

4 Indexing to flood hazard vulnerability curves

Once the flood hazard has been quantified and the timing aspects of flood hazard understood, the potential of the flood flows to cause damage or danger can be indexed against vulnerability curves linked to meaningful hazard thresholds.

The vulnerability of the community and its assets can be described by using thresholds related to the stability of people as they walk or drive through flood waters, or shelter in a building during a flood. The vulnerability to hazard will also be influenced by whether the primary consideration is, for example, strategic land-use planning, which is aimed at ensuring land use is compatible with the flood risk, or assessing development proposals or emergency management planning, which is aimed at addressing residual flood risks.

4.1 General flood hazard classification

A flood hazard assessment conducted as part of a flood study often provides baseline information for general consideration as part of an initial scoping exercise for a floodplain management study. In such a preliminary assessment of risks or as part of a constraints analysis for strategic land-use planning, a combined set of hazard vulnerability curves such as those presented in Figure 6 can be used as a general classification of flood hazard on a floodplain. Further information on the source of the hazard vulnerability curves presented in Figure 6 is available in Smith et al. (2014).

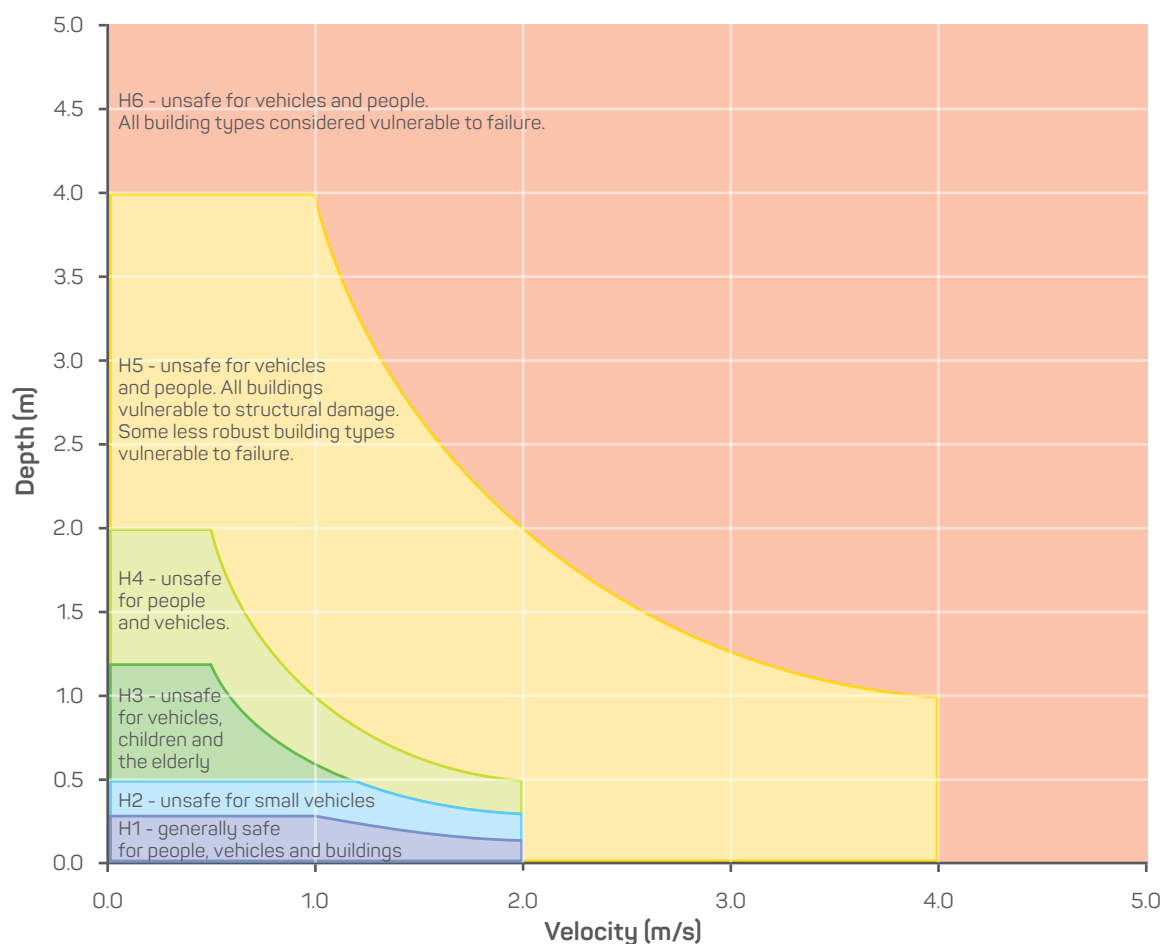


Figure 6: General flood hazard vulnerability curves

The combined flood hazard curves presented in Figure 6 set hazard thresholds that relate to the vulnerability of the community when interacting with floodwaters. The combined curves are divided into hazard classifications that relate to specific vulnerability thresholds as described in Table 1. Table 2 provides the limits for the classifications provided in Table 1.

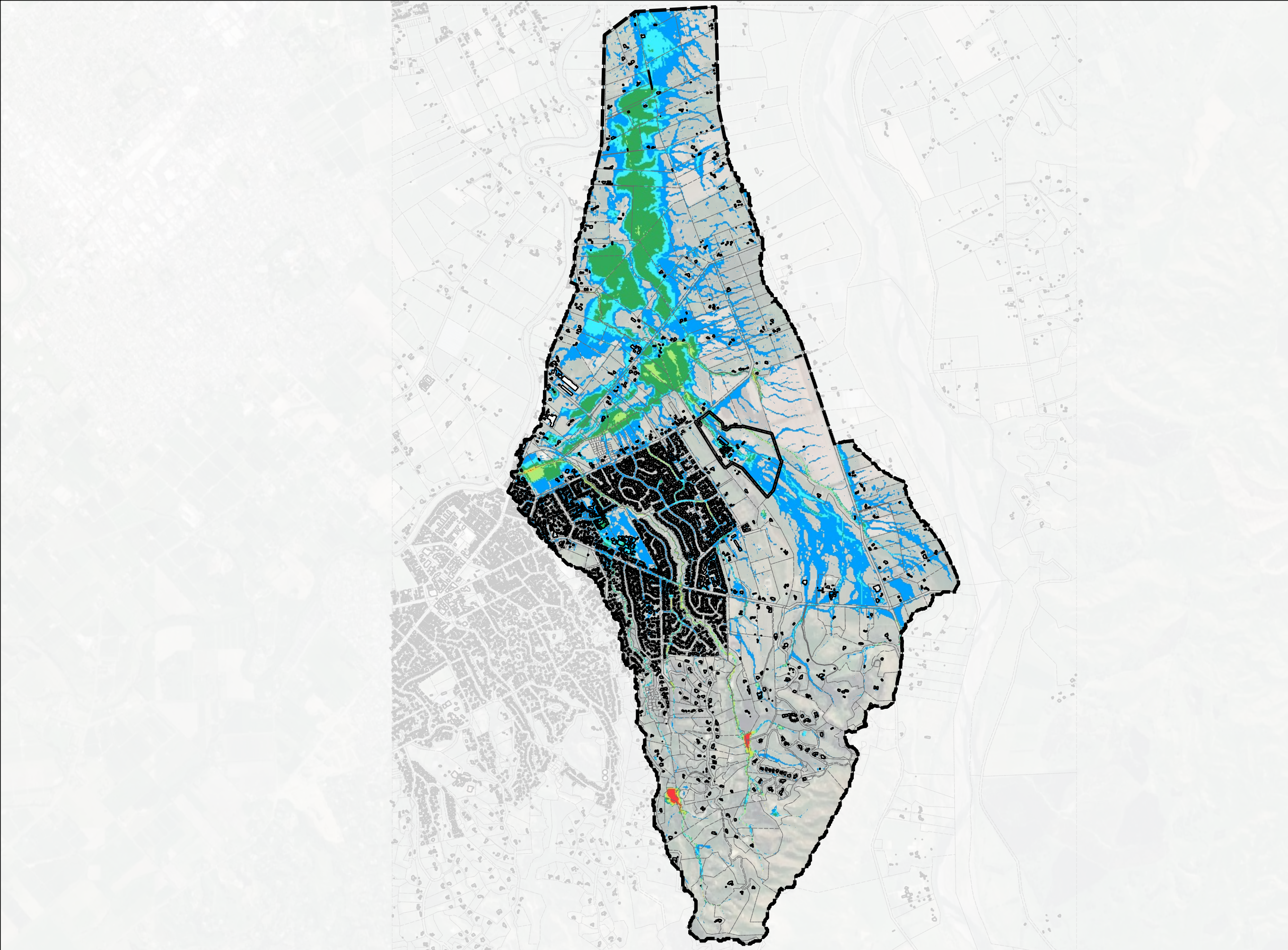
A flood hazard map classified against these general vulnerability thresholds based on the flood behaviour derived using flow modelling for the example floodplain presented in Figure 3 is shown in Figure 7. Additional examples are provided in the appendix.

Table 1: Combined hazard curves – vulnerability thresholds

Hazard Vulnerability Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles, children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Table 2: Combined hazard curves – vulnerability thresholds classification limits

Hazard Vulnerability Classification	Classification limit (D and V in combination) m ² /s	Limiting still water depth (D) m	Limiting velocity (V) m/s
H1	$D \cdot V \leq 0.3$	0.3	2.0
H2	$D \cdot V \leq 0.6$	0.5	2.0
H3	$D \cdot V \leq 0.6$	1.2	2.0
H4	$D \cdot V \leq 1.0$	2.0	2.0
H5	$D \cdot V \leq 4.0$	4.0	4.0
H6	$D \cdot V > 4.0$	-	-

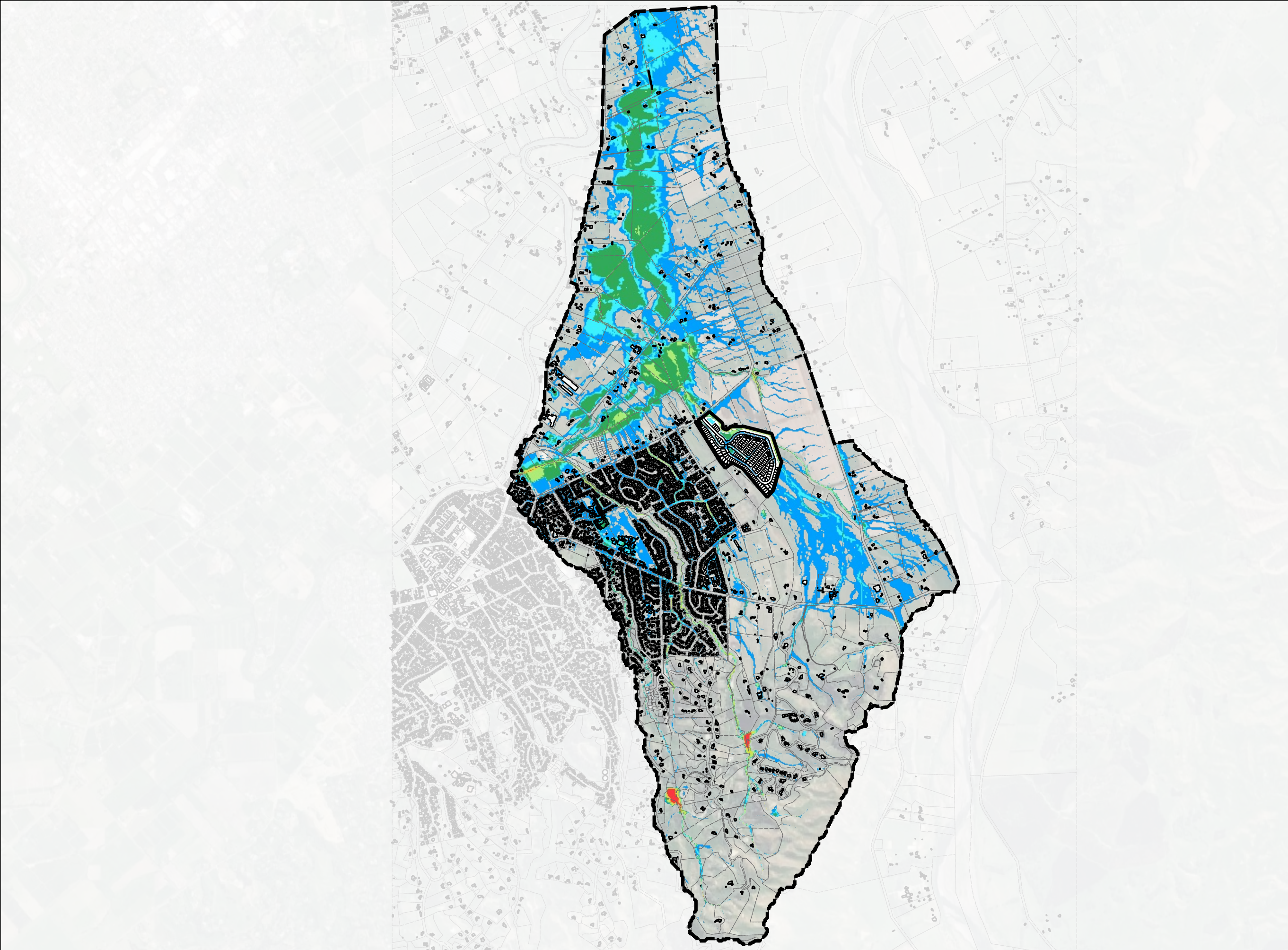


- NOTES
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LEGEND

-  2D Model Extent
Overlay Ex
-  Parcels LINZ
-  Ex Buildings LINZ
- Overlay
-  Site
-  Ex Buildings LINZ
-  Parcels LINZ
- EX_Unblocked - 50yr_CC - v132
EX_50YR_CC_Unblocked_ZAEM1_Max
- Band 1 (Gray)
-  H1
-  H2
-  H3
-  H4
-  H5
-  H6
- Background
Google Satellite

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				Draft	YW							
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LEGEND

 2D Model Extent
Overlay Proposed

 Pr Lot Boundaries

Overlay

 Site

 Ex Buildings LINZ

 Parcels LINZ

PR_Unblocked - 50yr, CC - v133

PR_50YR_CC_Unblocked_135_ZAEM1_Max

Band 1 (Gray)

 H1

 H2

 H3

 H4

 H5

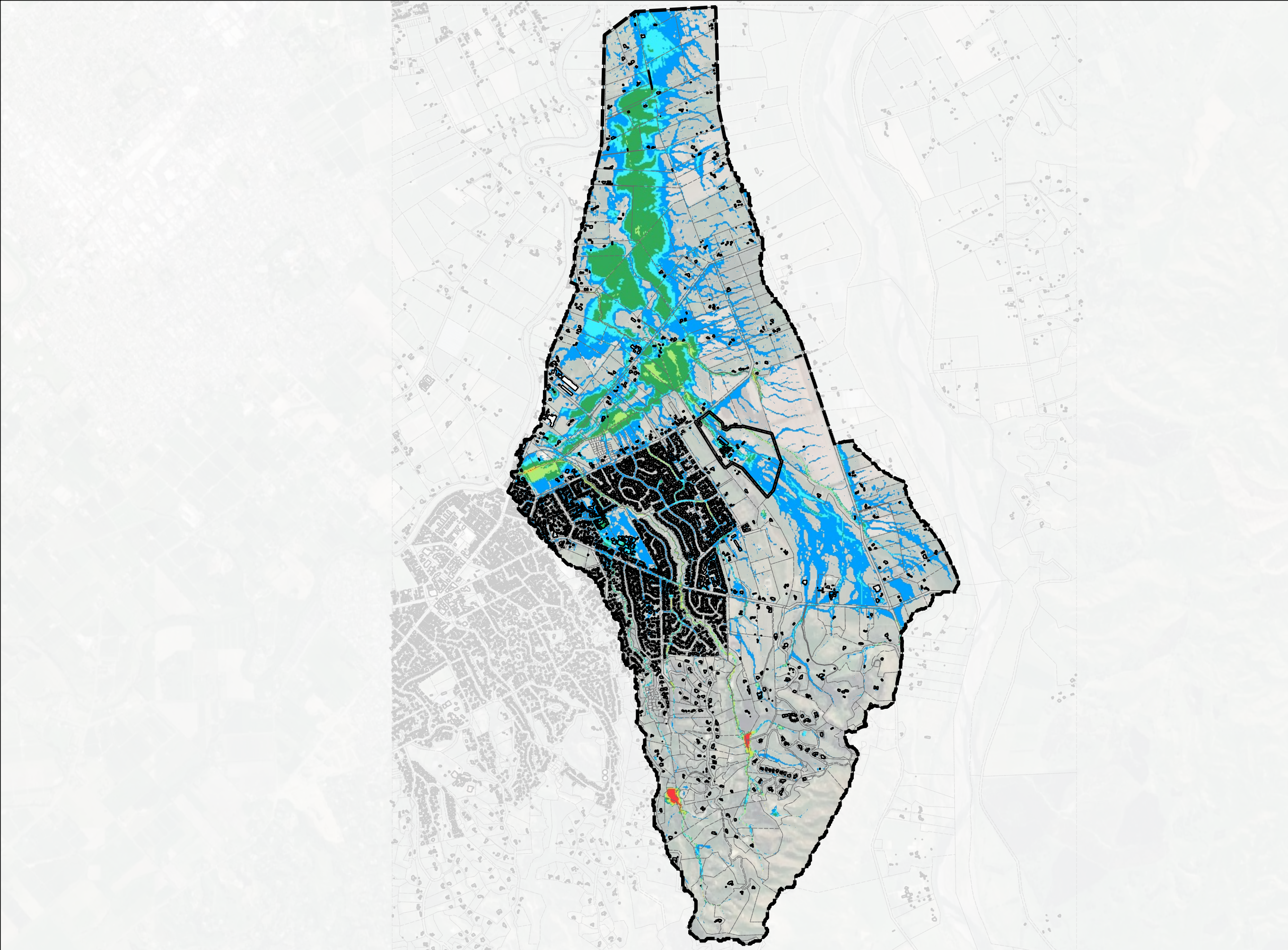
 H6

Background Proposed

 Site

Background
Google Satellite

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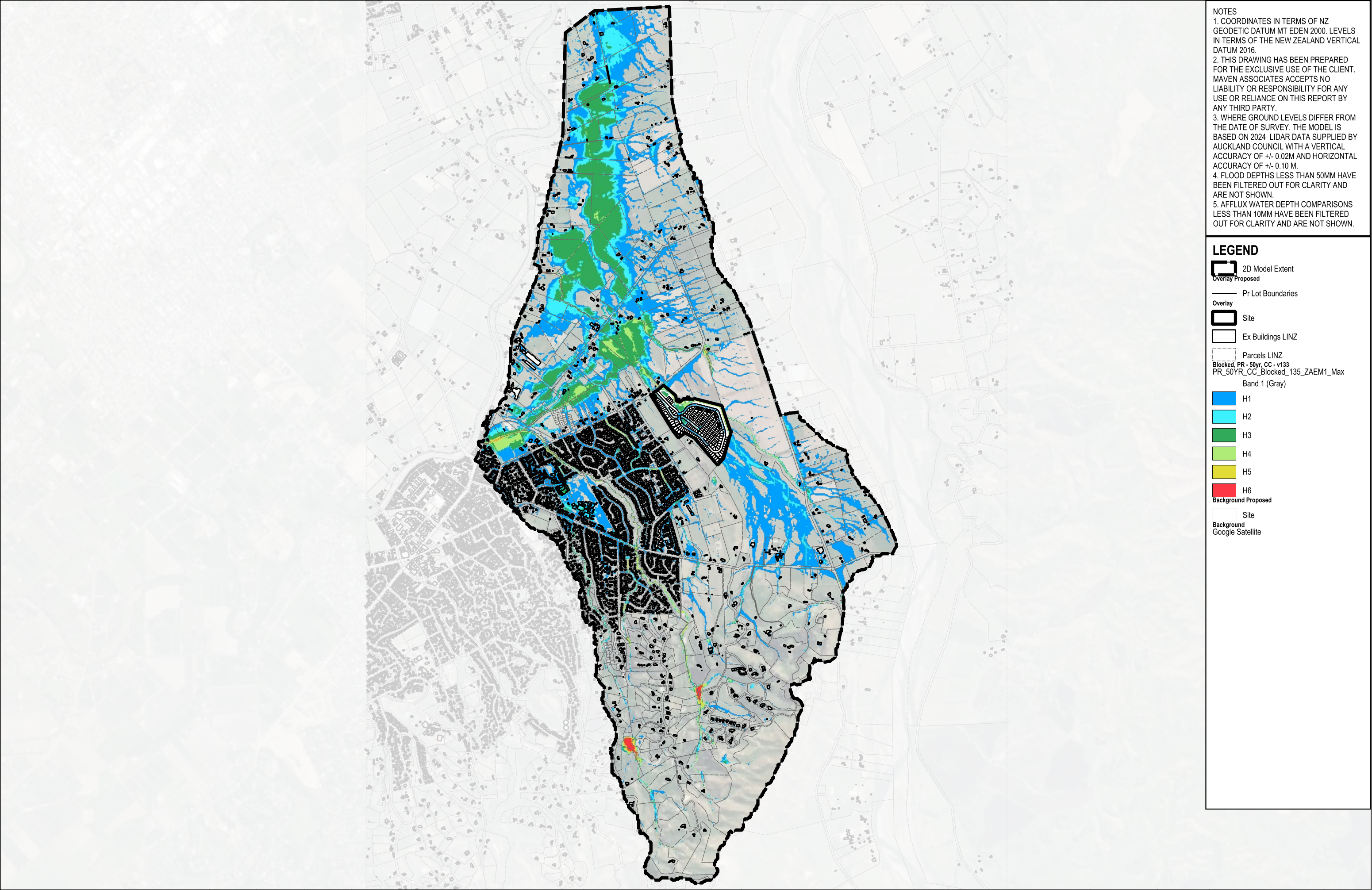
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Overlay Ex
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- Overlay
- Site
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- Parcels LINZ
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- H2
- H3
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- H6
- Background
Google Satellite

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LEGEND

2D Model Extent
 Overlay Proposed

Pr Lot Boundaries

Overlay

Site

Ex Buildings LINZ

Parcels LINZ

Blocked, PR - 50yr, CC - v133

PR_50YR_CC_Blocked_135_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

H5

H6

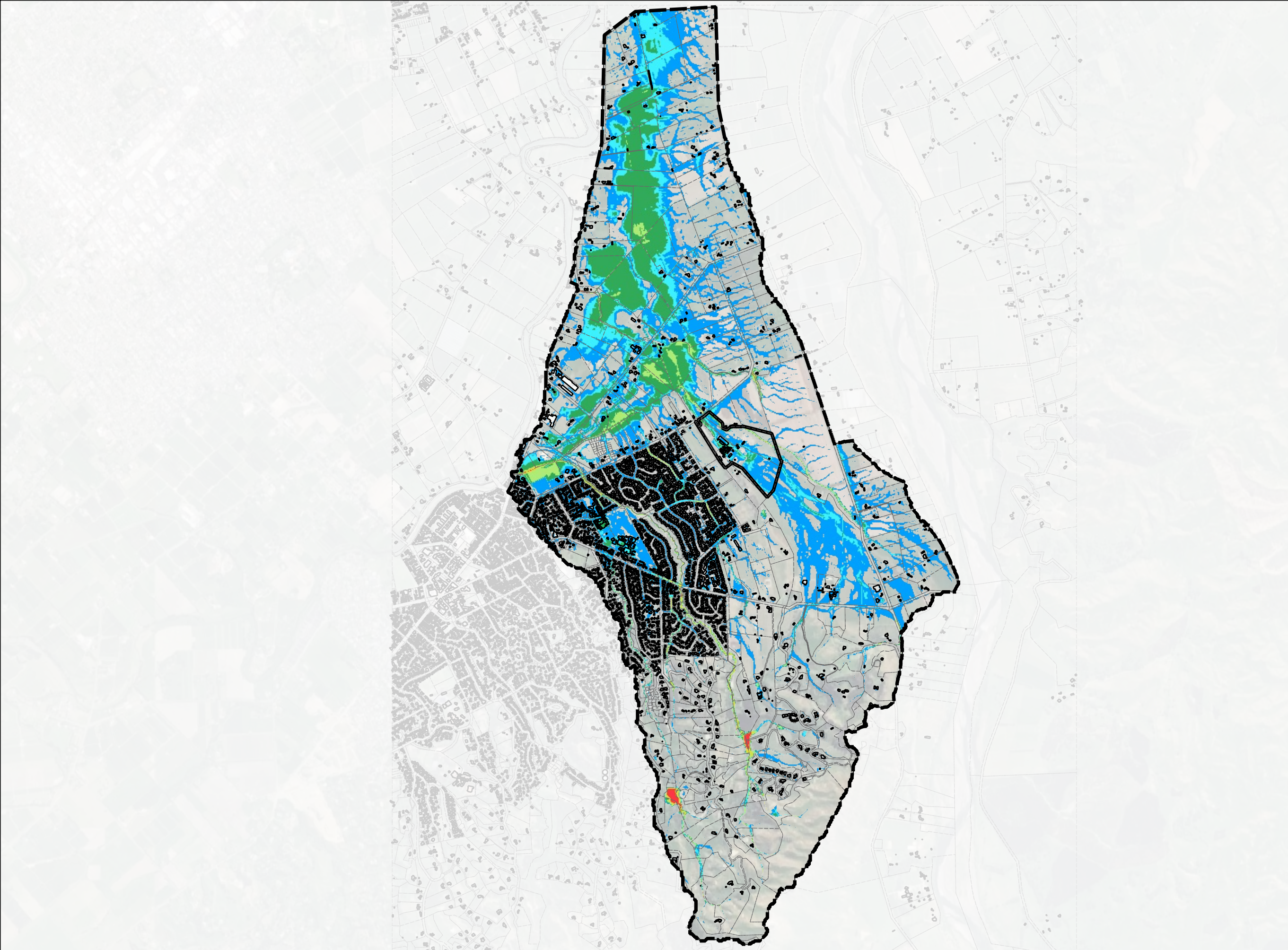
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Site

Background

Google Satellite

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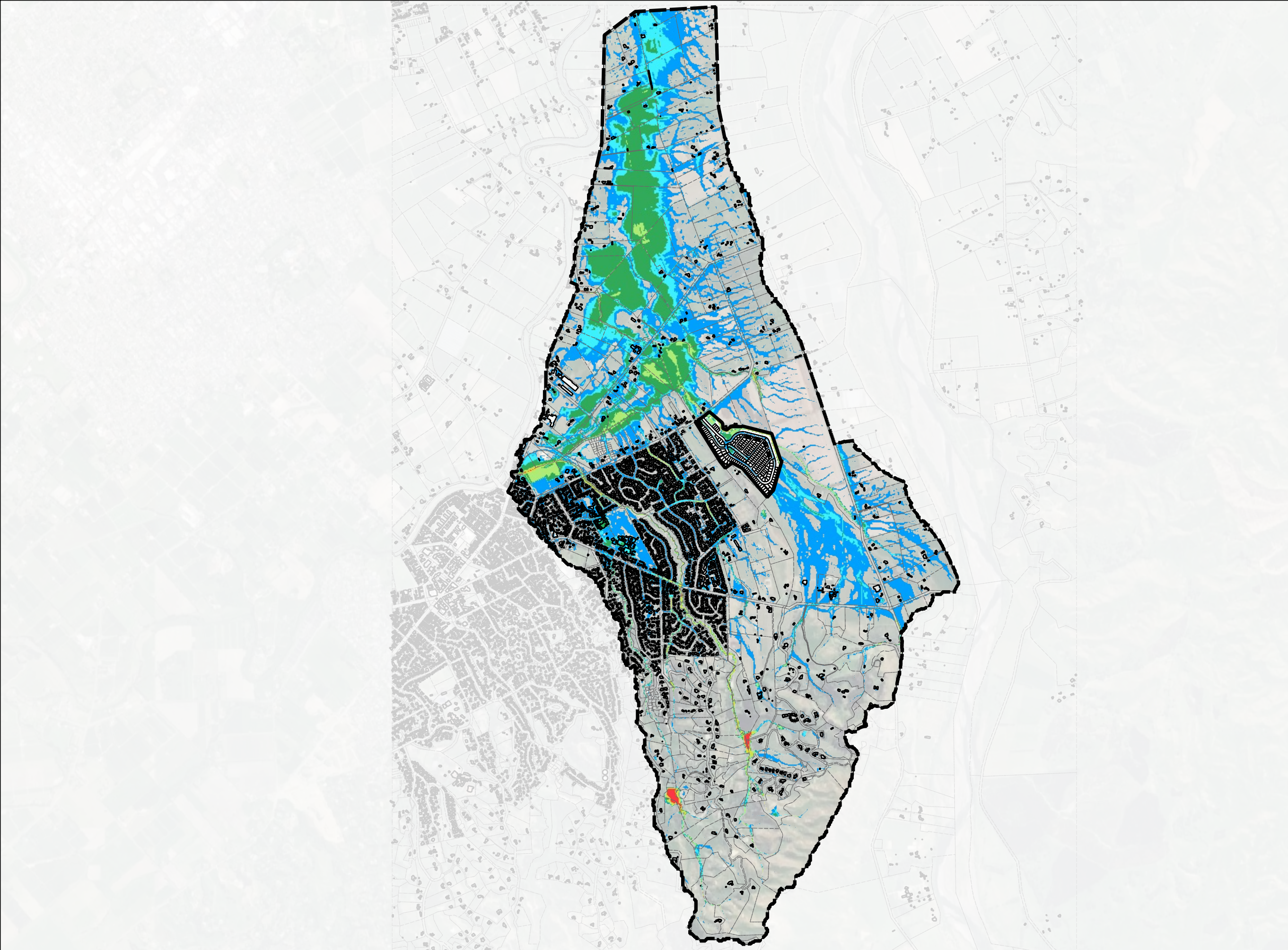
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LEGEND

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- Parcels LINZ
- Ex Buildings LINZ
- Overlay
- Site
- Ex Buildings LINZ
- Parcels LINZ
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- H2
- H3
- H4
- H5
- H6
- Background
Google Satellite

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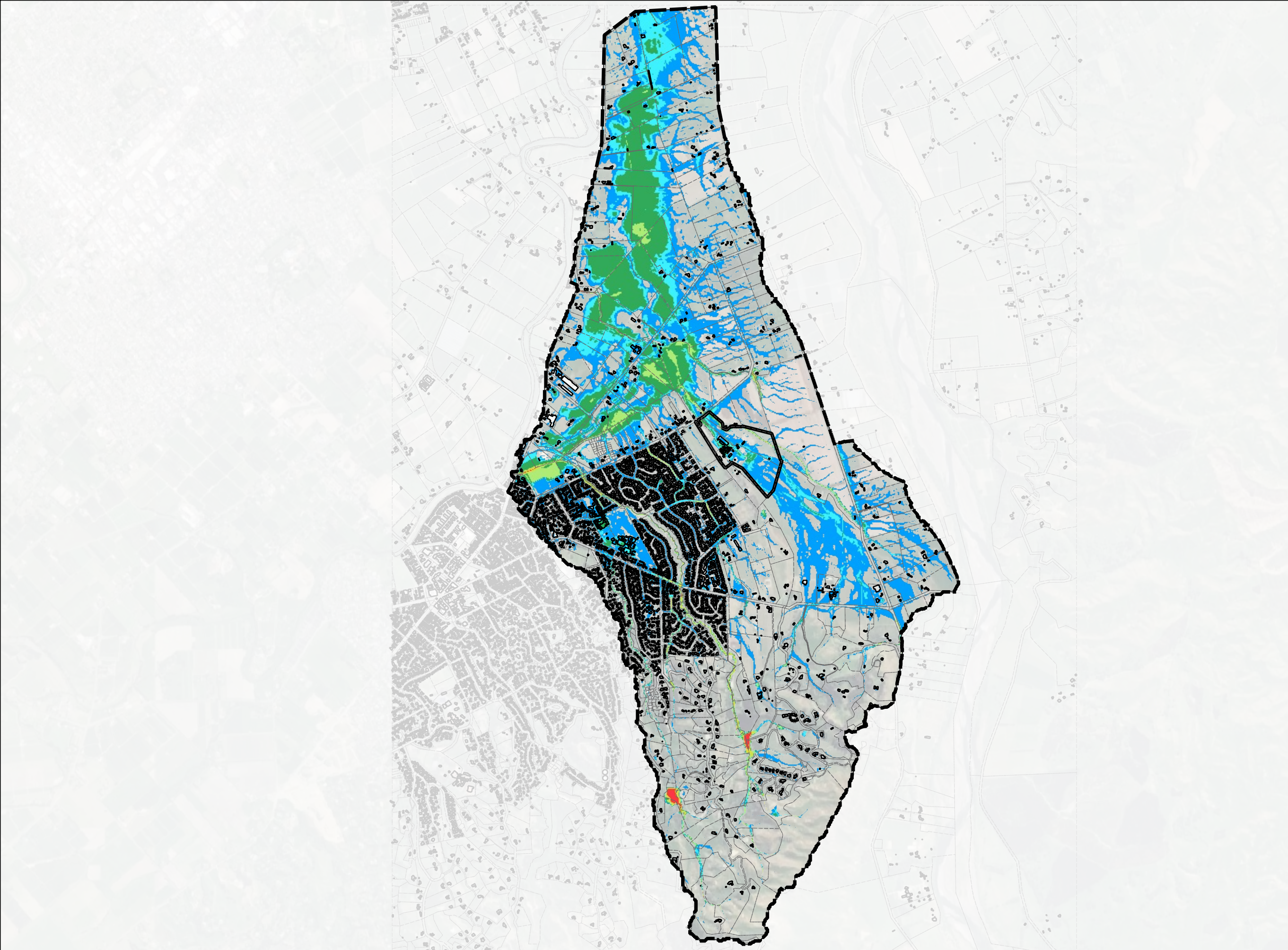
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LEGEND

-  2D Model Extent
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-  Pr Lot Boundaries
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-  Site
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-  Parcels LINZ
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-  H2
-  H3
-  H4
-  H5
-  H6
-  Background Proposed
-  Site
-  Background
- Google Satellite

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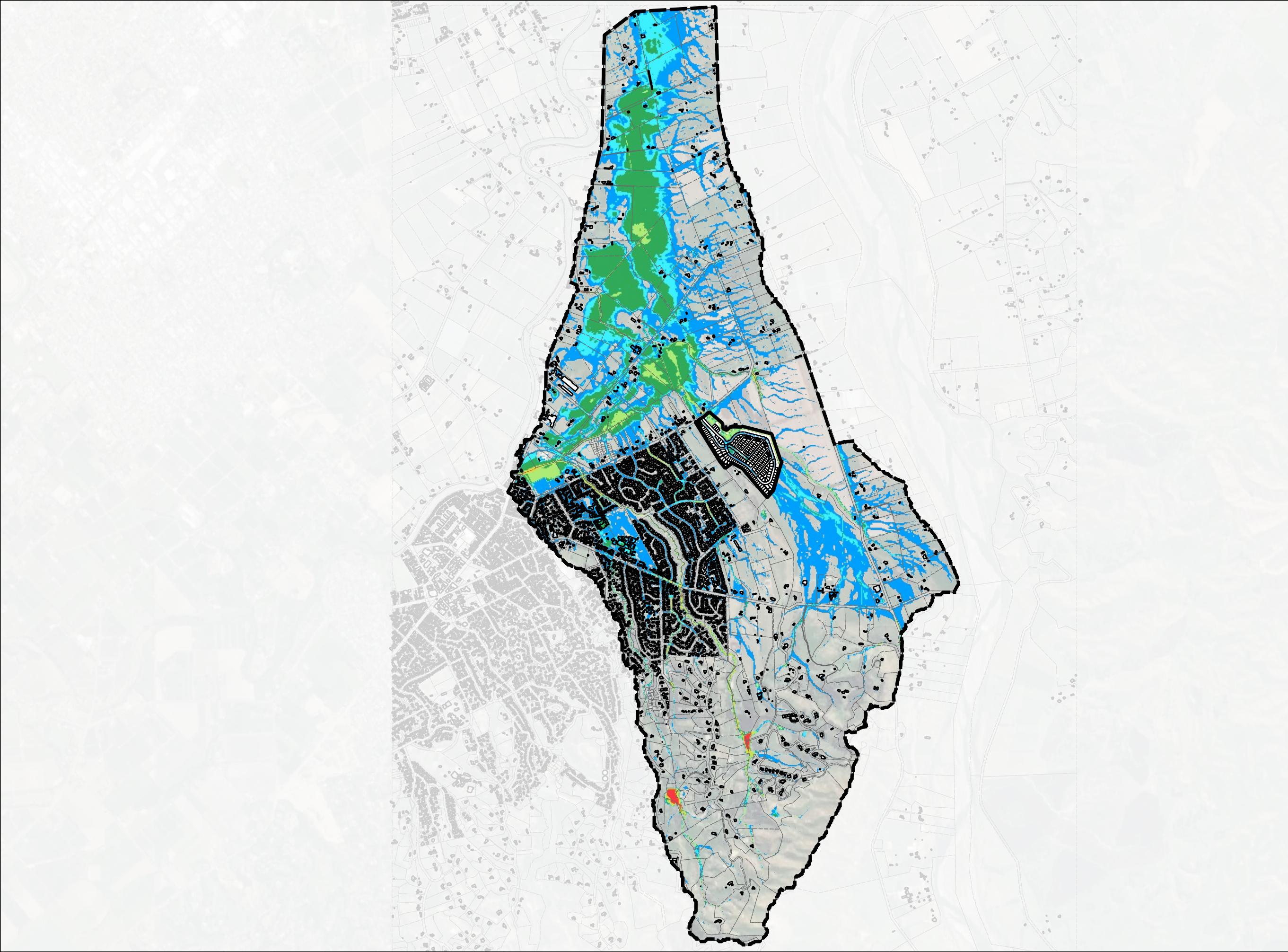
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- Parcels LINZ
- Ex Buildings LINZ
- Overlay
- Site
- Ex Buildings LINZ
- Parcels LINZ
- Blocked, EX - 100yr, CC - v132
EX_100YR_CC_Blocked_ZAEM1_Max
- Band 1 (Gray)
- H1
- H2
- H3
- H4
- H5
- H6
- Background
Google Satellite

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LEGEND

-  2D Model Extent
-  Overlay Proposed
-  Pr Lot Boundaries
- Overlay

 Site

 Ex Buildings LINZ

 Parcels LINZ
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PR_100YR_CC_Blocked_135_ZAEM1_Max
Band 1 (Gray)

 H1

 H2

 H3

 H4

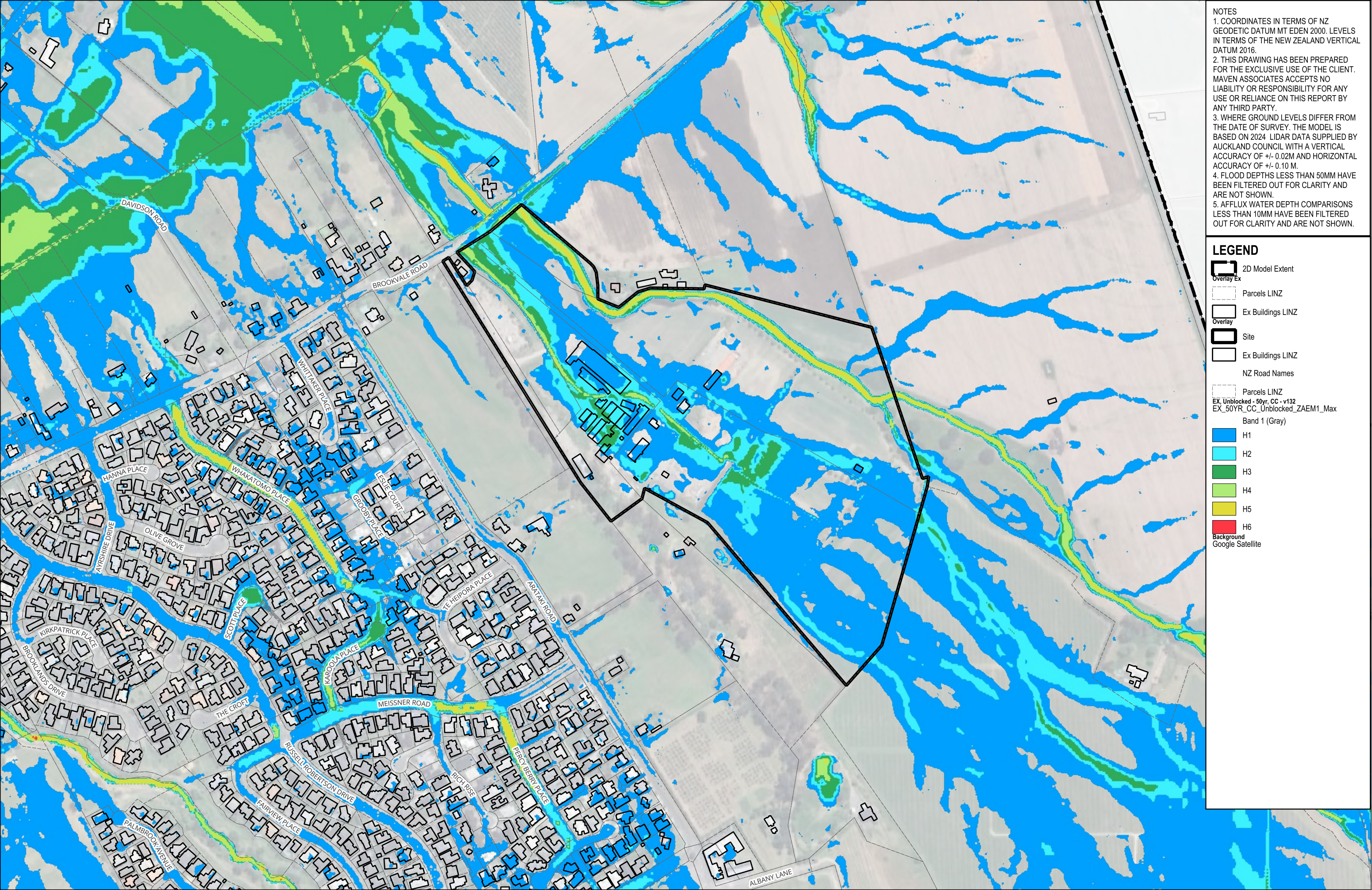
 H5

 H6
- Background Proposed

 Site

 Background Google Satellite

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A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW					SCALE	1:30,000	A
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LEGEND

2D Model Extent
Overlay Ex

Parcels LINZ

Ex Buildings LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

EX_Unblocked - 50yr, CC - v132
EX_50YR_CC_Unblocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

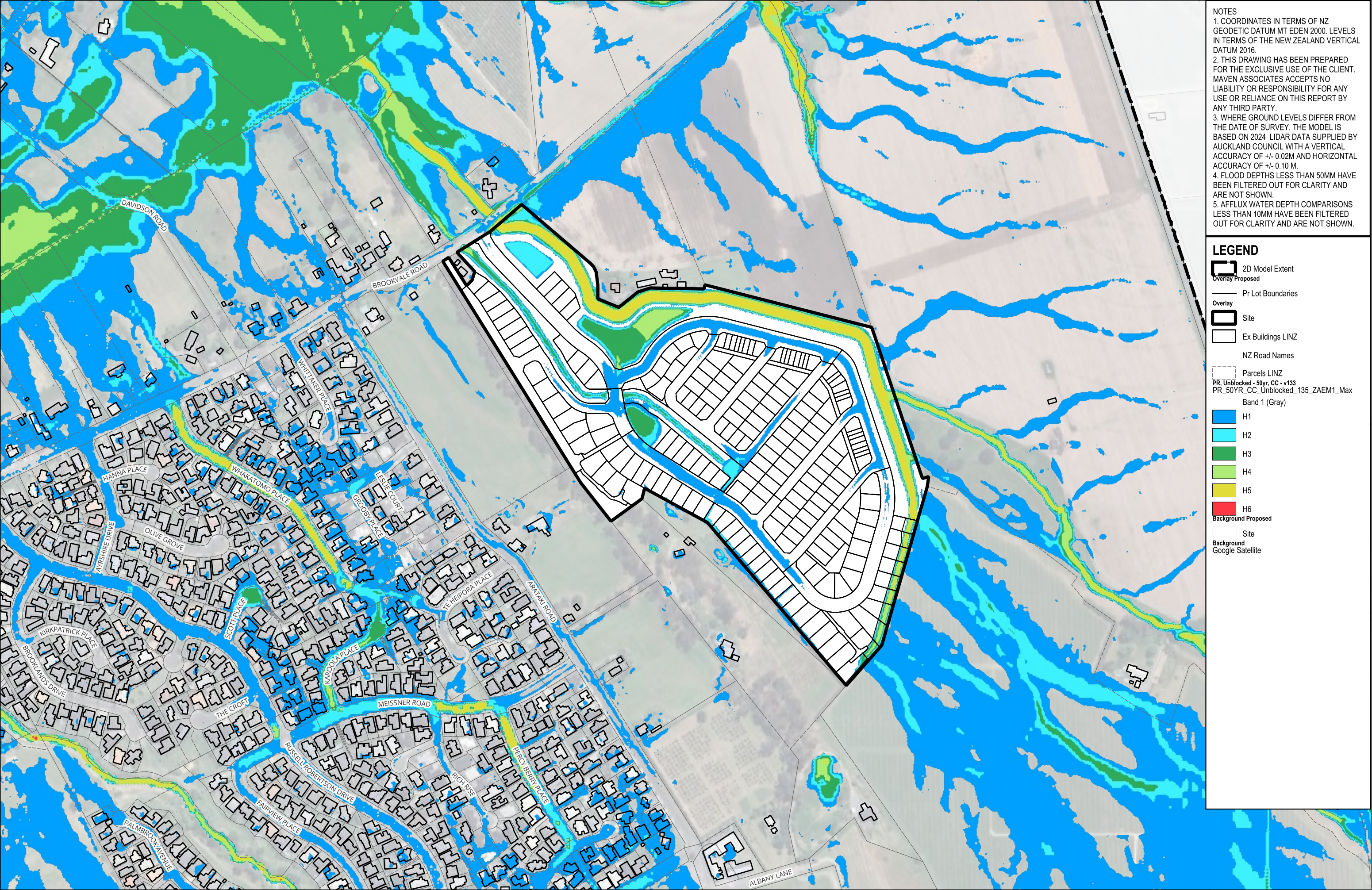
H4

H5

H6

Background
Google Satellite

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LEGEND

2D Model Extent
Overlay Proposed

Pr Lot Boundaries

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

PR_Unblocked - 50yr, CC - v133

PR_50YR_CC_Unblocked_135_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

H5

H6

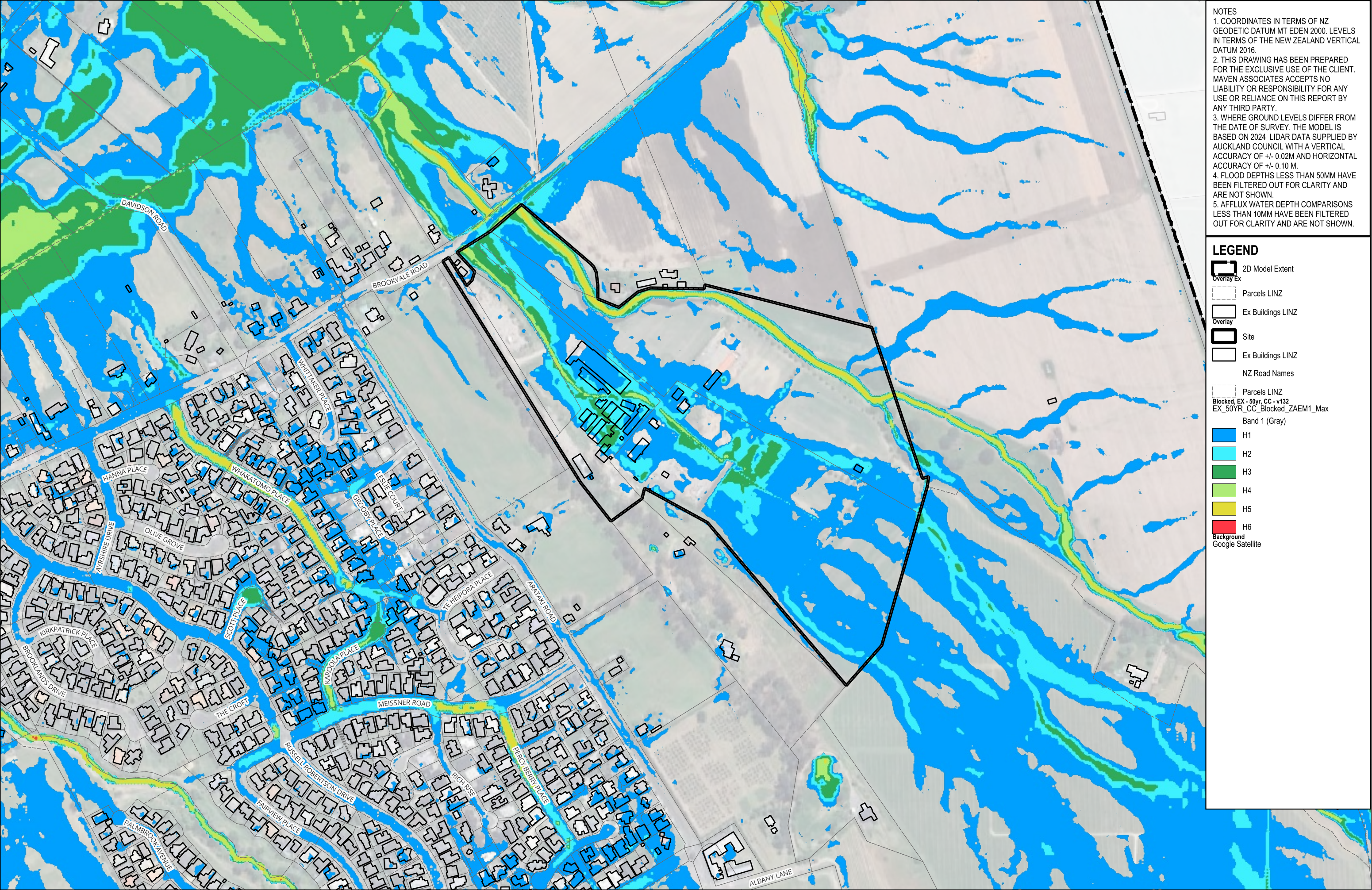
Background Proposed

Site

Background

Google Satellite

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LEGEND

2D Model Extent

Overlay Ex

Parcels LINZ

Ex Buildings LINZ

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, EX - 50yr, CC - v132

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Band 1 (Gray)

H1

H2

H3

H4

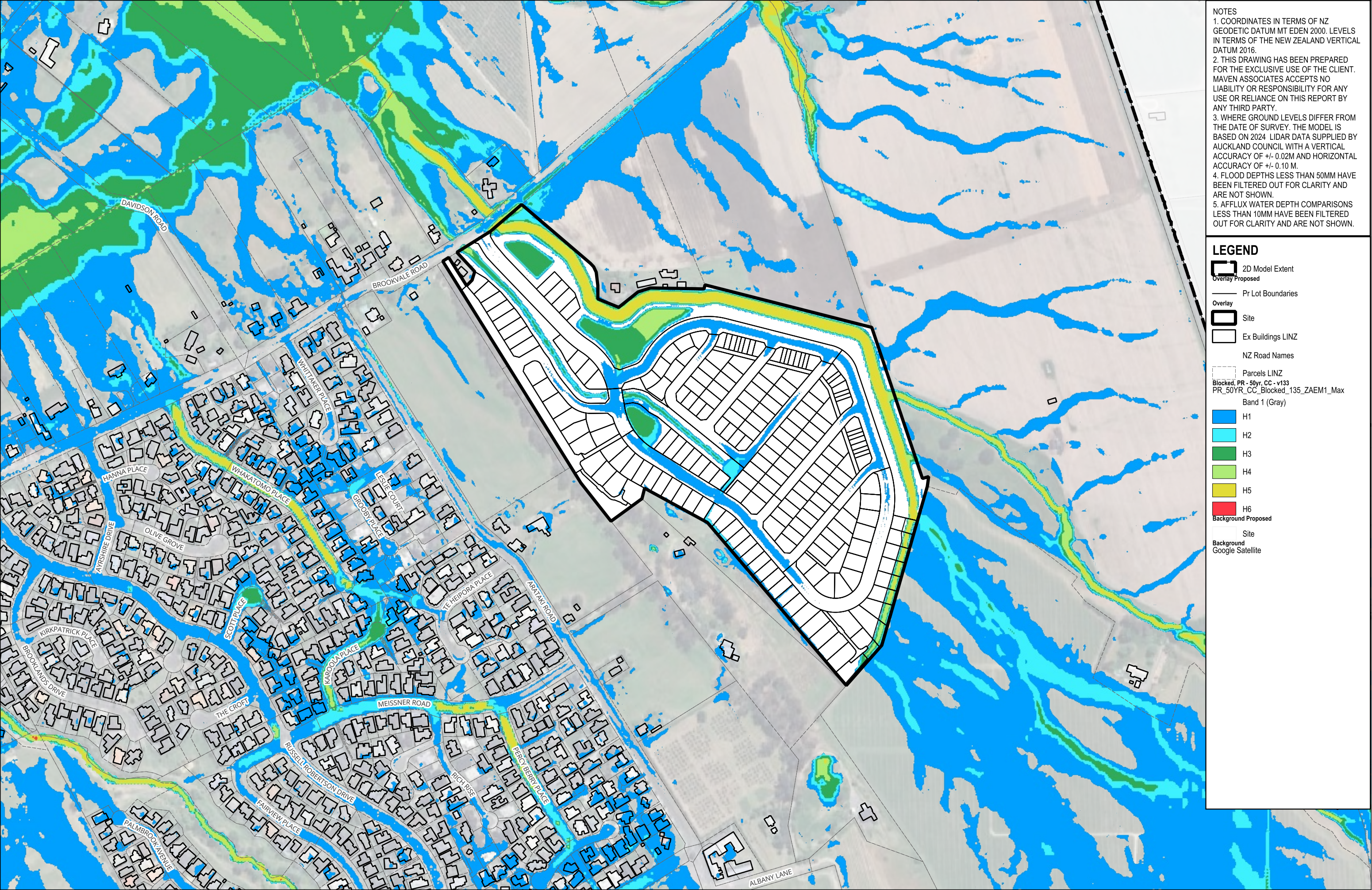
H5

H6

Background

Google Satellite

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LEGEND

2D Model Extent
Overlay Proposed

Pr Lot Boundaries

Overlay
Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, PR - 50yr, CC - v133
PR_50YR_CC_Blocked_135_ZAEM1_Max
Band 1 (Gray)

H1

H2

H3

H4

H5

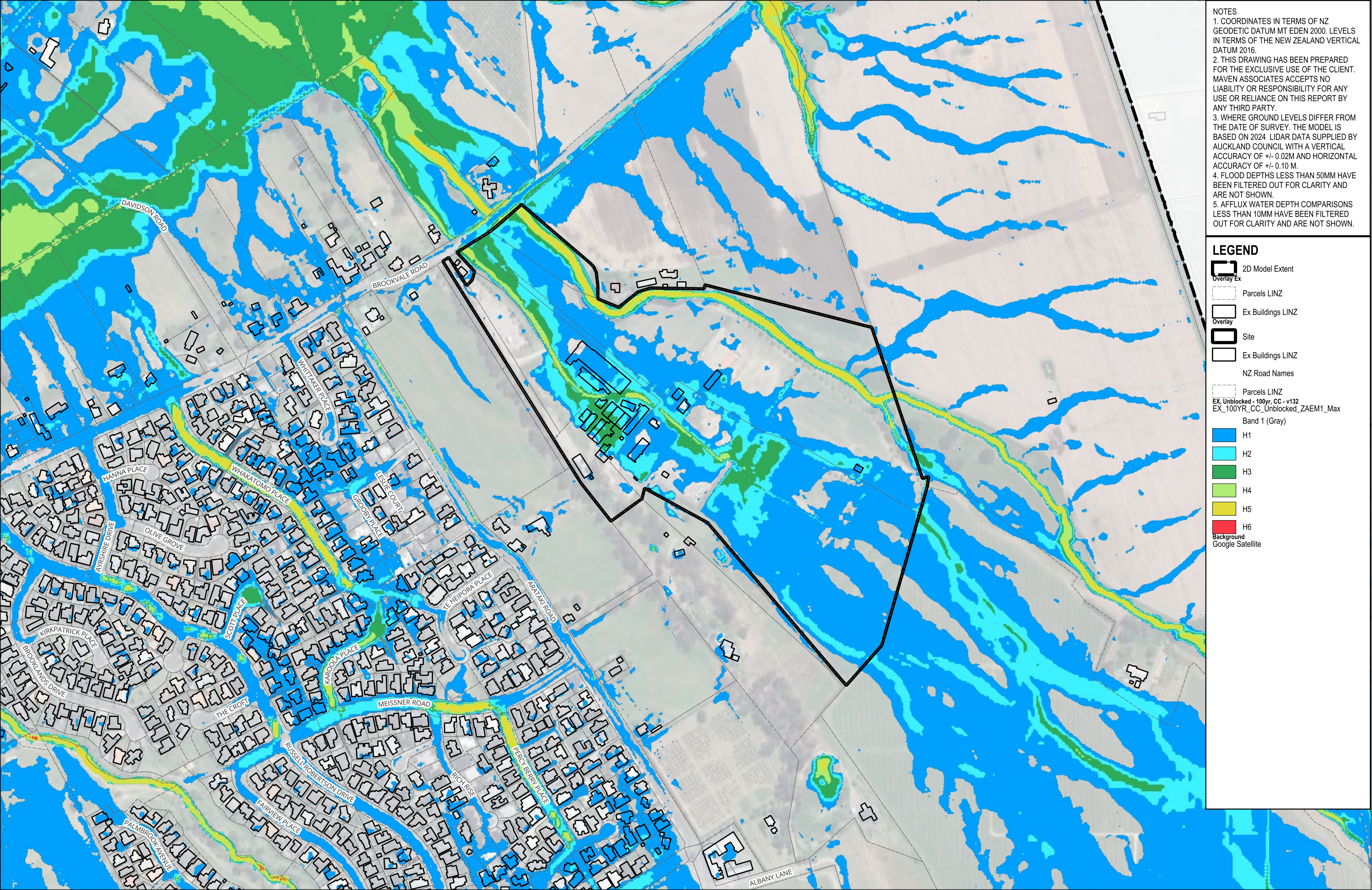
H6

Background Proposed

Site

Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 50yr ARI (CC) (Blocked) Sheet 2			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:5,000	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-232502	



NOTES

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LEGEND

2D Model Extent
Overlay Ex

Parcels LINZ

Ex Buildings LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

EX_Unblocked - 100yr, CC - v132

EX_100YR_CC_Unblocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

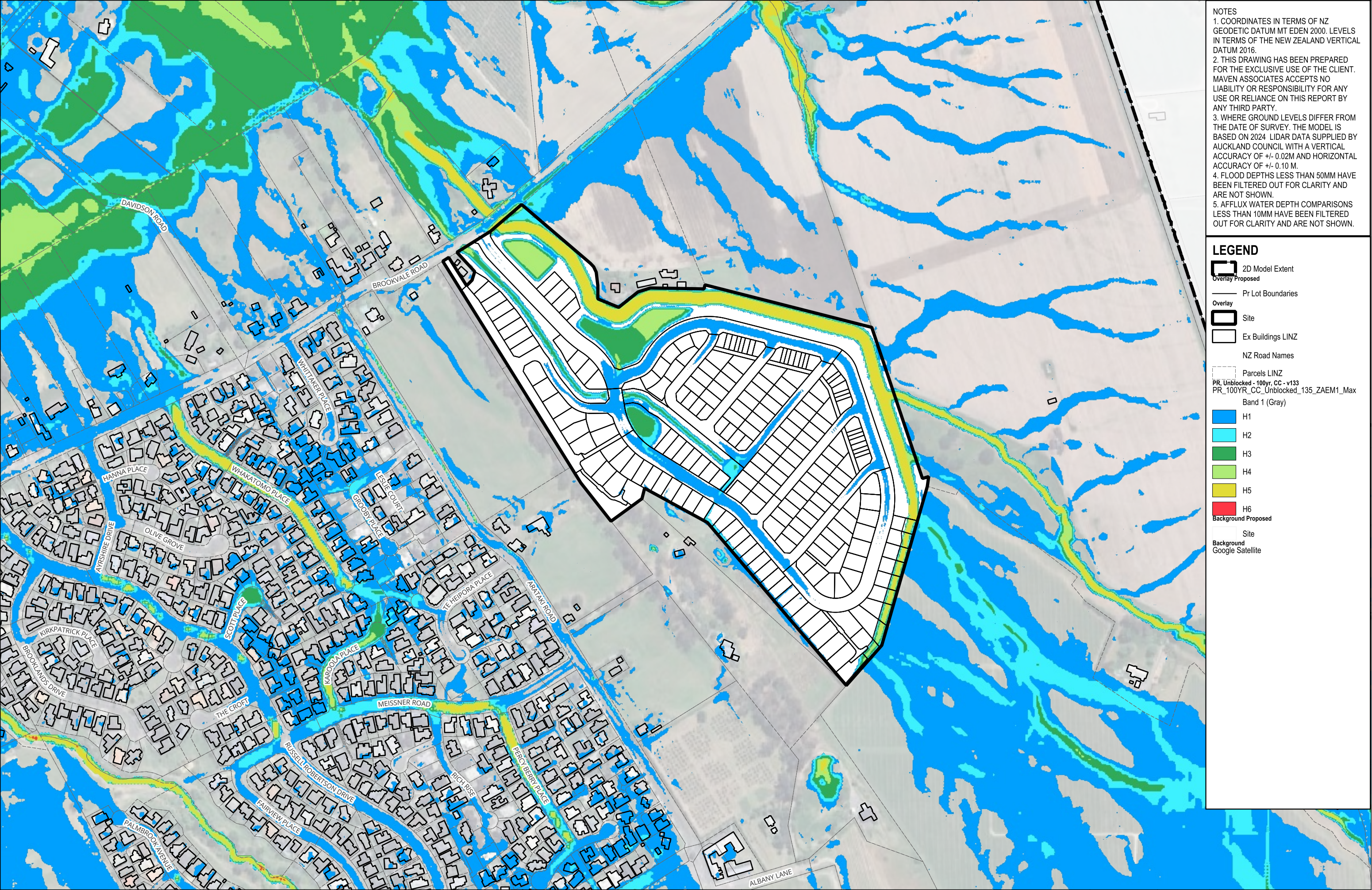
H4

H5

H6

Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Existing - 100yr ARI (CC) (Unblocked) Sheet 2			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:5,000	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-211602	



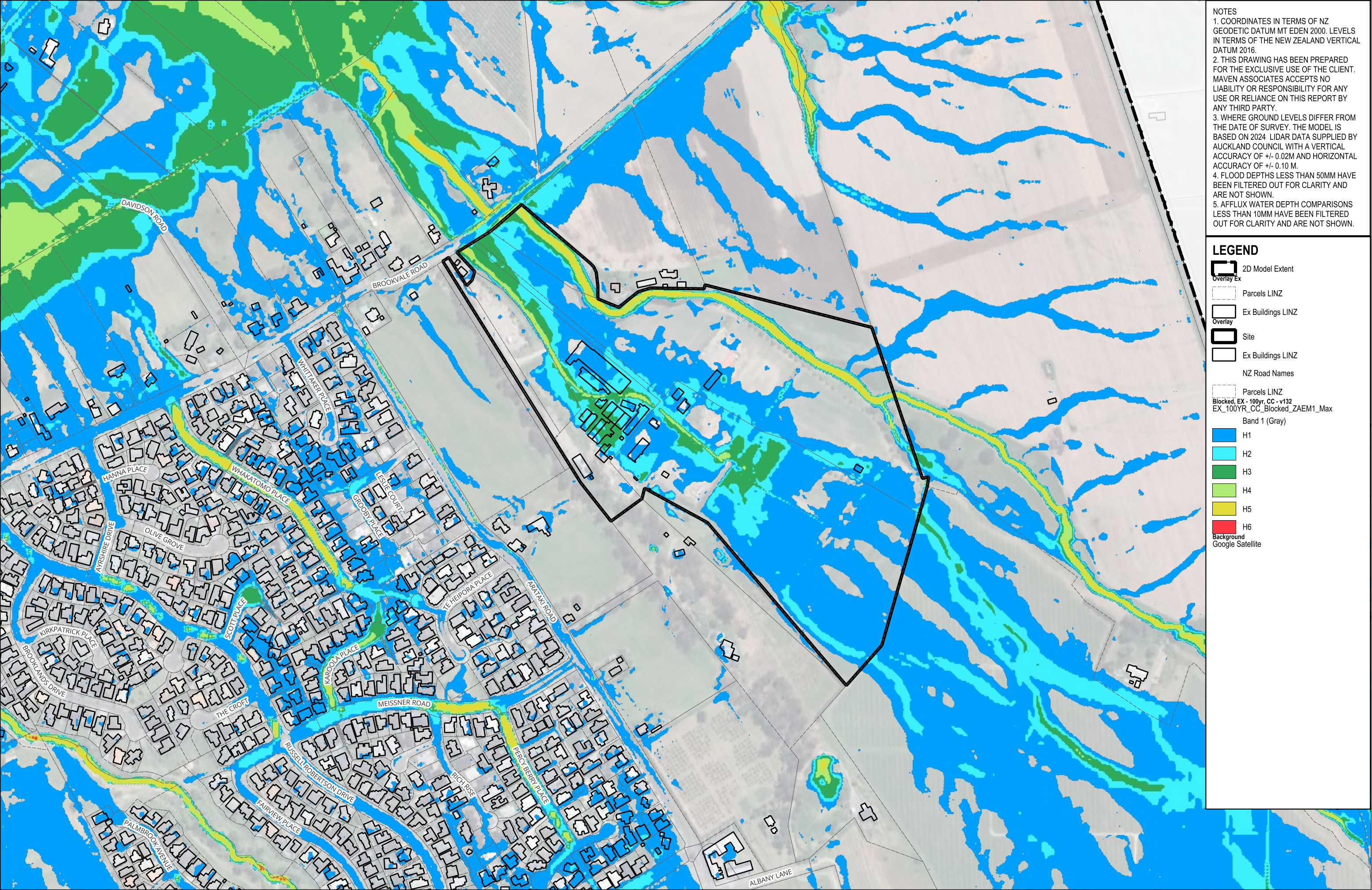
NOTES

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LEGEND

- 2D Model Extent
- Overlay Proposed
- Pr Lot Boundaries
- Overlay
- Site
- Ex Buildings LINZ
- NZ Road Names
- Parcels LINZ
- PR_Unblocked - 100yr, CC - v133
- PR_100YR_CC_Unblocked_135_ZAEM1_Max
- Band 1 (Gray)
- H1
- H2
- H3
- H4
- H5
- H6
- Background Proposed
- Site
- Background
- Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 100yr ARI (CC) (Unblocked) Sheet 2			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:5,000	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-231602	



NOTES

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LEGEND

2D Model Extent

Overlay Ex

Parcels LINZ

Ex Buildings LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, EX - 100yr, CC - v132
EX_100YR_CC_Blocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

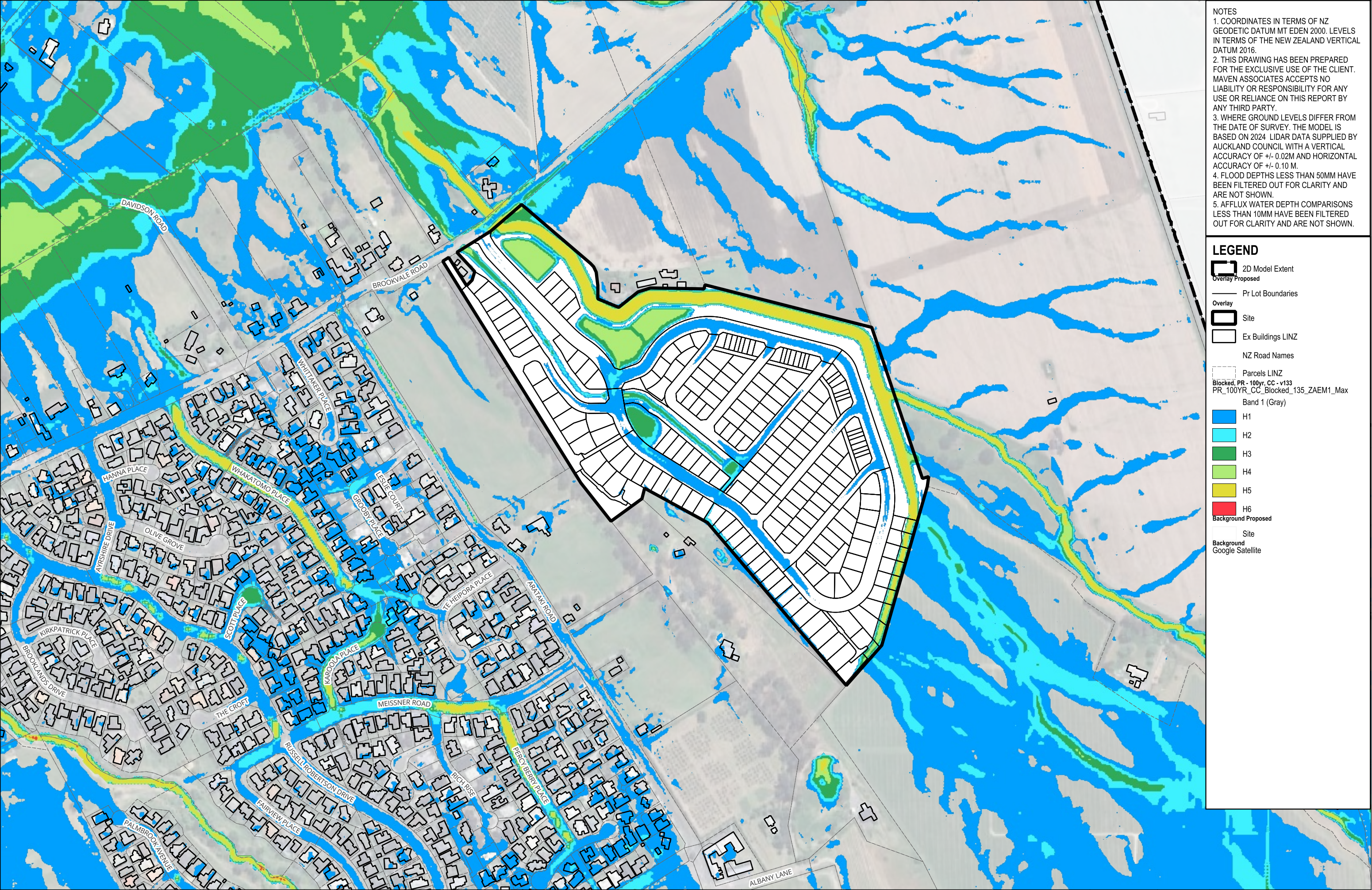
H4

H5

H6

Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Existing - 100yr ARI (CC) (Blocked) Sheet 2			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:5,000	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-212602	



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LEGEND

2D Model Extent
Overlay Proposed

Pr Lot Boundaries

Overlay
Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ
Blocked_PR - 100yr_CC - v133
PR_100YR_CC_Blocked_135_ZAEM1_Max
Band 1 (Gray)

H1

H2

H3

H4

H5

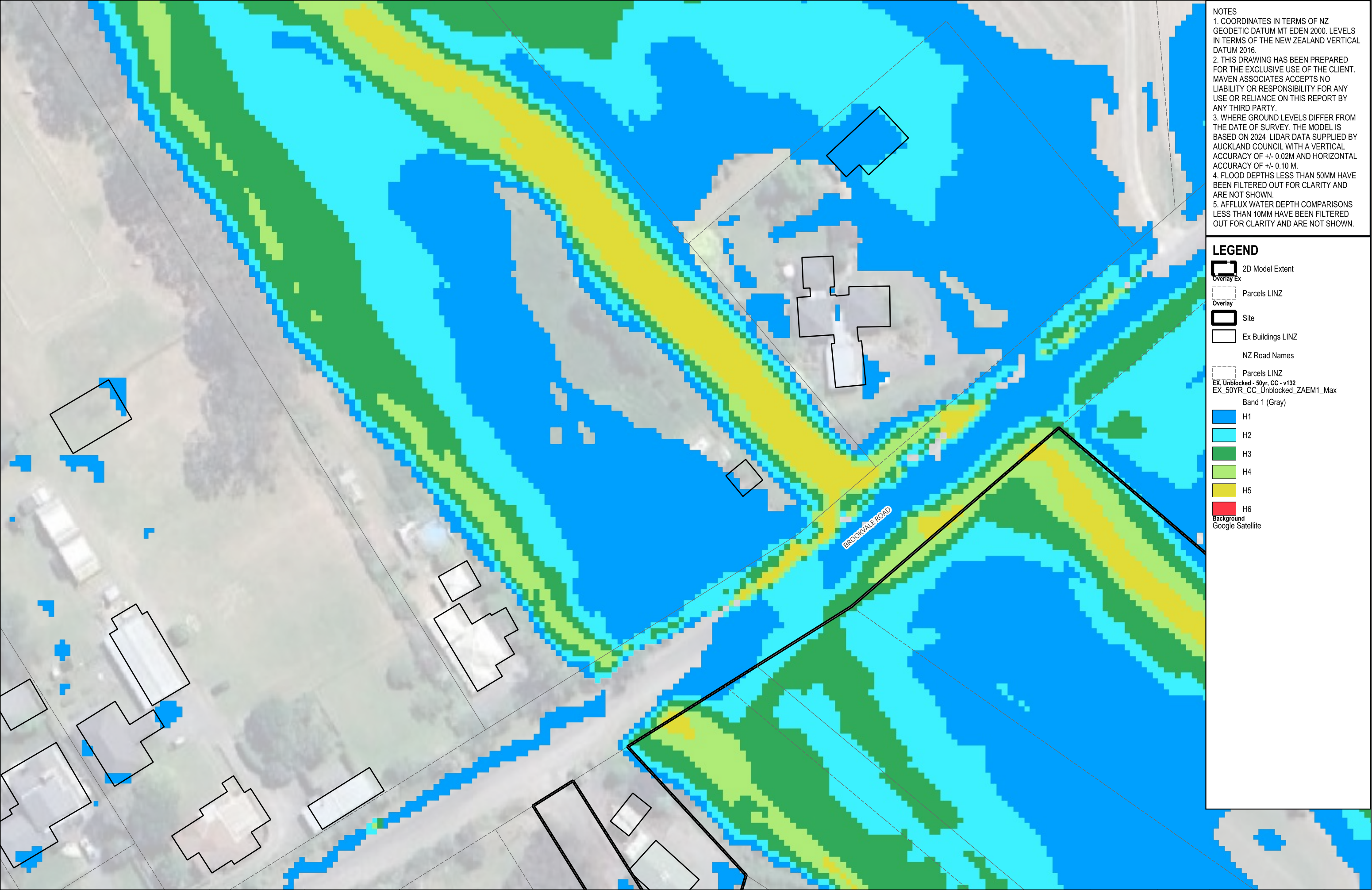
H6

Background Proposed

Site

Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 100yr ARI (CC) (Blocked) Sheet 2			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:5,000	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-232602	



NOTES

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LEGEND

2D Model Extent

Overlay Ex

Parcels LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

EX_Unblocked - 50yr_CC - v132

EX_50YR_CC_Unblocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

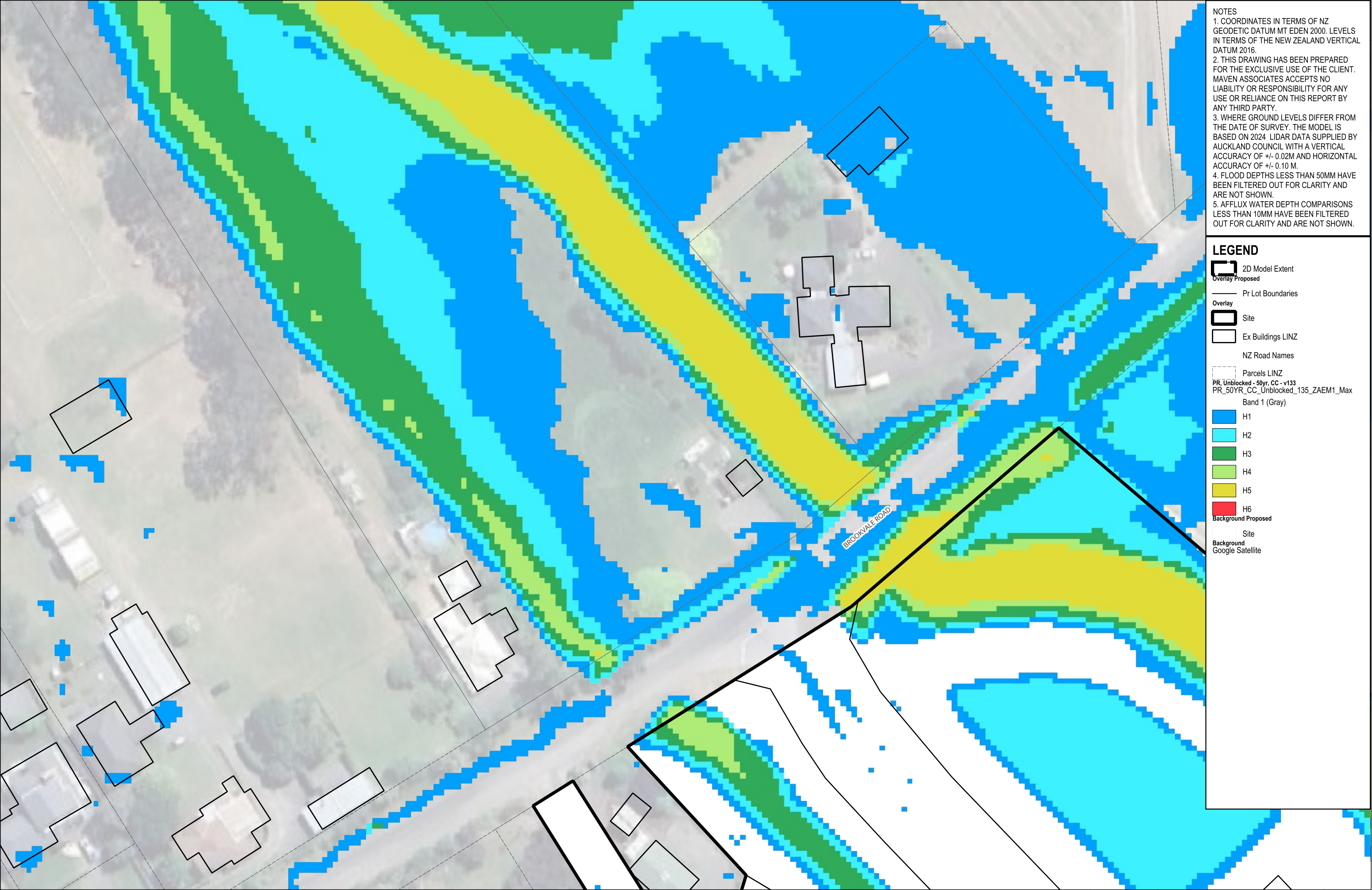
H5

H6

Background

Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Existing - 50yr ARI (CC) (Unblocked) Sheet 3			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:750	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-211503	



NOTES

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LEGEND

2D Model Extent
Overlay Proposed

Pr Lot Boundaries

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

PR_Unblocked - 50yr, CC - v133

PR_50YR_CC_Unblocked_135_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

H5

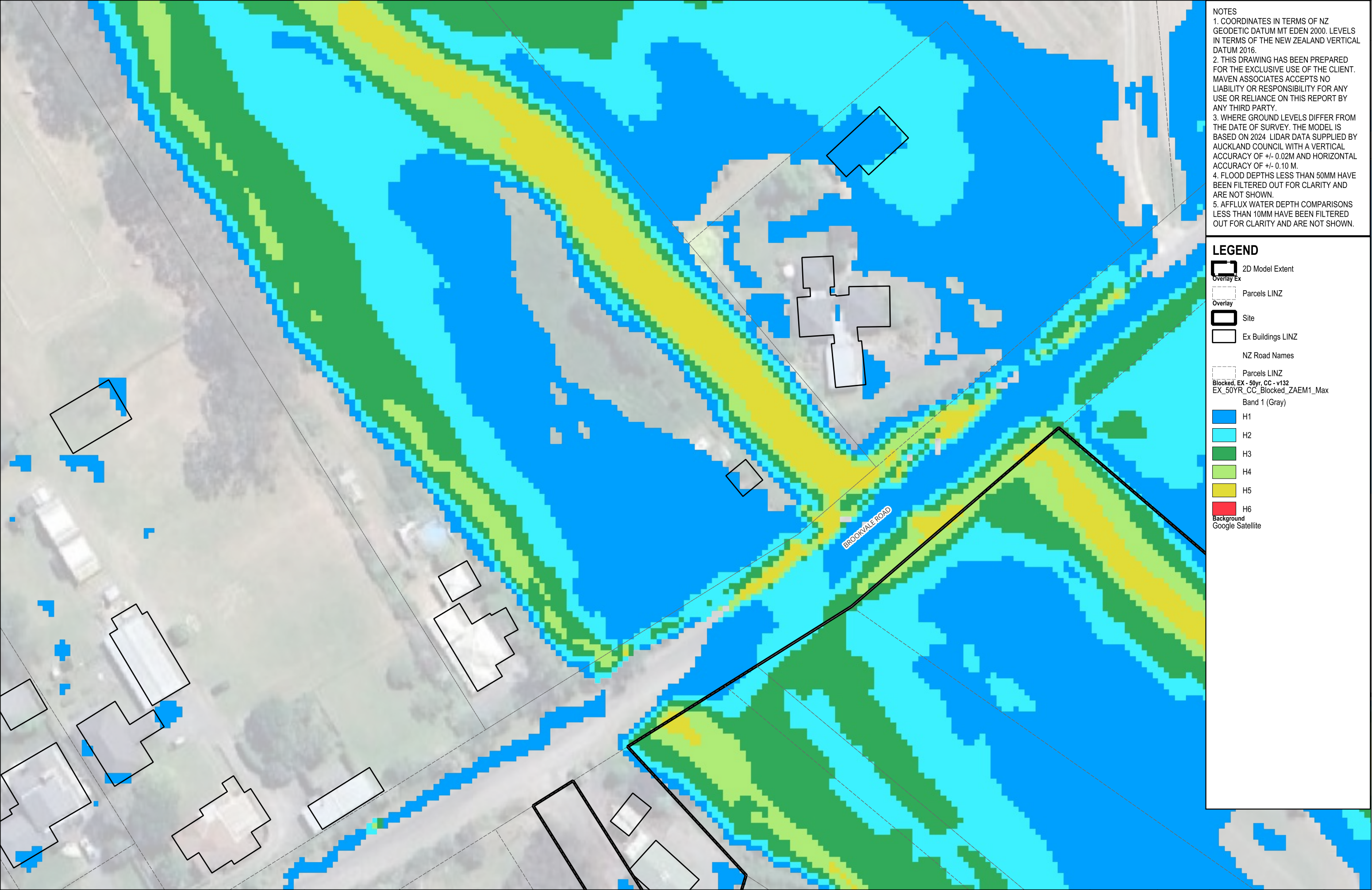
H6

Background Proposed

Site

Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 50yr ARI (CC) (Unblocked) Sheet 3		STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW					SCALE	1:750	A
				Draft	YW							
				Checked	TM					SHEET	135041-FL-231503	



NOTES

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LEGEND

2D Model Extent

Overlay Ex

Parcels LINZ

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, EX - 50yr, CC - v132

EX_50YR_CC_Blocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

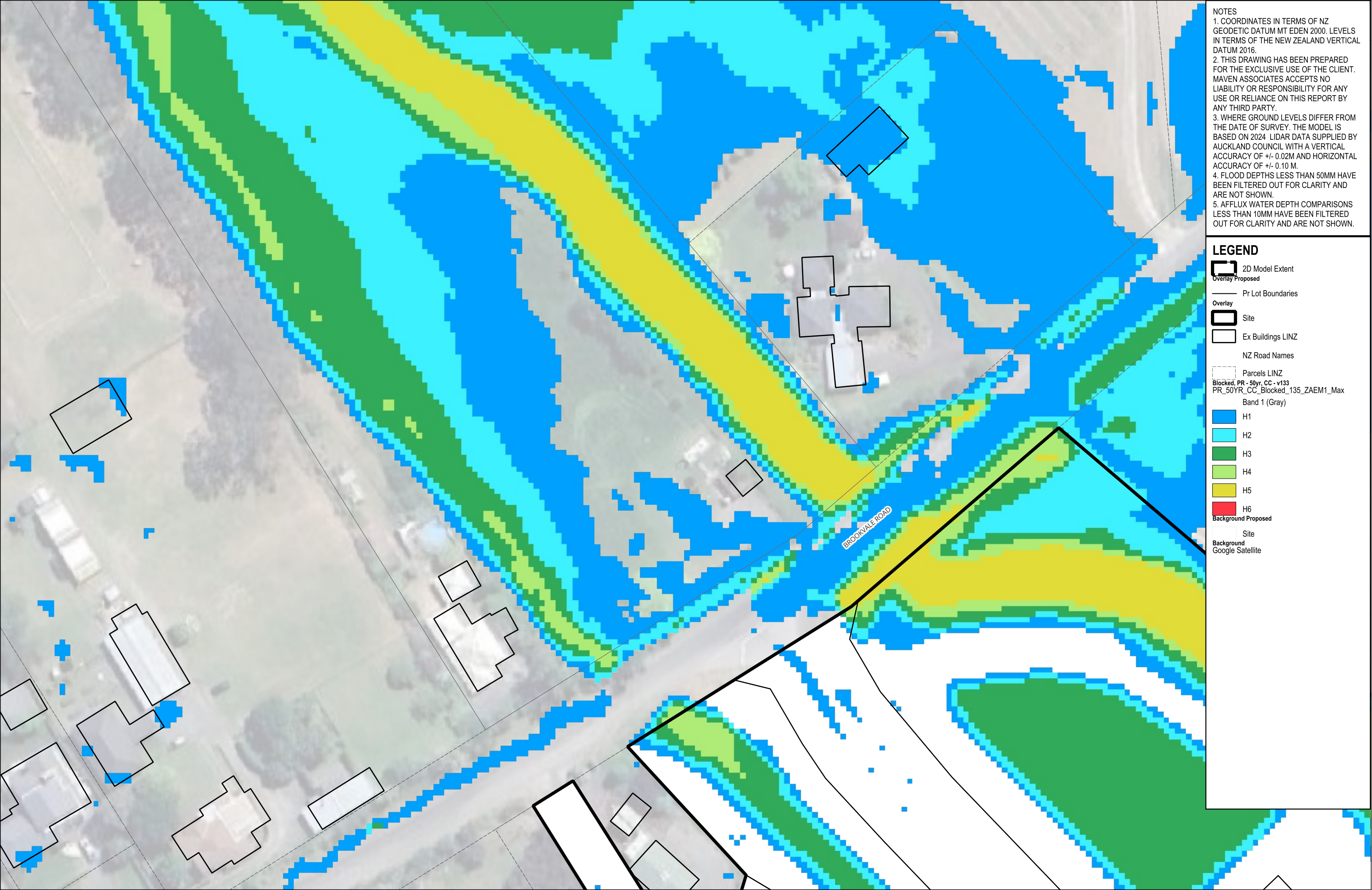
H4

H5

H6

Background Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Existing - 50yr ARI (CC) (Blocked) Sheet 3			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:750	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-212503	



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LEGEND

2D Model Extent

Overlay Proposed

Pr Lot Boundaries

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, PR - 50yr, CC - v133

PR_50YR_CC_Blocked_135_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

H5

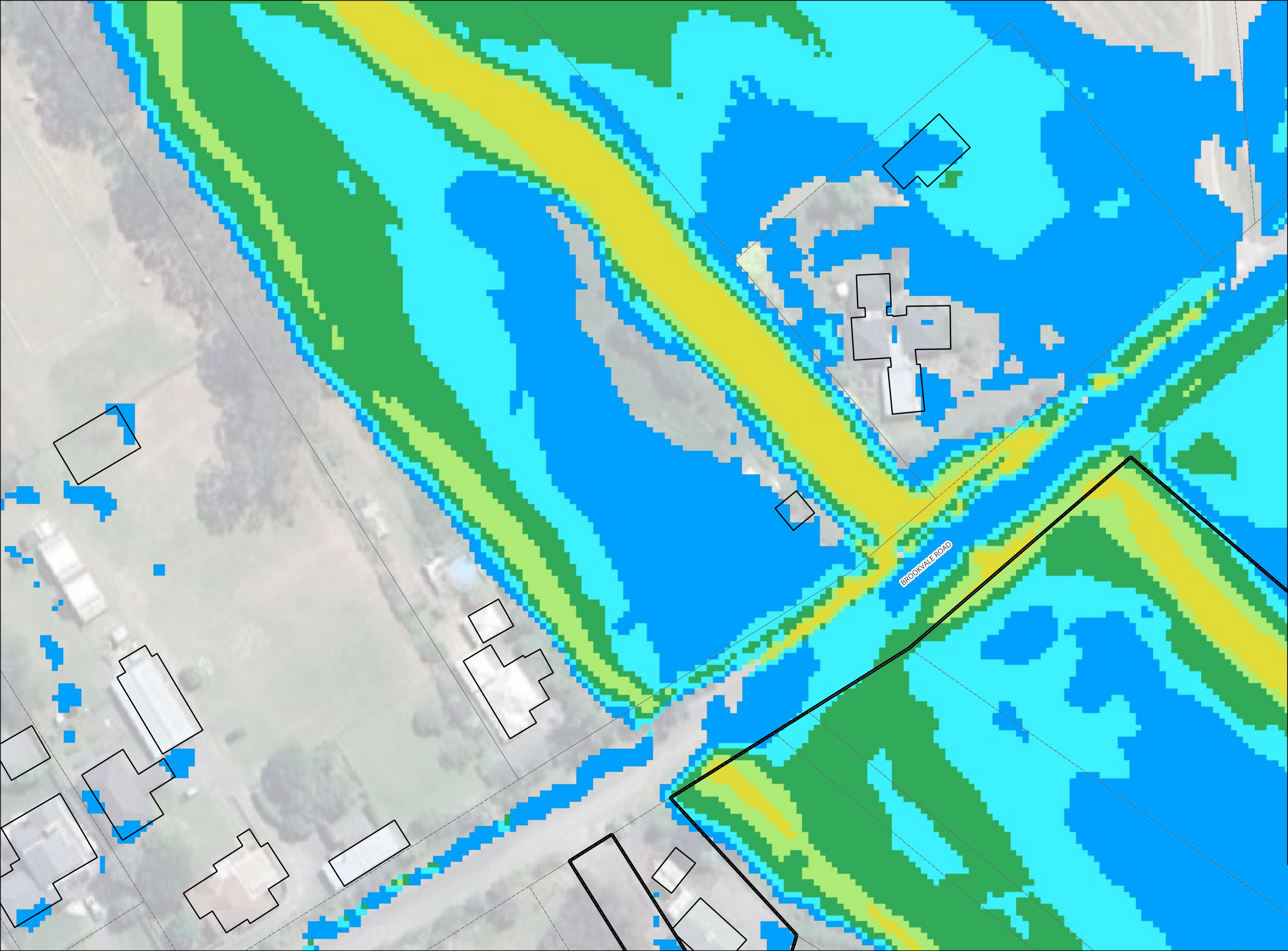
H6

Background Proposed

Site

Background Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 50yr ARI (CC) (Blocked) Sheet 3			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:750	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-232503	



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LEGEND

2D Model Extent
Overlay Ex

Parcels LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

EX_Unblocked - 100yr, CC - v132

EX_100YR_CC_Unblocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

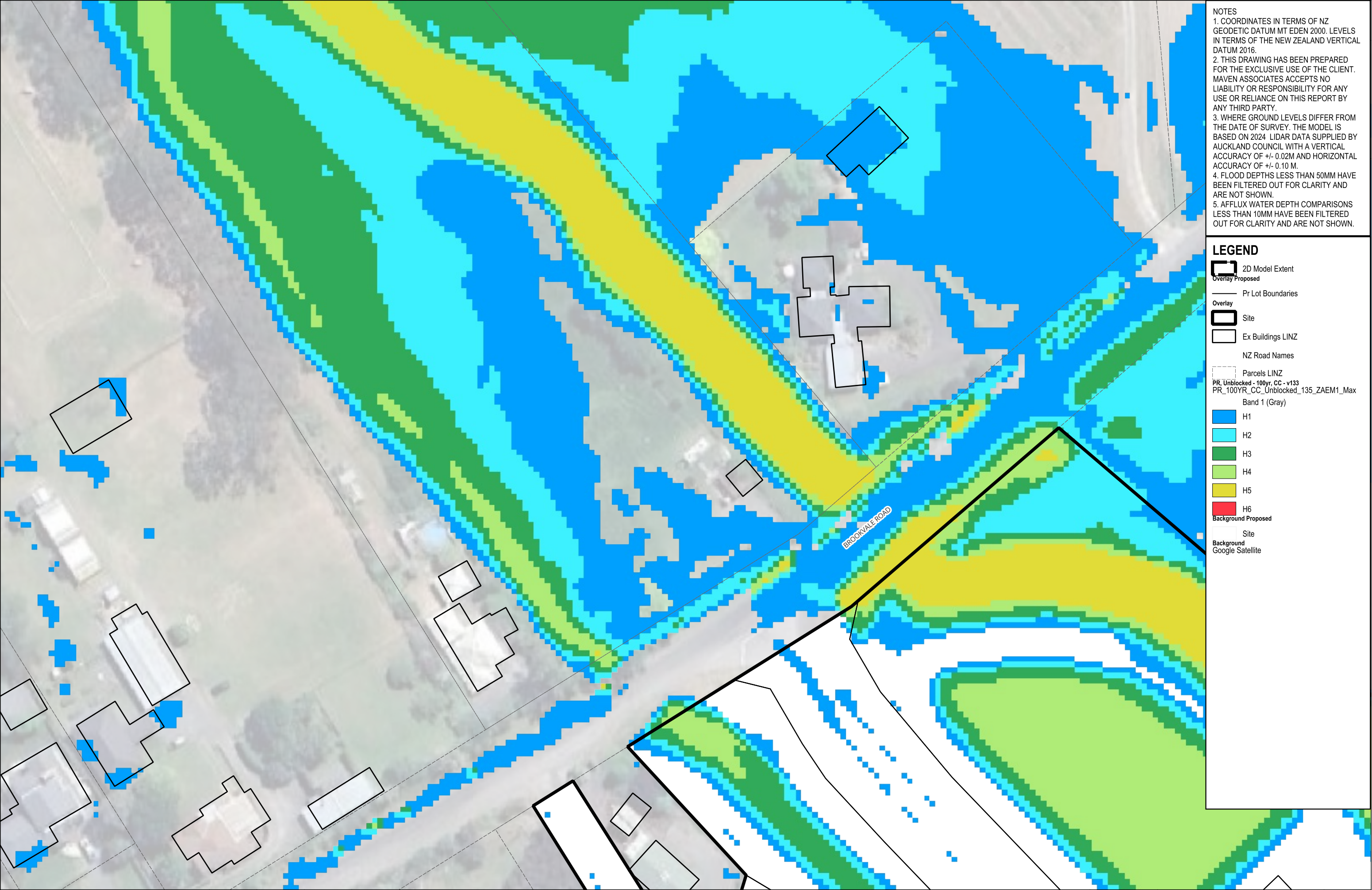
H5

H6

Background

Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Existing - 100yr ARI (CC) (Unblocked) Sheet 3		STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW					SCALE	1:750	A
				Draft	YW							
				Checked	TM					SHEET	135041-FL-211603	



NOTES

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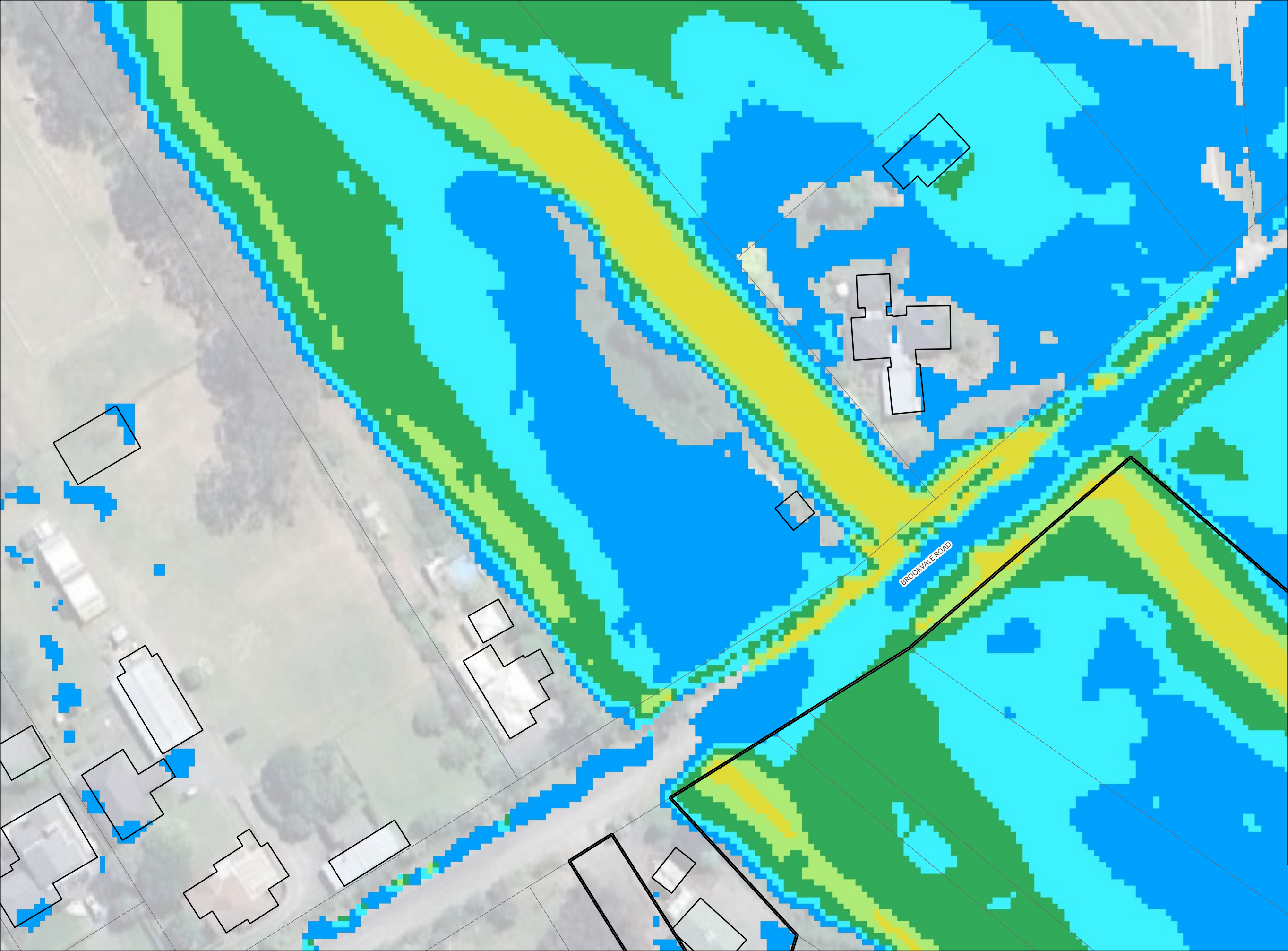
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LEGEND

- 2D Model Extent
- Overlay Proposed
- Pr Lot Boundaries
- Overlay
- Site
- Ex Buildings LINZ
- NZ Road Names
- Parcels LINZ
- PR_Unblocked - 100yr, CC - v133
- PR_100YR_CC_Unblocked_135_ZAEM1_Max
- Band 1 (Gray)
- H1
- H2
- H3
- H4
- H5
- H6
- Background Proposed
- Site
- Background Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	 Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 100yr ARI (CC) (Unblocked) Sheet 3			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:750	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-231603	



NOTES

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LEGEND

2D Model Extent
Overlay Ex

Parcels LINZ

Overlay

Site

Ex Buildings LINZ

NZ Road Names

Parcels LINZ

Blocked, EX - 100yr, CC - v132

EX_100YR_CC_Blocked_ZAEM1_Max

Band 1 (Gray)

H1

H2

H3

H4

H5

H6

Background
Google Satellite

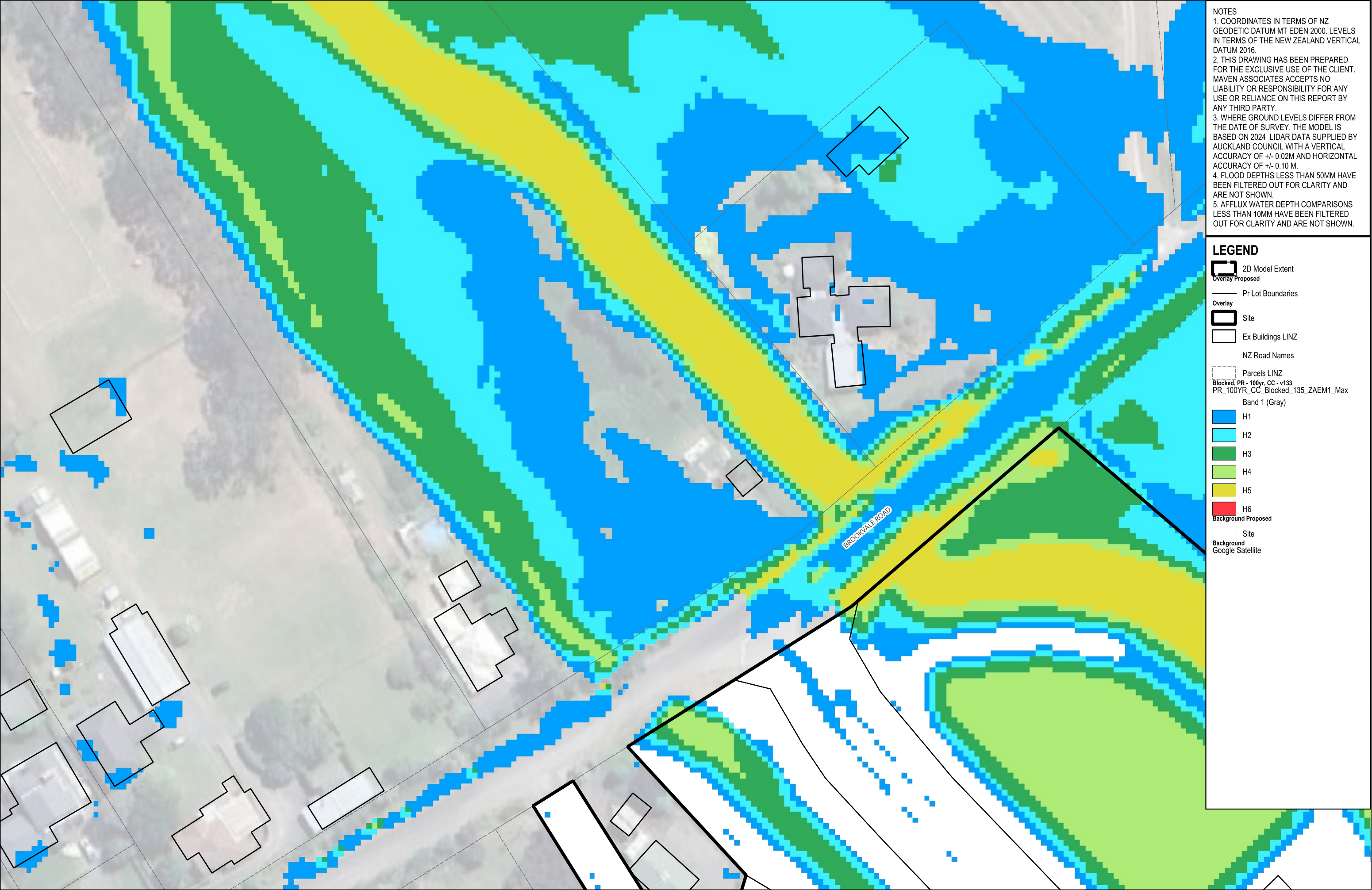
Revision Details		BY	Date	Survey	
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW
				Draft	YW
				Checked	TM

BROOKVALE GREEN
HAVELOCK NORTH
FOR
VERMONT STREET
PARTNERS NO. 4 LIMITED



Hazard - Existing - 100yr ARI (CC) (Blocked) Sheet 3

STATUS	FOR INFORMATION	Rev
SCALE	1:750	A
SHEET	135041-FL-212603	



NOTES

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LEGEND

2D Model Extent
 Overlay Proposed

Overlay

Site
 Ex Buildings LINZ

NZ Road Names

Parcels LINZ
Blocked, PR - 100yr, CC - v133
PR_100YR_CC_Blocked_135_ZAEM1_Max
Band 1 (Gray)

H1
 H2
 H3
 H4
 H5
 H6
Background Proposed

Site
Background
Google Satellite

Revision Details		BY	Date	Survey		BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED	Maven Associates 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023	Hazard - Proposed - 100yr ARI (CC) (Blocked) Sheet 3			STATUS	FOR INFORMATION	Rev
A	SUBSTANTIVE APPLICATION	YW	2026-06-24	Model	YW						SCALE	1:750	A
				Draft	YW								
				Checked	TM						SHEET	135041-FL-232603	