Douglas Partners

Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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bsi. ISO 9001 Quality Management
FS 604853 □

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Table of Contents

Page

Report on Shaft Condition Assessment
Donnybrook Shaft Remediation
Goodwood Road, Upper Capel

1. Introduction

an area known as "*First Mate Lease*" except one feature, known as "*Dog Shaft*", that is outside this

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-

2. Field Work Methods

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

3. Field Work Results

[illegible]

Table 1: Descriptions of the Mine Feature

Feature	Description
6	
6	
6	
7	

Feature	Comments
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

Table 2: Gas Meter Reading Summary

Feature	Lower Explosives Limit (%)	Oxygen (%)	Carbon Monoxide (%)	Hydrogen Sulphide (%)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		

[illegible]

Feature	Lower Explosives Limit (%)	Oxygen (%)	Carbon Monoxide (%)	Hydrogen Sulphide (%)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		

[illegible]

[illegible]

[illegible]

Table 3: Feature Volumes

Feature	Volume (m3)
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]

Table 4: Summarised Results of the Field Work

Feature	Approximate Maximum Dimensions [1] (LxWxD) (m)	Volume (m^3) [5]	Lateral Workings Detected?	Estimated Dimensions of Lateral Working		Depth of Lateral Working Below Ground Surface (m)[4]	Bearing of the Lateral Working	Comment	Harmful Gas Detected?	Fauna Detected?
				Height (m)	Width (m)					

Feature	Approximate Maximum Dimensions [1] (LxWxD) (m)	Volume (m^3) [5]	Lateral Workings Detected?	Estimated Dimensions of Lateral Working		Depth of Lateral Working Below Ground Surface (m)[4]	Bearing of the Lateral Working	Comment	Harmful Gas Detected?	Fauna Detected?
				Height (m)	Width (m)					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]

4. Discussion

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

5. References

Geotechnical Site Investigations.

for Australia". *Journal and News of the Australian Geomechanics Society*

6. Limitations

in accordance with DP's proposal dated 14 February 2022 and acceptance received from Ben

processes and also as a result of human influences. Such changes may occur after DP's field testing

DP's advice is based

provided, detailed ‘safety in design’ assessment is outside the current scope of this report and requires

Appendix A

About this Report

Introduction

[illegible]

Copyright

[illegible]

Borehole and Test Pit Logs

[illegible]

Groundwater

[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

Reports

[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

About this Report

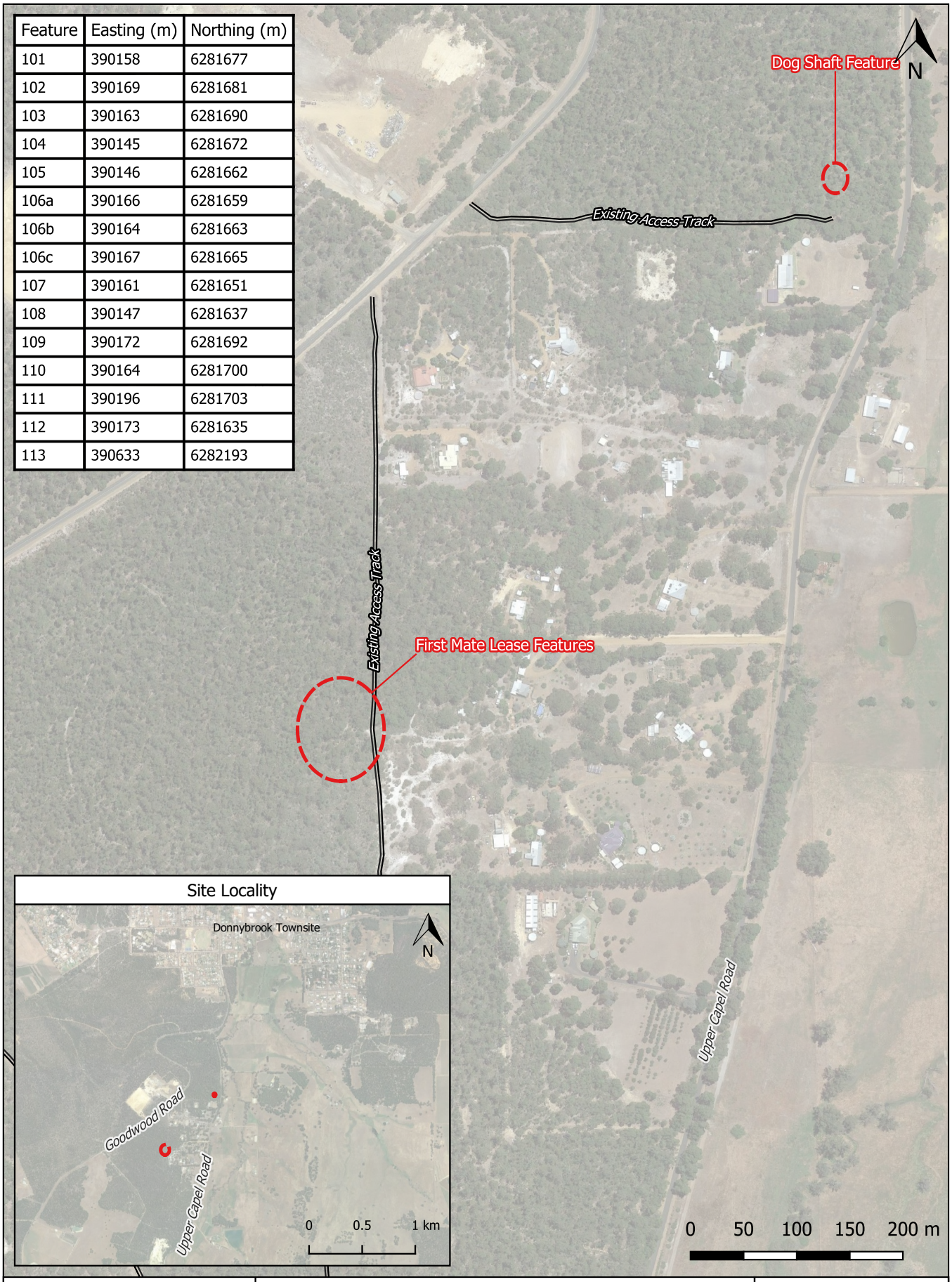
Site Anomalies

Information for Contractual Purposes

Site Inspection

Appendix B

Feature	Easting (m)	Northing (m)
101	390158	6281677
102	390169	6281681
103	390163	6281690
104	390145	6281672
105	390146	6281662
106a	390166	6281659
106b	390164	6281663
106c	390167	6281665
107	390161	6281651
108	390147	6281637
109	390172	6281692
110	390164	6281700
111	390196	6281703
112	390173	6281635
113	390633	6282193



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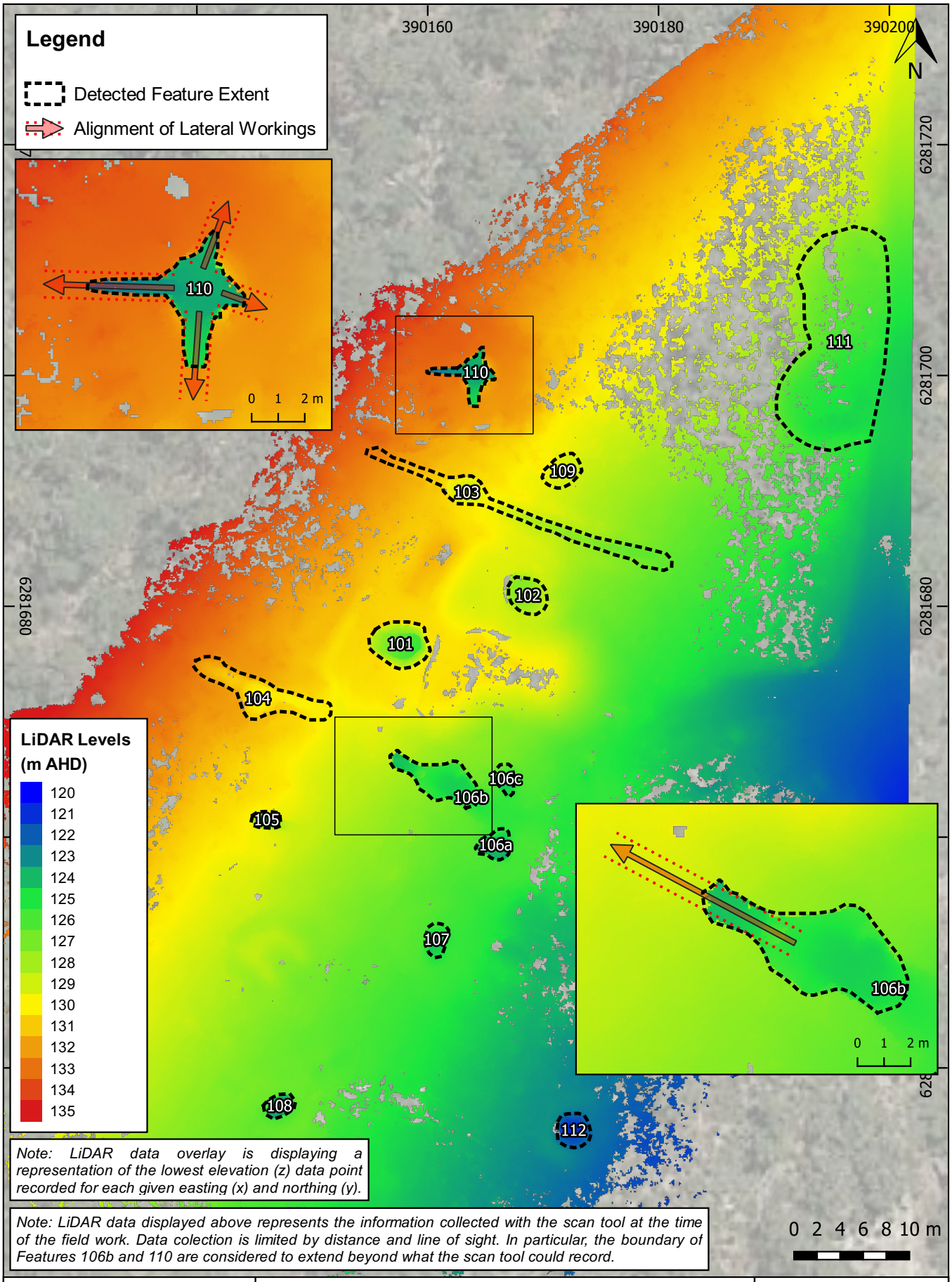
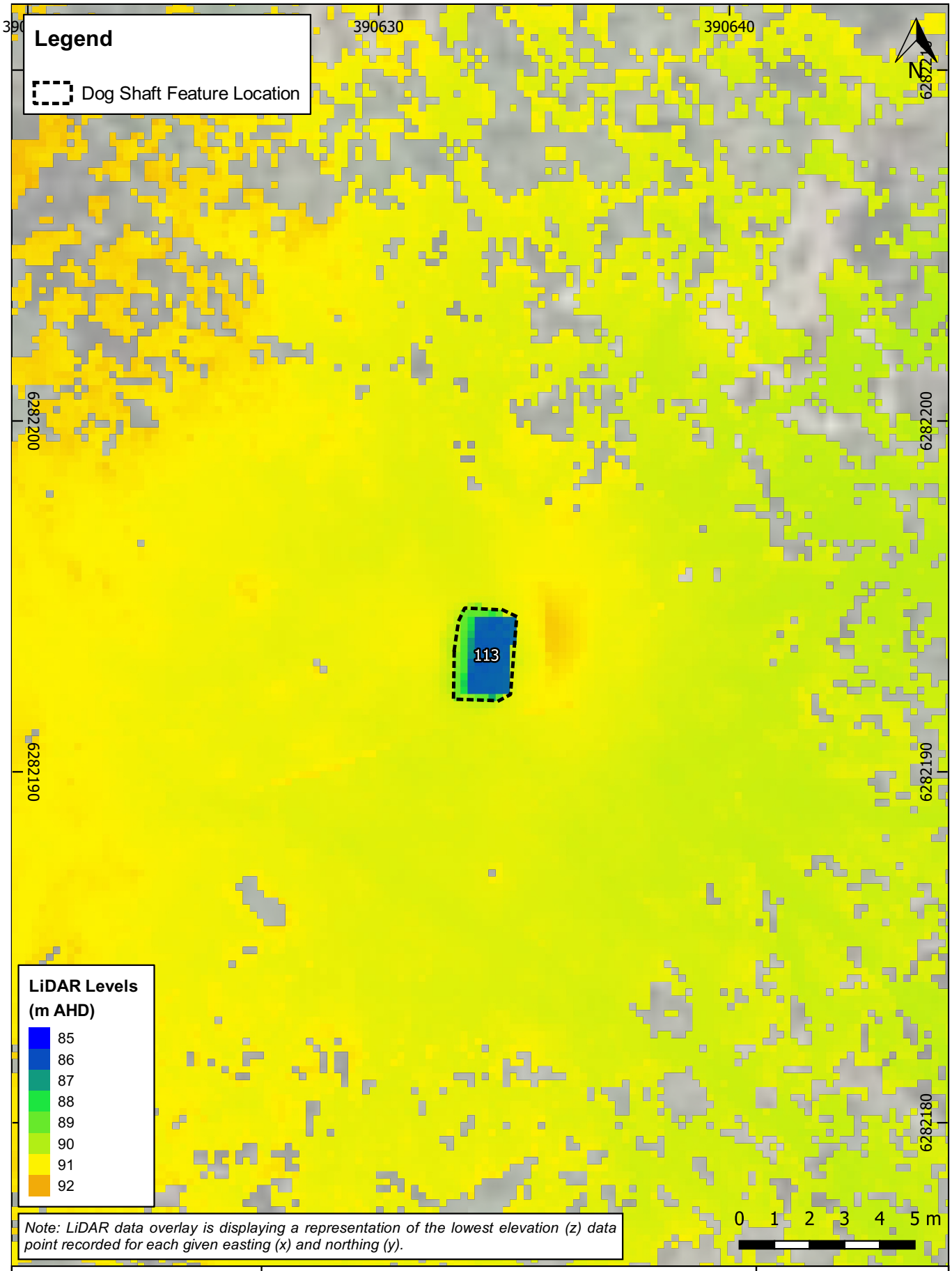
Location of Features and Site Locality
Donnybrook Shaft Remediation
Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT: 96721.02
Drawing No: 1
REV: 0
DATE: 8/4/2022



Douglas Partners Geotechnics / Environment / Groundwater	**First Mate Lease LiDAR data** **Donnybrook Shaft Remediation** **Argyle Forest Block, Donnybrook, WA**	PROJECT: 96721.02 Drawing No: 2 REV: 0
	CLIENT: Department of Mines, Industry Regulation and Safety	DATE: 28/4/2022



Note: LiDAR data overlay is displaying a representation of the lowest elevation (z) data point recorded for each given easting (x) and northing (y).

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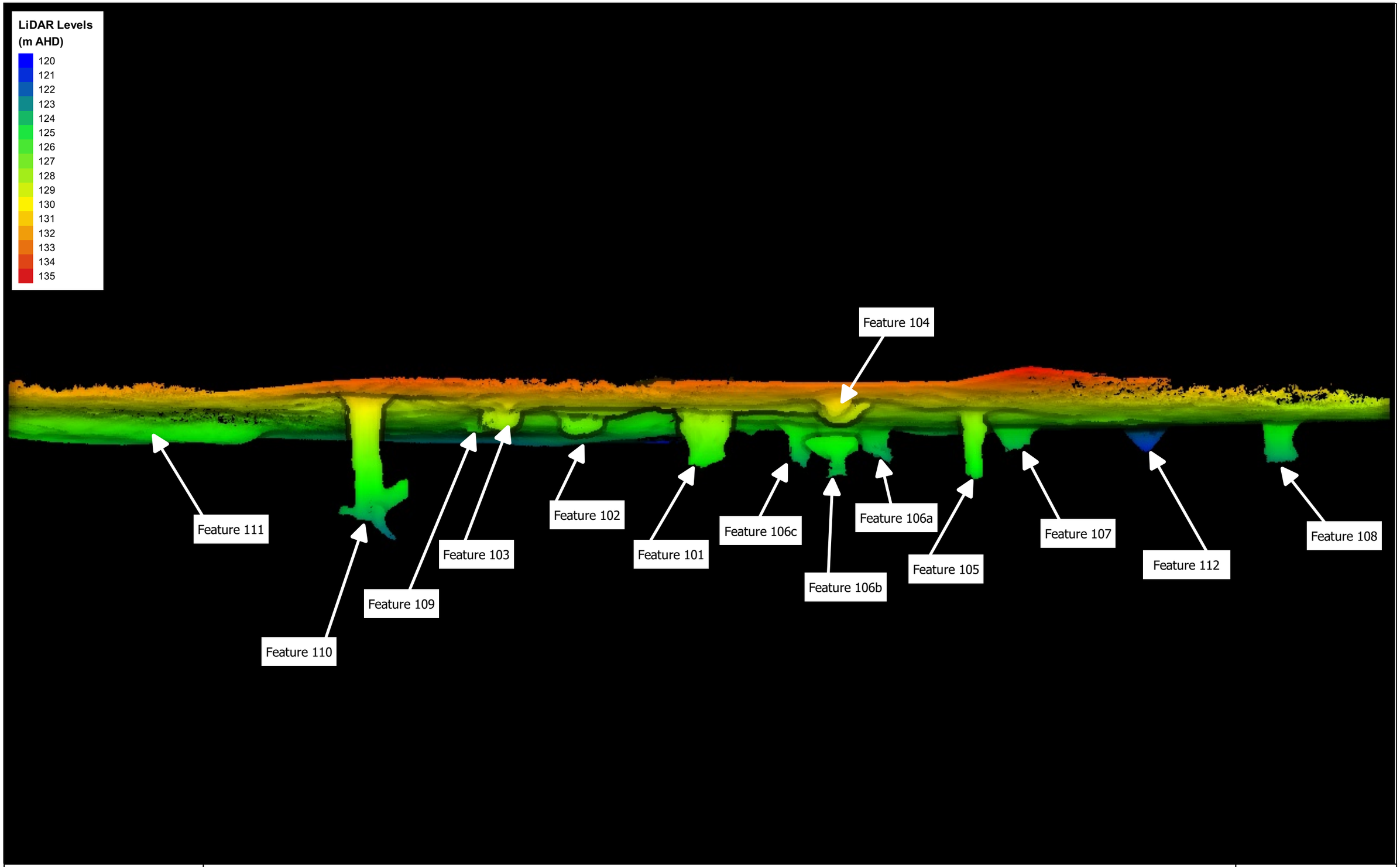
Dog Shaft & LiDAR Data

Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	3
REV:	0
DATE:	28/4/2022



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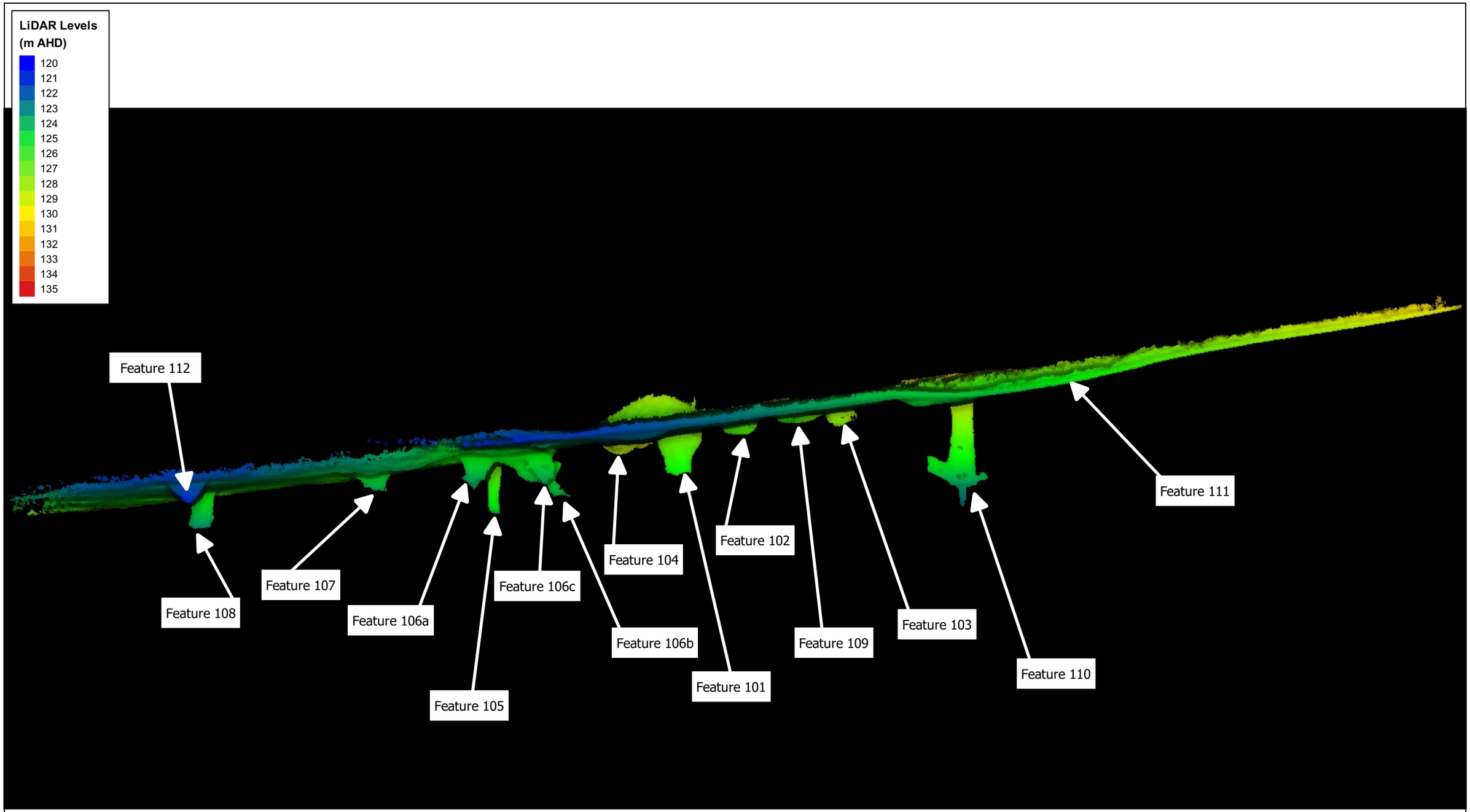
First Mate Lease LiDAR Model - Below Ground View - Facing East

Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	4
REV:	0
DATE:	8/4/2022



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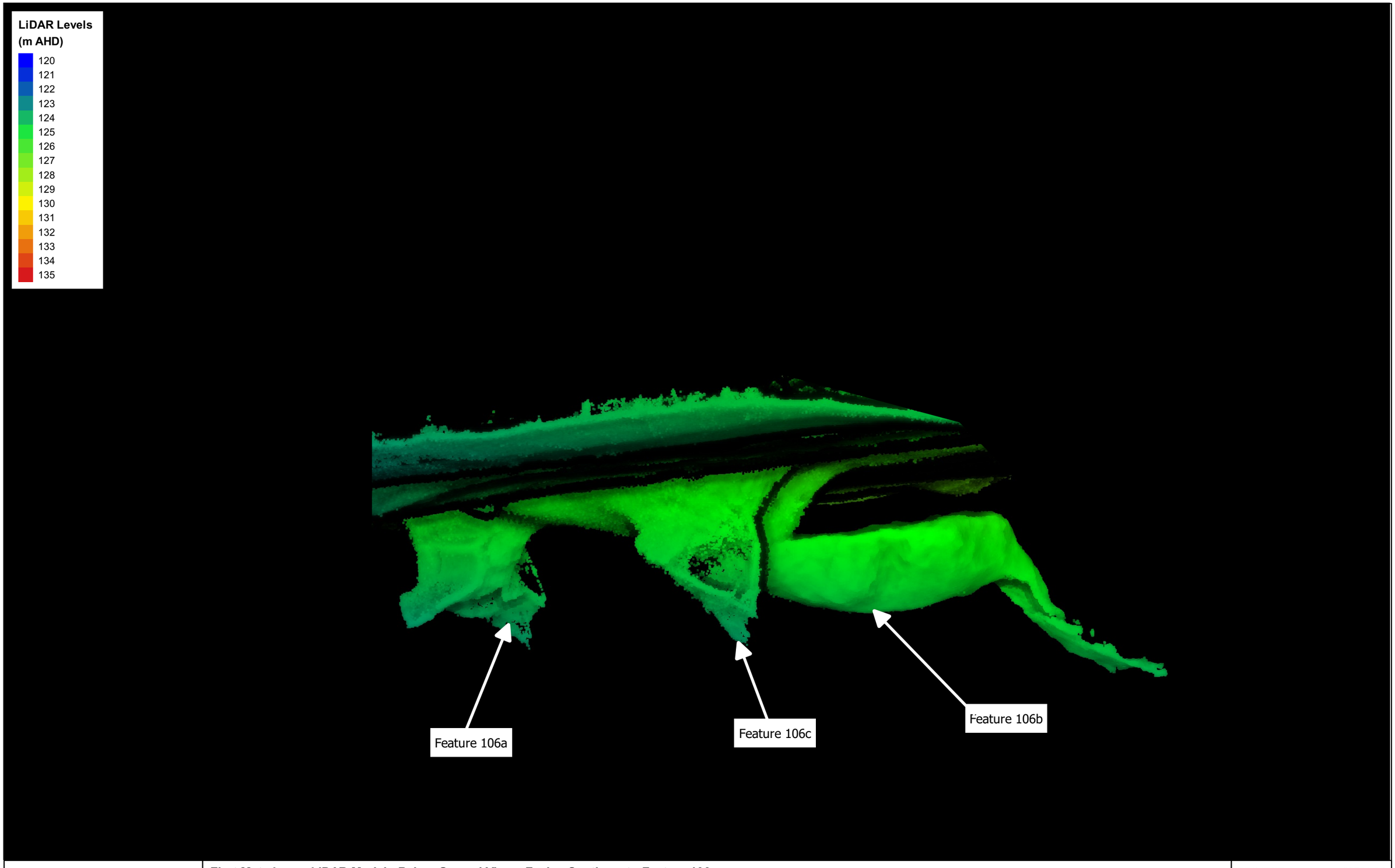
First Mate Lease LiDAR Model - Below Ground View - Facing West

Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	5
REV:	0
DATE:	28/4/2022



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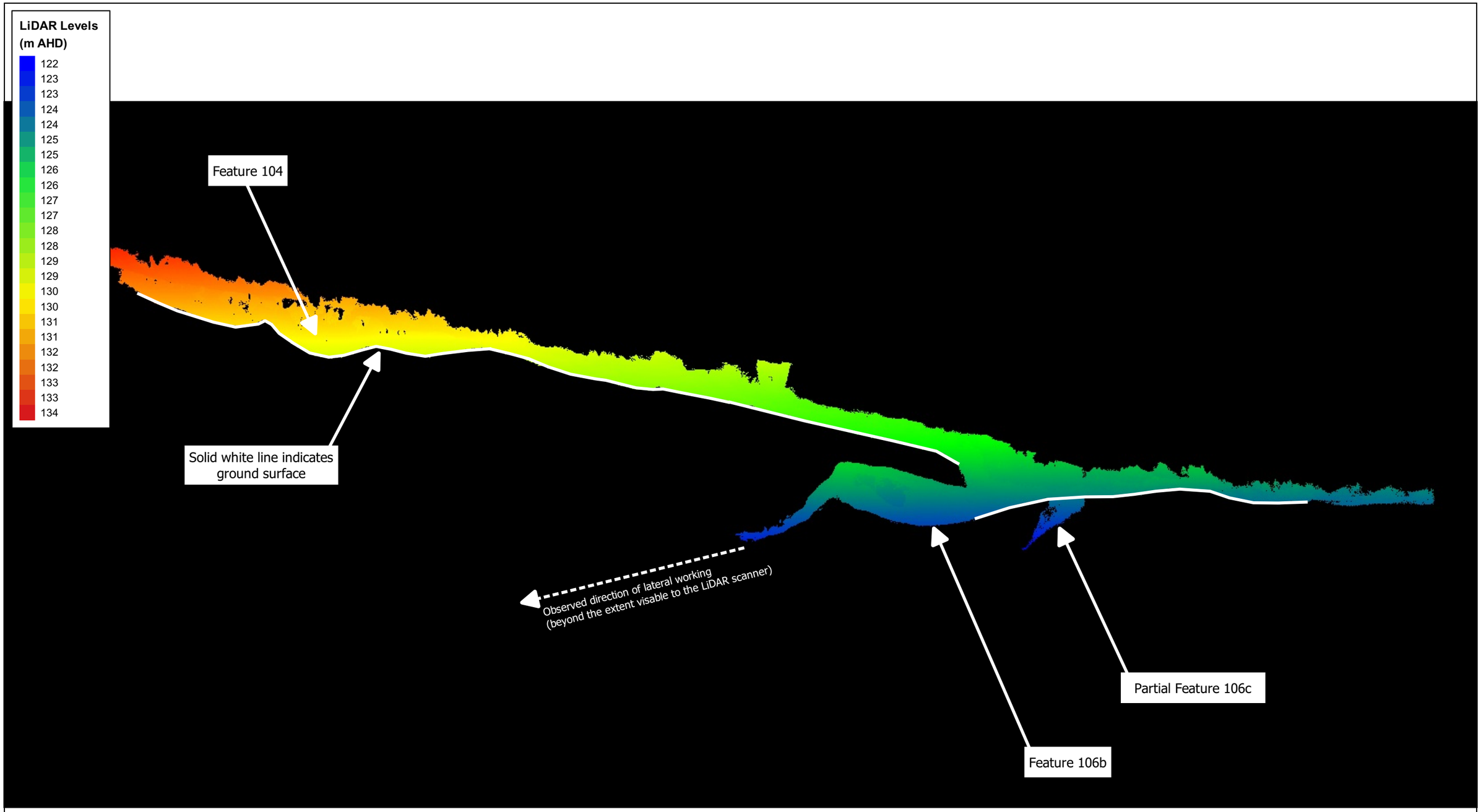
First Mate Lease LiDAR Model - Below Ground View - Facing Southwest - Feature 106

Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	6
REV:	0
DATE:	11/4/2022



0 2.5 5 m

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First Mate Lease LiDAR Model - Feature 106b and 104 Cross-section

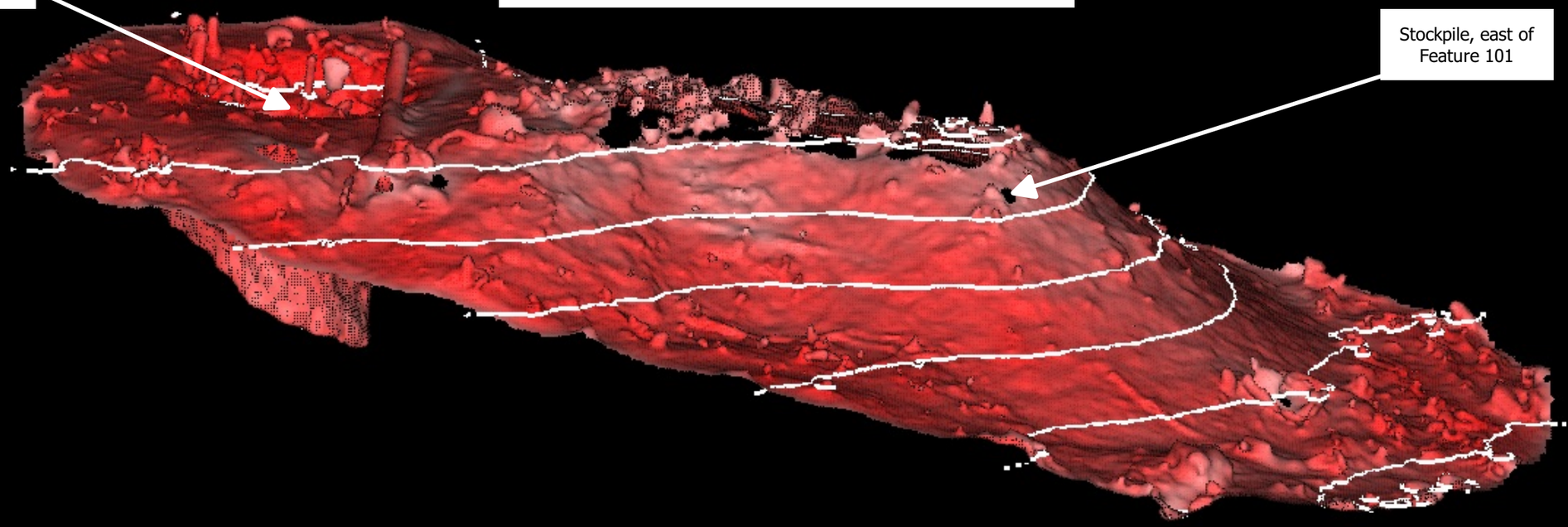
Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

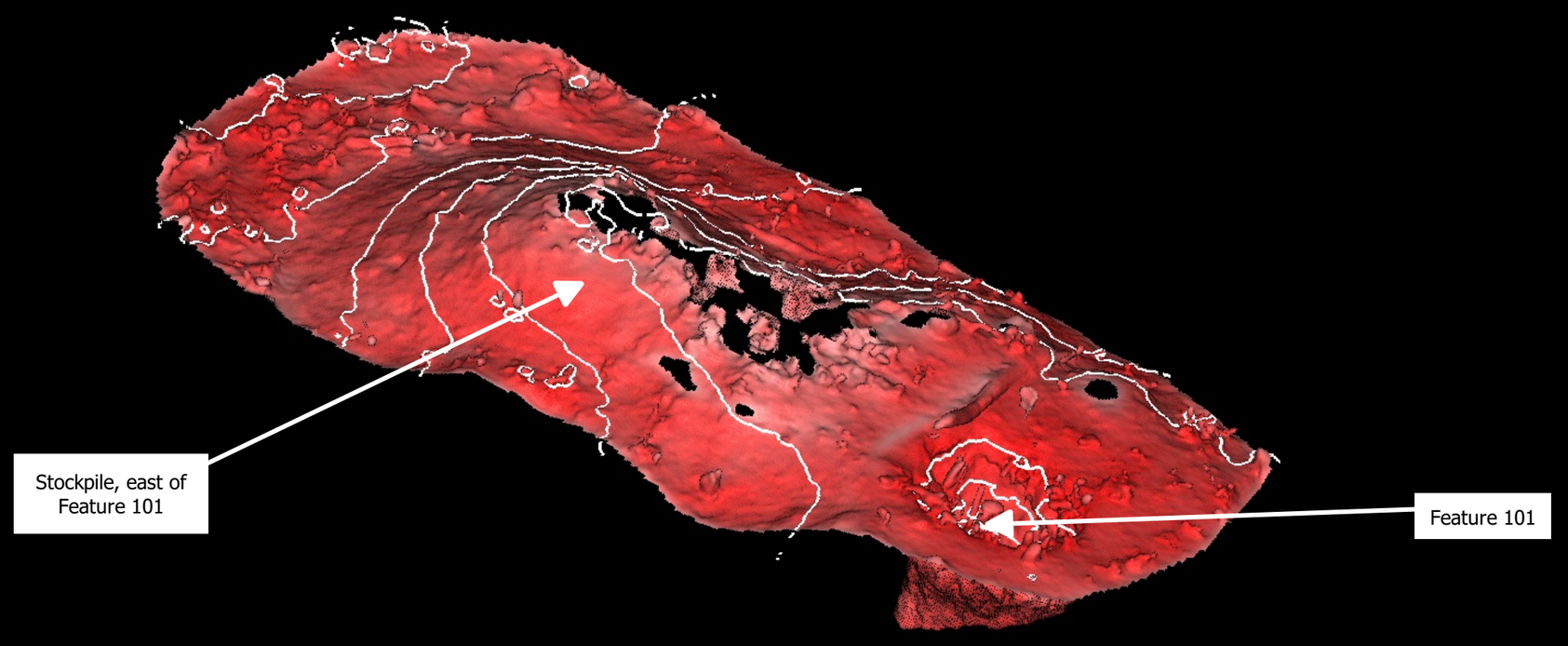
CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	7
REV:	0
DATE:	28/4/2022

Profile View - Facing North



Aerial View - Facing Southeast



Note: Contour lines are 1.0 m intervals

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First Mate Lease LiDAR Model - Mesh of Feature 101 and Stockpile

Donnybrook Shaft Remediation

Argyle Forest Block, Donnybrook, WA

CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	7
REV:	0
DATE:	28/4/2022

Photograph 1: Feature 101

Photograph 2: Feature 102

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Features 101 & 102**		

Photograph 3: Feature 103- central excavation

Photograph 4: Feature 104 - central excavation

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Features 103 & 104**		

Photograph 5: Feature 105

Photograph 6: Feature 105 - base

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Feature 105**	[illegible]	[illegible]
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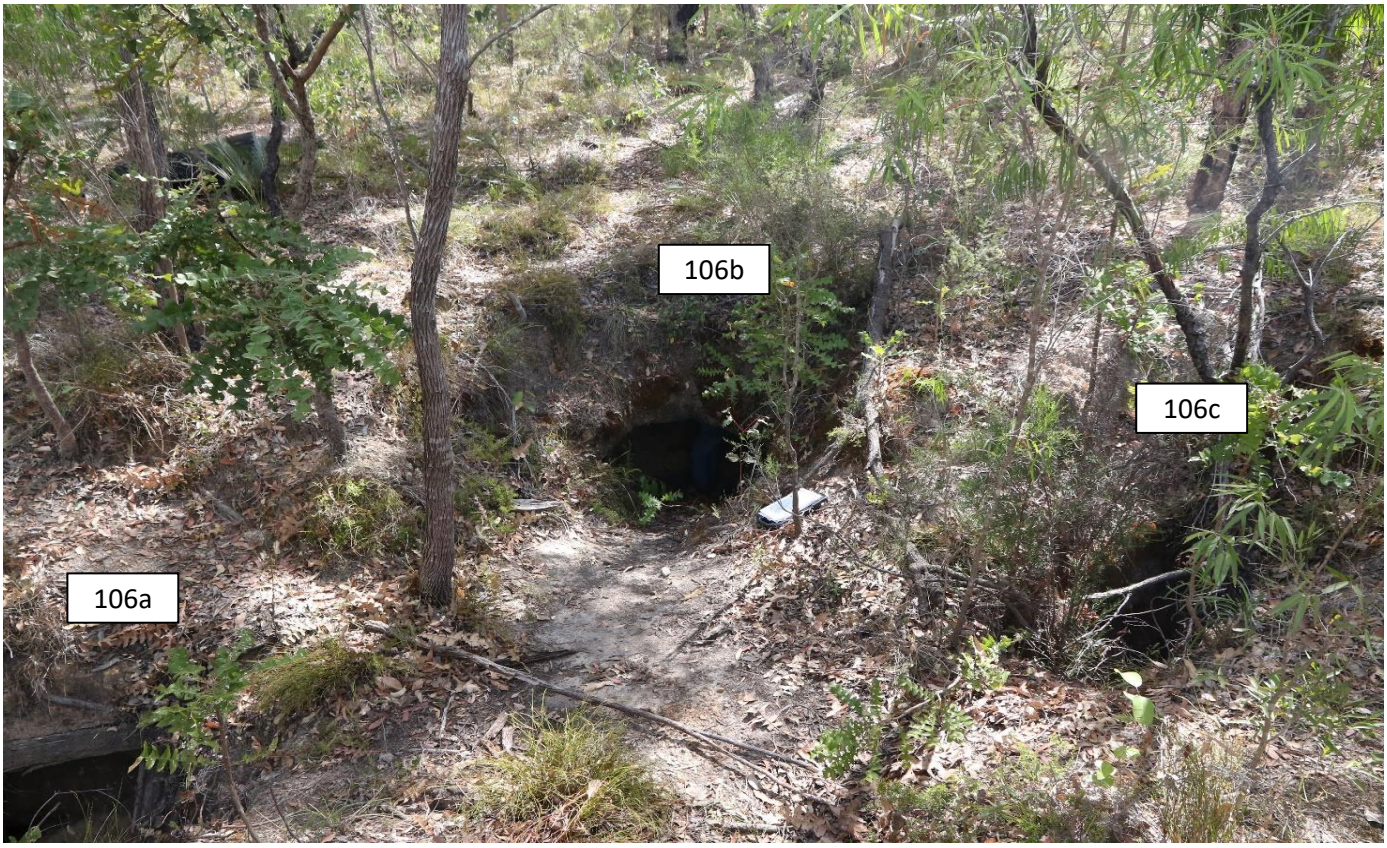

Photograph 7: Features 106a, 106b & 106c

Photograph 8: Feature 106a

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Feature 106**	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]

Photograph 9: Feature 106b - entrance

Photograph 10: Feature 106b - view from entrance

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Feature 106**	[illegible]	[illegible]
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Photograph 11: Feature 106c

Photograph 12: Feature 107

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Features 106 & 107**	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]

Photograph 13: Feature 108

Photograph 14: Feature 109

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Features 108 & 109**	□r□□□□□□□ □□□	□67 □□□□□□
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Photograph 15: Feature 110

Photograph 16: Feature 110 - lateral working visible from surface

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Feature 7**	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]

Photograph 17: Feature 111

Photograph 18: Feature 112

Douglas Partners Geotechnics / Environment / Groundwater	**Photographs - Features 111 & 112**	□r□□□□□□□ □□□	□67 □□□□□□
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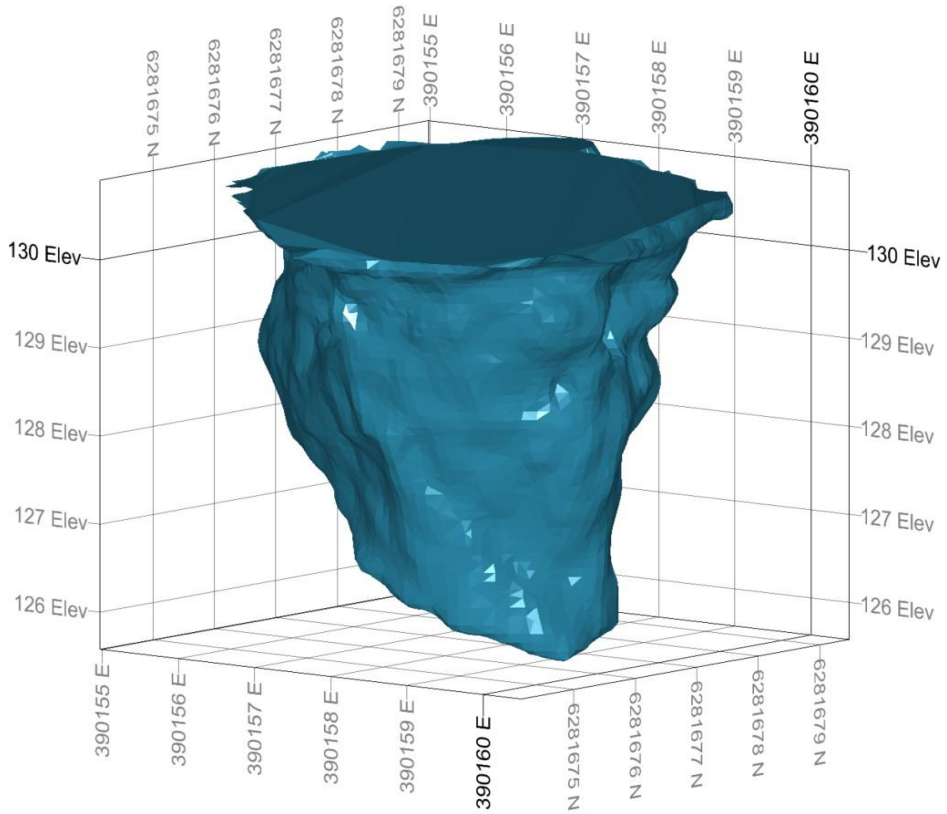
Photograph 19: Feature 113

Appendix C



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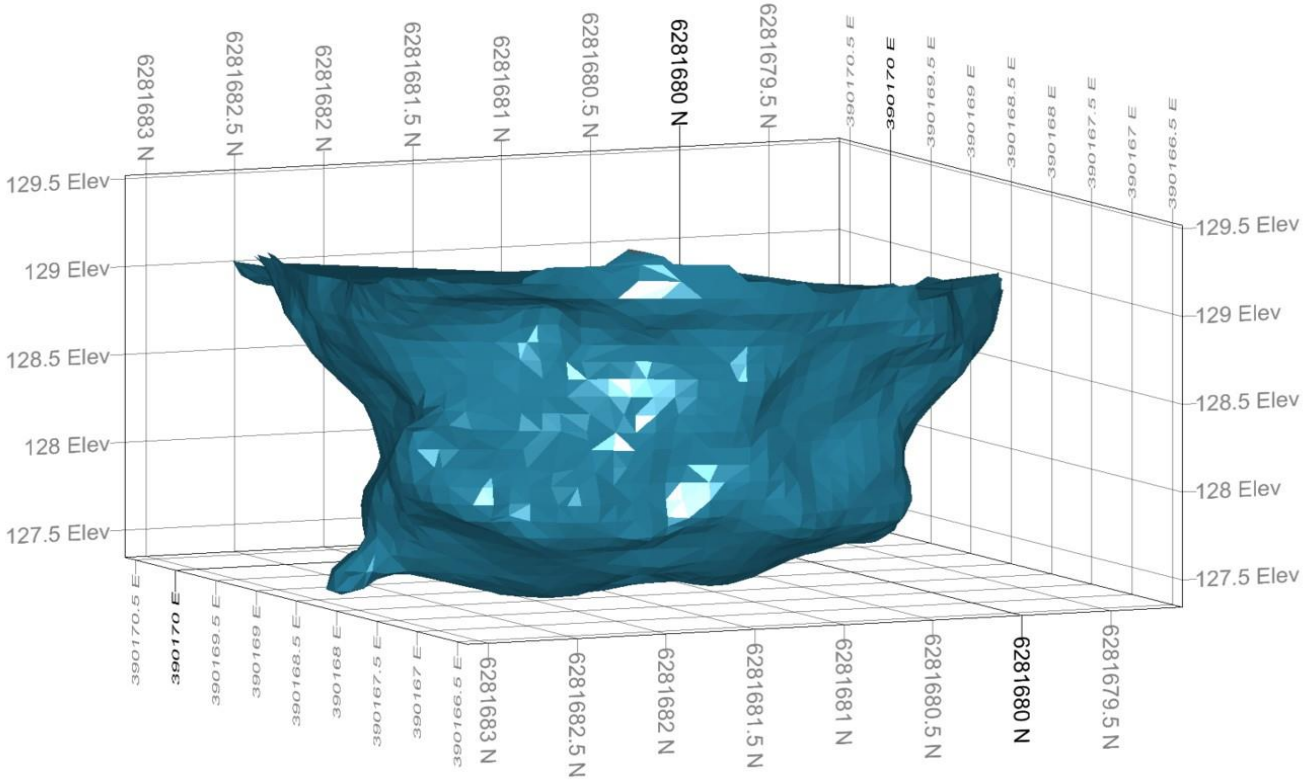

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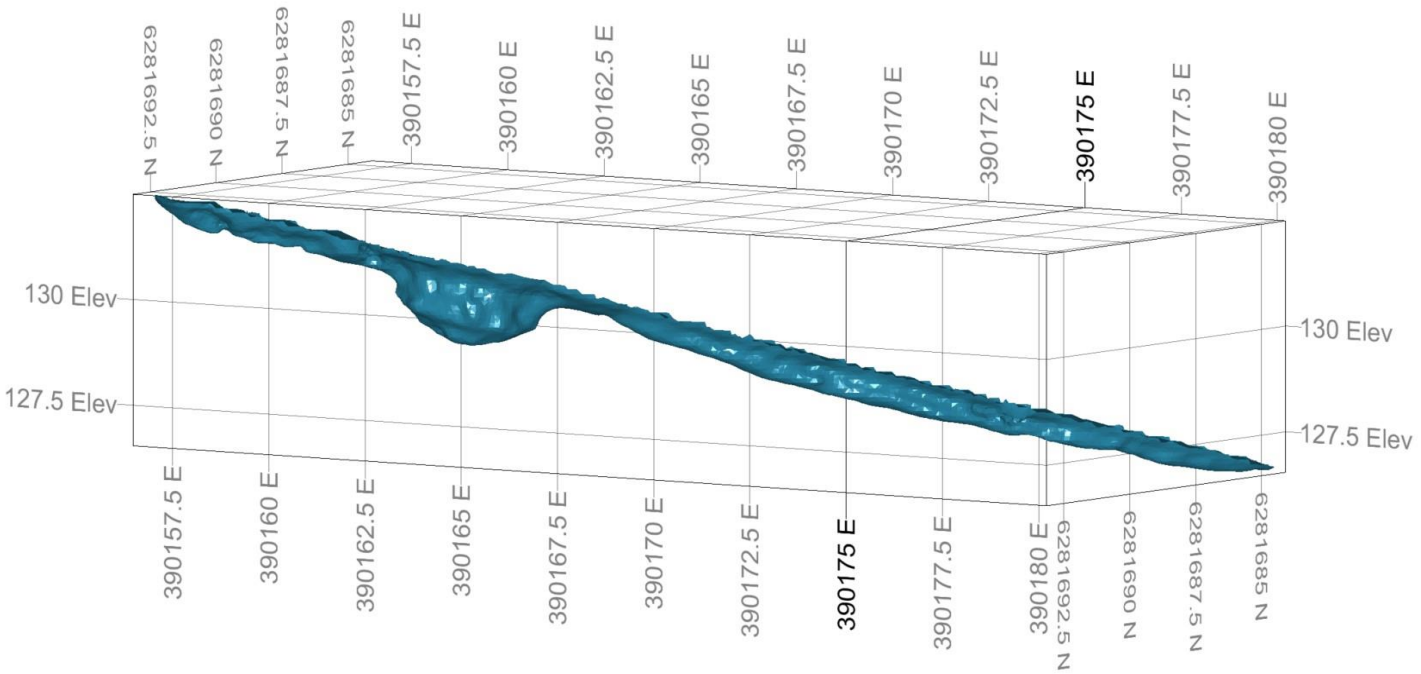

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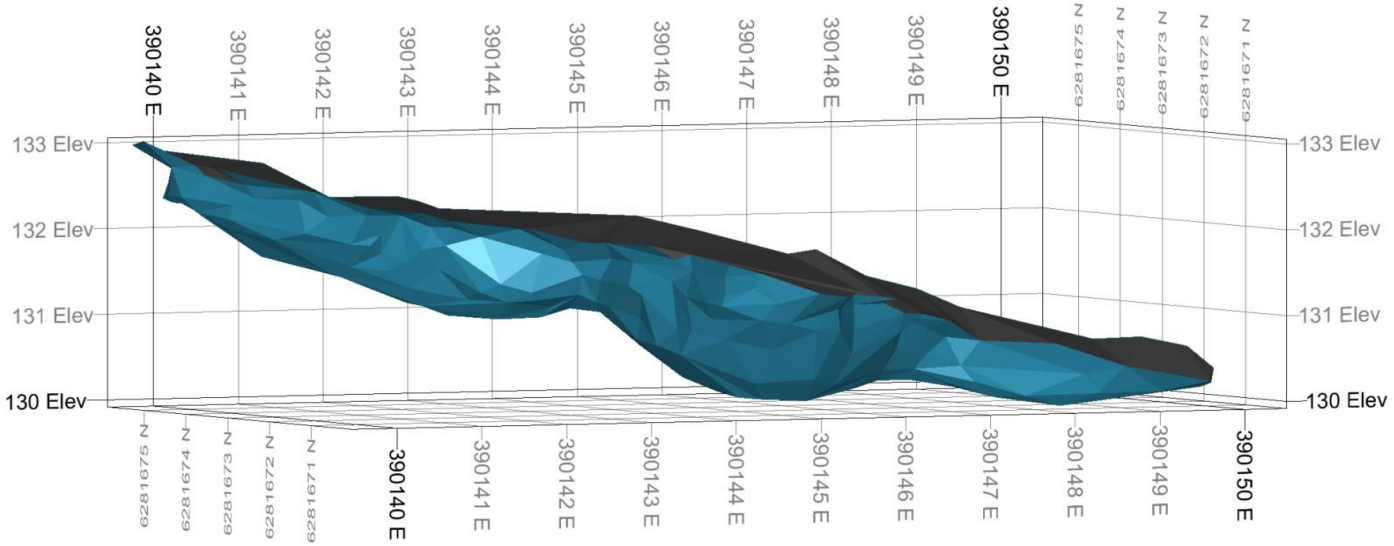

Feature 104

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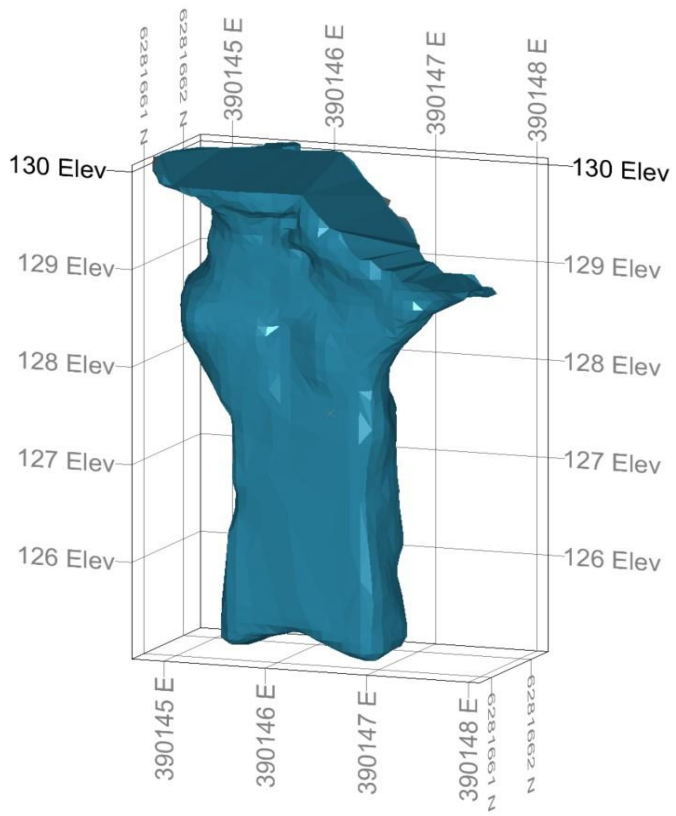

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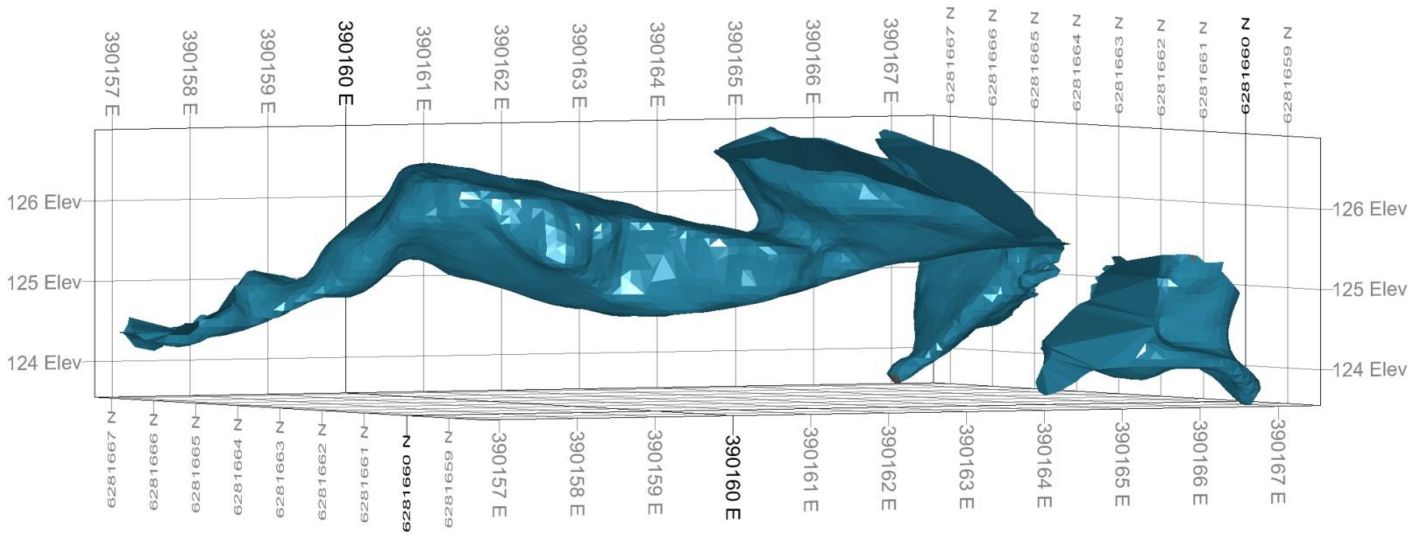
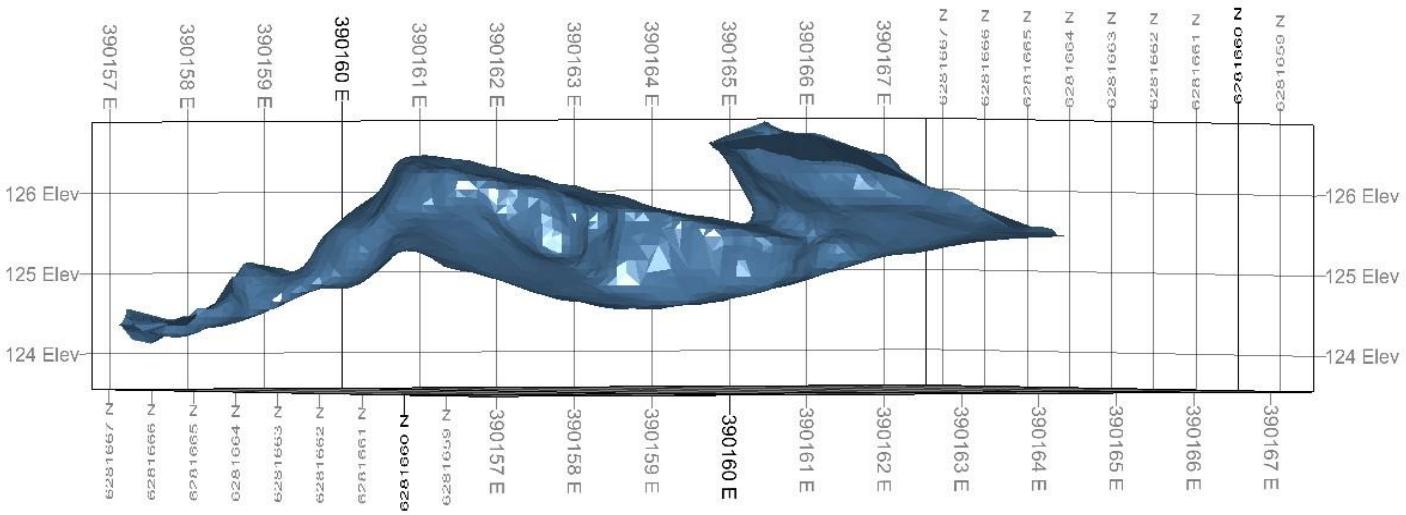
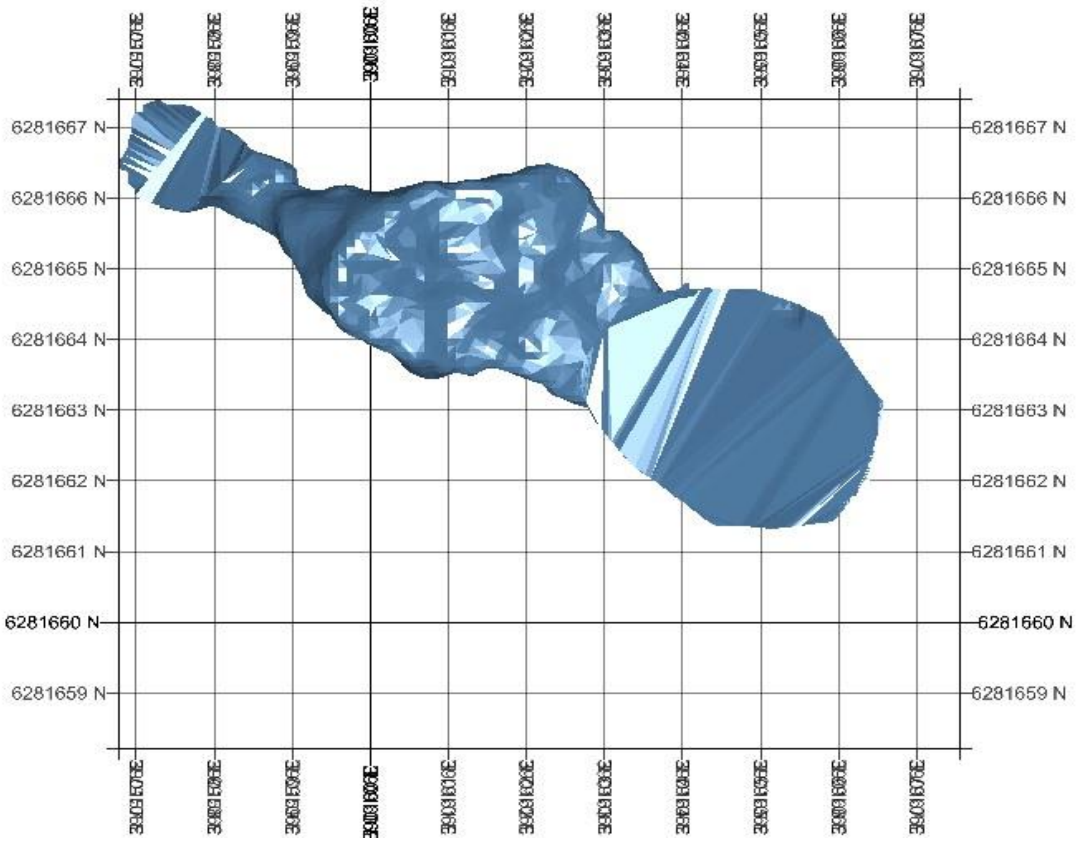


Features 106a, 106b and 106c



Feature 106b - profile



Feature 106b - plan view

Douglas Partners Geotechnics / Environment / Groundwater	**LiDAR Data Meshes - 106b**	[illegible]	[illegible]
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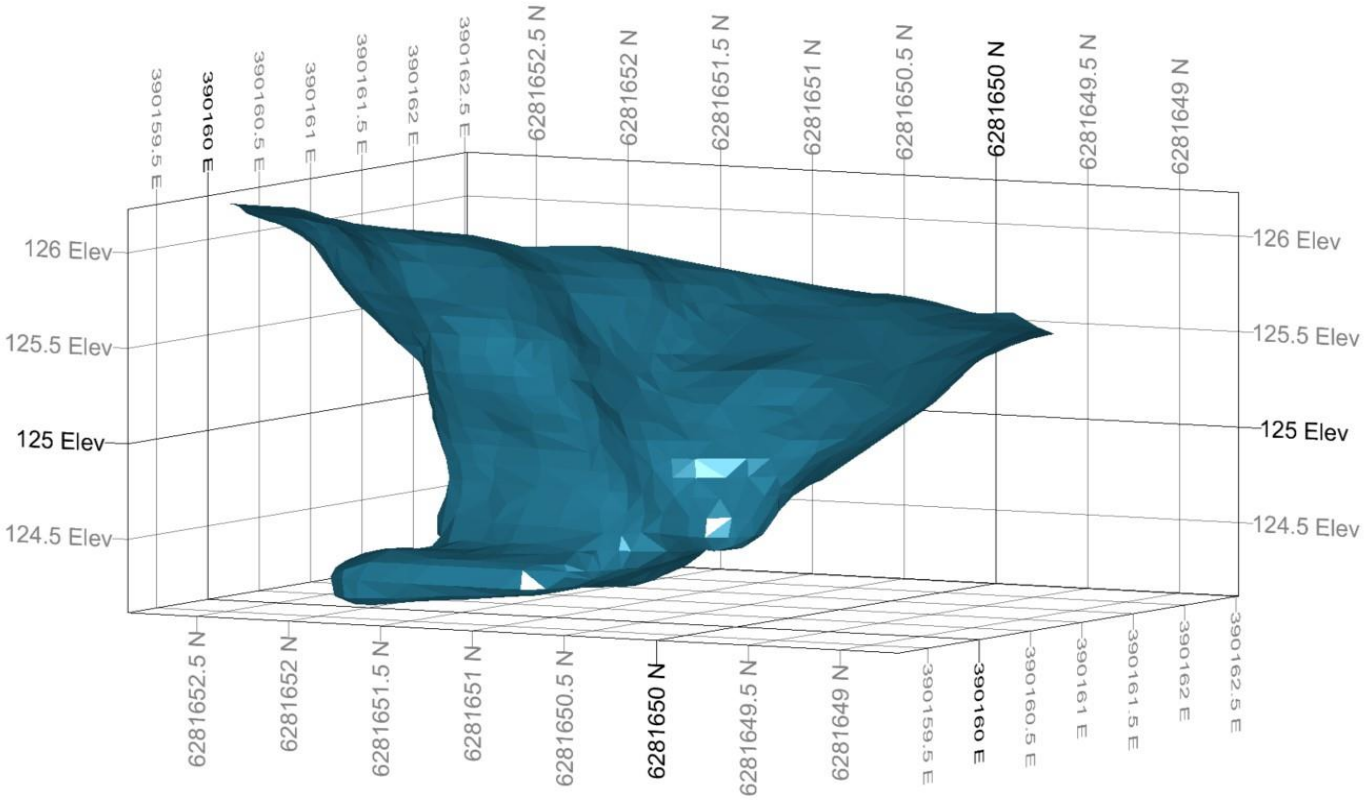

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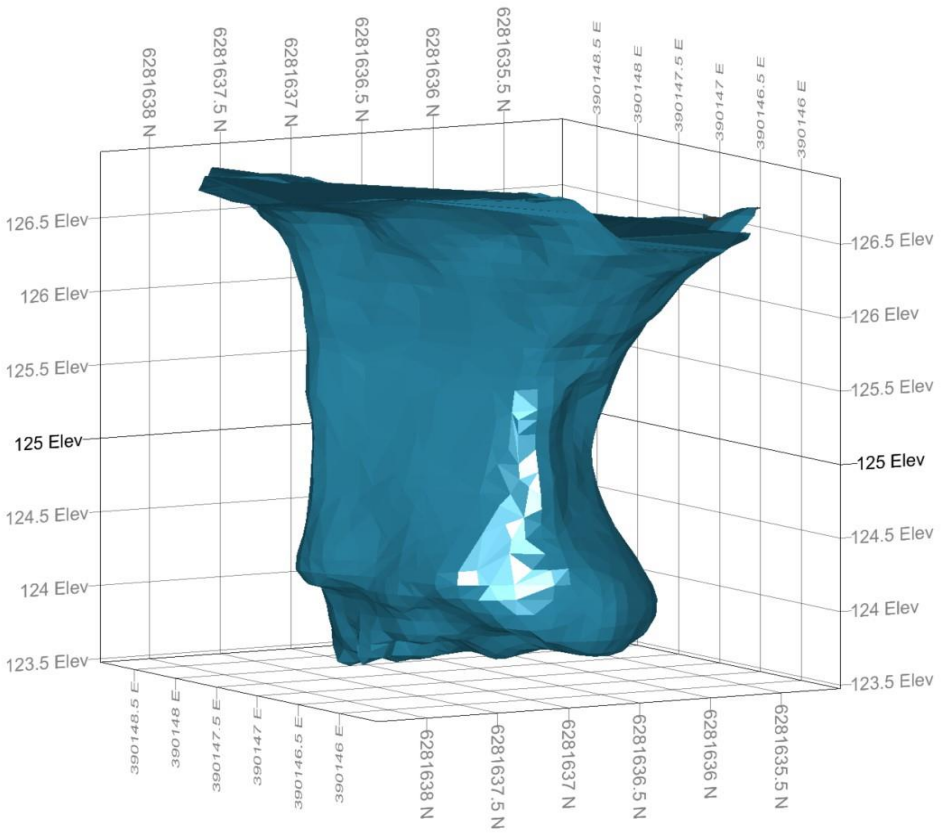

Feature 108

Douglas Partners Geotechnics / Environment / Groundwater	**LiDAR Data Meshes - 107 & 108**	[illegible]	[illegible]
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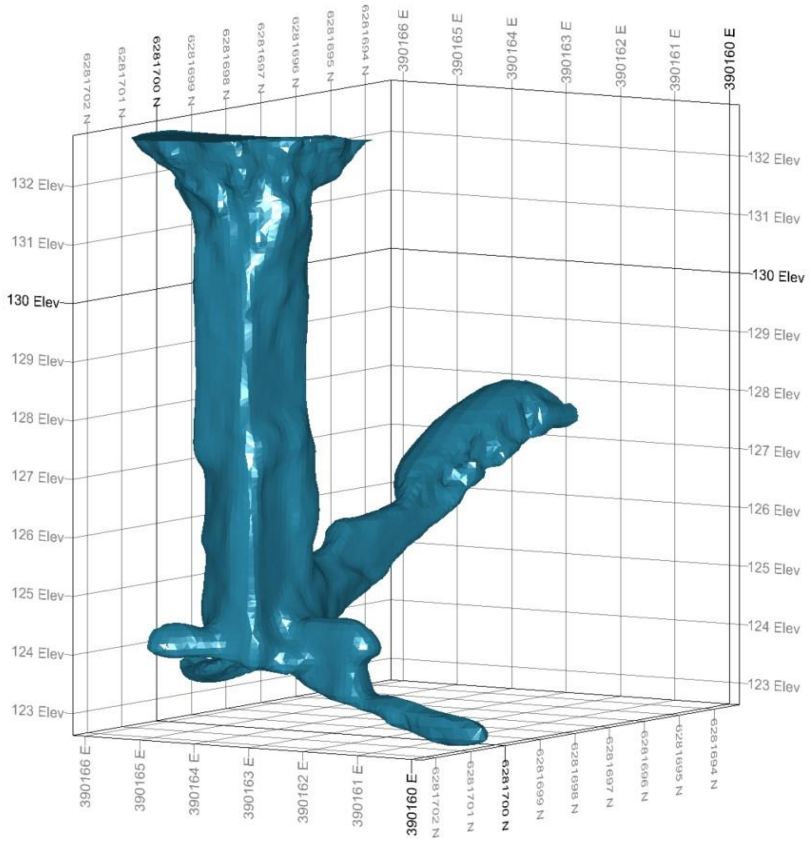

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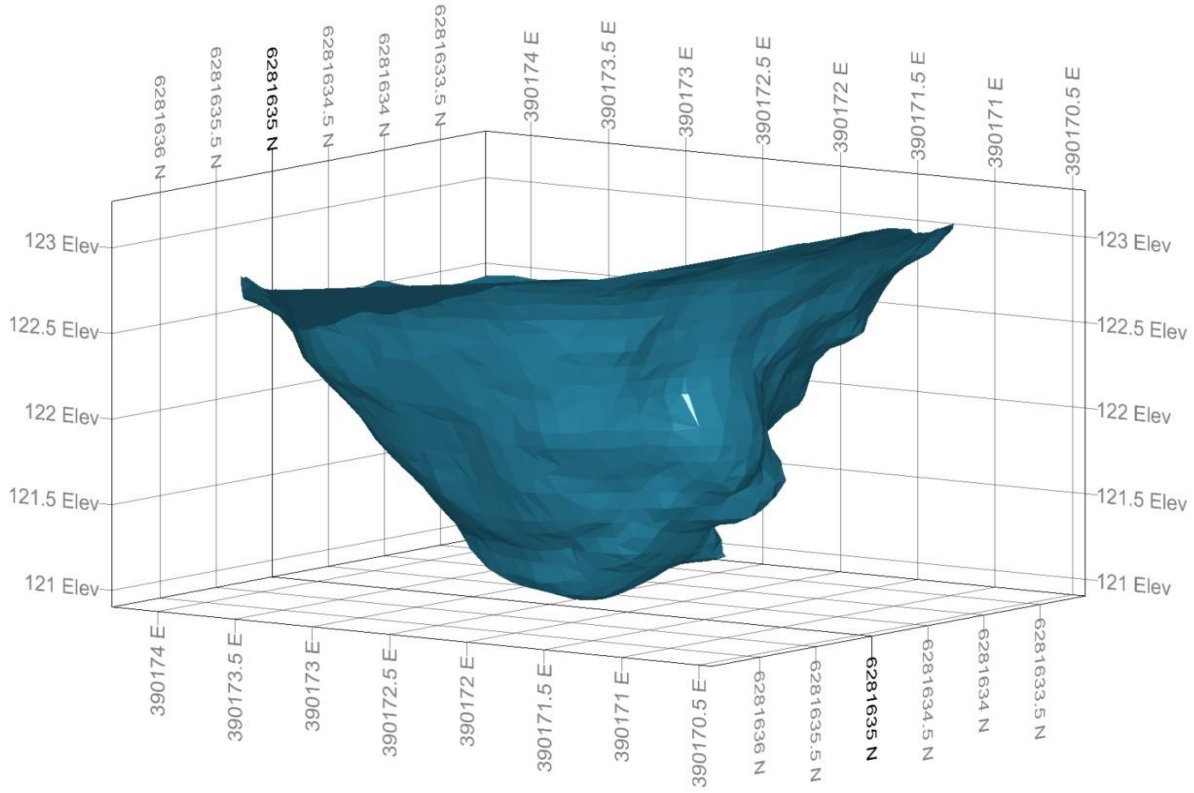

Feature 112

Douglas Partners Geotechnics / Environment / Groundwater	**LiDAR Data Meshes - 110 & 112**	□r□□□□□□□ □□□	□67 □□□□□
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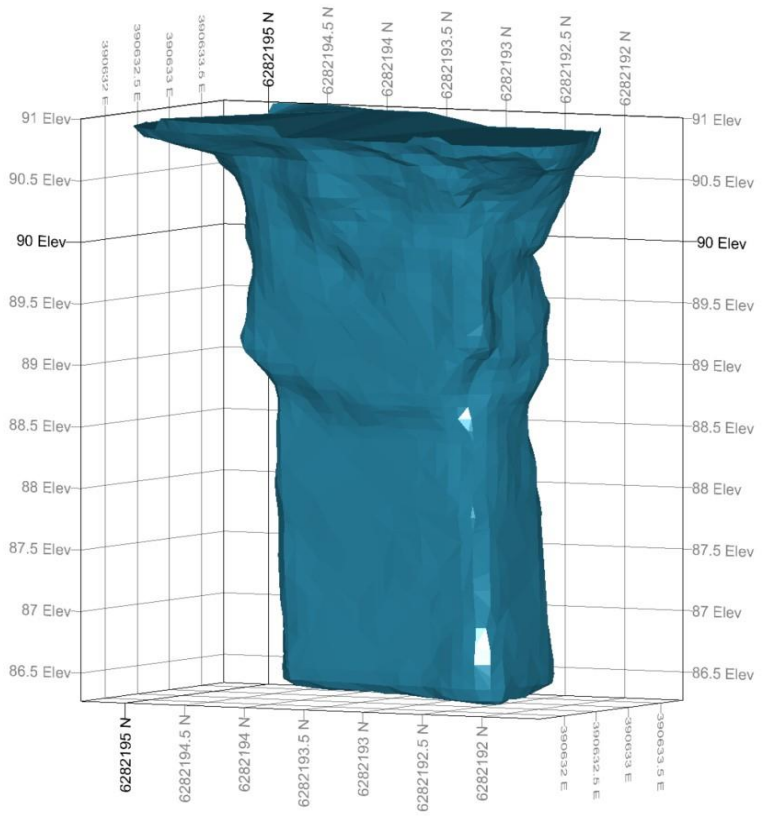
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Feature 113

Appendix D

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or L (5)
B - LIKELY	10^{-2}	VH	VH	H	M	L
C - POSSIBLE	10^{-3}	VH	H	M	M	VL
D - UNLIKELY	10^{-4}	H	M	L	L	VL
E - RARE	10^{-5}	M	L	L	VL	VL
F - BARELY CREDIBLE	10^{-6}	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

LANDSLIDE RISK

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 2: LIKELIHOOD

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

TABLE 1: RISK TO PROPERTY

Qualitative Risk		Significance - Geotechnical engineering requirements
Very high	VH	**Unacceptable** without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low. May be too expensive and not practical. Work likely to cost more than the value of the property.
High	H	**Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.
Moderate	M	**May be tolerated** in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as possible.
Low	L	**Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.
Very Low	VL	**Acceptable**. Manage by normal slope maintenance procedures.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

TABLE 3: RISK TO LIFE

Risk (deaths per participant per year)	**Activity/Event Leading to Death** (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

More information relevant to your particular situation may be found in other AUSTRALIAN GEOGUIDES:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.