

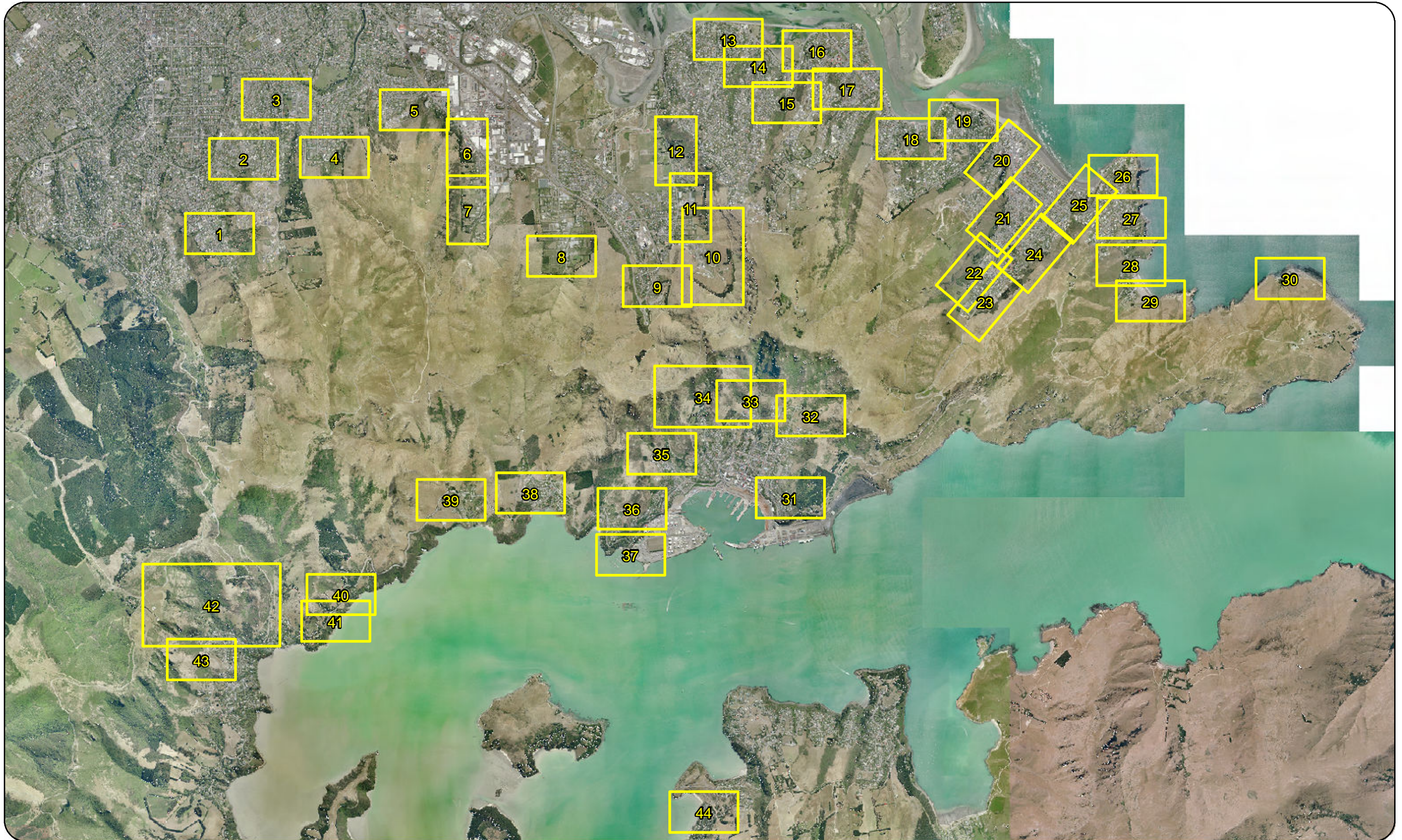
Port Hills zoning review



1:40,000 @A3
500 250 0 500 1,000 m

Port Hills Zoning Review: Zoning Changes

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Data Sources CERA, CCC
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Site specific considerations relating to the GNS model for Map 23:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following area:

- Properties on Sumnervale Drive near Evans Pass Road (e.g. 98, 1/104, 2/104, 106 and 114 Sumnervale Drive):

The GNS rockfall risk model significantly understates the risk to this entire area due to suburb wide averaging, changes of topography and different rock sources. Expert advice to the Advisory Panel indicated that, although the road between the rockfall source and these properties may act as a bench, the experts were not convinced that it provided sufficient protection. Despite the presence of the road, significant boulders were mapped beyond the risk line.



1:2,000
20 10 0 20 40 m

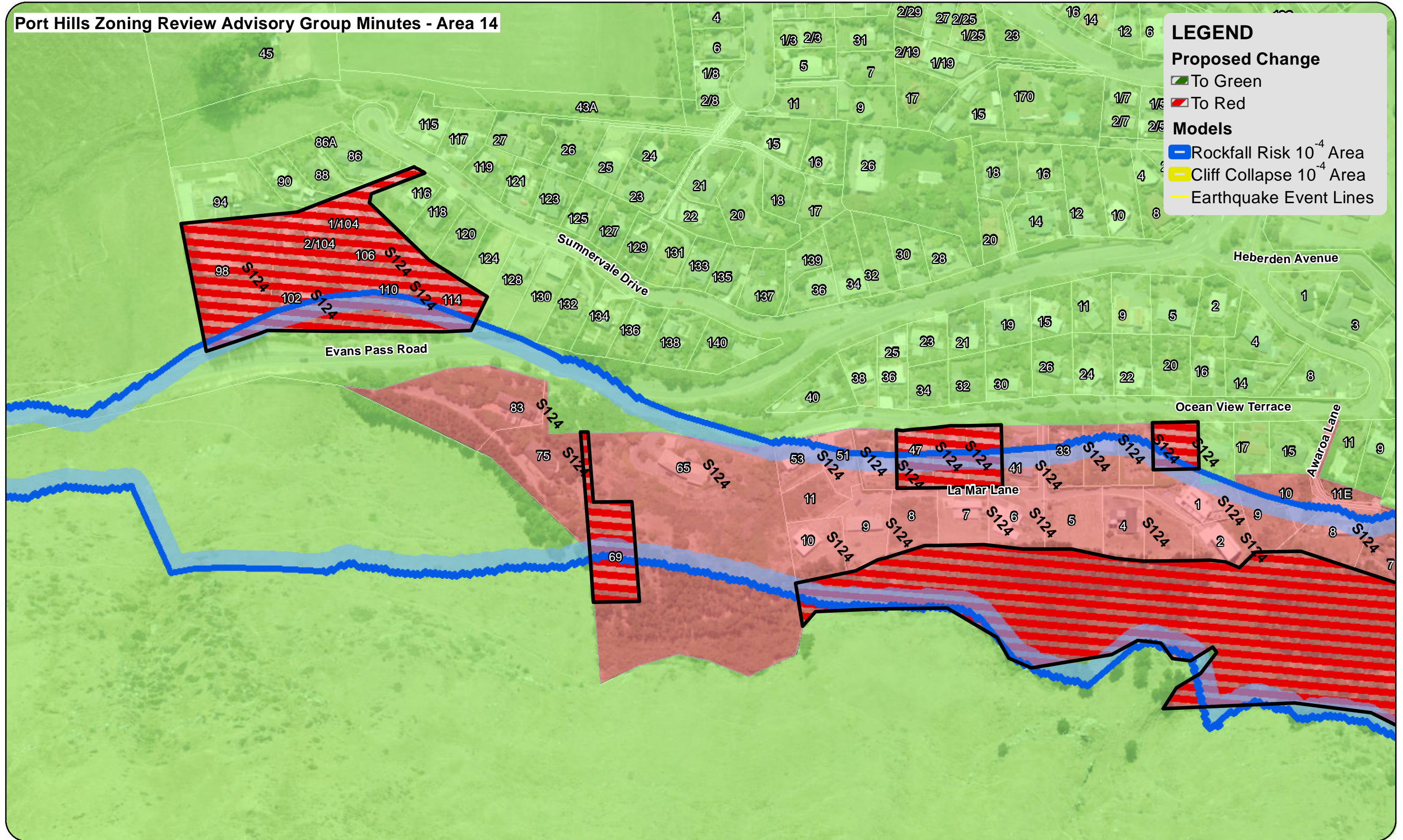
@A3

Port Hills Zoning Review: Zoning Changes

Map 23: Sumnervale

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Port Hills Zoning Review Advisory Group Minutes - Area 14



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 24:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Property at 74 Heberden Avenue:

The GNS rockfall model tends to overstate the life safety risk to this property as it does not account for local topography which would tend to direct rockfall away from the area. It also does not account for the presence of the road and flat terrain which reduces the likelihood of rocks reaching the area. (In most circumstances the presence of a flat area such as a road carriageway or building platform tends to reduce the rockfall risk for properties located below the flat area.)

- Property at 48 Heberden Avenue:

Expert advice to the Advisory Panel indicated that the GNS models significantly understates the life safety risk to this property, as it does not account for topographical constraints which would tend to focus rockfall in this area. Expert advice to the Advisory Panel indicated that although the road between the rockfall source and these properties may act as a bench, the experts were not convinced that it provided sufficient protection.

- Properties near the intersection of Heberden Ave and Arnold Street (e.g. 61, 2/55, 1/55, 51, 51A, 51B, 51C Heberden Avenue):

The GNS rockfall model tends to overstate the life safety risk to these properties as the cliffs and lower slopes in this area are man-made and were modified during the building development and have performed well in the numerous earthquakes.



1:2,000
20 10 0 20 40 m

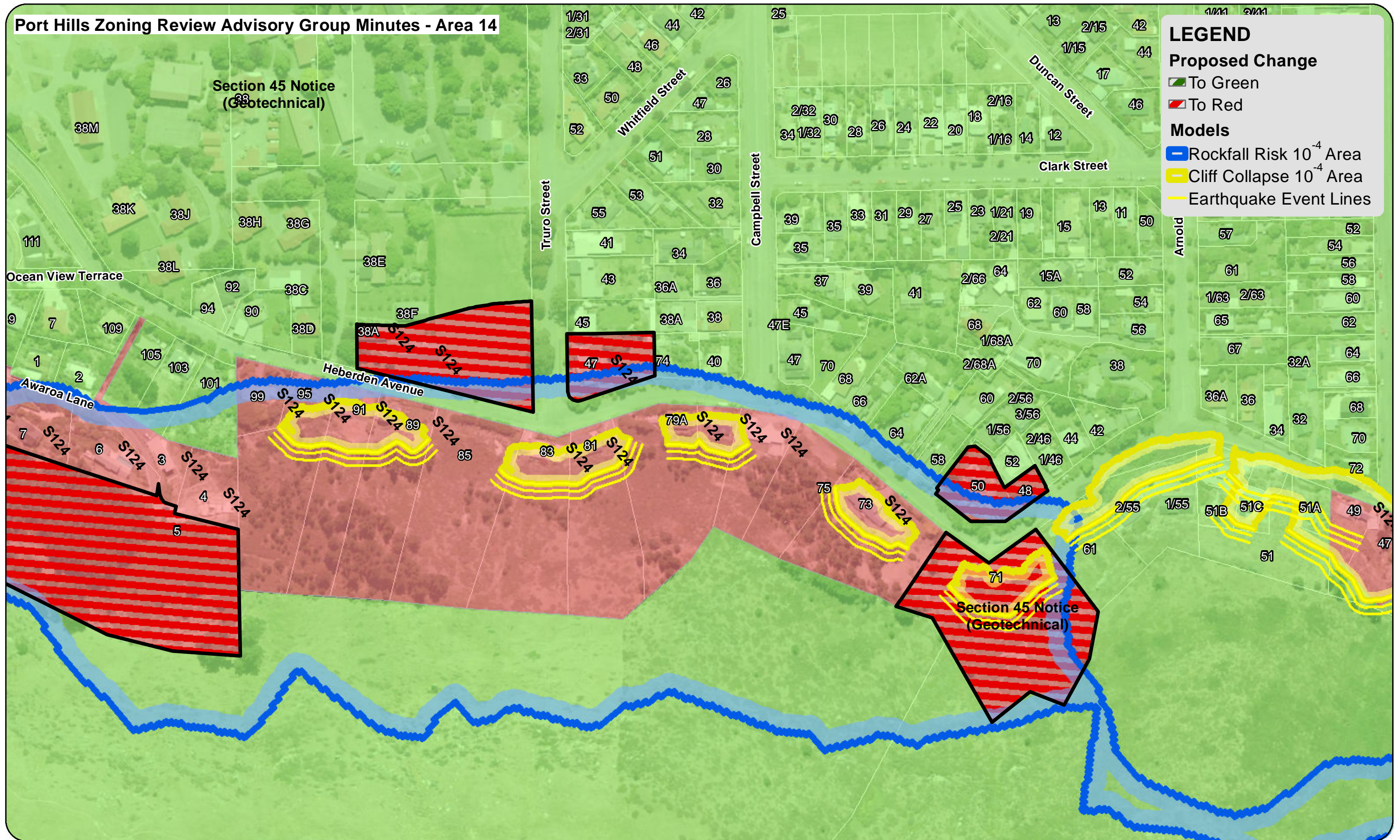
@A3

Port Hills Zoning Review: Zoning Changes

Map 24: Heberden 1

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Data Sources: CERA, CCC
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Port Hills Zoning Review Advisory Group Minutes - Area 14



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 25:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Property at 72 Colenso Street:

The GNS rockfall model tends to overstate the life safety risk to this property due to the presence of the road. (In most circumstances the presence of a flat area such as a road carriageway or building platform tends to reduce the rockfall risk for properties located below the flat area.)

- Properties between Colenso and Wiggins Streets (e.g. 35, 37, 39 Heberden Avenue):

The model overstates the life safety risk to 35 Heberden Avenue as it incorrectly treats a steep slope as a cliff. The model overstates the life safety risk to 37 and 39 Heberden Ave – expert advice indicates the properties are outside of the life safety risk and retreat line, with only a marginal effect.



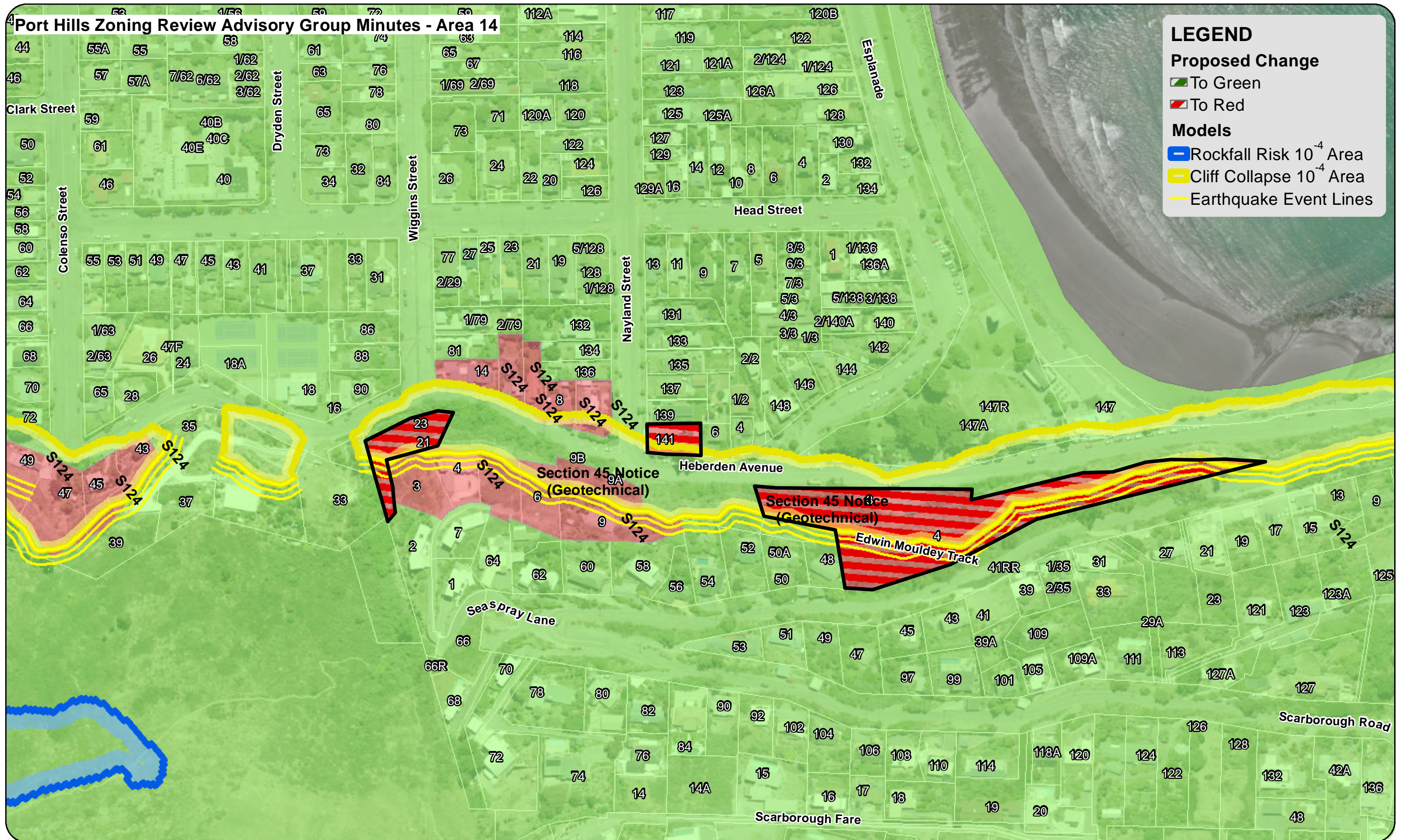
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@A3

Port Hills Zoning Review: Zoning Changes

Map 25: Heberden 2

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Site specific considerations relating to the GNS model for Map 26:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Properties around the start of Whitewash Head Road (e.g. 1 and 2 Whitewash Head):

The GNS rockfall model tends to overstate the life safety risk to this area as it is at the boundary of the numerical model. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints.)

- Properties in the Flowers Track area (e.g. 2, 3, 5 Flowers Track):

The GNS rockfall model tends to overstate the life safety risk to this area as there is not actually a cliff in this location, but a steep slope that was erroneously picked up in the GNS model. (This limitation is noted in the GNS report.)

- Properties north of Tirohanga Lane (e.g. 25A and 25B Taylors Mistake Road):

While the GNS cliff collapse model suggests a similar level of risk to these properties, they are exposed to different levels of risk due to the land crack pattern. 25A Taylors Mistake Road has the potential for immediate cliff collapse, carrying an immediate risk to life. On the other hand, expert advice indicated that the property at 25B Taylors Mistake Road is set back from the cliff edge and not subject to extensive land cracking.

- Properties on the north eastern cliff (e.g. between 23 Taylors Mistake Road and 40 Whitewash Head Road)

The GNS cliff collapse model tends to understate the life safety risk to this area. The north eastern cliff has a complex geology of interlayered basaltic lava and other material of volcanic origin. Cliff height is generally between 100m to 120m in this section of Whitewash Head. Approximately 450m of the cliff side had failed, up to 17m back from the original edge, during the recent earthquakes and aftershocks, resulting in the loss of an estimated 150,000m³ of cliff material. Significant ground displacement (mass movement) towards the new cliff line has been observed, as evidenced by ground cracking, generally located within 30m to 40m of the cliff line. The cliff is expected to retreat in portions, but large amounts have been known to collapse at one time, beyond the first line of cracking.

Based on the available geotechnical data, the Advisory Group considered that the properties in this area have the potential for immediate cliff collapse with an associated risk to life.



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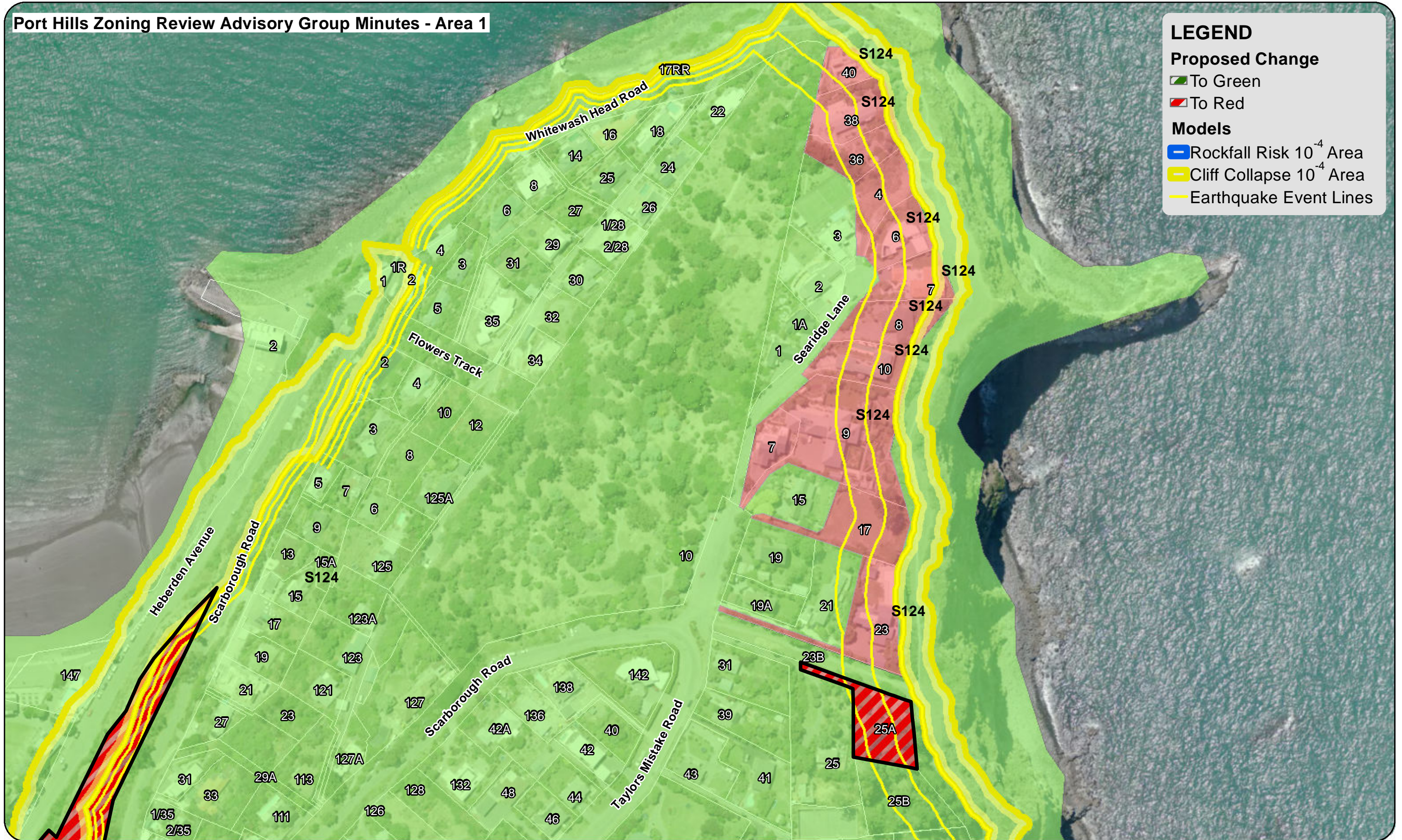
@A3

Port Hills Zoning Review: Zoning Changes

Map 26: Whitewash Head

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Port Hills Zoning Review Advisory Group Minutes - Area 1



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 27:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that the GNS risk model tends to overstate the risk to properties which appear to be impacted by earthquake event lines on this map, in the following areas:

- Properties in the Tirohanga Lane area (e.g. 3, 5 Tirohanga Lane and 26 Smugglers Cove):

The cliff collapse model tends to overstate the risk to this area – although properties are located close to the cliff there is a distinct lack of land cracking and damage, and no perceived life safety risk.

- Properties in the Smugglers Cove area (e.g. 16, 20, 22, 24 Smugglers Cove):

This part of the cliff is subject to a different kind of geology and there has been only minor loss at the cliff top. There is no immediate risk to life safety in this area and no land cracking or damage has been observed.

- Properties in the Taylors Mistake Road and Appian Lane area (e.g. 91, 93, 115, 125 Taylors Mistake Road and 8, 9 Appian Lane):

The dwellings on these properties are outside the immediate cliff collapse hazard and there is no visible damage to the cliff driven by local geology.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 27: Taylors Mistake Road

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Port Hills Zoning Review Advisory Group Minutes - Area 1



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 28:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Properties in the northern area of Taylors Mistake Road (e.g. 157, 159, 161A Taylors Mistake Road):

The GNS rockfall model tends to overstate the life safety risk to this area as it is at the boundary of the numerical model. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints). Additionally, the risk is overstated as the rockfall source is diminished. ('Diminished rockfall source' is one of a number of technical terms used by GNS and relates to the ability of the rockfall source to generate different amounts of rocks. A diminished rock source would be expected to generate fewer rocks than the neighbouring rock sources).

- Properties in the southern area of Taylors Mistake Road (e.g. 209, 211, 223, 231 and 233 Taylors Mistake Road):

The GNS cliff collapse model tends to overstate the life safety risk to this area, as it includes a steep slope which is not considered to pose a risk, as no damage was reported or observed.



1:2,000
20 10 0 20 40 m

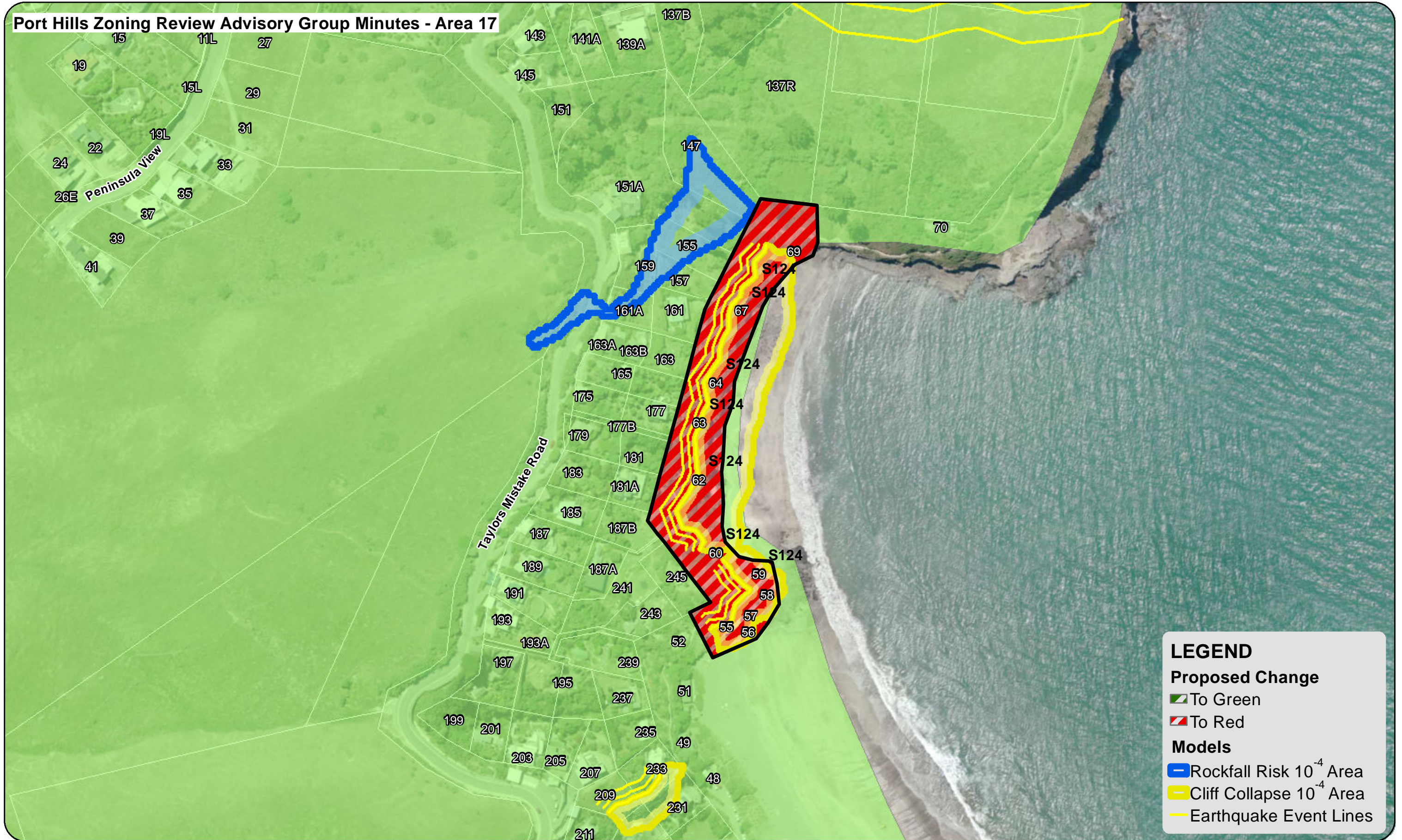
@A3

Port Hills Zoning Review: Zoning Changes

Map 28: Hobsons Bay

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Port Hills Zoning Review Advisory Group Minutes - Area 17



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 29:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:2,000
20 10 0 20 40 m

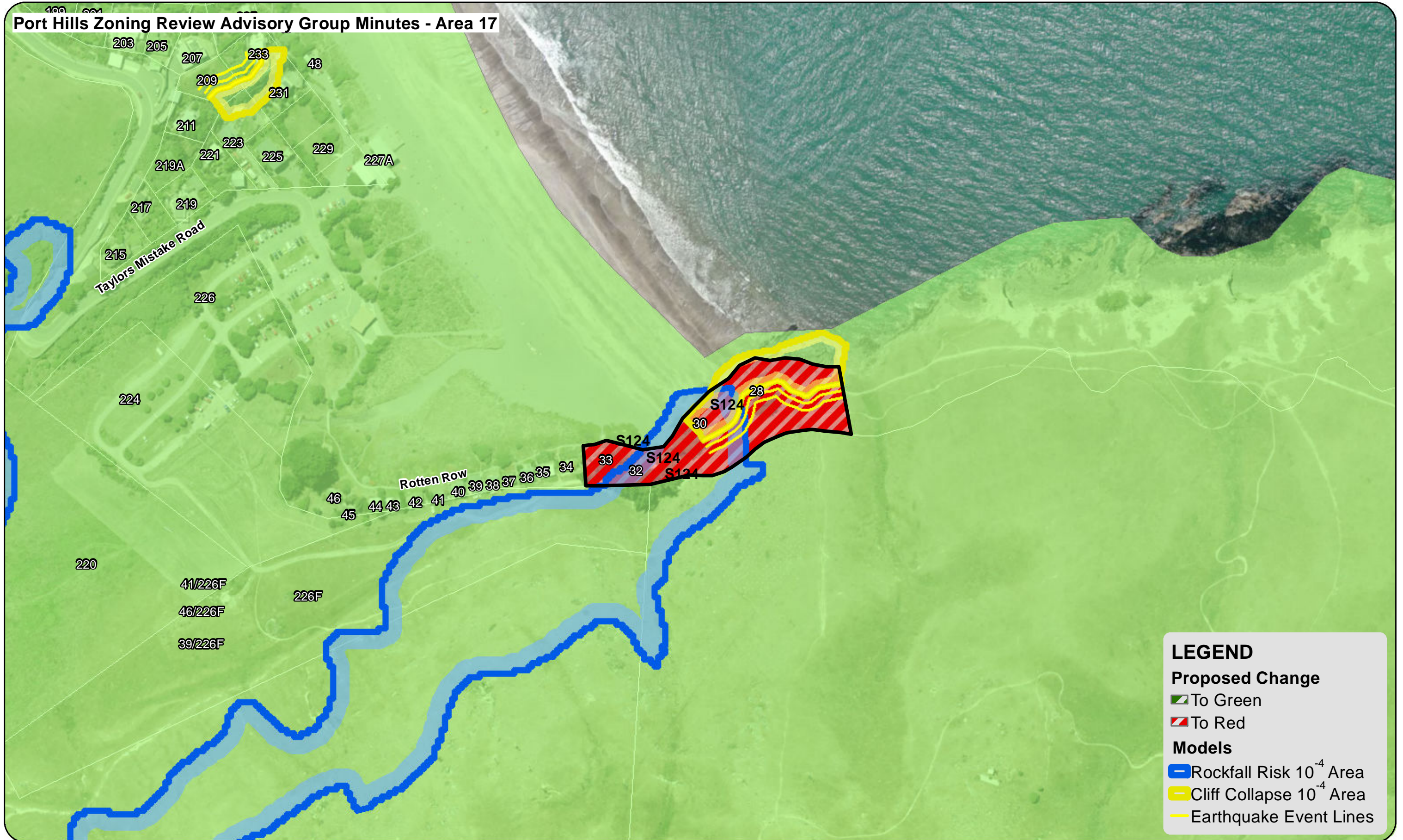
@A3

Port Hills Zoning Review: Zoning Changes

Map 29: Taylors Mistake Bay

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Port Hills Zoning Review Advisory Group Minutes - Area 17



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 30:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes



Map 30: Boulder Bay

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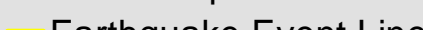
Port Hills Zoning Review Advisory Group Minutes - Area 17

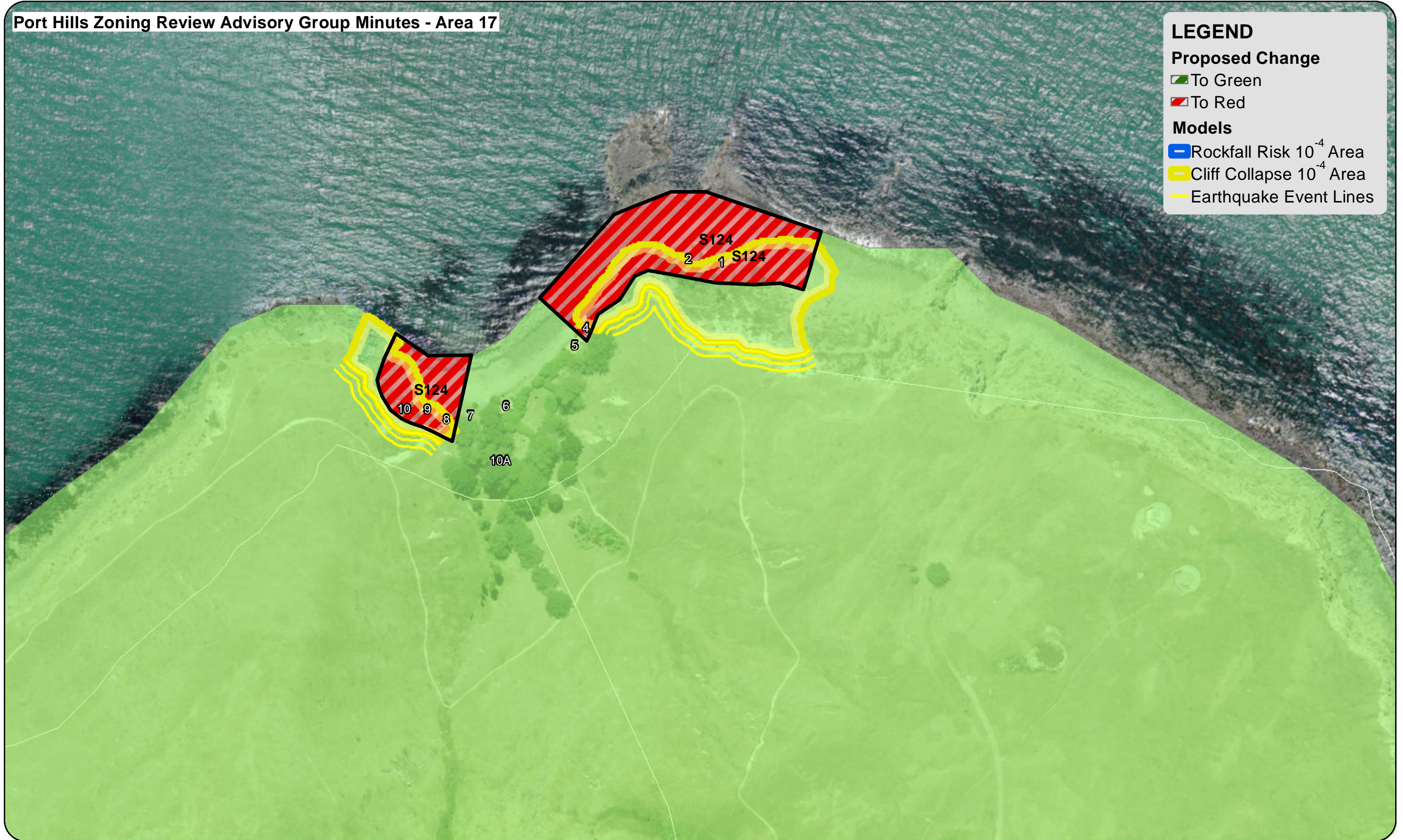
LEGEND

Proposed Change

-  To Green
-  To Red

Models

-  Rockfall Risk 10^{-4} Area
-  Cliff Collapse 10^{-4} Area
-  Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 31:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.

The Advisory Group considered the Lyttelton Port area to be a separate item and did not consider zoning for these properties.



1:2,000
20 10 0 20 40 m

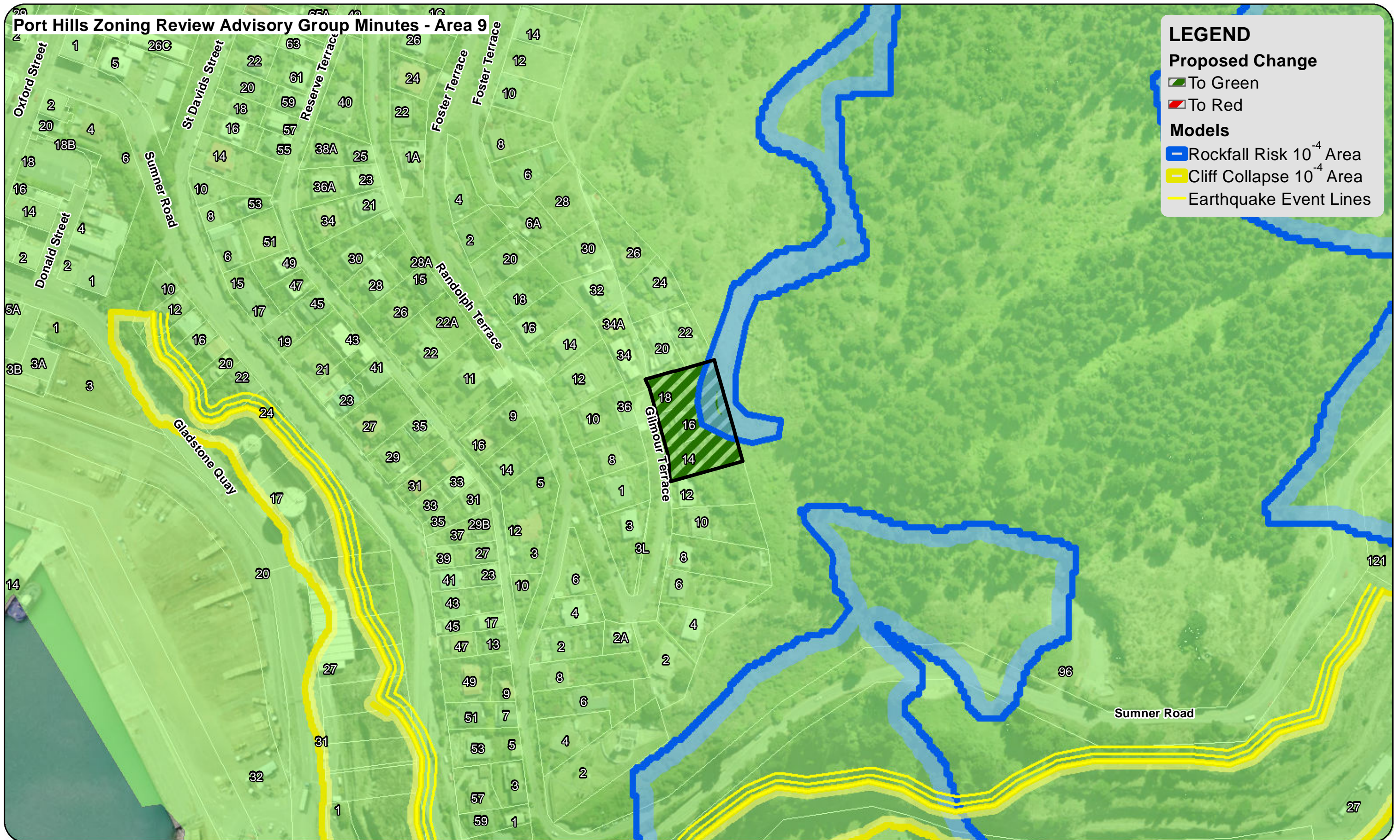
@A3

Port Hills Zoning Review: Zoning Changes

Map 31: Gilmour Terrace

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Port Hills Zoning Review Advisory Group Minutes - Area 9



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 32:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following area:

- Properties in the College Road area (e.g. 19 and 22 College Road):

The GNS rockfall model tends to overstate the life safety risk to this area, because it is at the boundary of the model, and also because the local topography would tend to direct rockfall away from these properties. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints.)



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 32: Brenchley Road

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Port Hills Zoning Review Advisory Group Minutes - Area 9

LEGEND

Proposed Change

To Green

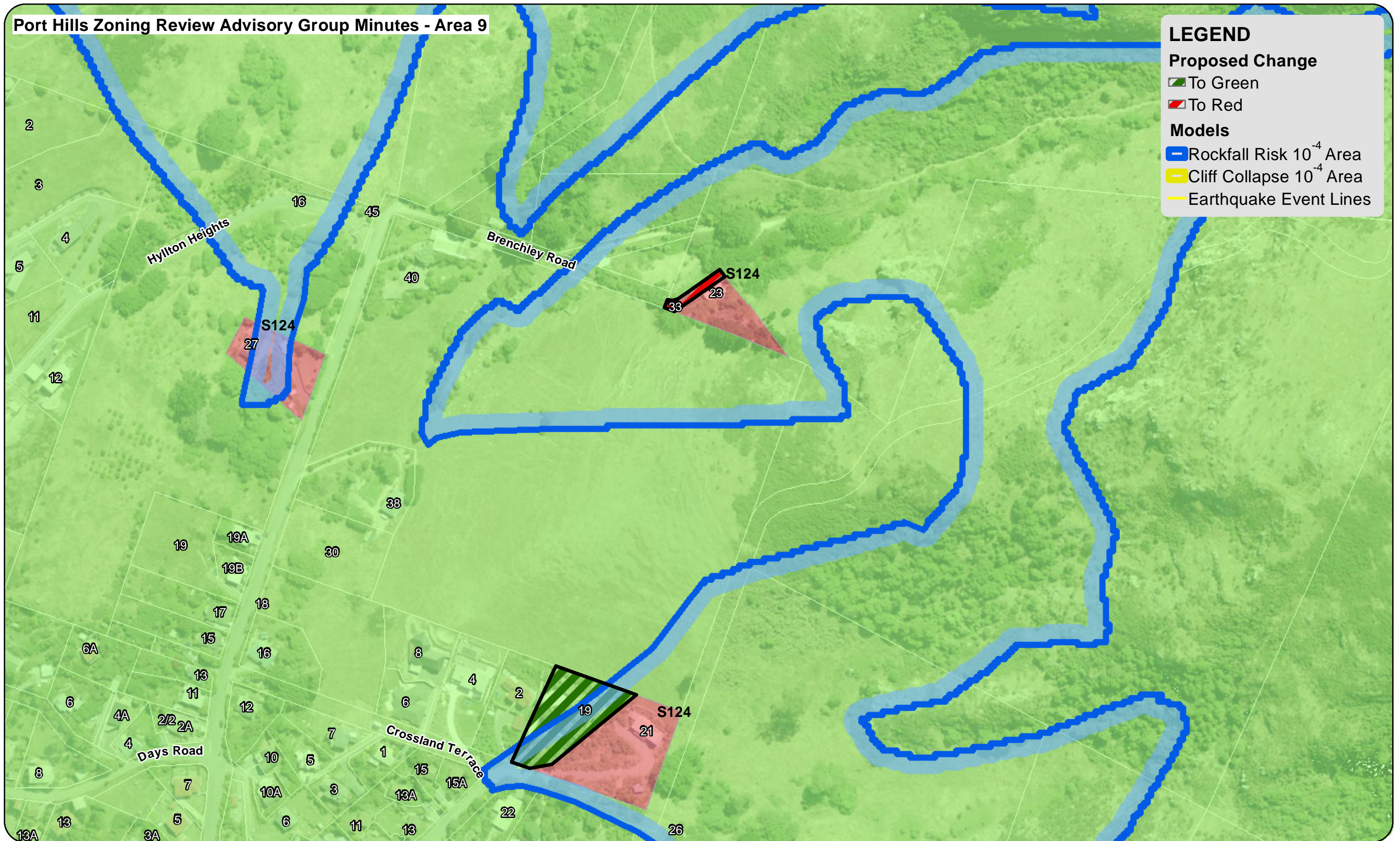
To Red

Models

Rockfall Risk 10^{-4} Area

Cliff Collapse 10^{-4} Area

Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 33:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Property at 2A Norton Close:

The GNS rockfall model tends to overstate the life safety risk to this property due to topographical effects, namely the presence of a gully which would tend to direct rockfall away.

- Property at 7 Endeavour Place:

The GNS rockfall model tends to overstate the life safety risk to this property due to the presence of gullies to the west and north-east which would tend to divert rockfall away.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 33: Endeavour Place

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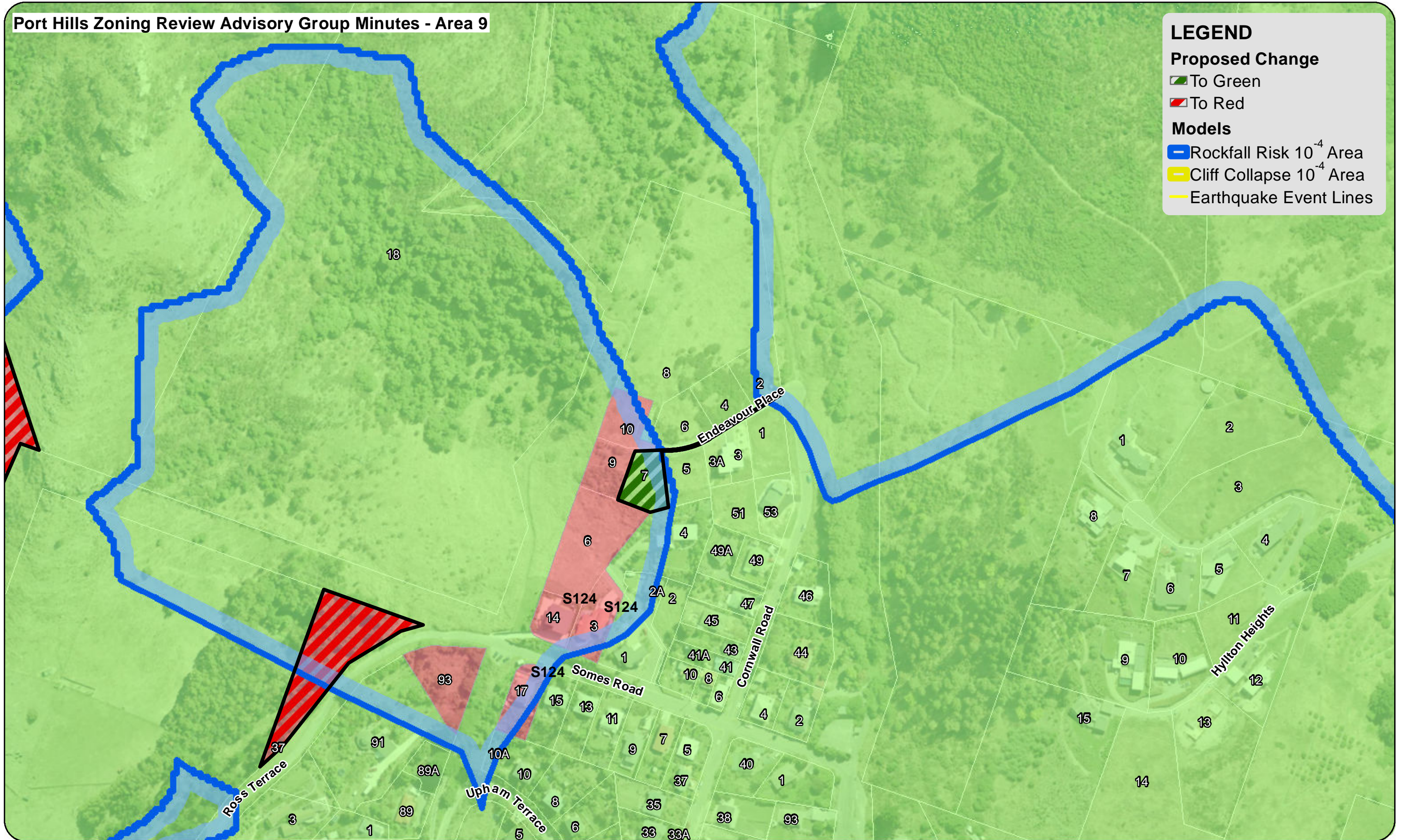
LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 34:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:3,000
30 15 0 30 60 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 34: Hawkhurst Road

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Port Hills Zoning Review Advisory Group Minutes - Area 41

LEGEND

Proposed Change

To Green

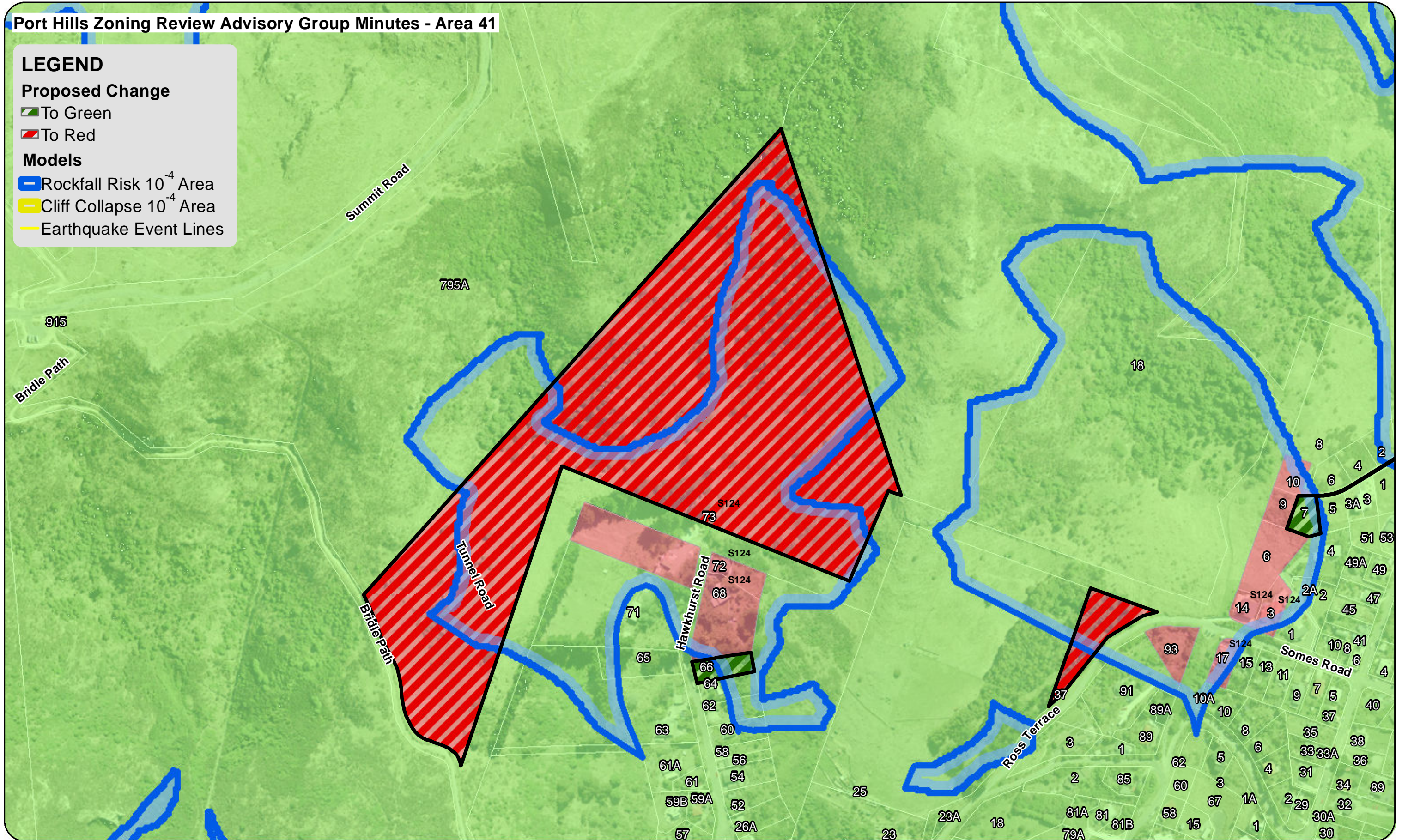
To Red

Models

Rockfall Risk 10^{-4} Area

Cliff Collapse 10^{-4} Area

Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 35:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following area:

- Property at 21 Harmans Road:

The Advisory Group agreed that ground truthing does not support the model for this property, as the identified rock source is in poor condition. The GNS rockfall model is therefore considered to understate the risk to this property.



1:2,000
20 10 0 20 40 m

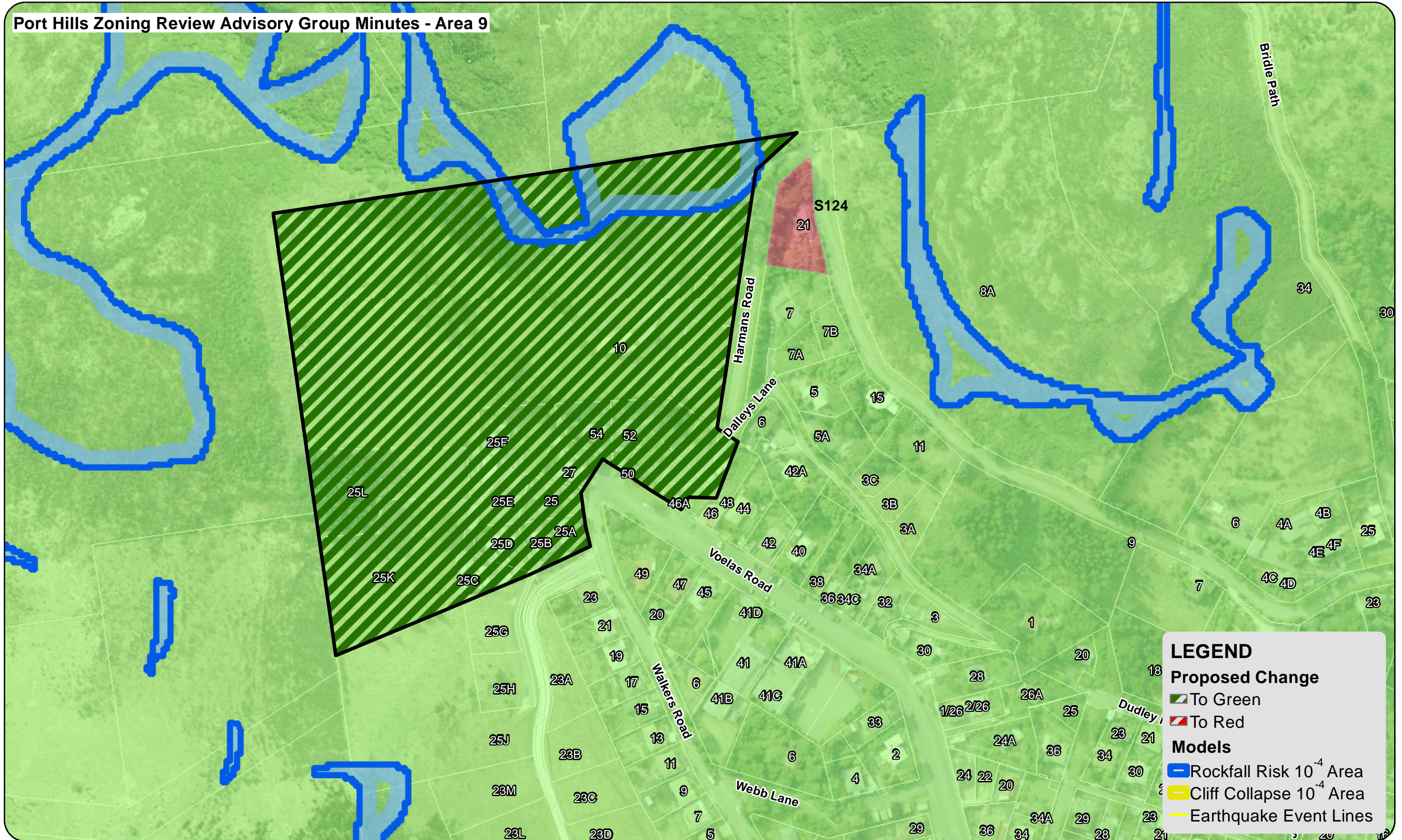
@A3

Port Hills Zoning Review: Zoning Changes

Map 35: Voelas/Walkers Road

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Port Hills Zoning Review Advisory Group Minutes - Area 9



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 36:

Further expert advice provided to the Minister for Canterbury Earthquake Recovery was that the rockfall source affecting the property at 36 Brittan Terrace was too localised to be modelled by GNS, but poses a high life risk. The rockfall source is very complex, and source treatment is unlikely to be feasible due to access and terrain.

The Advisory Group considered the Lyttelton Port area to be a separate item and did not consider zoning for these properties.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 36: Buxtons Road

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Port Hills Zoning Review Advisory Group Minutes - Area 11

LEGEND

Proposed Change

To Green

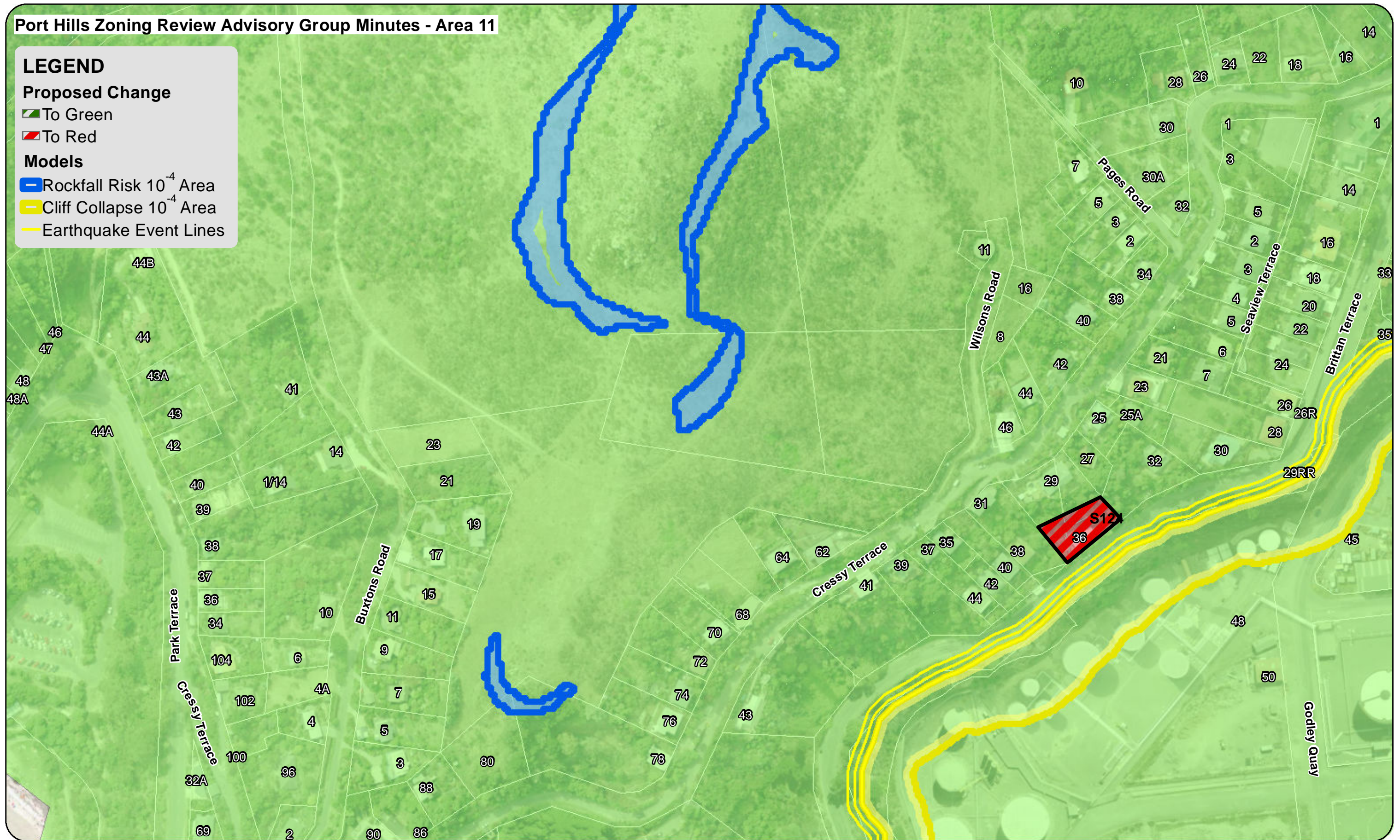
To Red

Models

Rockfall Risk 10^{-4} Area

Cliff Collapse 10^{-4} Area

Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 37:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.

The Advisory Group considered the Lyttelton Port area to be a separate item and did not consider zoning for these properties.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 37: Naval Point

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Port Hills Zoning Review Advisory Group Minutes - Area 9



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 38:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 38: Mariners Cove

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Port Hills Zoning Review Advisory Group Minutes - Area 11



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 39:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:2,000
 20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 39: Rapaki Bay

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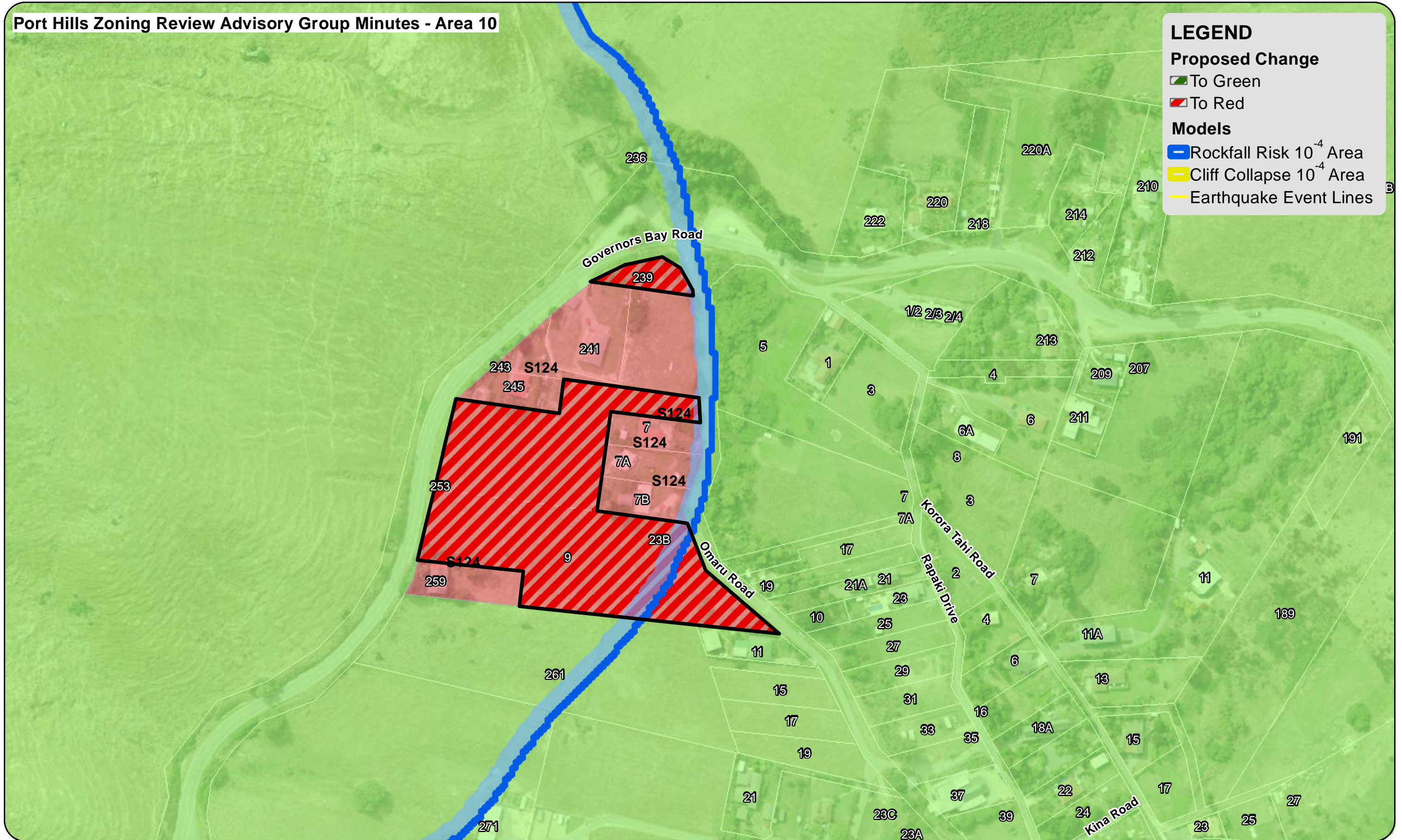
LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 40:

None identified by the Port Hills Zoning Review Group Advisory Group that had an effect on zoning recommendations.



1:2,000
20 10 0 20 40 m

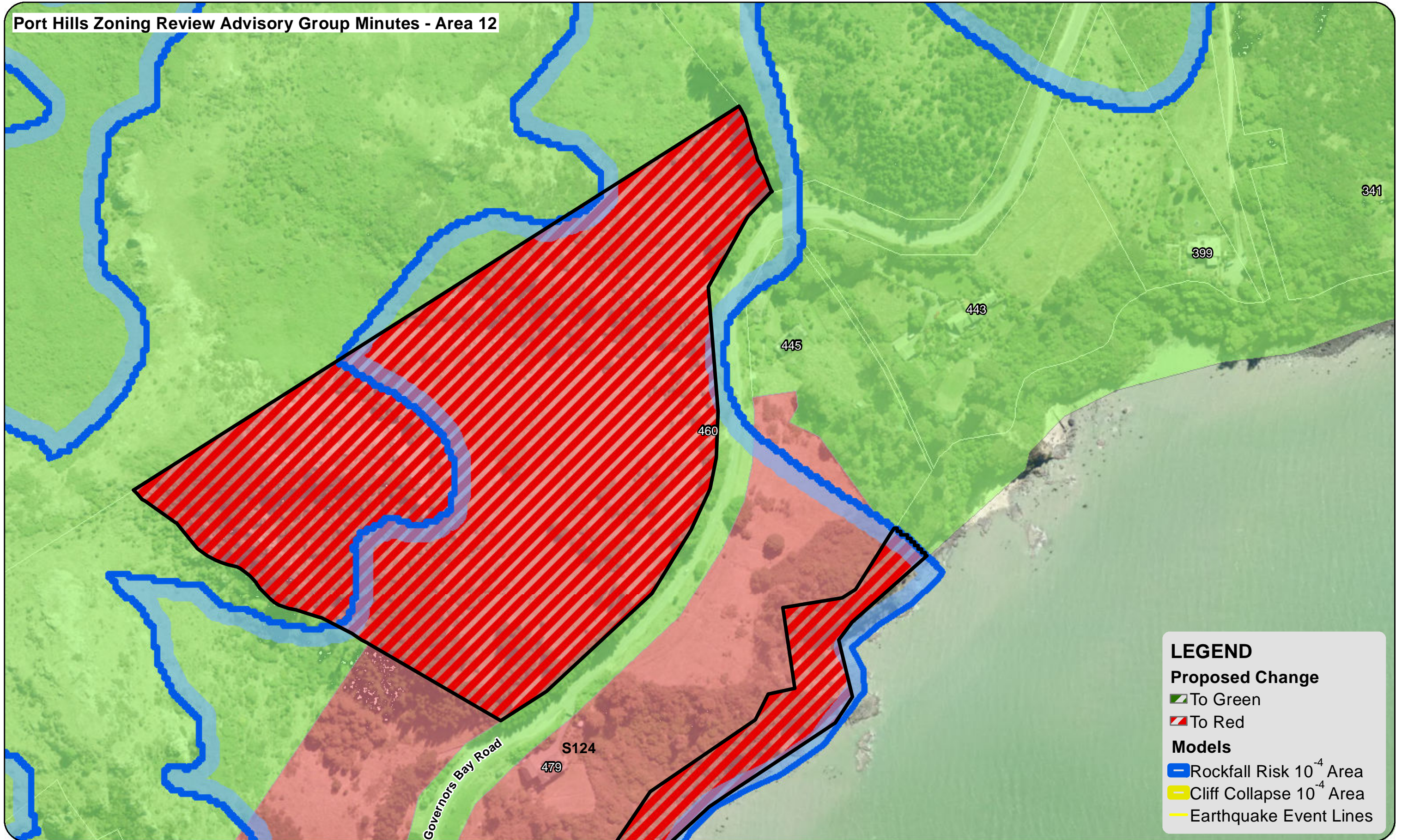
@A3

Port Hills Zoning Review: Zoning Changes

Map 40: Governors Bay Road

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Port Hills Zoning Review Advisory Group Minutes - Area 12



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 41:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following area:

- Property at 524 Governors Bay Road:

The GNS rockfall model tends to overstate the life safety risk to this property because it does not account for local topographical effects – the property is located along a ridge line – and there is also a boundary effect in the numerical model. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints.)



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20 10 0 20 40 m

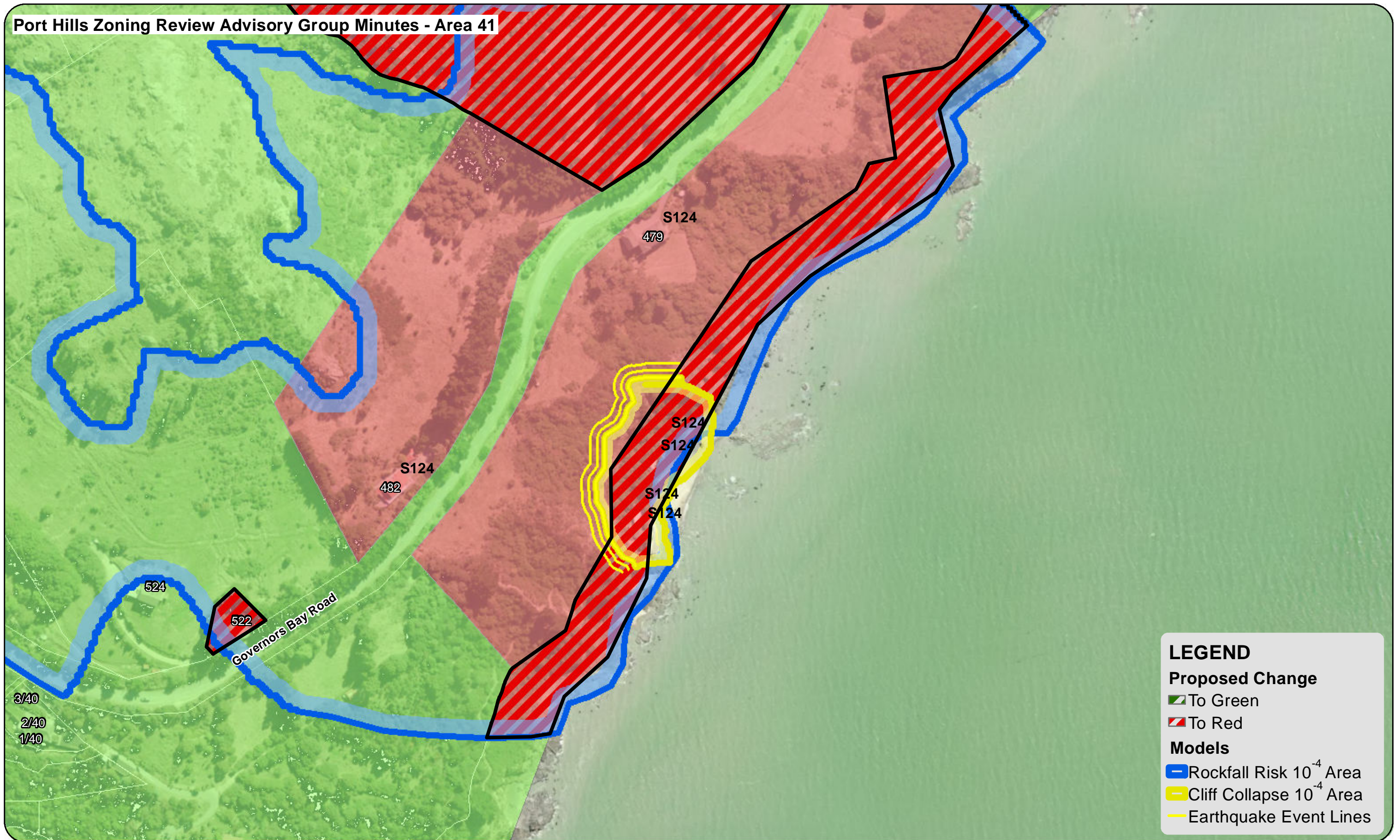
@A3

Port Hills Zoning Review: Zoning Changes

Map 41: Maori Gardens

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Port Hills Zoning Review Advisory Group Minutes - Area 41



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10^{-4} Area
- Cliff Collapse 10^{-4} Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 42:

None identified by the Port Hills Zoning Review Advisory Group that had an effect on zoning recommendations.



1:4,000 @A3
 50 25 0 50 100 m

Port Hills Zoning Review: Zoning Changes

Map 42: Zephyr Terrace

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Port Hills Zoning Review Advisory Group Minutes - Area 12

LEGEND

Proposed Change

To Green

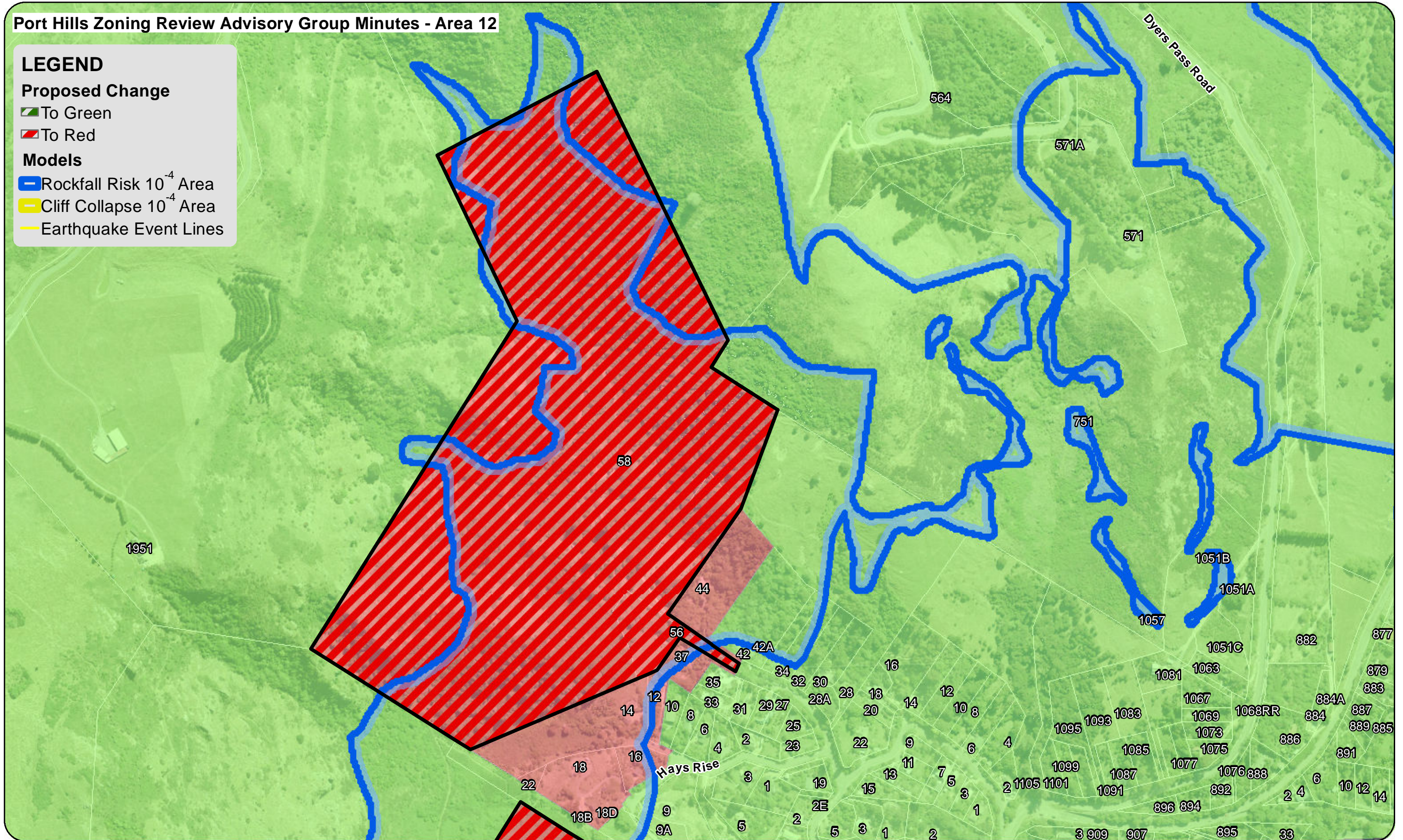
To Red

Models

Rockfall Risk 10^{-4} Area

Cliff Collapse 10^{-4} Area

Earthquake Event Lines



Site specific considerations relating to the GNS model for Map 43:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following areas:

- Property at 48 Main Road (near Chrystalwood Lane):

The GNS rockfall model tends to overstate the life safety risk to this property. Expert advice to the Advisory Panel indicated that this was based on field observations and the position of this area around the boundary of the numerical model. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints.)

- Property at 8 Glas Brae (near Chrystalwood Lane):

The GNS rockfall model tends to overstate the life safety risk to this property. Expert advice to the Advisory Panel indicated that this was based on field observations and the position of this area around the boundary of the numerical model. (The GNS model, like all numerical models, becomes less certain at the edges of the modelled area due to inherent model assumptions and mathematical constraints.) A drainage line (gully) was noted by the field teams as having a sheltering effect, which also tends to focus boulders past any dwellings – the large rock source tends to be on the other side of the gully.



1:2,000
20 10 0 20 40 m

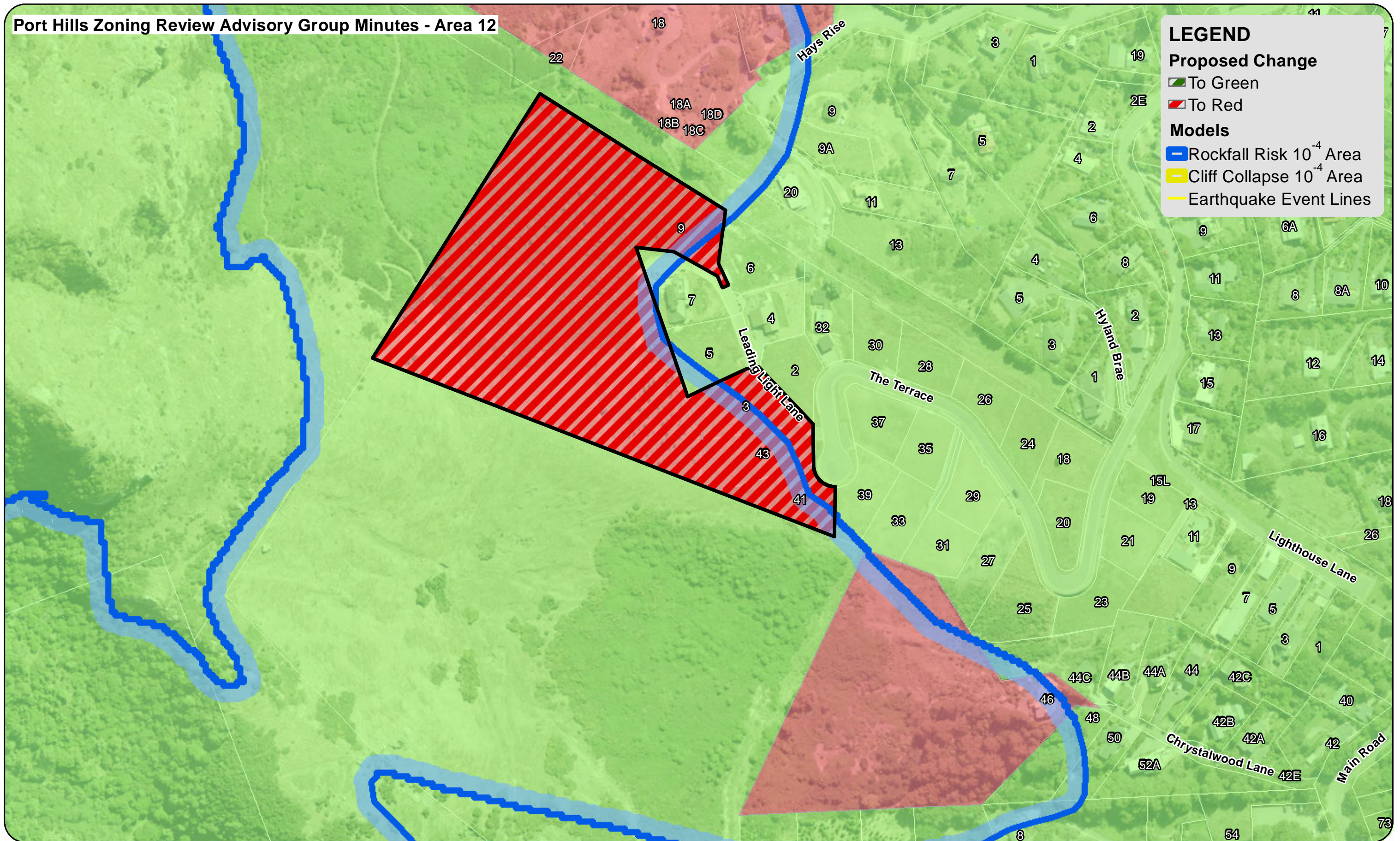
@A3

Port Hills Zoning Review: Zoning Changes

Map 43: Leading Light Lane

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Projection New Zealand Transverse Mercator
Datum Geodetic Datum of New Zealand 2000
Compiled 27/08/2013

Port Hills Zoning Review Advisory Group Minutes - Area 12



LEGEND

Proposed Change

- To Green
- To Red

Models

- Rockfall Risk 10⁻⁴ Area
- Cliff Collapse 10⁻⁴ Area
- Earthquake Event Lines

Site specific considerations relating to the GNS model for Map 44:

Expert advice provided to the Port Hills Zoning Review Advisory Group indicated that there are site specific considerations relating to the GNS risk model around the following area:

- Properties on Marine Drive near Hays Bay (332, 334, 336, 342 Marine Drive):

These properties are in an area which is not covered by the GNS models as there was no Light Detection and Ranging (LiDAR) data available for this area. Based on several site visits and expert advice it is noted that rock outcrops directly above select properties were weakened and fractured during recent earthquakes. As a result, this area is now exposed to significant rock roll hazard, and significant rock roll has occurred on the properties. As a result the Advisory Group considered there was a significantly elevated hazard to life on these properties that can be directly compared to other red zoned areas on the Port Hills.



1:2,000
20 10 0 20 40 m

@A3

Port Hills Zoning Review: Zoning Changes

Map 44: Marine Drive

Produced By CERA (U)
Data Sources CERA, CCC
Projection New Zealand Transverse Mercator
Datum Geodetic Datum of New Zealand 2000
Compiled 27/08/2013

Port Hills Zoning Review Advisory Group Minutes - Area 13

LEGEND

Proposed Change

To Green

To Red

Models

Rockfall Risk 10^{-4} Area

Cliff Collapse 10^{-4} Area

Earthquake Event Lines

