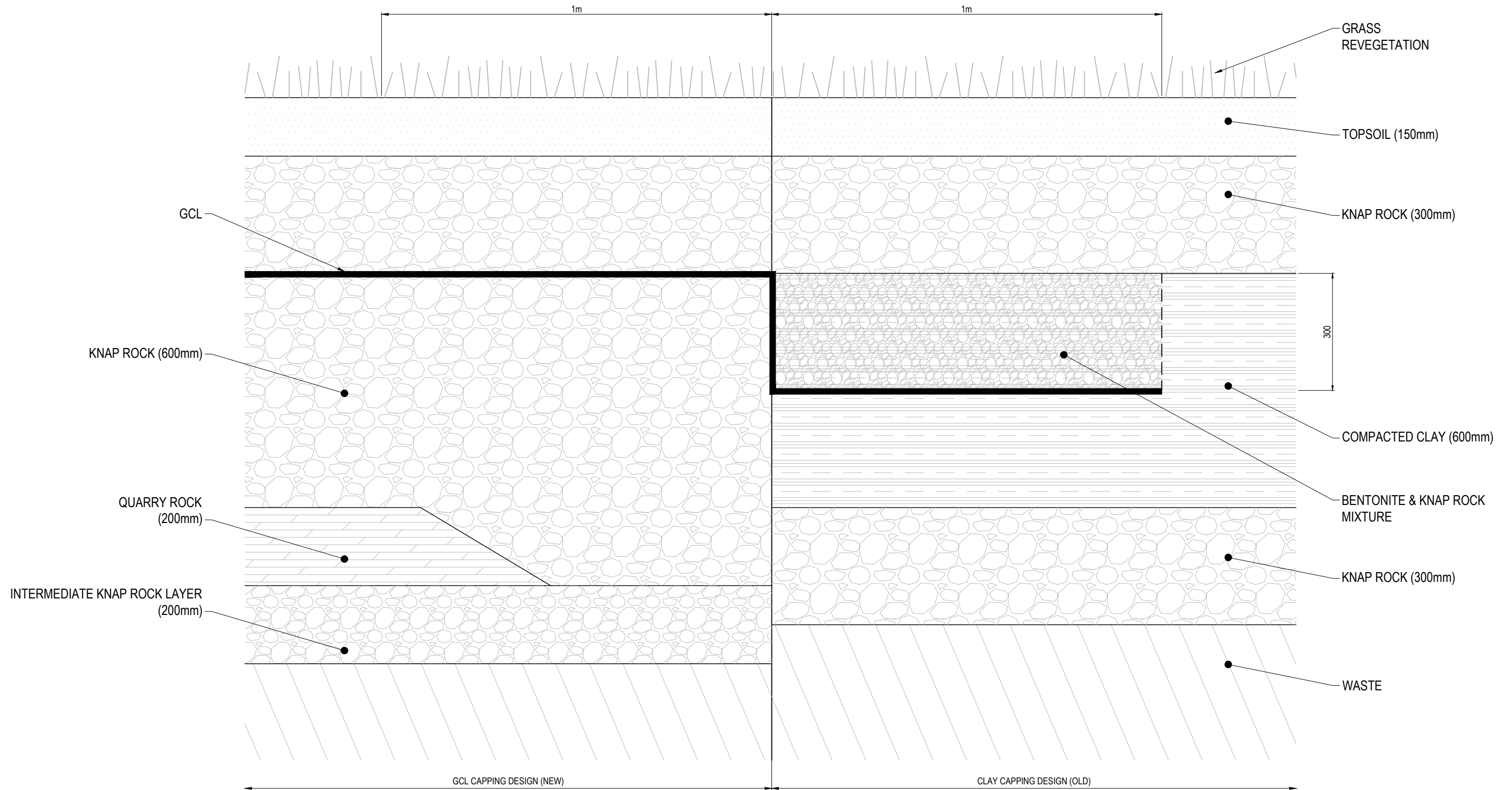
SCALES AT A1



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CLIENT AB LIME LTD.		PROJECT LANDFILL INVESTIGATION	
DRAWN NBL	DRAWING CHECK KJ	REVIEWED CW	APPROVED VP
DESIGNED WVS	DESIGN REVIEW BC	DATE 29.05.20	DATE 29.05.20

TITLE LANDFILL FINAL CAPPING DESIGN GAS WELL CAPPING DETAIL		SCALE 1:5 (A1)	DRAWING No IZ000400-1000-NG-DRG-1015	REV A
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CONSENT ISSUE

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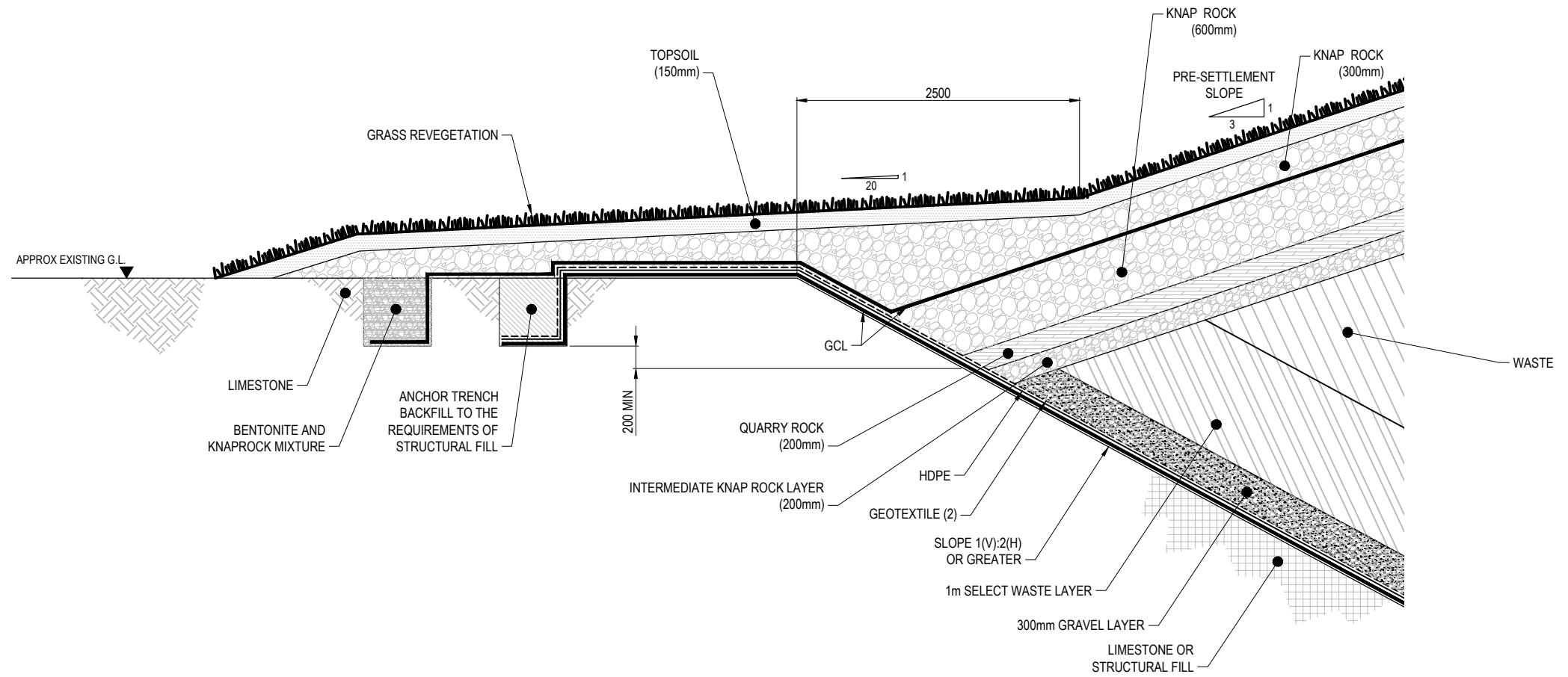
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CLIENT AB LIME LTD.		TITLE LANDFILL FINAL CAPPING DESIGN HORIZONTAL CONNECTION DETAIL	
PROJECT LANDFILL INVESTIGATION		SCALE 1:5 (A1)	
DRAWN NBL	DRAWING CHECK KJ	REVIEWED CW	APPROVED VP
DESIGNED KJ	DESIGN REVIEW CW	DATE 29.05.20	DATE 29.05.20

DRAWING No	IZ000400-1000-NG-DRG-1016	REV	A
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CONSENT ISSUE

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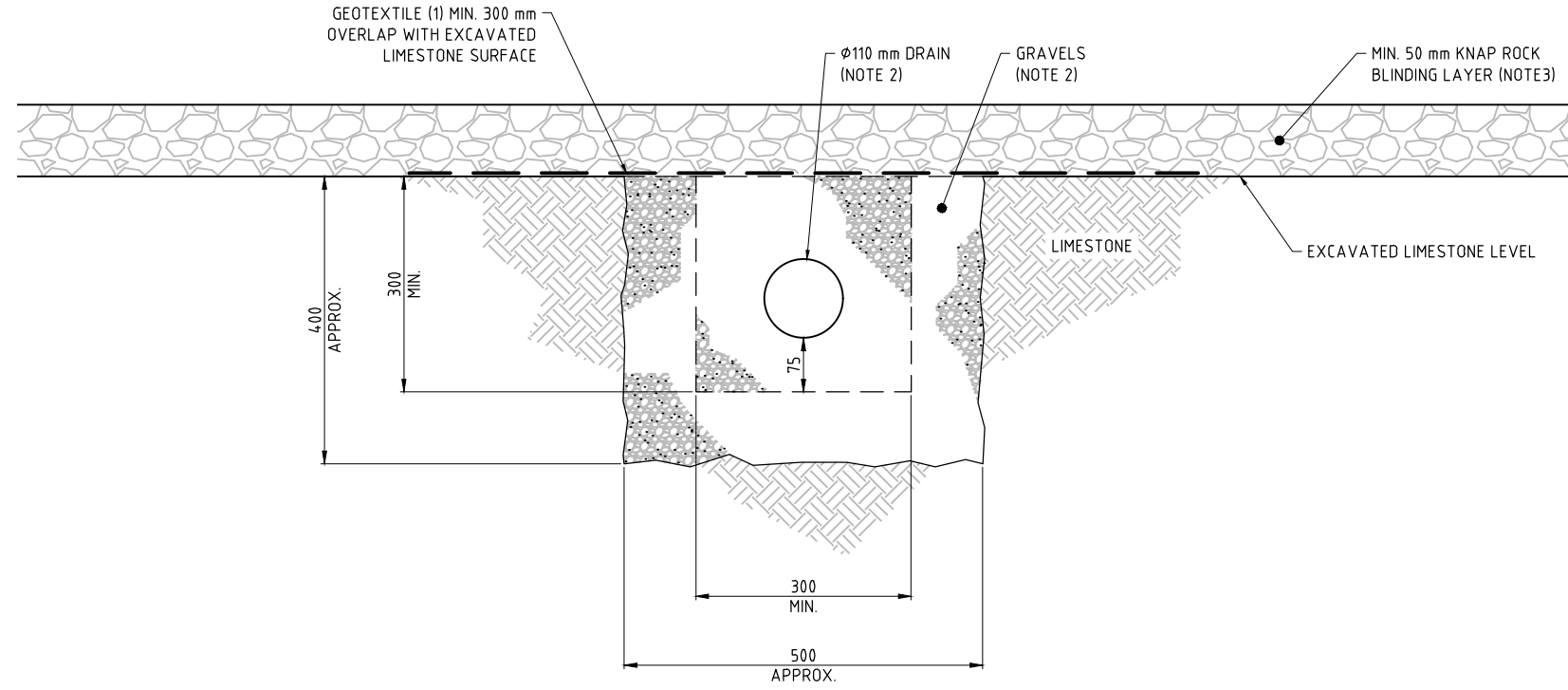
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CLIENT AB LIME LTD.		DRAWING CHECK KJ	
PROJECT LANDFILL INVESTIGATION		REVIEWED CW	APPROVED VP
DRAWN NBL	DESIGNED KJ	DATE 29.05.20	DATE 29.05.20

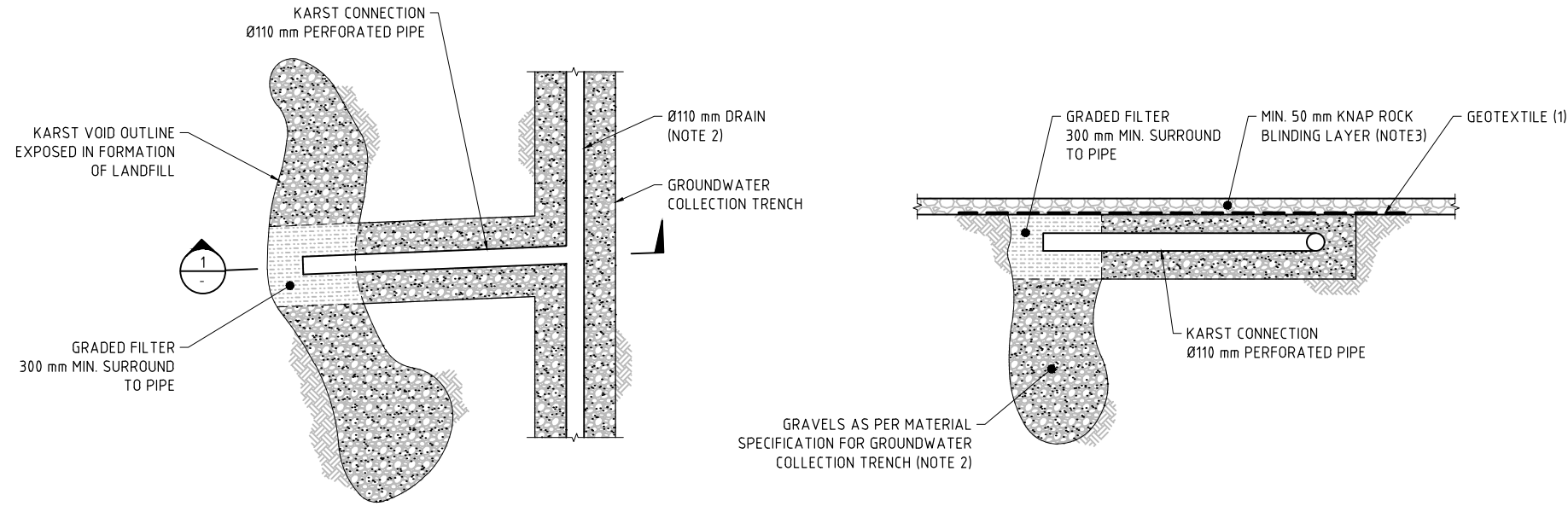
TITLE LANDFILL FINAL CAPPING LAYER & SIDE SLOPE SECTION		SCALE AS SHOWN	DRAWING No IZ000400-1000-NG-DRG-1017	REV A
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DETAIL A GROUNDWATER COLLECTION TRENCH
 SCALE 1:5 (A1)

NOTE:

1. GEOTEXTILE (1) IS A SEPARATION LAYER AND SHALL MEET THE REQUIREMENTS OF TYPE B, CLASS 3 AS DEFINED IN TNZ F/77, 2003 (SPECIFICATION ITEM 3.3). BIDIM A19 IS AN ACCEPTABLE SEPARATION LAYER.
2. REFER TO LATEST TECHNICAL SPECIFICATION FOR FURTHER DETAILS.
3. THE BLINDING LAYER SHALL MEET THE REQUIREMENTS OF STRUCTURAL FILL.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.



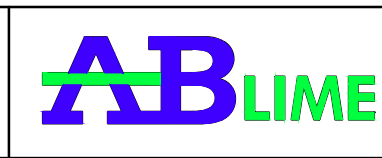
DETAIL B KARST VOID TREATMENT PLAN
 SCALE NTS

SECTION 1 KARST VOID TREATMENT CROSS SECTION
 SCALE NTS

CONSENT ISSUE

REV	DATE	APP'D	REVISION
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CLIENT AB LIME LTD.		PROJECT LANDFILL INVESTIGATION	
DRAWN NBL	DRAWING CHECK KJ	REVIEWED CW	APPROVED VP
DESIGNED KJ	DESIGN REVIEW CW	DATE 29.05.20	DATE 29.05.20

TITLE GROUNDWATER COLLECTION TRENCH DESIGN SECTION & DETAILS		
SCALE AS SHOWN	DRAWING No IZ000400-1000-NG-DRG-1019	REV A

Attachment 2. Schedule 2 to AUTH-201346-V3

Application No: A071-010

Schedule 2 Waste Acceptance Criteria Leachable and Total Concentration Limits

Contaminant threshold is the maximum allowable concentration if a TCLP test is not carried out.

Contaminant	Contaminant Threshold (mg per litre)	Leachable Concentration (mg per litre)	Total Concentration (mg per litre)
Arsenic	100	5.0	
Benzene	10	0.5	
Benzo(a)pyrene	0.8	0.04	
Beryllium	20	1.0	
Cadmium	20	1.0	
Carbon Tetrachloride	10	0.5	
Chlorobenzene	2000	100	
Chloroform	120	6	
Chromium (VI)	100	5	
Chlorpyrifos	4	0.2	
m-Cresol	4000	200	
o-Cresol	4000	200	
p-Cresol	4000	200	
Cresol (total)	4000	200	
Cyanide (amenable)	70	3.5	
Cyanide (total)	320	16	
2,4-D	200	10	
1,2-Dichlorobenzene	86	4.3	
1,4-Dichlorobenzene	150	7.5	
1,2-Dichloroethane	10	0.5	
1,1-Dichloroethylene	14	0.7	
Dichloromethane	172	8.6	
2,4-Dinitrotoluene	2.6	0.13	
Ethylbenzene	600	30	
Fluoride	3000	150	
Fluroxypyr	40	2	
Halogenated compounds			1000
Lead	100	5	
Mercury	4	0.2	
Methyl ethyl ketone	4000	200	
Molybdenum	100	5	
Nickel	40	2	
Nitrobenzene	40	2	
C6-C9 petroleum hydrocarbons	N/A	N/A	650
C10-C36 petroleum hydrocarbons	N/A	N/A	10000
Phenol (non-halogenated)	288	14.4	

Attachment 3. Special Waste Application Form

Special Waste Permit Application

[Print](#)[Log out](#)

User Profile | Your Permits | New Permit Application

PERMIT #:

COMPANY:	<input type="text"/>	NAME:	<input type="text"/>
PHONE NUMBER:	<input type="text"/>	MOBILE:	<input type="text"/>
EMAIL:	<input type="text" value="FSmith@ablime.co.nz"/>		
BILLING ADDRESS:	<input type="text"/>		

TYPE:

DESCRIPTION:

ATTACH LAB RESULTS (IF AVAILABLE): No file chosen

SOURCE:

TOTAL QUANTITY: LOAD SIZE:

NO. DELIVERIES: FREQUENCY:

PACKAGING / CONTAINMENT METHOD:

SELECT COMPANY:

- APPLICATION CONDITIONS:**
1. Only the legal owner of the waste may apply to hold a permit
 2. Each permit will only be valid for a maximum of twelve months
 3. Two days notice of special waste disposal must be given
 4. AB Lime Ltd have the right to refuse waste at any stage

DECLARATION
I declare that the above waste is accurately described

NAME: DATE (DD/MM/YYYY):

Accept these terms and conditions

[Send Application](#)

Attachment 4. Special Wastes Characteristics Tables







Hazardous Characteristic	General Description	HSNO definition (summary)
Explosives	An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) that is, in itself, capable by chemical reaction of producing gas at such a temperature and pressure, and at such a speed, as to cause damage to the surroundings.	See document.
Flammable	Solids, or waste solids, other than those classed as explosives, which are readily combustible, or may cause or contribute to fire through friction.	See document. A liquid is flammable if it: gives off a flammable vapour which ignites in a closed cup flash point test at a temperature $\leq 93^{\circ}\text{C}$;
Oxidising	Substances or wastes which, in themselves are not necessarily combustible, but may, generally by yielding oxygen, cause or contribute to the combustion of other materials.	Oxidising substances not organic peroxides, being substances which while in themselves not necessarily combustible may, generally by yielding oxygen, chlorine or fluorine, cause or contribute to the combustion of other material. Organic peroxides, being substances which contain the bivalent oxygen [-O-O-] structure and may be considered as derivatives of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.
Corrosive	Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue; or in the case of leakage, will materially damage, or even destroy other goods. An aqueous waste with pH less than 2 or greater than 12.5 is defined as corrosive.	See document.
Toxic	This characteristic is defined in terms of landfill waste acceptance for many substances under this heading in Tables 2 to 7.	Acute toxicity including oral, dermal, and inhalation effects. Skin irritation (including corrosive effects) Eye irritation Sensitisation Reproductive/Developmental/Teratogenic effects or Chronic Toxicity Other statistically significant biological effects
Ecotoxic	This characteristic is defined in terms of landfill waste acceptance for many substances under this heading in Tables 2 to 7.	Aquatic toxicity Effects on the soil environment Effects on terrestrial vertebrates Effects on terrestrial beneficial invertebrates Biocidal action

Type of material	Criteria
Asbestos	see AB Lime- Procedure 4.30
Aesthetically disturbing	
Odourous	
Dusts	
Demolition material	
Overlength	
Wire rope	
Bulky objects	

Attachment 5. Approved Hazardous Waste 4.30


4.30 Policy & Procedure Name: Approved Hazardous Waste

Positions responsible for implementing	Health & Safety Coordinator, Quarry Manager, Environmental Manager, Landfill Supervisor
Purpose of the Policy	To ensure approved hazardous waste is accepted and disposed of appropriately.
Reporting lines	Health & Safety Coordinator, Quarry Manager , Area Supervisor, Staff

Personal Protective Equipment (PPE):					
					

Policy & Procedure	Picture	Training Required
Policy: General		
Asbestos, medical waste and methamphetamine contaminated waste are consented hazardous wastes that can be accepted in the AB Lime Landfill.		

Policy & Procedure	Picture	Training Required

Policy: Accepting Approves Hazardous Wastes – Asbestos 1. Discrete Loads			
<p>Asbestos must be disposed of in accordance with Health and Safety at Work (Asbestos) Regulations 2016. A copy of these regulations can be found at the main office and at the Landfill office.</p>			
<p>It must be double wrapped</p>			
<p>It must be on pallets</p>			
<p>It must be identified with Asbestos stickers</p>			
<p>It must come in on an approved carrier</p>			
<p>It must have a Special Permit</p>			

We require 48 hours' notice to prepare a burial site before the waste arrives		
Disposal follows standard special waste disposal procedures.		

Policy & Procedure	Picture	Training Required
Policy: Accepting Approves Hazardous Wastes – 2. Bulk Rubble		
Delivery Method to Site: <ul style="list-style-type: none"> • Truck and Trailer bins to be lined with plastic sheeting • Plastic Sheeting to be folded over top of loads and appropriated labelled with Asbestos Stickers. 		
Delivery expectations: <ul style="list-style-type: none"> • That the rubble will be dampened down at the point of loading • The product will have been dampened down prior to travel 		

Policy & Procedure	Picture	Training Required
Policy: Accepting Approves Hazardous Wastes – Disposal		
Disposal site will be recorded via GPS. Elevations will be done at the end of each day.		
The trucks will deposit the rubble via a tip-face prepared for this waste only		

At the tip-face a spray boom will operate to eliminate any dust during disposal.		
A hand operated spray will also be used for dust suppression as the product moves down into the deposition hole and settles.		
A sheet of liner will be in position allow the rubble move freely into the designated burial site		
A digger will move each load into position after deposition to allow the layers to build in a space effective manner		
After each load is deposited 1m of fresh municipal waste will be immediately compacted over the top of it		
At final height, geo grid will be placed over the entire deposition site with Asbestos labels secured to it		

Policy & Procedure	Picture	Training Required
Policy: Accepting Approves Hazardous Wastes – Personal Safety Equipment		
Truck Drivers will not be permitted to leave their trucks at the tip face except to open the bin. Masks must be used.		
AB Lime staff will wear disposal overalls, with hoods, that will be disposed of into the landfill prior to leaving the Landfill footprint (including toilet, meal and coffee breaks)		

A new suit is required for each load if there is a break between receiving loads.		
AB Lime staff will wear appropriate face masks to eliminate inhalation of dust		
AB Lime staff will wear gloves and company approved footwear		
AB Lime staff will shower prior to leaving the AB Lime workplace. AB Lime will provide wash and towels.		

Policy & Procedure	Picture	Training Required
Policy: Accepting Approves Hazardous Wastes – Medical Waste		
It must come in on an approved carrier		
It must have a Special Permit		
48 hours' notice to prepare a burial site before the waste arrives		

Disposal follows standard special waste disposal procedures.		
--	--	--

Policy & Procedure	Picture	Training Required
Policy: Accepting Approves Hazardous Wastes – Contaminated Waste		
It must come in on an approved carrier		
It must have a Special Permit		
48 hours' notice to prepare a burial site before the waste arrives		
Disposal follows standard special waste disposal procedures.		

Attachment 6. Example of Special Waste Permit

Permit No:

Date:

Special Waste Permit: Difficult/Discretionary Waste

Company:

Phone Number:

Billing Address:

Name:

Mobile Number:

Email:

Waste Type:

Description:

Source:

Load Size:

Frequency:

Total Quantity:

No Deliveries:

Packaging/Containment Method

Carrier Company:

Application Conditions:

1. Only the legal owner of the waste may apply to hold a permit
2. Each permit will only be valid for a maximum of twelve months
3. Two days notice of special waste disposal must be given
4. ABLime Ltd have the right to refuse waste at any stage

Declaration and Acceptance:

I declare that the above waste is accurately described and accept these terms and conditions.

Name: Date:

AB Lime Ltd Use Only:

Status: / ~~DECLINED~~

Decline Comments if applicable:

Waste Codes:

Pricing: ex GST

Standing Special Permit

Application Fee

Permit Expiry Date:

Delivery Date

Special Permit Application Continued.....

Special Waste Permit: Difficult/Discretionary Waste

Conditions of Permit

1. AB Lime Ltd reserve the right to refuse waste at any stage
2. This permit will only be valid for up to a maximum of twelve months
3. This permit shall be read together with the Special Waste Permit Application (above)
4. Only the special waste described in the application (as modified in the Disposal Conditions) of the specified quantity may be disposed under this permit
5. The specified waste can only be delivered to the landfill on the date specified and between the hours specified
6. The landfill operator will not accept the specified Special Waste where:
 - a. It does not conform to the description, quantity or codes
 - b. It is not delivered when specified on this permit
 - c. It is not delivered as specified by any Disposal Conditions
 - d. It is not suitably contained

Disposal Conditions

1. One days notice must be given prior to waste being delivered and only between the hours of 8.30am - 4.30pm, Monday to Saturday
2. All loads must be covered and delivery to landfill securely contained
3. Offensively odourous waste will not be accepted. Please take all steps to desodorise waste.
4. All Waste must be greater than 20% solid. Liquid waste is not accepted at the AB Lime Landfill.

Additional Conditions if applicable: N/A

Signed on behalf of AB Lime Ltd:

Fiona Smith

Date:

23-May-18

Applicant Acceptance

The Undersigned declares that:

- The waste which accompanies this permit is as described by this permit
- It will meet all costs associated with the disposal of this waste
- It accepts the above terms and conditions

Name

Date

Title

Special Waste Permit Application Difficult/Discretionary Waste



Approved
Applicant
Permit #:2295

Company:

Blue Sky Meats

Phone Number:

03 2313 421

Email:

christian@bluesky.co.nz

Billing Address:

729 Woodlands-Morton Mains Road

Name:

Christian Harvey

Mobile:

0276666876

Type:

Animal (ovine) wool on pelts

Description:

Raw animal wool on pelts

Source:

729 Woodlands-Morton Mains Road, Morton Mains, RD1, Invercargill

Total Quantity:

max 80,000 kg

Load Size:

10,000-20,000 kg

No. Deliveries:

up to 4

Frequency:

Weekly

Packaging / Containment Method:

Loose load

Select Company:

Freight Haulage

Application Conditions:

1. Only the legal owner of the waste may apply to hold a permit
2. Each permit will only be valid for a maximum of twelve months
3. Two days notice of special waste disposal must be given
4. AB Lime Ltd have the right to refuse waste at any stage

Declaration

I declare that the above waste is accurately described

Name:

Christian Harvey

Date (dd/mm/yyyy):

02/03/2020

Accept these terms and conditions

AB Lime Use Only**Status:**

CONFIRMED

Decline Comments:**Waste Code****L-Code:**

02 01 02

W-Code:

W14

D/R-Code:

D1

Standing Permit:

2251

Conditions of Permit:

1. AB Lime reserve the right to refuse waste at any stage
2. This permit will only be valid for up to a maximum of twelve months
3. This permit shall be read together with the Special Waste Permit Application
4. Only the special waste described in the application (as modified in the Special Disposal Conditions) of the specified quantity may be disposed under this permit
5. The specified waste can only be delivered to the landfill on the date specified and between the hours specified
6. The landfill operator will not accept the specified Special Waste where:
 - o It does not conform to the description, quantity or codes
 - o It is not delivered when specified on this permit
 - o It is not delivered as specified by any Special Disposal Conditions
 - o It is not suitably contained

Disposal Conditions

1. Two days notice must be given prior to waste being delivered and only between the hours of 10 am – 4 pm, Monday to Saturday
2. All loads must be covered and delivery to landfill securely contained.

Additional conditions:

REPLACES 2251

Expiry Date:

16/03/2021

Delivery Date:

16/03/2020

Signed on Behalf of AB Lime Ltd**Name:**

Fiona Smith

Date:

16/03/2020

WasteNet Council Use Only**Status:**

CONFIRMED

Decline Comments:**Cost per Tonne:**

\$238.75 excluding GST

Application Fee:

\$25.00 ex GST

Issue Date:

18/03/2020

Signed on behalf of WasteNet Southland**Name:**

Donna Peterson

Date:

18/03/2020

Applicant Acceptance**The Undersigned declares that:**

- The waste which accompanies this permit is as described by this permit
- It will meet all costs associated with disposal of this waste

Name:

Christian Harvey

Date (dd/mm/yyyy):

18/03/2020

Title:

Technical Compliance Manager

√ Confirmation of terms and conditions

Attachment 7. Bore Logs

Groundwater Monitoring Bore Specifications

Bore ID	Easting	Northing	TOC Elevation (mAMSL)	Ground Elevation (mAMSL)	Piezometer diameter (mm)	Bore Depth (mBGL)	Casing Depth (mBGL)
SKM104	2153261.85	5443788.63	187.68	187.42	50	67.7	55.7
SKM106	2153764.46	5443144.92	186.98	186.79	50	77.5	65.5
SKM108	2152768.01	5442563.30	66.31	66.19	50	20.5	14.5
SKM201	2152809.80	5442869.24	74.55	73.69	50	10.2	1.7
SKM202	2152840.95	5442773.92	75.01	74.33	50	10.1	1.6
SKM203	2153019.64	5442834.00	74.66	73.99	50	10	1.5
SKM204	2153092.44	5442858.04	77.01	76.28	50	10	1.5

Attachment 8. Sampling Protocols

The sampling procedures outlined below should be followed at all times. Any variations from the procedures and the reasons for the variation should be noted at the time of sampling. Reviews of the procedures will need to be made should further clarification of the sampling protocol be required or changes to equipment and subsequent methodology occur. Details of specific equipment purchased by the landfill operators will be added when added when information is available.

B.1 Sample Control

- The appropriate sample bottles for each sampling round should be ordered from the analytical laboratory. The laboratory should also be phoned if there is any change from the normal schedule to advise when the samples will be dropped off to them.
- Using labels provided by the laboratory label each bottle. Prepare a chain of custody form and fill out the field sheets with sample numbers and relevant details
- Do not open sample containers until immediately before the sample is to be taken, then fill as quickly as possible. Do not touch the inside of the lid or container with fingers or other objects. Reject a bottle if the lid has fallen off.
- A chilly bin or waterproof bad with “Slikka” pads must be used to keep the samples chilled.
- All equipment should be maintained and operated in accordance with the manufacturer’s specifications. Records of services and calibrations intervals should be kept.

B.2 Safety

- Treat all samples and sampling locations as toxic. Wear protective gloves at all time and change at each location. Try not to unduly splash or breathe waters. Be careful around all waterways.
- Follow AB Lime H&S procedures for all sampling activities

B.5 Groundwater

Pre-fieldwork procedures checklist	Equipment checklist	Field procedures
<ul style="list-style-type: none"> ▪ Review Sampling Procedures ▪ Organise equipment & documentation ▪ Check equipment is in good working condition (i.e. calibrated) & properly decontaminated 	<ul style="list-style-type: none"> ▪ Site map ▪ Keys for well locks ▪ Field recording sheets ▪ Chain of Custody form ▪ Camera/phone 	<ul style="list-style-type: none"> ▪ Sampling should be carried out from the least contaminated to the most contaminated site
		<p><u>Measure static water level</u></p> <ul style="list-style-type: none"> ▪ Measure the static water level before purging ▪ Read water level measurement to the nearest 0.01m from the top of casing ▪ Decontaminate the dipper using Deacon 90 between each well. Thoroughly rinse with distilled water.
	<p><u>Purging Equipment</u></p> <ul style="list-style-type: none"> ▪ Groundwater Dipper ▪ Air compressor ▪ Red and Blue hoses ▪ Micro purge 	<p><u>Purging (this is for bailing)</u></p> <ul style="list-style-type: none"> ▪ Calculate the volume of groundwater requires to remove 3 bore volumes (based on volume of

	<ul style="list-style-type: none"> ▪ Clear curly cord ▪ Black extension tubing ▪ Portable Sonde ▪ Calibrated bucket ▪ Calculator 	<p>standing water as measured above and bore dimensions)</p> <ul style="list-style-type: none"> ▪ Purge water from the borehole into the bucket. Using the portable sonde, record the DO, conductivity, pH, TDS, temperature. Note odour, colour & clarity of the water. ▪ Once the field parameters have stabilised or 3 bore volumes of water have been removed, the sample bottles can be filled.
	<p><u>Sampling Equipment</u></p> <ul style="list-style-type: none"> ▪ Sample Bottles ▪ Distilled water ▪ Residue free detergent (Deacon 90) ▪ Disposable Gloves ▪ Chilly bin ▪ Ice 	<p><u>Sampling</u></p> <ul style="list-style-type: none"> ▪ Fill sample bottles ▪ Store samples on ice ▪ Decontaminate all equipment with the Deacon 90 between sites. Rinse thoroughly with distilled water.

Attachment 9. ELCOSEAL Installation Guide



GEOFABRICS[®]
Smarter Infrastructure

ELCOSEAL[®]

**Geosynthetic Clay Liner
Installation Guide**

ABOUT ELCOSEAL

ELCOSEAL is a needle-punched Geosynthetic Clay Liner (or GCL) produced in Australia in accordance with the ISO 9001:2015 Quality Management System.

ELCOSEAL consists of premium grade sodium bentonite powder, which acts as the swelling and sealing component, embedded and sandwiched between two or more geotextiles. The composite is then needle-punched through all layers and thermally-locked developing high connection strength. Thus, ELCOSEAL is a shear strength transmitting GCL.

ELCOSEAL is generally fast and easy to install, however the performance of the GCL is dependent on the quality of its installation. It is the installer's responsibility to follow these guidelines and the

project specifications and drawings whenever possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation to ensure that the installation has been executed properly. Variance from this guideline is at the engineer's discretion.

Recommended further reading:

- ASTM D 5888 - *Standard Guide for Storage and Handling of GCLs*
- ASTM D 6102 - *Standard Guide for Installation of GCLs*
- ASTM D 5889 - *Standard Practice for Quality Control of GCLs*
- ASTM D 6072 - *Standard Guide for Obtaining Samples of GCLs*

BEFORE YOU BEGIN

Prior to delivery of ElcoSeal on-site ensure the project team has:

- Read these guidelines;
- Raise any questions not answered by these guidelines with Geofabrics;
- Read the ElcoSeal Safety Data Sheet and Bentonite Material Safety Datasheet (available on the Geofabrics website);
- All the required equipment to unload, store and install ElcoSeal on site;
- All the required PPE for safe handling and installation of ElcoSeal.

Personal Protective Equipment

The use of respiratory, eye, hand and body protection is recommended when handling ElcoSeal Geosynthetic Clay Liners. Please refer to the ElcoSeal Safety Data Sheet for more information prior to any commencement of work. ElcoSeal contains powdered sodium bentonite which contains quartz/cristobalite which is classified as hazardous according to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS).



A respirator with a removable dust mask should be used



Safety glasses with side shields should be worn



Wear gloves of impervious material



Wear suitable protective workwear. Overalls are recommended.



GHS Classified as hazardous

PACKAGING, TRANSPORTATION, UNLOADING & STORAGE

Packaging

ELCOSEAL rolls are packed in moisture tight plastic wrapping. The standard roll dimensions and weights are listed in Table 1 below.

Every ELCOSEAL roll has a unique roll number on the wrapping label and on the panel itself. This information allows for matching of manufacturing quality assurance (MQA) records.

! *After transportation and unloading the plastic wrapping should be checked. Minor damage should be repaired with weather-resistant adhesive tape. Wrapping should only be removed immediately before use.*

Table 1: ELCOSEAL Roll Dimensions & Freight Capacities

Grade	Width (m)	Length (m)	Diameter (m)	Roll Mass (kg)	Rolls per B Double	Rolls per 20ft Container	Rolls per 40ft Container
X800	4.7	45	~0.56	~1,035	20	15	22
X1000	4.7	35	~0.52	~915	23	15	24
X2000	4.7	30	~0.56	~890	23	15	25
X3000	4.7	30	~0.57	~940	23	16	23

Transportation

ELCOSEAL rolls are usually delivered to site in closed containers or covered trailers on flatbed trucks. At the point of unloading, the rolls need to be accessible either from the top of the trailer or the container opening. Please see the table above for average freight capacities for B Double and 20ft and 40ft containers.

Should any damage to rolls occur in transit it must be immediately brought to the attention of Geofabrics, who will advise on the required course of action.

Unloading

A flat, hard, dry and free draining surface must be provided for unloading and storage. Offloading on site will require heavy equipment: an excavator (tracked or wheeled); front-end loader; or a forklift. Heavy equipment must be correctly rated for the expected load (see Table 1 on the previous page). Rolls may be offloaded using:

- A** A Spreader Bar with steel tube insert through the core of the rolls. Refer to the *ELCOSEAL Spreader Bar Safe Usage Guideline* from the Geofabrics website for detailed information; **OR**
- B** A 'carpet prong', rated to 1,200 kg and matched to the forklift, protruding from the front end of the forklift (>4.5 tonne) or other equipment. The prong should be at least $\frac{3}{4}$ the length of the ELCOSEAL core and also must be capable of supporting the full weight of ELCOSEAL without significant bending; **OR**
- C** The two slings provided by the Geofabrics (upon request) wrapped around the ELCOSEAL roll at third ($\frac{1}{3}$) points along the roll, fixed to an excavator bucket or a front-end loader. Slings should not be used for general lifting and transportation around the site. If excessive deformation or bending of the roll occurs the integrity of the geocomposite may be affected. A steel tube or similar reinforcement can be inserted into the core of the roll to prevent excessive deformation across the roll during off-

Storage

ELCOSEAL rolls should be stored in their original, unopened packaging in a location away from construction traffic but sufficiently close to the active work area to minimise handling.

The designated storage area should be level, dry, well-drained, stable, and should protect the product from:

- Precipitation;
- Chemicals;
- Standing water;
- Excessive heat;
- Ultraviolet radiation;
- Vandalism and animals.

ELCOSEAL rolls should always be stored lying flat, continuously supported, and should never be stored standing on one end. Enclosed indoor storage such as shipping containers or a warehouse environment is preferred if ELCOSEAL® is to be stored for long periods.

The maximum storage height is four rolls.

- !** *ELCOSEAL rolls should not be exposed to moisture prior to installation. Damaged wrappers should immediately be repaired with weather resistant tape. Wrapping should only be removed from ELCOSEAL rolls immediately prior to installation.*

INSTALLATION

What You'll Need On Site

Prior to commencement of installation the following equipment will be required:

- Excavator (tracked or wheeled) or a front-end loader. Equipment should be rated for the expected load. Please see Table 1 on page 2 of this document for roll masses;
- Spreader bar/loading frame;
- HP Paste;
- Trowel;
- Carpet knife or safety knife;
- Felt pens or chalk;
- Measuring tape;
- Broom;
- PPE including dust mask, goggles, gloves and protective workwear.

Weather Conditions for Installation

Light rainfall (defined as <5mm/hour intensity) should not affect the installation of ELCOSEAL provided deployed panels are covered and confined by 300 mm of cover soil (or equivalent) within 2 hours of first exposure to the light rain. Heavy direct raindrop impact should be avoided. The ELCOSEAL panels can be covered during heavy rainfall events with a tarpaulin or plastic sheet if there is not enough time to complete soil cover placement.

Avoid placing ELCOSEAL in areas where water is ponding unless panels can be confined immediately (with 300 mm cover soil or equivalent).



ELCOSEAL rolls should not be exposed to moisture prior to installation. During installation ELCOSEAL panels should be covered with a tarpaulin or plastic sheet during heavy rain events.

Subgrade Preparation

The preparation of the subgrade before placement of any lining material is critical to the system's performance. The surface(s) upon which ELCOSEAL is to be laid should be suitable for the intended application and function.

ELCOSEAL will generally be placed on either an earthen e.g. compacted clay, or geosynthetic e.g. geotextile or geocomposite) subgrade.

Earthen Subgrades

The surface upon which ELCOSEAL® will be deployed should conform to the following:

- The subgrade should be firm and unyielding (typically compacted to >90% density), without abrupt elevation changes, and be proof rolled with a smooth drum roller immediately prior to deployment of the ELCOSEAL panels. The subgrade should not be disturbed or rutted by the equipment deploying the rolls or other traffic. No foreign matter or stones loose on the surface or penetrating out of the subgrade >10 mm should be allowed. The engineer's approval of the subgrade needs to be obtained immediately prior to roll deployment;
- In applications where ELCOSEAL is the sole or primary barrier, and will be subjected to constant or long-term hydraulic heads exceeding 300 mm (1 ft), subgrade surfaces consisting of gravel or granular soils may not be appropriate due to their large void contents and puncture potential. In these applications, the top 150 mm of the subgrade should possess a particle size distribution where at least 80% of the soil is finer than 0.25 mm (or #60 sieve) - unless the ELCOSEAL grades X2000 or X3000 are being used (see below);
- For X2000 and X3000 grades (with a composite woven/nonwoven carrier geotextile) in high hydraulic head applications:

Subgrade materials recommended without further investigation are:

- » Clays or clay-based mixes;
- » Sandy clays (with > 20% fines);
- » Silty or loamy clays (with > 20% fines)
[fine grained soils should be placed at suitable moisture contents for construction operations and roll deployment - that provide adequate bearing capacity to deploy the rolls without disturbance of the subgrade - i.e no rutting or large deflections];
- » Well graded sands and gravels (max < 32 mm, d60 < 5 mm, d20 < 0.15 mm).
[these materials should bind and have good bearing capacity when compacted/rolled].

Subgrade materials not recommended without further investigation:

- » Single-sized and gap-graded sands and gravels of any size or description;
- » Sands or soils that have low bearing capacity at the moisture contents during the construction/deployment operations i.e. materials that do not bind when rolled; will heave/shove under equipment or foot traffic during or after deployment);
- » Subgrades that have a bony or porous appearance after compaction and rolling.

Geosynthetic Subgrades

When deploying ELCOSEAL over a geosynthetic material such as a geomembrane or geotextile, the surface should be firm and unyielding as per the requirements for earthen subgrades. The equipment used to deploy ELCOSEAL should be approved for use by the Design Engineer and/or the Supplier of the underlying geosynthetic material. Generally, the underlying geosynthetic and ELCOSEAL® rolls will be deployed consecutively such that each layer is side-cast from equipment tracking over the earthen subgrade - unless specialised light rubber tyred dispensers are available and approved by the Design Engineer that allow direct trafficking over the geosynthetics.

GCL Placement

The ELCOSEAL roll wrapping should only be removed immediately prior to installation. On site, ELCOSEAL is unrolled along the prepared subgrade using the Spreader Bar assembly as shown in Figures 1 and 2 (overleaf).



ELCOSEAL should only be trafficked by light, low tyre pressure vehicles (no tracked vehicles).

Rolls must be laid without folds on the subgrade with a standard overlap of 300 mm in both the longitudinal and transverse direction as detailed in Figures 3, 4 and 5. For longitudinal or edge overlaps, the blue coloured line on the underside of the panels can be used to ensure the correct overlap width. The edge of deployed or previously placed panels needs to coincide or match with the visible blue line on the roll being deployed.

The transverse or end overlaps need to be sealed using bentonite paste. The treatment of end (transverse) overlaps is detailed in Figures 6 and 7.

Rolls can be cut to length with a carpet/Stanley knife. When overlapping cut panels, bentonite paste will need to be applied as per the requirements for end (transverse) overlaps on the following page under *ELCOSEAL Panel Overlaps*.

No trafficking or walking should occur over the overlap region during installation. The overlap must also be free from folds and foreign matter e.g. soil. Any soil particles on the laps must be swept away carefully.

Overlaps should occur in the direction of ground slope in a similar manner to roof tiles.

Damage to ELCOSEAL During Installation

Where ELCOSEAL has been damaged during installation, covering with an overlapping piece of ELCOSEAL can repair such areas. The overlap should be at least 500 mm and should be completed in accordance with the ELCOSEAL Panel Overlaps section.

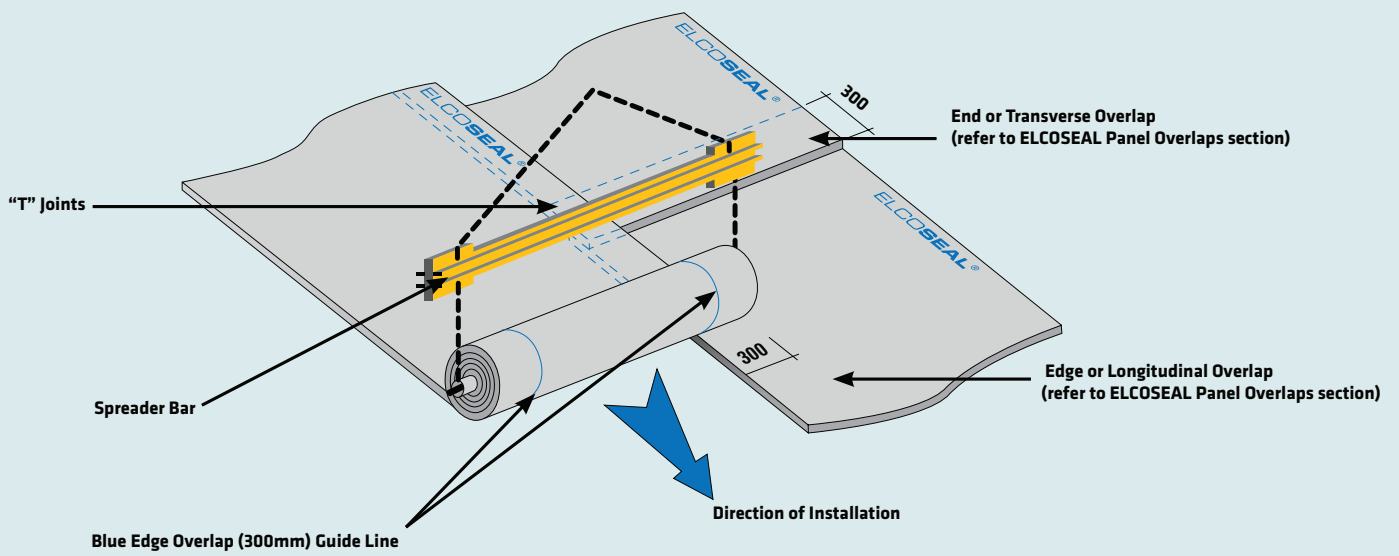


Figure 1 ELCOSEAL deployment using the standard ELCOSEAL Spreader Bar

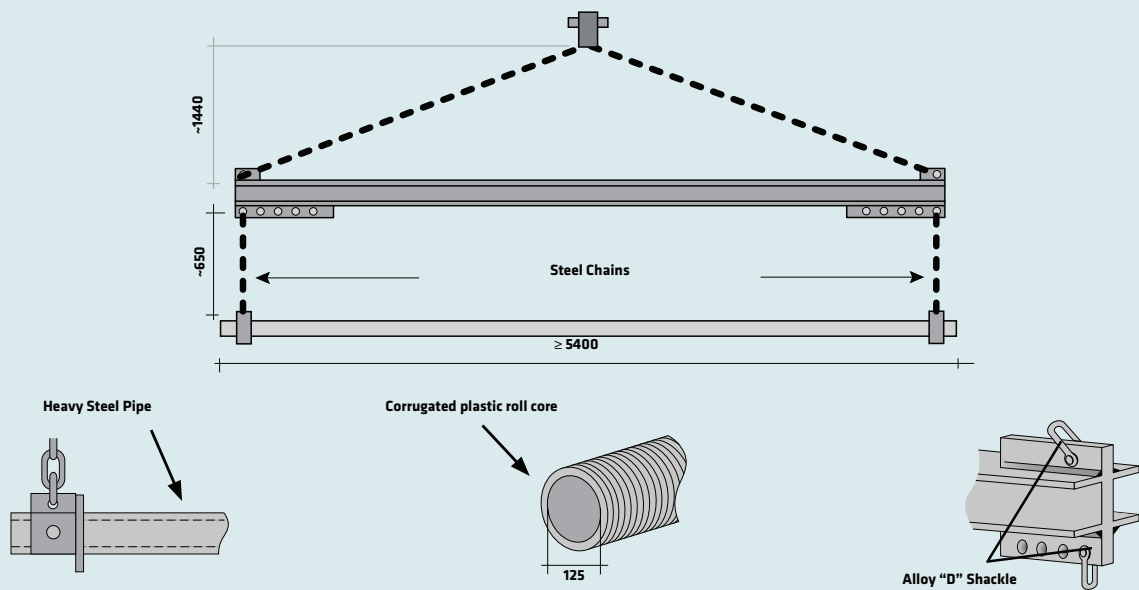


Figure 2 ELCOSEAL typical Spreader Bar assembly

! Refer to the ELCOSEAL Spreader Bar Safe Use Guide prior to using the lifting equipment and ensure that occupational health and safety requirements have been met and potential hazards eliminated.

ELCOSEAL Panel Overlaps

Logitudinal Overlaps

The longitudinal overlap is where GCL rolls overlap along their length. The installation of a longitudinal overlap can be seen in Figure 1. The width of this overlap shall be a minimum of 300 mm which is indicated by a blue marker line printed on the bottom of the roll. The overlapping area has bentonite powder impregnated into the top nonwoven fibres of the GCL as seen in Figure 3 for grades X800 and X1000 and in Figure 4 for grades X2000 and X3000. When hydrated, the impregnated bentonite will swell into the fibre porespace to provide a sealed hydraulic barrier. An installed cross section can be seen in Figure 5.

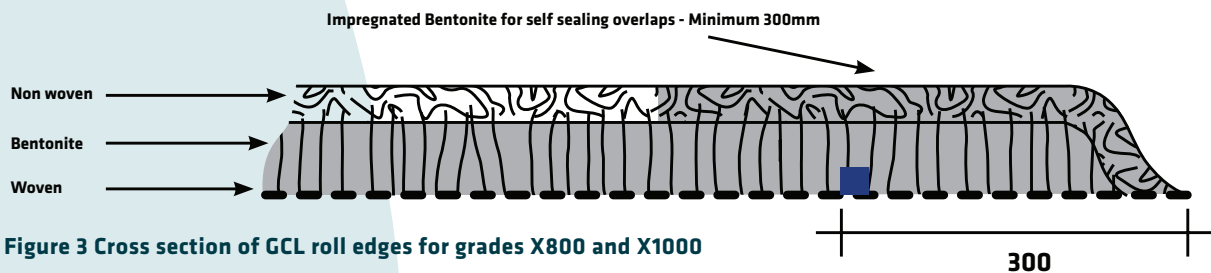


Figure 3 Cross section of GCL roll edges for grades X800 and X1000

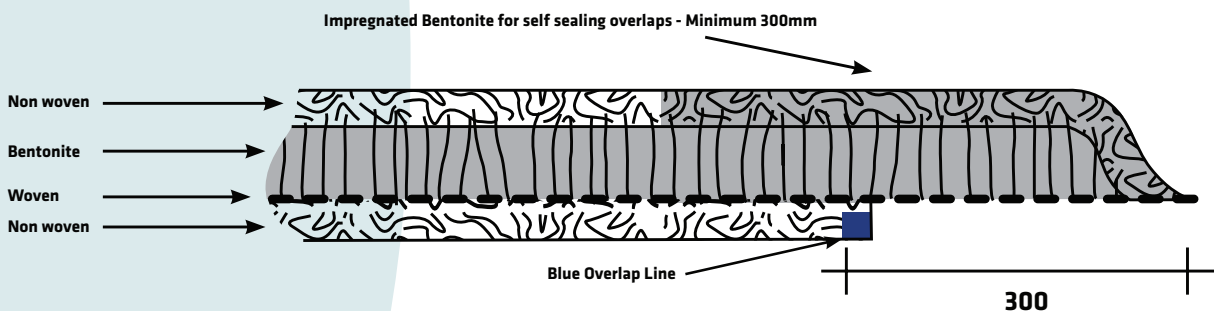


Figure 4 Cross section of GCL roll edges for grades X2000 and X3000

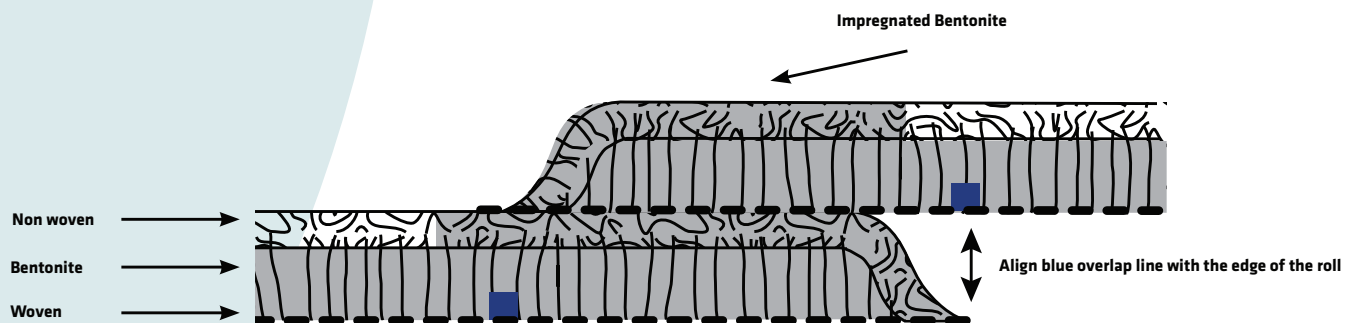


Figure 5 Longitudinal (or edge) overlap with self-sealing impregnated bentonite (X1000 shown)

Transverse Overlaps

Transverse overlaps occur at the end of rolls. The width of the GCL transverse overlap shall be a minimum of 300 mm. It is recommended that the topside of the underlying ELCOSEAL panel be marked as per Figure 6, as a reference point for paste placement. The top ELCOSEAL panel is then pulled back after marking.

All transverse/roll end overlaps should be sealed with bentonite paste. Geofabrics supplies HP paste which is an extensively tested sealing solution available in 20 L containers. As indicated in Figure 6, HP paste should be placed within the 300 mm overlap with a minimum width of 200 mm and a nominal thickness of 10 mm. The paste can be easily poured from the 20 L container and spread into place using a trowel or broom. Approximately 10L or ½ of a container is used for each roll width at the transverse overlap. Once the paste is applied, the top panel is then rolled back into place and pressed down (Figure 6). Care should be taken to prevent folds or creases. The end overlap cross section for X1000 is shown in Figure 7. If an alternative method of end of roll overlap sealing is required, please consult your local Geofabrics office.

To ensure the integrity of the ELCOSEAL® lining system it is essential that the treatment of end overlaps be carefully supervised. End overlaps in sumps or inverts are to be avoided.

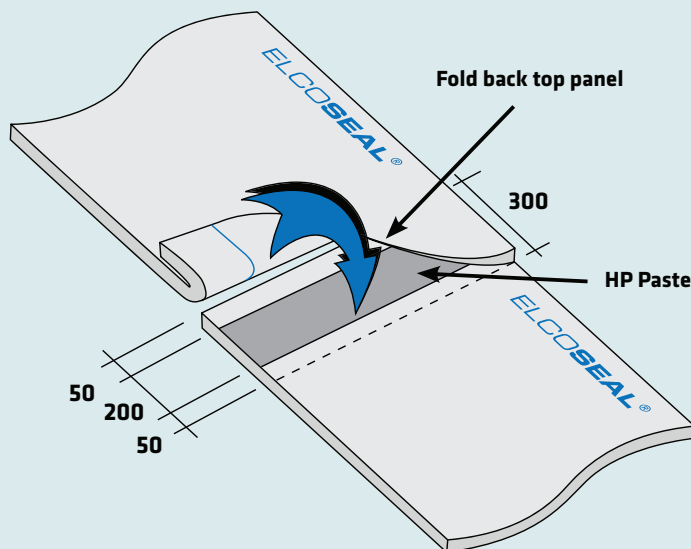


Figure 6 Transverse (end) overlap installation with applied HP Paste of minimum 200 mm width

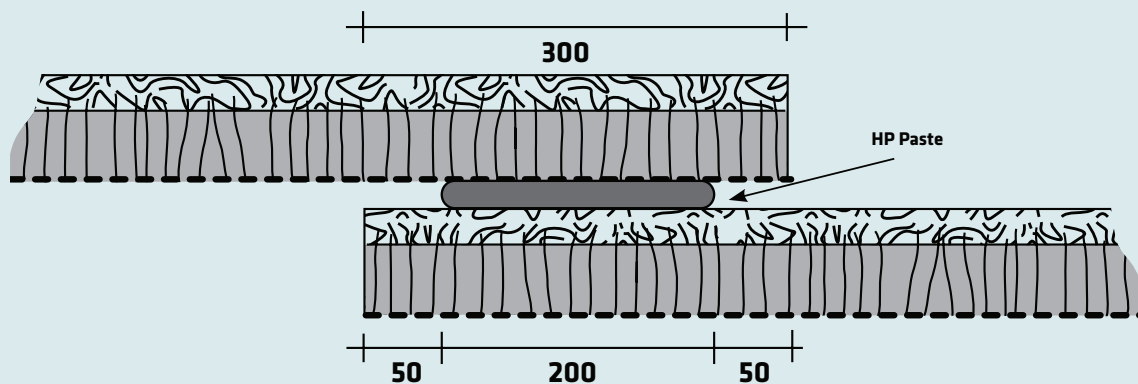


Figure 7 Transverse (end) overlap cross section (X1000 shown)

Installation on Slopes

The stability of lining system components on slopes should be assessed on a case-by-case basis. Geofabrics can assist in this respect upon request.

ELCOSEAL panels should be deployed in the direction of the slope as per Figure 8 and anchored at the crest of the slope (Figure 9). End (or transverse) overlaps on steep slopes should be avoided. If overlaps on slopes are unavoidable, please consult your local Geofabrics branch for information on custom extra-long GCL rolls.

Cover soil should be placed up the slope (starting at the toe). It must not be placed down the slope unless stability for this approach has been carefully investigated.

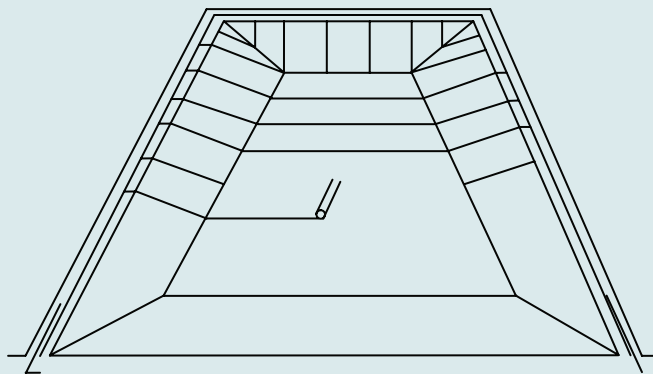


Figure 8 Recommended panel layout for sloping sites

Anchor Trenches

Anchor trench and slope stability considerations should be assessed by the Design Engineer.

As a general guide:

- An anchor trench should be used at the top of slopes steeper than 7H: 1V. (see Figure 9 for a typical anchor trench detail);
- The anchor trench should be constructed free of sharp edges or corners and maintained in a dry condition. The ELCOSEAL panels should be placed down the front face and along the base of the anchor trench. The base of the anchor trench should not contain large gravel or loose material and the trench backfill material should be compacted.

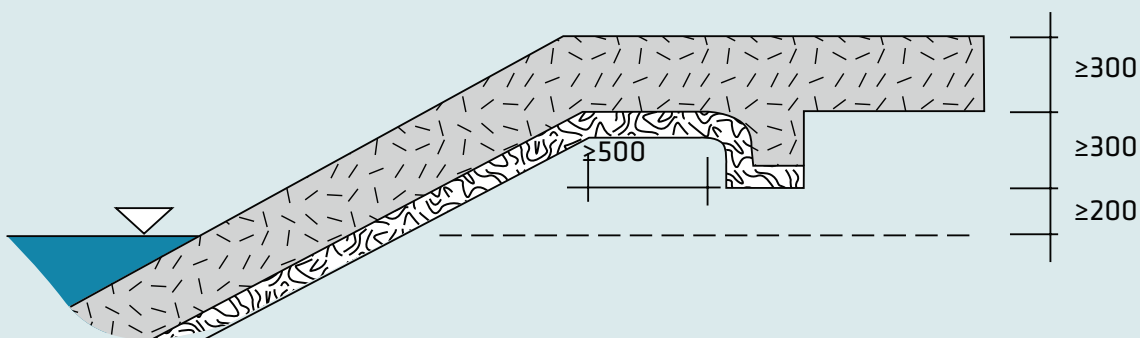


Figure 9 Typical anchor trench (all dimensions shown are typical values only)

Connections & Penetrations

Overlaps around connections, penetrations, and where panels have been cut should be carried out according to the principles outlined in Figures 5, 6 and 7. Most situations require site specific design input, however some commonly used details are shown below:

- Integration with thick compacted clay liners is shown in Figure 10;
- Cut-off trenches using ELCOSEAL GCL in cohesive soil are typically constructed as shown in Figure 11;
- Attachment and sealing against concrete structures, can be achieved according to Figures 12a and 12b. These typical connections are appropriate where the structure needs to be waterproofed to a height above and below the maximum containment level. Temporary fixing of the vertical ELCOSEAL panel to the structure (as shown) is required to allow the backfill placement;
- Penetrations such as pipe ducts are typically carried out according to Figure 13;
- Further connection methods and penetrations details can be discussed with Geofabrics.

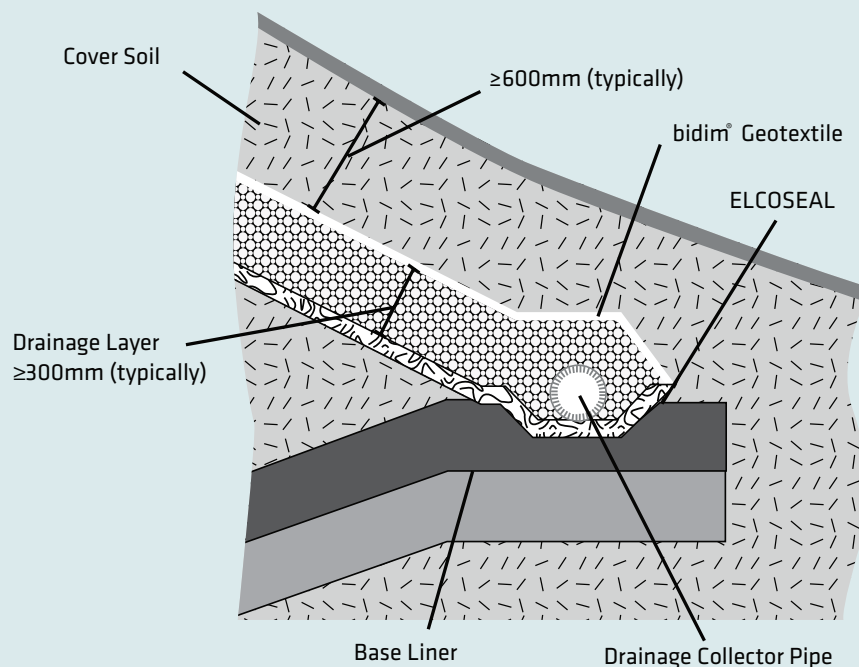


Figure 10 ELCOSEAL cap connection with base liner

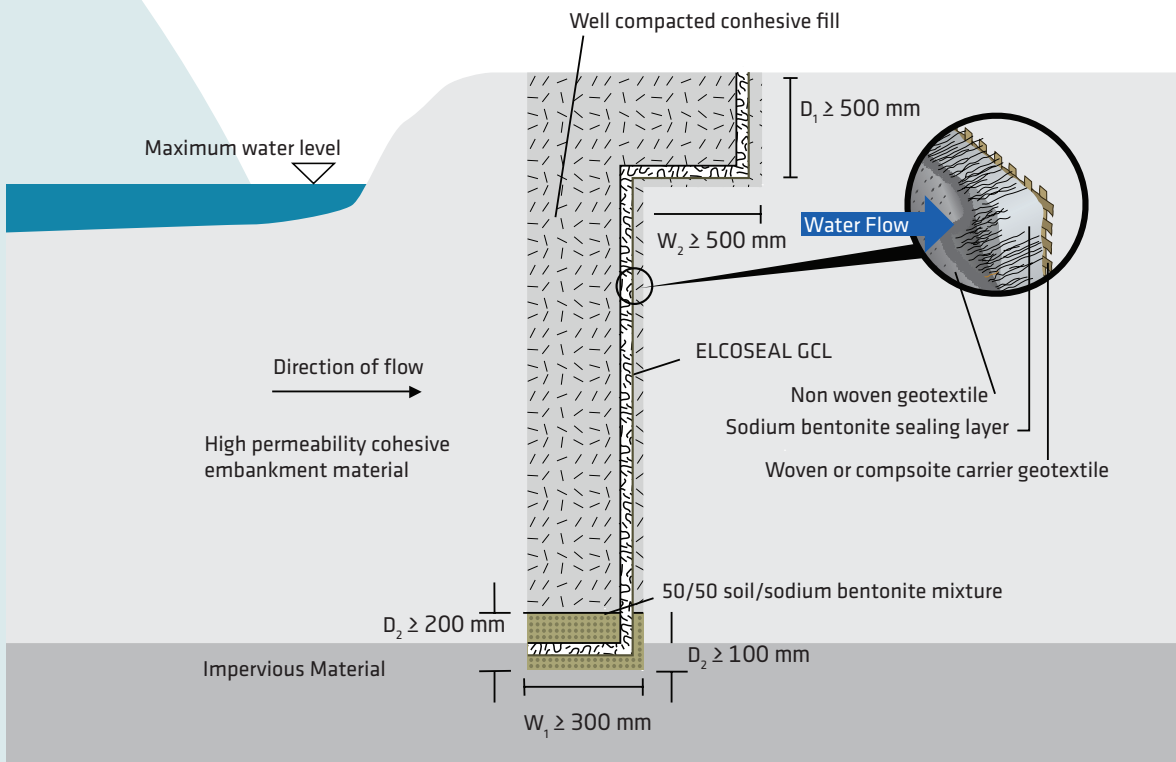


Figure 11 ELCOSEAL cut off trench detail for cohesive soils

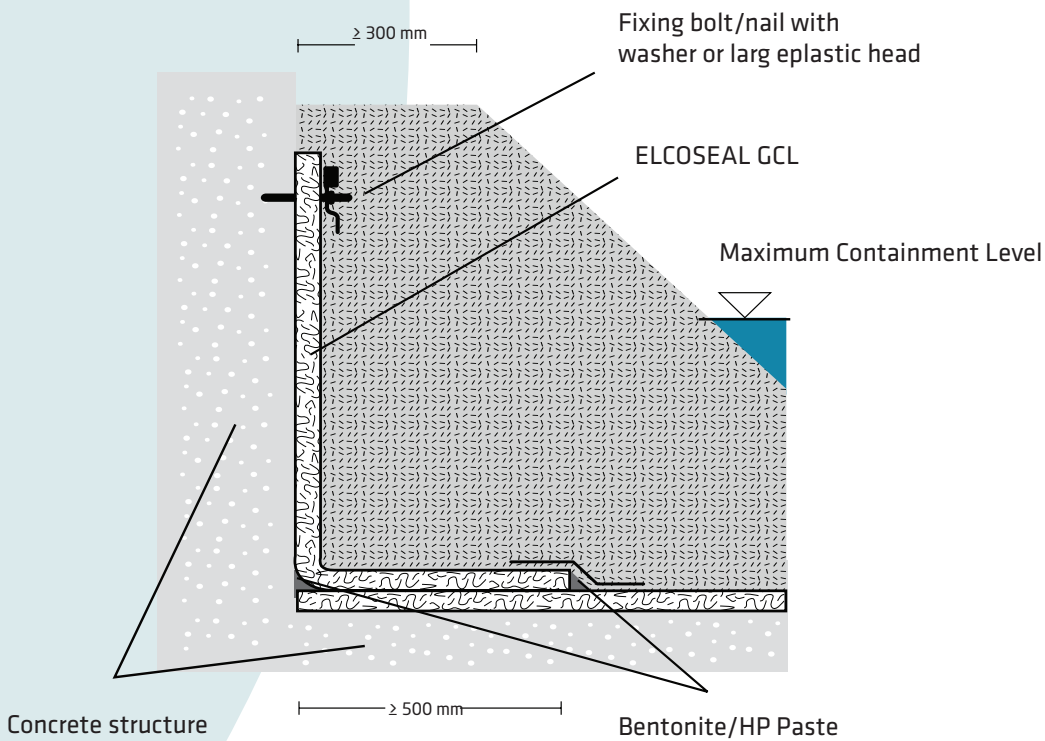


Figure 12a Typical connection to a concrete structure where the ELCOSEAL panel is required to extend above the maximum containment level

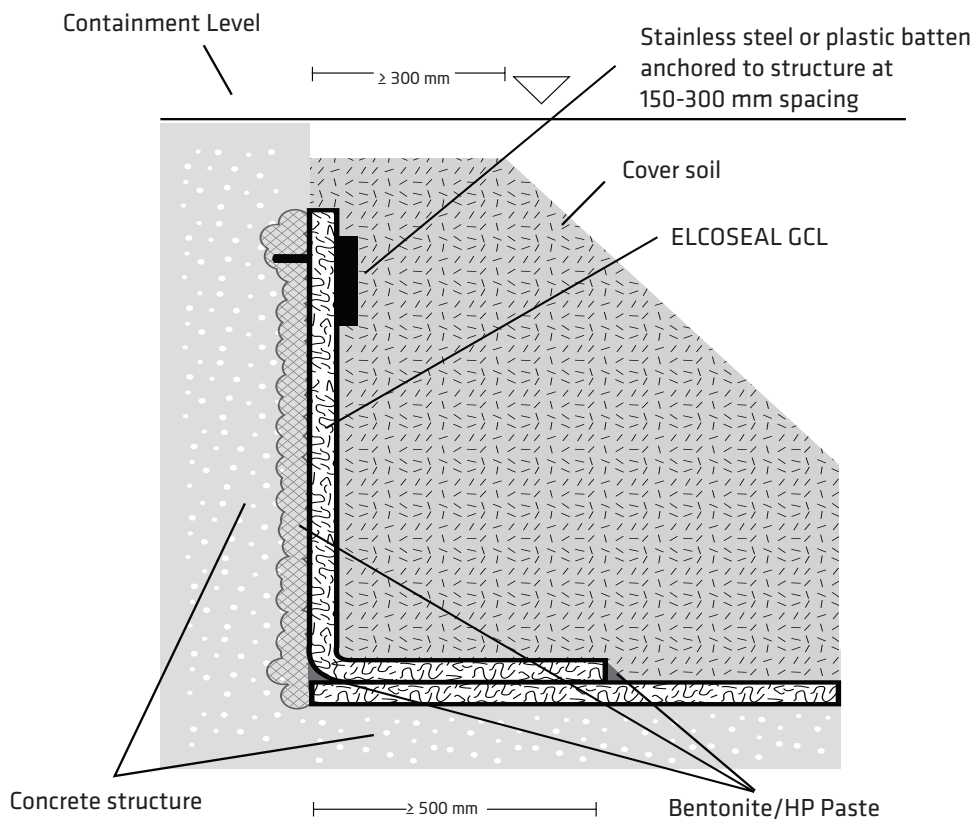


Figure 12b Typical connection to a concrete structure where the ELCOSEAL panel if required to extend below the maximum containment level

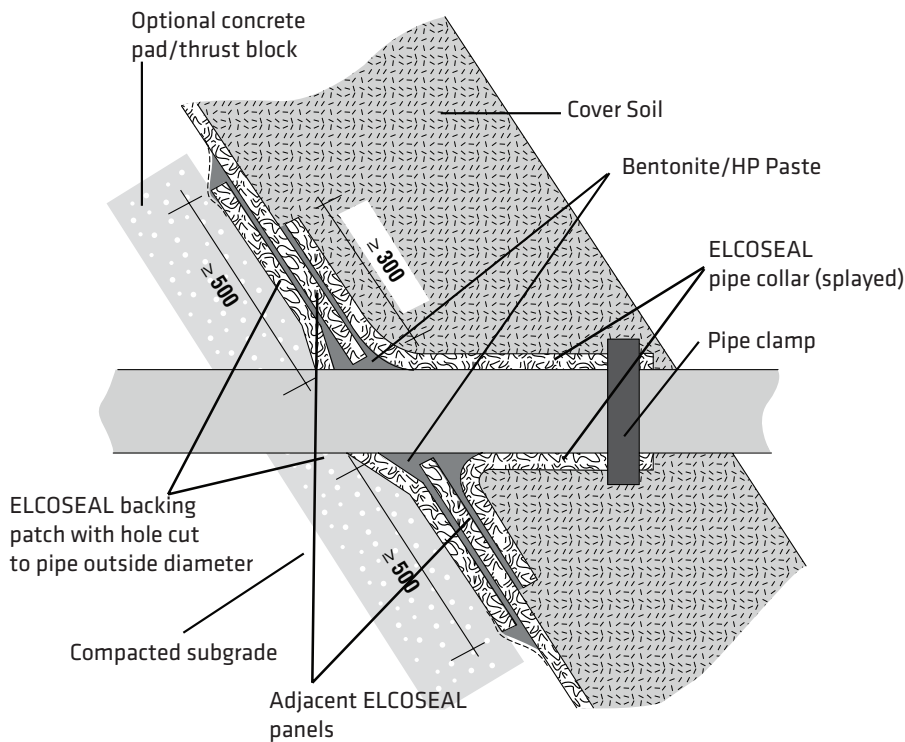


Figure 13 Typical pipe penetration detail

Preparation for Placing Soil Cover

Where the ELCOSEAL is not confined by the cover soil the same working day as deployment, a temporary layer of plastic should be laid to protect ELCOSEAL from prematurely hydrating (Figure 14).

If the deployed ELCOSEAL panels have hydrated (for example during a rainfall event) without confinement, special operating conditions may need to be imposed during cover soil placement. For example:

- If ELCOSEAL m.c.¹ <50% No special considerations;
- If ELCOSEAL 50% <m.c. <100% Avoid direct traffic (including foot traffic) on panels;
- If ELCOSEAL m.c. >100% Contact Geofabrics for advice.

1. m.c. = moisture content of the bentonite, % by weight

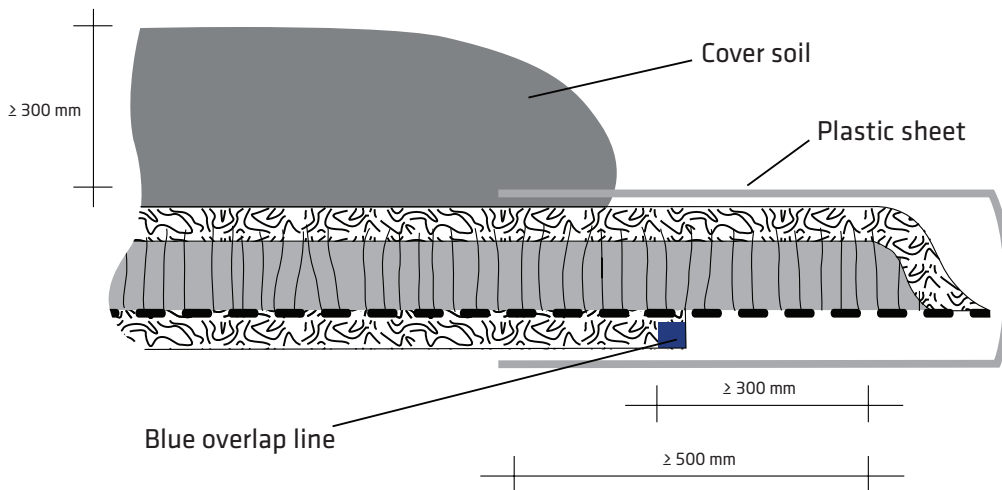


Figure 14 Covering ELCOSEAL with plastic sheet overnight or during wet weather

Soil Cover Placement

A cover soil layer of at least 300 mm thick (approx. 6 kN/m² confining stress) should be placed and compacted over ELCOSEAL each working day immediately after the deployed panels have been inspected. In general, fine-grained cohesive material is recommended, although stones up to 32 mm are acceptable if the material is well graded ($C_u > 5$) or stones up to 16 mm if single sized. Silty soils or organic material are not recommended without further stability analysis. Calcareous or limestone based cover soils should be evaluated prior to use.

Disturbance of the overlap area during placement (by means of vehicles spreading cover soil) must be avoided. It may be necessary to place the cover soil in this area manually or carefully using vertical placement by an excavator. The cover should not be pushed or graded in a direction that may cause the overlap to move (Figure 15).

ELCOSEAL may not be trafficked directly. The cover material should be pushed in front of the construction equipment thus creating a safe working platform. Overlaps should not be moved or squeezed during this process. In the case of an expected repeated dynamic load on ELCOSEAL, a sand layer of at least 300 mm should be laid first on the ELCOSEAL.

Generally, temporary access roads should not go over deployed panels. These areas should be sealed last to minimise traffic volume over deployed material. Where site traffic cannot be avoided e.g. the delivery of cover material by lorries) additional protection measures will be required. For temporary roads, a minimum roadbase thickness over ELCOSEAL of 600 mm is acceptable without any further analysis. Shallower coverage or alternative cover materials may be allowed after further analysis or field trials to assess the damage potential.

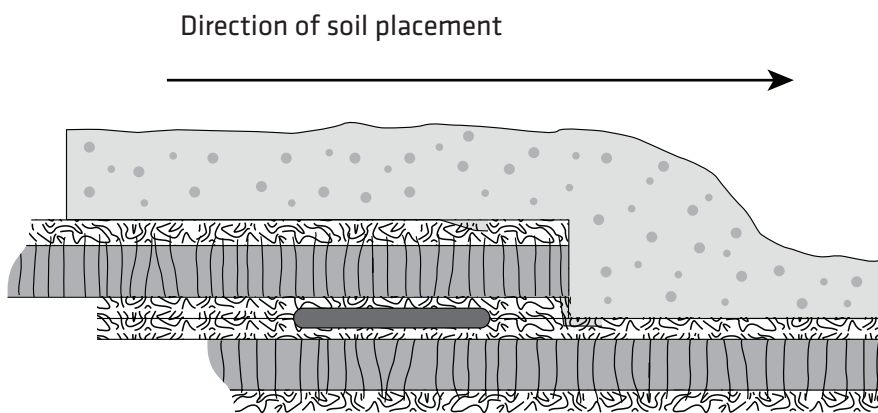


Figure 15 Cover soil placement

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Attachment 10. Phased Filling of Area 15

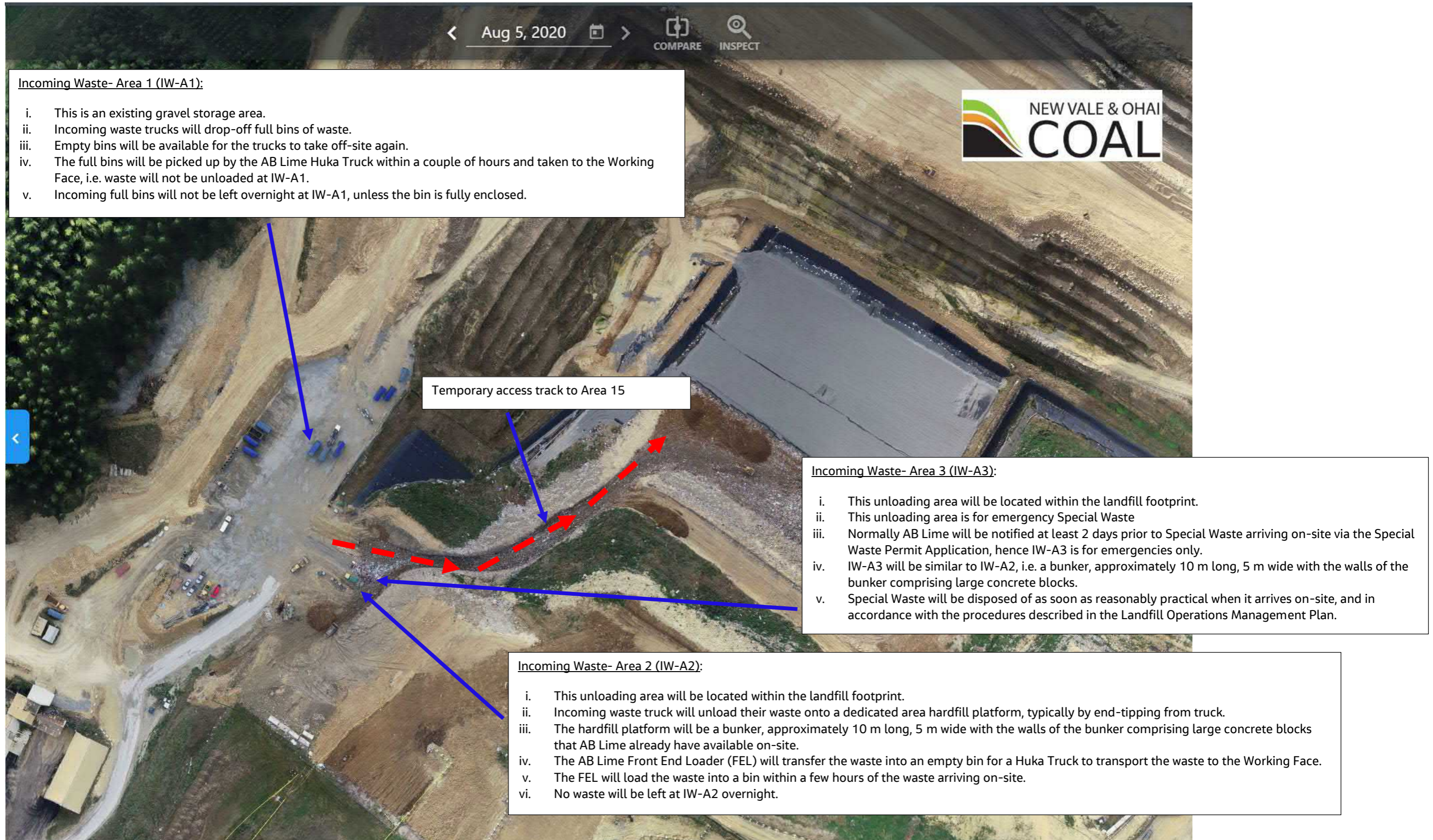


Figure 1: Incoming Waste and Access Track Temporary Locations



Phase 1 Filling
Volume Airspace = 25,000 m³
Phase 1 consists of 19 cells
Filling sequence: 1, 2, 3 and 4 as follows (see concept cross sections):
1: Cell 15-1A to 15-1E
2: Cell 15-1F to 15-1J
3: Cell 15-1K to 15-1O
4: Cell 15-1P to 15-1S
AR= Temporary access road to Working Faces of Phase 1

Figure 2: Phase 1 – Concept Filling Plan for Area 15



Phase 2 Filling

Volume Airspace = 70,000 m³

Phase 2 consists of 27 cells

Filling sequence: 1, 2, 3, 4, 5, 6 as follows (see concept cross sections):

- 1: Cell 15-2A to 15-2E
- 2: Cell 15-2F to 15-2J
- 3: Cell 15-2K to 15-2O
- 4: Cell 15-2P to 15-2S
- 5: Cell 15-2T to 15-2W
- 6: Cell 15-2X to 15-2AA

AR= Temporary access road to Working Faces of Phase 2

Figure 3: Phase 2 – Concept Filling Plan for Area 15



Phase 3 Filling

Volume Airspace = 88,000 m³

Phase 3 consists of 27 cells

Filling sequence: 1, 2, 3, 4, 5, 6 as follows (see concept cross sections):

- 1: Cell 15-3A to 15-3E
- 2: Cell 15-3F to 15-3J
- 3: Cell 15-3K to 15-3O
- 4: Cell 15-23 to 15-3S
- 5: Cell 15-3T to 15-3W
- 6: Cell 15-3X to 15-3AA

AR= Temporary access road to Working Faces of Phase 3

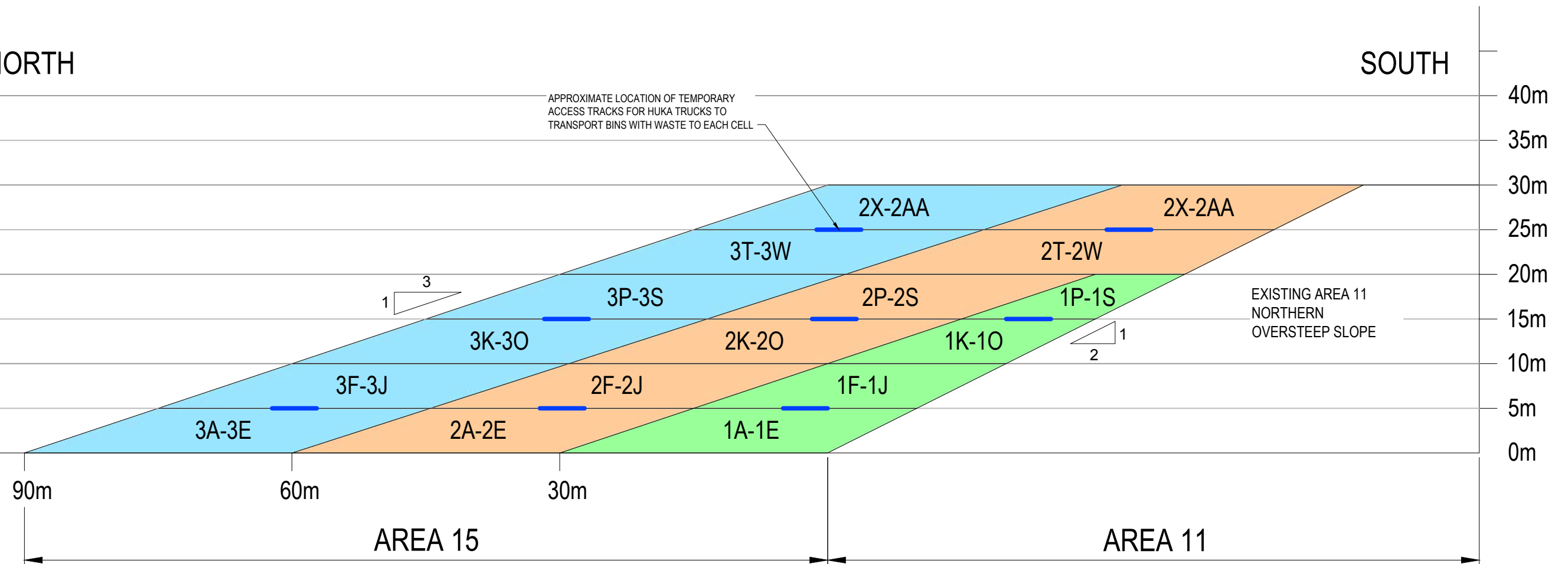
Figure 4: Phase 3 – Concept Filling Plan for Area 15

NOTE

- NOTE: 1A-1E = CELLS 15-1A + 15-1B + 15-1C + 15-1D + 15-1E, SEE ALSO CROSS SECTIONS EAST-WEST FOR PHASES 1-3

NORTH

SOUTH



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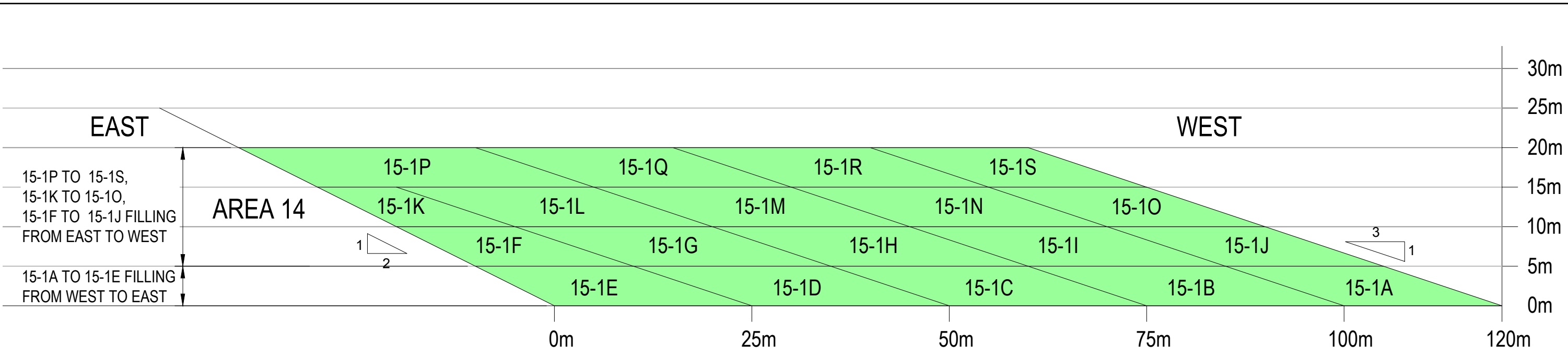
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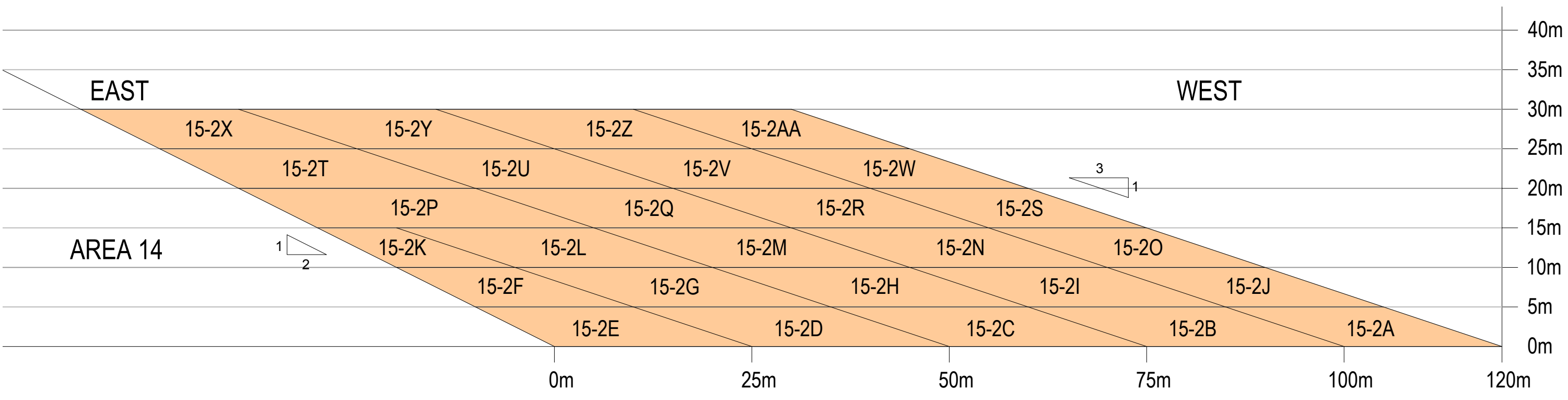
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DESIGNED KJ	DESIGN REVIEW CW	DATE 02/09/2020	DATE 01/09/2020

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PHASE 1 FILLING - AREA15



PHASE 2 FILLING - AREA15

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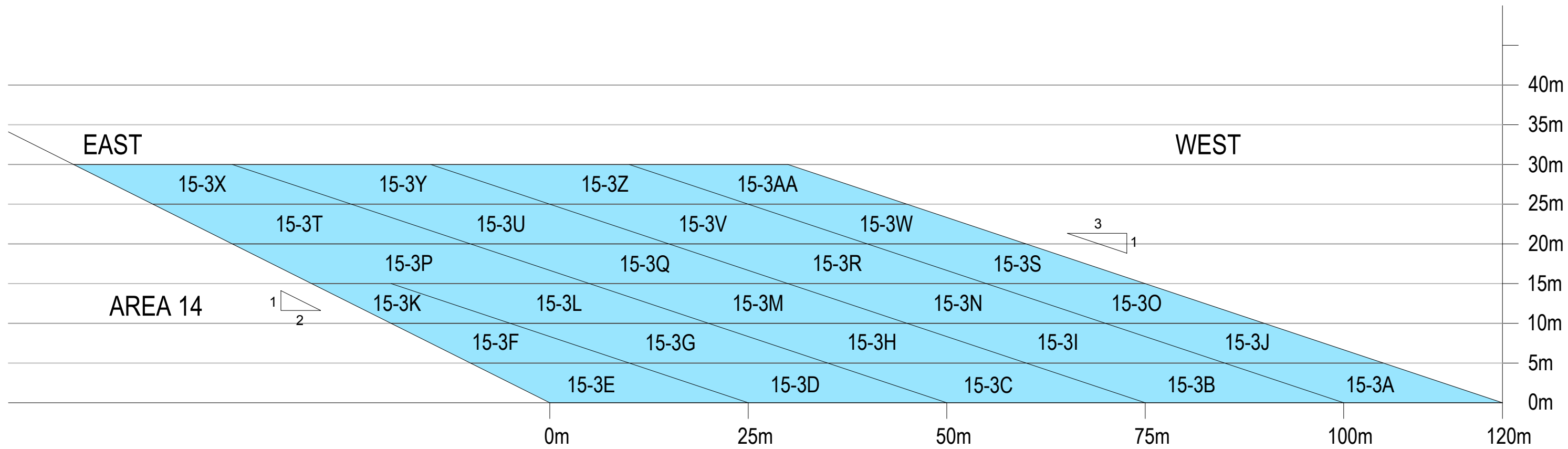
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PHASE 3 FILLING - AREA15

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