



Flood hazard mapping for Hurunui District Plan Review

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Executive summary

The operative Hurunui District Plan identifies distinct areas of the district as being at risk of flooding and contains rules to control certain activities (including the building of new dwellings) within these areas. As part of their District Plan review process, Hurunui District Council approached Environment Canterbury for additional information on flood hazards within the district. Both parties were aware that the operative District Plan provides a limited means of minimising the flood hazard across the district (as controls are limited to relatively isolated areas) and that other areas are also potentially at risk from flooding.

Environment Canterbury holds limited information on historical flooding, and has not undertaken detailed floodplain investigations or hydraulic modelling for any of the rivers within the Hurunui District. Attention was therefore focused on attempting to identify areas of the district which are potentially at risk of flooding from the major rivers and areas which Environment Canterbury records showed to be previously affected by local flooding. This report describes the methodology for mapping these areas and recommends that they be included in the reviewed District Plan. The degree of flood risk at any location within the mapped areas will be highly variable and it is therefore suggested that an assessment of the flood risk be undertaken on a case by case basis when certain activities (e.g. construction of new dwellings) are proposed.

It is important to note that this report does not constitute a comprehensive assessment of the flood risk across the entire district, and it cannot be assumed that land outside of the mapped areas is not at risk of flooding.

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1 Introduction

Hurunui District Council is currently reviewing its District Plan and has approached Environment Canterbury for information on flood hazards within the Hurunui District.

The District Plan identifies a number of areas that are prone to flooding or ponding and a key discussion point has been how and to what extent flood hazard areas could be identified in the District Plan.

Environment Canterbury and Hurunui District Council staff met regularly between October and December 2012 to assess and review what flood hazard information is available at Environment Canterbury and Hurunui District Council.

Environment Canterbury staff have also attended a number of Hurunui District Council workshops to discuss the available flood hazard information and how it can be incorporated into the District Plan.

This report reviews the information that Environment Canterbury holds on flooding within Hurunui District and how that information can be used as part of the review of the Natural Hazards Section of the District Plan.

2 Background

2.1 The Operative District Plan

Existing flood hazard areas of the Operative District Plan are listed in Appendix A9.1 of the District Plan.

“Appendix A9.1 – Schedule of natural hazard areas”.

Rivers:

- | | |
|------------------------------|---------------------|
| • Chatterton River | Planning map H |
| • Jed River | Planning maps 8 & D |
| • Motunau River | Planning map 5 |
| • Waiau River | Planning map P |
| • Kowai River (North Branch) | Planning map A |

Ponding:

- | | |
|--------------------|---------------------|
| • Amberley Beach | Planning maps 2 & B |
| • Leithfield Beach | Planning maps 2 & L |
| • Hawarden | Planning map I |
| • Leithfield | Planning map K |

Coastal Inundation:

- | | |
|------------------|----------------|
| • Amberley Beach | Planning map B |
|------------------|----------------|

2.2 Information sources

Hurunui District Council has identified a lack of information on flooding within the district, and more information is needed in order to effectively manage flood hazards and give effect to the Canterbury Regional Policy Statement.

Information that Environment Canterbury holds on flooding in the Hurunui District is generally limited to photographs of the major rivers and coastal ponding areas taken during and after significant flood events. No detailed floodplain investigations or hydraulic modelling have been undertaken by

Environment Canterbury for any of the rivers within the Hurunui District. Given that Hurunui District Council also has limited information on flooding, Environment Canterbury was asked by Hurunui District Council to identify areas that were considered potentially at risk of flooding. Both parties considered it impractical to conduct a comprehensive and detailed assessment of the flood risk across the entire district (primarily due to time and budget constraints). Attention was therefore focussed on identifying areas which could be affected by flooding from the major rivers within the district, and defining the extent of areas which Environment Canterbury photographs identified as susceptible to inundation by ponding of local rainfall runoff.

Information held by both local authorities on flood hazards within the Hurunui District is not comprehensive and the majority of reports identify flood hazards at a scale that is too coarse to translate into District Plan provisions. More detailed site specific information consists of photographs (aerial and ground) of past flood events, historical flood investigations undertaken by Environment Canterbury or The North Canterbury Catchment Board, and flood reports for a small number of flood events. In addition there is anecdotal information held by residents of the district and staff of Environment Canterbury and Hurunui District Council.

Floodplain modelling has been limited to isolated reaches of rivers in response to development proposals. Specific sites investigated on behalf of proponents of development include areas on the floodplain of the Kowai River North Branch at Ropley Street and Grays Road in Amberley, and development on the left bank of the Chatterton River upstream of Woodbank Road in Hanmer Springs.

2.2.1 Reports

When undertaking this review a number of published reports have been considered and these are listed in the References section of the report. Most of these reports are of a general nature and of limited value in mapping flood areas although they do confirm the flood risk in a particular locality.

2.2.2 Environment Canterbury files

Correspondence and reports dating from the North Canterbury Catchment Board's and subsequently the Canterbury Regional Council's (Environment Canterbury's) involvement in flooding issues in Hurunui District provide some information on flood susceptibility. For the area north of the Waipara River this involvement only dates from the early 1970s. Prior to that date functions under the Rivers Control Act 1941 were carried out in that area by the Ministry of Works and Development.

2.2.3 Flood photographs

The photographing of flood events within Hurunui District has been dependent on frequency of flood events, and, in relation to the taking of aerial photographs, the suitability of flying conditions. Aerial photography has generally been limited to the coastal margins south of the Waipara River and the Amberley locality (1974, 1986, and 2008), the floodplains of the Waiau and Hurunui rivers (1988 and 1993) and the Pahau River (1993 and 2008).

3 Site specific investigation and mapping

This investigation has been divided into four sections:

- 3.1 The floodplains of the major rivers
- 3.2 The coastal strip between the Waipara River and the Hurunui/Waimakariri District boundary
- 3.3 Isolated areas that are currently mapped in the District Plan
- 3.4 Isolated areas that could be mapped for inclusion in the District Plan

3.1 The floodplains of the major rivers

3.1.1 Methodology for identifying land which is potentially floodable from the major rivers

Draft lines were drawn as shapefiles in ArcGIS with the aim of defining areas which could be subject to flooding from each river in an extreme flood event (with a return period up to at least 200 years (0.5% annual exceedance probability)). Mapping included the Kowai, Waipara, Blythe, Waitohi,

Hurunui, Pahau, Waiau, Mason, Hanmer and Conway rivers. The primary sources of information used in establishing the lines were 1:50,000 scale topographic maps and vertical aerial photographs. In some cases this was supplemented by the use of Google 'street view' photographs and oblique aerial photographs, where available. For the Waipara River and Kowai River detailed LiDAR topographic data was available, and this was used as the primary source of information. Field visits were made to a small number of locations in order to confirm the presence of topographic features which were not clearly evident from the maps or photographs.

Many of the rivers in the Hurunui District are confined by natural terraces or higher ground, and the lines typically follow these features. The placement of the lines has generally been based on a judgement of whether the ground is likely to be higher than potential flood levels and whether there is any risk of overflows from further upstream affecting the area. When drawing the draft lines, no attempt was made to assess the probable maximum discharge of each river, to calculate cross sectional areas, likely flood levels, or to assess the design standard or integrity of any river control works. The lines are therefore based on a desktop assessment of the topography at a relatively broad scale, rather than specific calculations and analysis.

Having reviewed the draft lines provided by Environment Canterbury, Hurunui District Council wrote to landowners within the mapped areas to request feedback on the location of the lines and the potential implications of using the maps in the District Plan. Environment Canterbury and Hurunui District Council staff made site visits to approximately 40 properties/areas and discussed the mapping and its intended use. Modifications were made to the draft lines as appropriate, based on site observations and discussions with landowners. In some cases lines were able to be moved toward the river (e.g. to follow an intermediate terrace) or adjusted to follow topographic features with greater accuracy. In other cases, site observations provided a higher degree of confidence that the location of the draft lines were suitable. The appropriate location of the lines could not always be determined from the site visit and in some situations a more detailed review was necessary in order to determine where the line should be.

To enable the mapping to be conducted with greater accuracy and confidence, Environment Canterbury obtained LiDAR data for the margins of the rivers that had been mapped (where LiDAR data was not already available), with the exception of the Conway and Blythe rivers. LiDAR (Light Detection and Ranging) data is acquired using a laser scanner mounted on an aircraft which measures the ground level at approximately one point every square metre. This point data is used to generate very accurate and high resolution digital elevation maps which enable subtle topographic features to be identified.

All of the draft lines have been reviewed and modified based on the LiDAR data. In many cases the LiDAR data enables lower terraces to be identified that are still of sufficient height to limit the extent of flooding from the river. These terraces are often not marked on topographic maps and their height and continuity is often not easily established from aerial photographs. Although these features are more easily identified from the LiDAR data, a judgement still has to be made as to whether the ground is sufficiently elevated to be free of any flood risk.

A precautionary approach has generally been taken when drawing the lines. However, given the limited information used and the degree of judgement required, it is possible that some areas outside of the lines may actually be floodable from the relevant river. It is also highly likely that there will be areas within the lines which are not actually floodable, as a result of both the methodology and scale of the mapping. Gorge sections of the rivers have not been mapped as land in these areas is typically either part of the riverbed (where the flood risk is obvious), or well above potential flood levels. Further rationale on the placement of the lines is provided for each river below.

The lines only consider flooding from each river, and areas both outside and inside of the lines may also be susceptible to flooding from smaller rivers and streams, coastal flooding, drainage related flooding or local runoff.

3.1.2 Kowai

The Kowai River has been mapped to the limit of the 2012 LiDAR data, except for the northernmost part of the north branch which extends just beyond the LiDAR extent. For this small area, aerial photographs, topographic maps and observations made during a site visit have been used to determine the location of the line.

North Branch – The north branch of the Kowai is typically confined by one main natural terrace. The line generally follows this terrace, except at the Ropley Street/Riverside Way subdivision where the line runs out along the railway embankment and around the subdivision boundary and cuts back into the main terrace. An investigation undertaken by Davie Lovell-Smith in 1996 at the time of subdivision indicated that the area was unlikely to be flooded in an event with a return period up to 500 years.

South Branch – The south branch of the Kowai is also well confined, but generally by several sets of terraces. The terrace that the line follows has typically been determined based on the height of the terrace relative to the bed of the river and its continuity. At Leithfield, the main terrace cuts across Leithfield Road and runs around behind the township. A much lower terrace runs just to the north of Leithfield Road for a time and gradually runs out toward Terrace Road. In this location the line follows the lower terrace to a point where it is considered to be of insufficient height to contain potential Kowai River overflows, and the line then cuts back to the main terrace again.

Around SH1 the main Kowai River terraces meet the main coastal terrace which forms the boundary of a lower lying area also identified to be at risk of ponding from local runoff/and or coastal flooding. The mapping for both the North and South branches of the Kowai River is shown in **Figure 1**.

3.1.3 Waipara

The Waipara River has been mapped up to Stringers Road, which is the limit of the 2012 LiDAR coverage. The river is well confined by natural terraces in the upper reaches and by hill country in the lower reaches, and the line follows these features on either side. The mapping for the Waipara River is shown in **Figure 2**.

3.1.4 Blythe

No LiDAR data has been obtained for the Blythe River, and mapping was completed using 1:50,000 scale topographic maps, vertical aerial photographs and observations made during a drive through the Blythe Valley. The Blythe River is well confined by natural terraces, although in many areas there are multiple sets of terraces whose height and continuity is difficult to determine in the absence of any LiDAR data. The line on both sides of the river generally follows a terrace which is identifiable as being of sufficient height to limit the extent of potential flood flows. In some instances there may be lower terraces which are also of sufficient height that were unable to be identified with the confidence required to use them as the line boundary. Below the Blythe Road/Napenape Road intersection, the line on both banks generally follows the base of the hill country out to the coast. The mapping for the Blythe River is shown in **Figure 3**.

3.1.5 Waitohi

From above Powers Road through to Bakers Road, the Waitohi River is generally well confined by a series of natural terraces. The terrace that the line follows through this reach has generally been determined based on the height of the terrace relative to the bed of the river and its continuity. On the right bank, the line follows a lower terrace from upstream of Bakers Road, which increases in height again and becomes well-defined alongside Gilberts Road. The line follows this through to the base of the hill country on SH 7 and around to the Hurunui confluence. On the left bank the terrace runs out and becomes poorly defined between Bakers Road and Medbury Road. The river has the potential to flood out through this lower area, and in this eventuality overflows would be picked up by the stream channel which begins in this vicinity and joins the Waitohi near the Hurunui confluence. The line therefore follows the northern side of this stream channel. In some areas there is a ridge of higher ground between the stream channel and the main stem of the river where the flood risk is likely to be low. However, it is difficult to define the likely extent of such areas. The mapping for the Waitohi River is shown in **Figure 4**.

3.1.6 Hurunui

Amuri Plain – From the upper gorge through to the SH 7 Bridge there are several terraces on both sides of the river. On the left bank, these continue through to the Pahau River confluence and lower gorge, whereas the right bank below SH7, through to the lower gorge, is generally bounded by hill country. The terrace that the line follows has generally been chosen based on its height relative to the bed of the river (determined from the LiDAR data), with site visits made to several properties at the upper reaches of the mapped area. The mapping for the Amuri Plain section of the Hurunui River is shown in **Figures 5A & 5B**.

Lower Hurunui – From SH 1, the lines on either side of the river generally follow well-defined terraces, or the base of the hill country. From approximately 3 km upstream of Darrochs Road (on the left bank) the main terrace begins to run out, and there is a wider area of lower terraces and historic river channels. In this area, the height of the terraces relative to the mean bed level (established from the LiDAR data), and observations made during a site visit, were used to determine the placement of the line. The lower terraces join back into a well-defined terrace below Darrochs Road, which the line follows through to the Hurunui Mouth Bridge. At the Hurunui Huts, the line follows the lower boundary of the residential sections as it is considered unlikely that flood waters would reach this level. Environment Canterbury has recently begun flood modelling work for the lower Hurunui River. The mapping for the lower Hurunui River is shown in **Figure 6**.

3.1.7 Pahau

From the upper extent of the mapping at Cascade Road, the lines on both sides of the river generally follow the main river terraces through to Top Pahau Ford Road. Downstream of Top Pahau Ford Road the terrace on the right bank begins to reduce in height, but is still relatively well-defined through to the Hurunui confluence. Although this terrace is quite low in places, it is considered to be of sufficient height to limit the extent of flood flows from the river, as it is well back from the main channel. Below Top Pahau Ford Road on the left bank, the terrace gradually runs out, and the line follows a slight ridge of higher ground through to SH 7, where the terrace becomes more defined again. The line deviates from the main terrace near the Hurunui confluence to follow a lower terrace, which is still set well back from the main channel. The mapping for the Pahau River is shown in **Figure 7**.

3.1.8 Waiau

Hanmer Plain – From the gorge below the Hope River confluence, the right bank line follows the base of the hill country adjacent to SH 7 through to the gorge below the Hanmer River confluence. On the left bank the line follows the main river terrace, which gradually reduces in height in a downstream direction until it runs out above the confluence with the Percival River (which has not been mapped). Where the terrace begins to run out, the line cuts back to include an ill-defined relatively low lying area where several streams, and the Percival River, flow into the Waiau. Water from the Waiau has the potential to back up into this area. The mapping for the Hanmer Plain section of the Waiau River is shown in **Figure 8**.

Emu/Amuri Plains – From the upstream gorge, the lines generally follow the main river terraces or the base of the hill country. On the right bank, the main terrace on the north side of SH 7 begins to run out near Mouse Point. The line therefore cuts back in to the terrace that runs along Flintoft Mouse Point Road, and continues around through to Rotherham. On the left bank, the line follows the main terrace right around to the Mason confluence. A stopbank runs adjacent to River Road below the intersection of Hossack Downs Road. However, this is not designed to contain a major flood and has failed in several past events. The line joins onto the main terrace behind Waiau township. The township sits on a low terrace of the Waiau and Mason rivers; however, this terrace may not be of sufficient height to prevent overflows affecting the township in a major flood event. Below the township, the lines on either side follow the base of the hill country, or the main river terrace, through to the gorge below the Stanton River confluence. The mapping for the Emu/Amuri plains section of the Waiau River is shown in **Figures 9A & 9B**.

Spotswood/Parnassus – From the upstream gorge the left bank line follows the base of the hill country around to Parnassus, to include the large area of developed riverbed. The line follows a ridge of slightly higher ground over SH 1 to the terrace alongside Connemara Road, then across the Leader River confluence to the base of the hill country which leads into the lower gorge. On the right bank, the line follows the base of Mt Emily and picks up the terrace to the south of Waiau West Road. This terrace cuts back across Waiau West Road to the east of Leamington Stream, and runs around to SH 1 north of Spotswood. Immediately below SH 1 there are no obvious topographical features to define the limit of potentially floodable areas. In this area, the line follows a very slight ridge of higher ground and picks up the beginnings of a terrace, which gradually becomes more defined in a downstream direction. The line follows this terrace until it picks up the base of the hill country near Caroline Stream and runs around into the lower gorge.

A lower terrace and stopbank exists along the right bank of the Waiau, in the vicinity of Leamington Road. This stopbank has not been designed to contain a major flood flow and only runs part way

along this reach of the river, and has therefore not been used as the line boundary. The mapping for the Spotswood/Parnassus section of the Waiau River is shown in **Figure 10**.

3.1.9 Mason

The Mason River has been mapped to just above the Lottery River confluence, which is the limit of the 2013 LiDAR coverage. A low terrace exists along the right bank of the Mason River upstream of Inland Road; however, this may not be of sufficient height to limit the extent of potential overflows above the bridge. The line therefore follows the base of the hill and runs down along the main high terrace to the Waiau confluence. On the left bank, a stopbank runs from the main terrace out to the Inland Road Bridge. This bank has not been designed to contain a major flow in the Mason River and it is possible that it could fail in such an event, especially given the river's alignment. Below the Inland Road Bridge, there are no substantial terraces along the left bank of the Mason River (until a slight ridge develops through Waiau township). Any overflows occurring upstream of the township have the potential to spread across to the main high terrace, and the line therefore follows this to where it joins the Waiau River. The mapping for the Mason River is shown in **Figure 11**.

3.1.10 Hanmer

The line on the left bank of the Hanmer River follows the base of the hill country from the upper extent of the mapping through to the Waiau River confluence. On the right bank, the line also follows the base of the hill country to the eastern end of Hossack Road, where it picks up the main river terrace. This terrace gradually decreases in height in a downstream direction until becomes quite ill-defined about 1 km upstream of SH 7A. Through this area, the line follows a slight ridge of higher ground out to the confluence with the Waiau. The mapping for the Hanmer River is shown in **Figure 12**.

3.1.11 Conway

No LiDAR data has been obtained for the Conway River, and mapping was completed using 1:50,000 scale topographic maps and vertical aerial photographs. Site visits were also made to areas around Ferniehurst and downstream of SH 1. The mapping begins at approximately 5.0 km upstream of the railway bridge at Ferniehurst, as beyond this point the river is generally well-confined by higher ground. The line on the right bank follows the base of the hill country down to the Ferniehurst Road Bridge, where it picks up a terrace through to the intersection of Ferniehurst Road and SH 1. From here it generally follows the base of the hill country, and in some places the highway, right through to the bridge on Conway Flat Road. The final reach follows the main terrace out to the coast.

On the left bank, the line generally follows the base of the hill right through to the SH 1 Bridge, with the exception of short stretch downstream of the railway bridge, where the line follows a well-defined terrace. Below SH 1, the line picks up a terrace which roughly follows the line of Claverley Road, joining back into the base of the hill country downstream of the Conway Flat Road Bridge and running out to the coast. The mapping for the Conway River is shown in **Figure 13**.

3.2 The coastal strip between the Waipara River and the Hurunui/Waimakariri District boundary

3.2.1 Methodology

Much of this area, which is generally bounded by Ashworths Road (State Highway 1) then Hursley Terrace Road to the west, and the Pacific Ocean to the east, is identified in the Operative Hurunui District Plan as being subject to ponding.

The introduction of the present provisions into the District Plan was based on historical flood hazard information, such as flood reports and photographs of flooded areas held by the Hurunui District Council and/or Environment Canterbury.

The mapping of this area has been reviewed, taking into account both the information available at the time of the previous District Plan review and flood hazard information that has become available since. The flood risk to large parts of this area was confirmed when significant areas were flooded in July and August 2008. At the time, the July rainfall event was assessed as having a return period of around 50 years. However, current rainfall frequency data (NIWA High Intensity Rainfall System Version 3) suggests a return period for the event of around 20 years. LiDAR topographical information has

allowed estimates of the level of flooding depicted in aerial photographs to be made by comparing flood photographs with the LiDAR ground levels.

When assessing the available flood hazard information, consideration has been given as to whether or not boundaries of the present area identified as subject to ponding should be altered to either remove or add areas.

Areas where significant ponding was recorded in July and August 2008, but which are not identified as ponding areas in the existing District Plan, are the townships of Amberley Beach and Leithfield Beach, an area immediately to the north of the Kowai River, which is presently mapped in part, and an area to the west of Ashworths Road (State Highway 1) immediately to the north of Harleston Road.

If the above areas are included in the District Plan mapping, the only part of the coastal strip that would be excluded is the area to the east of Ashworths Road and bounded by Ashworths Beach Road, the Hurunui/Waimakariri District Boundary and the Pacific Ocean. It is likely that flooding would occur in the interdune parts of this area, but Environment Canterbury staff have been unable to find any flood photographs of this area to establish the degree of ponding.

Although there are significant areas subject to ponding within the area identified in the District Plan there are also significant areas that are on relatively higher ridges where there is little or no flood risk. Because of the difficulty of mapping to the scale required to identify such areas with certainty at a site specific level, the present approach in the District Plan of mapping broader areas, and carrying out a more detailed assessment if required for a development proposal, is the most practical planning approach for implementing provisions to minimise damage from flooding in this locality.

Following a review of the available flood hazard information it is considered that changes to the zone boundaries could be made in the following locations:

- 3.2.2 Harleston Road/Ashworths Road (State Highway 1)
- 3.2.3 Leithfield Beach township
- 3.2.4 Amberley Beach township
- 3.2.5 Between the Kowai River and Newcombes Road

3.2.2 Harleston Road/Ashworths Road (State Highway 1)

A TV3 video of the flood of 31 July 2008 shows extensive ponding in an area to the west of Ashworths Road (State Highway 1) and north of Harleston Road. The estimate of the flood level in this area from the video is 4.2 metres above mean sea level (m.a.m.s.l.). This level was determined by comparing an image (**Figure 14**), taken from the TV3 video, with LiDAR ground levels. **Figure 15** shows ground at a level of 4.2 m.a.m.s.l. or lower, based on LiDAR data, shaded red.

Environment Canterbury does not hold any flood levels for this locality, so cannot be definitive as to whether or not **Figure 14** shows flood levels at their peak. In addition, the accuracy of the LiDAR ground levels is of the order of ± 150 mm. To allow for flooding associated with rainfall events greater than the event of 31 July 2008, an area bounded approximately to the west by the 5.0 m.a.m.s.l. contour has been identified as potentially at risk from ponded floodwaters.

We recommend that the flood area identified in the District Plan be amended to include this area as shown in **Figure 16**.

3.2.3 Leithfield Beach township

A TV3 video of the flood of 31 July 2008 shows extensive ponding within Leithfield Beach township. The estimate of the flood level at the beach settlement in the video is 2.8 m.a.m.s.l. This level was determined by comparing an image (**Figure 17**) taken from the TV3 video with LiDAR ground levels. **Figure 18** shows ground at a level of 2.8 m.a.m.s.l. or lower, based on LiDAR data, shaded red.

Environment Canterbury does not hold any flood levels for this locality, and a flood report on the 2008 floods prepared for Hurunui District Council by Pattle Delamore Partners Ltd does not provide flood levels, so there is uncertainty as to whether or not **Figure 17** shows flood levels at their peak. In addition the accuracy of the LiDAR ground levels is of the order of ± 150 mm so the area shown in **Figure 18** should not be treated as a precise representation of the area flooded at a flood level of 2.8 m.a.m.s.l.

In addition to the flood risk associated with local rainfall events as occurred in 2008, Leithfield Beach township is also potentially at risk from flooding associated with Kowai River breakouts and seawater inundation.

For flood risk to be adequately addressed there needs to be an appropriate mechanism in the District Plan and we recommend that the boundary of the flood area identified in the District Plan be modified to include Leithfield Beach township, as shown in **Figure 19**.

3.2.4 Amberley Beach township

A TV1 news clip video of the flood of 31 July 2008 shows extensive ponding to the west of Amberley Beach township, with the ponding encroaching onto the eastern margins of the township. The estimate of the flood level in the area immediately adjacent to the beach settlement in the video is 2.85 m.a.m.s.l. This level was determined by comparing an image (**Figure 20**) taken from the TV1 video with LiDAR ground levels. **Figure 21** shows ground at a level of 2.85 m.a.m.s.l. or lower, based on LiDAR data, shaded red.

Environment Canterbury does not hold any flood levels for this locality and a flood report on the 2008 floods prepared for Hurunui District Council by Pattle Delamore Partners Ltd does not provide flood levels, so there is uncertainty as to whether or not **Figure 20** shows flood levels at their peak. In addition the accuracy of the LiDAR ground levels is of the order of ± 150 mm so the area shown in **Figure 21** should not be treated as a precise representation of the area flooded at a flood level of 2.85 m.a.m.s.l.

In addition to the flood risk associated with local rainfall events, Amberley Beach township is also potentially at risk from flooding associated with seawater overtopping the foreshore. The existing seawater inundation line at Amberley Beach relates to a particular event, however, overtopping may occur at other locations along the foreshore and because of this, seawater inundation risk should be considered when assessing flood risk anywhere within the coastal flood area.

For flood risk to be adequately addressed there needs to be an appropriate mechanism in the District Plan, and we recommend that the boundary of the flood area identified in the District Plan be modified to include Amberley Beach township, as shown in **Figure 22**.

3.2.5 Between the Kowai River and Newcombes Road

At the time of the last review of the Hurunui District Plan an attempt was made to map individual ponding areas within the area bounded by Hursley Terrace, Newcombes Road, the Pacific Ocean and the Kowai River. This map of ponded areas was then included in the District Plan. Comparing the District Plan mapping with photographs taken on 31 July 2008, there appear to be significant discrepancies between areas flooded and areas mapped as floodable in the District Plan. **Figure 23** shows part of the area between Newcombes Road and the Kowai River during the July 2008 flood event. The current District Plan mapping for this area is shown in **Figure 24**.

Parts of this area are also potentially at risk from flooding associated with the Kowai River and it is recommended that the current mapping in the District Plan be modified to also include all the area between Newcombes Road and the Kowai River. This approach would be consistent with that adopted for the balance of the coastal strip. **Figure 25** shows the area in this locality that would be subject to District Plan controls through being either part of the river floodplain mapping area or the coastal ponding area.

3.3 Isolated areas that are currently mapped in the District Plan

3.3.1 Methodology

There are a number of isolated areas currently mapped in the District Plan as being subject to flooding or ponding that have not been commented on under sections 3.1 or 3.2.

Available flood hazard information for these areas has been reviewed, but because they cover a wide range of different flooding scenarios there is no general methodology that applies to all areas. In some cases Environment Canterbury was not involved in the initial identification of these areas in the District Plan, and in other instances involvement was through providing flood hazard information. In one case Environment Canterbury was involved with site specific modelling. Comments on each location outline Environment Canterbury's involvement with the identification of the area in the District

Plan, flood hazard information that it holds for the site, and recommendations for any changes to the identification of the site in the Proposed District Plan.

These areas are:

- 3.3.2 Chatterton River (Planning map H)
- 3.3.3 Cheviot (Jed River in District Plan)(Planning maps 8 & D)
- 3.3.4 Motunau River (Planning map 5)
- 3.3.5 Waiau River (Planning map P)
- 3.3.6 Kowai River (North Branch) (Planning map A)
- 3.3.7 Hawarden (Planning map I)
- 3.3.8 Leithfield (Planning Map K)

3.3.2 Chatterton River (Planning map H)

An area on the true left bank of the Chatterton River upstream of Woodbank Road is defined in the District Plan as a 'Flood Hazard Area'

Anecdotal information about overflows from the river occurring in the early 1970s resulted in the flood risk being identified in the District Plan, and a floodplain investigation of the area being undertaken by Environment Canterbury in 1998.

Residential development of much of the area identified as a flood hazard area has since occurred. This has been subject to flood mitigation, in the form of river control works, being undertaken. Uncertainty remains over the long-term maintenance of the flood mitigation works and it is recommended that the identification as a flood hazard area remains until there is certainty over the long term maintenance of these works.

3.3.3 Cheviot (Planning maps 8 & D)

The flood inundation area immediately to the south of Cheviot township is identified by a line rather than a polygon. This method of identification has the potential to result in some uncertainty with regard to the area to which any rules may apply, as the western boundary of the area is not defined.

Environment Canterbury staff are not aware of Environment Canterbury having any involvement in the identification of this area in the District Plan.

Environment Canterbury has a number of photographs of the locality taken in the 1970s, 1986 and 1992. Most of these photographs are taken from State Highway 1 between Nonoti Road and Cheviot, and although they do confirm the significant flood risk in this locality, they provide insufficient photographic coverage to accurately define the flood area. An oblique aerial photograph published in The Press following a flood event in 2008 shows flooding along the south-western edge of Cheviot township.

Environment Canterbury staff have attempted to map the extent of areas documented as having been previously flooded (**Figure 26**) using the photographs referred to above. It is not clear from the photographs how far floodwaters extend to the west, and the boundary of the mapping in the vicinity of Nonoti Road and Homeview Road has mostly been estimated based on local knowledge and a visual survey of the area. No LiDAR data is currently available for the area to assist in the mapping.

The part of the line north of Mina Road generally follows the existing District Plan line, as the photographs do not provide any additional information on where the boundary should be. Across the south-western edge of Cheviot township, the 2008 photograph has been used where possible to define the edge of the mapped area; otherwise the original line has been followed.

We recommend that the line in the District Plan be replaced by the area identified in **Figure 26**.

3.3.4 Motunau River (Planning map 5)

The area identified is generally on the floodplain of the Motunau River and extends approximately from Gardiners Road to Cotswold Road and is bounded to the east by Motunau Beach Road and to the west by downland and covers an area of approximately 70 hectares.

Environment Canterbury staff are not aware of Environment Canterbury having any involvement in the identification of this area in the District Plan and Environment Canterbury does not hold any flood hazard information for the site. Environment Canterbury has not mapped the floodplain of the Motunau River for inclusion in the District Plan.

Topographical information at a scale of 1:50,000 indicate that the area mapped includes some higher ground above a natural terrace and it would be appropriate to redefine this area to exclude this higher ground. The area which is currently defined by cadastral boundaries has been redefined using topographical information at a scale of 1:50,000 and aerial photographs (**Figure 27**).

We recommend that if Hurunui District Council holds the information to support the identification of this area as prone to flooding, they should retain this area in the District Plan, but with refinement of the boundaries to exclude higher ground.

3.3.5 Waiau River (Planning map P)

The District Plan identifies an area at Waiau township as 'Subject to River Cutback'. The area is located on the true left bank of the Mason River between Leslie Street and the river, and just downstream of the River Road Bridge.

The area identified in the District Plan appears to be a significant part of the area that was affected by active erosion when the 'Waiau Township River Protection District' was formed in 1906, following a period of active erosion by the Mason River between 1904 and 1906 (Amuri County Council Report by E B Dalmer (County Engineer) dated 19 August 1940). The last rate was struck in 1921/22 but the Waiau Township River Protection District was not formally abolished until 1971.

In 2004, with the support of the local community, Environment Canterbury established a river rating area to manage both the Waiau and Mason rivers in the vicinity of, and upstream of, Waiau township. There is only one rating class for the Waiau township Rating District and the rate is levied on capital value.

The area identified as 'Subject to River Cutback' is within the river floodplain area mapped for inclusion in the District Plan. We recommend that if the floodplain mapping is adopted for inclusion in the District Plan then the current identification of this area be removed.

3.3.6 Kowai River (North Branch) (Planning map A)

The District Plan identifies an area on the true left bank of the Kowai River North Branch immediately upstream of Grays Road as at risk from flooding. Parts of this area were flooded in July 2008 and a flood study by URS in 2006 confirmed this risk.

The area identified is within the river floodplain areas mapped for inclusion in the District Plan. We recommend that if those areas are adopted for inclusion in the District Plan then the current identification of this area be removed.

3.3.7 Hawarden (Planning map I)

The District Plan identifies an area at Hawarden located between High Street and Seymour Street and bounded to the east by Wellington Street as 'Subject to ponding'.

Investigations by the North Canterbury Catchment Board into flooding and drainage issues around Hawarden were initiated in 1974, and a report on a proposed scheme was presented to the Waipara County Council on 13 September 1976. Lack of community support and opposition to the granting of water rights for the proposed works led to the proposed scheme not proceeding. In 1981, a scaled-down scheme involving the maintenance of the existing drainage network was proposed. A classification for this scheme was undertaken by North Canterbury Catchment Board staff in 1982. Discussions with Geoff Scholes (former Environment Canterbury Rivers Area Engineer) indicate that this classification was not given effect to.

Environment Canterbury does not hold any detailed maps of historic flooding within the Hawarden township or any background information on the identification of this area in the District Plan.

We recommend that if Hurunui District Council holds the information to support the identification of this area as 'Subject to ponding', they should retain this area in the District Plan.

3.3.8 Leithfield (Planning map K)

The District Plan identifies an area at Leithfield, located between the Kowai River South Branch and Leithfield Road, and bounded to the east by Old Main North Road and to the West by Terrace Road as being 'Subject to Ponding'. This area is separated from the township by a low stopbank built in response to earlier flood events.

The District Plan also identifies a 'Building Line Restriction' that applies to the Rural Lifestyle area located to the west of Terrace Road between Leithfield Road and the Kowai River South Branch. The building line restriction offers a level of control over the siting and floor level of dwellings on the floodplain.

Both the area identified as 'Subject to Ponding' and the area to which the 'Building Line Restriction' applies are within the river floodplain areas mapped for inclusion in the District Plan. The existing controls over these areas will be retained in the proposed controls relating to floodplain areas and it is recommended that if these floodplain areas are adopted for inclusion in the District Plan then the current specific identification of these areas be removed.

3.4 Isolated areas that could be mapped for inclusion in the District Plan

3.4.1 Methodology

As part of the consultation process with Hurunui District Council, Environment Canterbury was provided with brief comments on areas that the ward committees recognised as having flooding issues.

Areas identified which have not been considered in other parts of this report are:

- 3.4.2 Eastern Drain in the vicinity of Osborn and Douglas roads, Amberley
- 3.4.3 Lower lying areas of Leithfield township
- 3.4.4 Armstrongs Road at Waikari
- 3.4.5 School Creek at Culverden

Environment Canterbury Staff are aware that flooding has occurred in these areas, but in most instances Environment Canterbury does not hold sufficient site specific flood hazard information to map flood areas with certainty.

3.4.2 Eastern Drain

With regard to Eastern Drain, it would be possible to identify previously flooded areas from photographs which were taken in 1986 and 2008. However, any study of this area should be incorporated into a comprehensive study of the flood risk to the rest of Amberley township.

3.4.3 Leithfield township

The lower lying parts of the township are mapped as part of the Kowai River floodplain, and if that mapping is included in the District Plan then the flood risk to these lower lying areas from local rainfall events can be considered as part of any flood risk assessment.

3.4.4 Waikari

Environment Canterbury does not hold any detailed flood hazard information for Waikari and its immediate environs.

3.4.5 School Creek

Environment Canterbury has limited information with which to define a flood hazard area. The North Canterbury Catchment Board prepared a preliminary report on School Creek (Dwyer and Norton - 26/3/1971). An engineering report and an economic report were prepared in July 1971 and June 1971 respectively. A comprehensive flood mitigation scheme has not proceeded, but in 1977 a rating area

was established for the purpose of undertaking limited maintenance works on School Creek upstream of SH7. This work was limited to the removal of shingle from several small shingle traps.

3.4.6 Waipara township

Photographs taken at the time of the flood event of 31 July 2008 (**Figure 28**) show significant ponding in what appears to be an old borrow pit located immediately to the west of the Main North Railway Line on the north side of Waipara Flat Road at Waipara township.

The extent of this borrow pit has been defined for possible inclusion as a flood assessment area in the District Plan (**Figure 29**).

4 Use of the maps

The methodology used to generate the maps should be a key consideration in determining their appropriate use. With the exception of the coastal ponding areas and the ponding area at Cheviot (both of which are based on documented evidence of past flooding), the maps simply indicate broad areas which Environment Canterbury considers to be potentially at risk of flooding from a particular source, based primarily on topographic information. The mapping therefore does not define 'flood prone' land, but defines areas where the flood risk needs to be assessed in greater detail prior to certain activities occurring. The degree of flood risk within the mapped areas will be highly variable, and may range from areas which are suitable for certain activities (e.g. construction of new dwellings) with little or no mitigation, to areas in which certain activities should be avoided due to the high level of risk. An assessment of the flood risk can be undertaken on a case by case basis when development is proposed.

Hurunui District Council have indicated a preference to include the maps in the District Plan and have a set of rules which apply to certain activities within these areas. Environment Canterbury does not have sufficient information to map flood depths or levels associated with a 200 year return period (0.5% annual exceedance probability) flood event, or to map 'High Hazard' flood areas within the district. However, in most situations, Environment Canterbury would be able to provide the necessary information to establish if a new dwelling proposal met these requirements, or for a proposal to be amended so that it did meet the requirements (e.g. change of building site or elevated floor level).

The maps do not constitute a comprehensive assessment of the flood risk across the entire district. If a property is outside of the mapped areas, it cannot be assumed that there is no risk of flooding. For example, a site on the banks of a small stream which has not been mapped may actually have a greater risk of flooding than a site on the wide floodplain of a river which has been mapped.

The maps may need to be reviewed as new information (e.g. flood modelling investigations or updated hydrological data) becomes available, or following any significant flood events in the district. The maps may also need to be reviewed to account for future changes in climate and other factors such as river bed aggradation/degradation, channel re-alignment and erosion. This should be undertaken during the next review of the District Plan, but it may also be necessary prior to this time.

5 Recommendations

We recommend that the following changes be made to '**Appendix A9.1 - Schedule of natural hazard areas**' of the District Plan and suggest that these areas be referred to as 'Flood Hazard Assessment Areas'.

1. Add the floodplains of the major rivers as mapped in **Figures 1 to 13**.
2. Add an area located at the corner of Harleston and Ashworths Road (**Figure 16**).
3. Add Leithfield Beach township (**Figure 19**).
4. Add Amberley Beach township (**Figure 22**).
5. Amend the area between the Kowai River and Newcombes Road west to Hursley Terrace Road to include all of this area (**Figure 25**).
6. Amend the area at Cheviot, currently identified on Planning maps 8 & D as at risk from flooding, by closing the present line to form a polygon as shown in **Figure 26**.

7. Amend the area identified on Motunau River (Planning map 5) to follow the river terrace along the western boundary **(Figure 27)**.
8. Delete the area identified at Waiau township as 'Subject to River Cutback' provided the area is included as part of the river floodplain maps **(Figure 9B and Figure 11)**.
9. Delete the area identified as at risk from flooding located on the Kowai River North Branch at Grays Road, Amberley township provided the area is included as part of the river floodplain maps **(Figure 1)**.
10. Delete the area identified as 'Subject to Ponding' adjacent to Leithfield Road, Leithfield township provided the area is included as part of the river floodplain maps **(Figure 1)**.
11. Delete the Building Line Restriction on Rural Lifestyle zoned area at Leithfield Road, Leithfield township, provided the area is included as part of the river floodplains maps **(Figure 1)**.
12. Add an area covering an old borrow pit at Waipara township located adjacent to the west side of the Main North Railway Line and north of Waipara Flat Road **(Figure 29)**.

6 Acknowledgements

Tony Oliver (Hazards Analyst, Environment Canterbury) and Justin Cope (Team Leader Hazards and Coastal Environmental Quality and Hazards, Environment Canterbury) for reviewing this report.

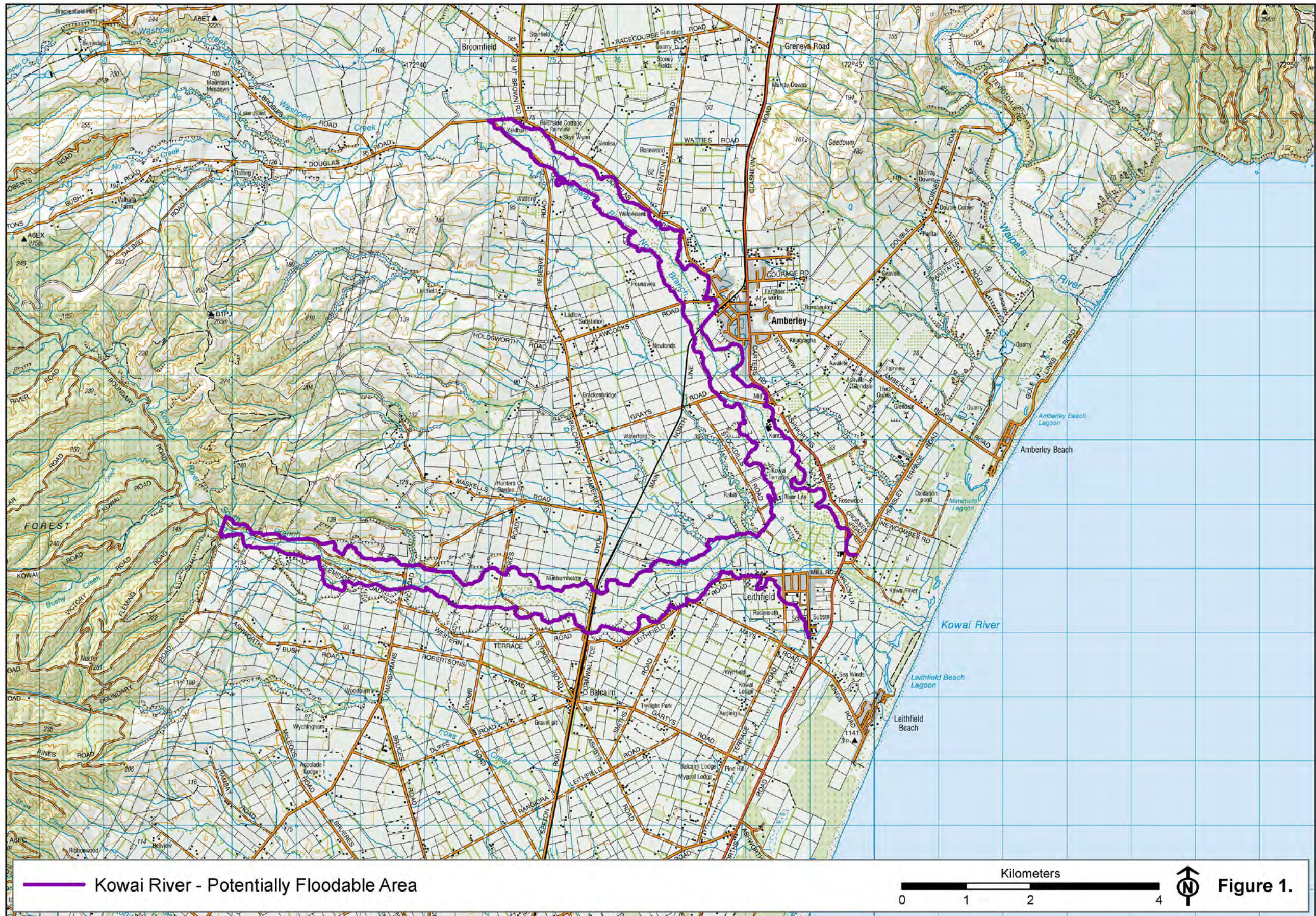
Wendy Donald (Corporate Administrator – Investigations and Monitoring, Environment Canterbury) for assistance with editing and formatting this report.

7 References

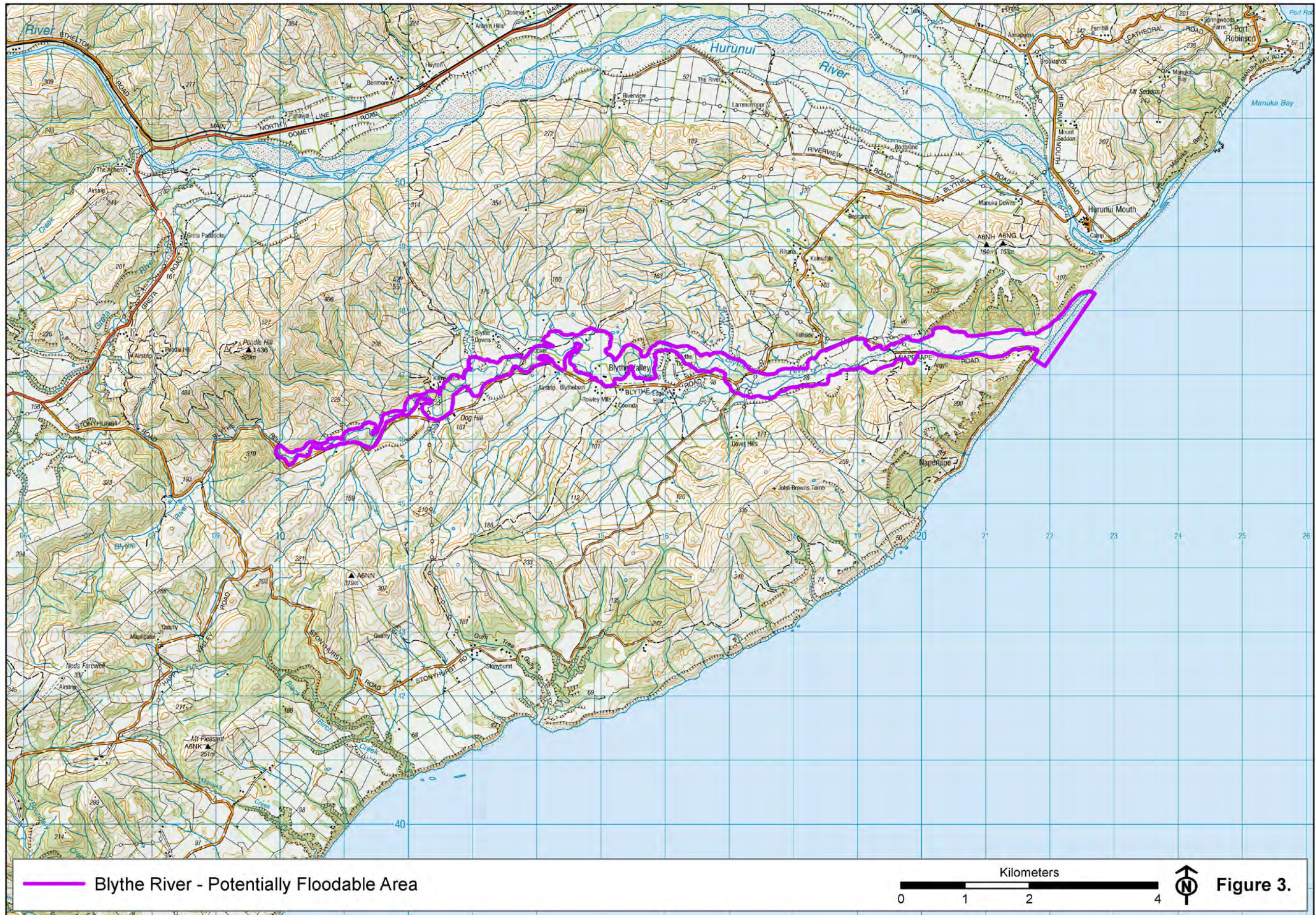
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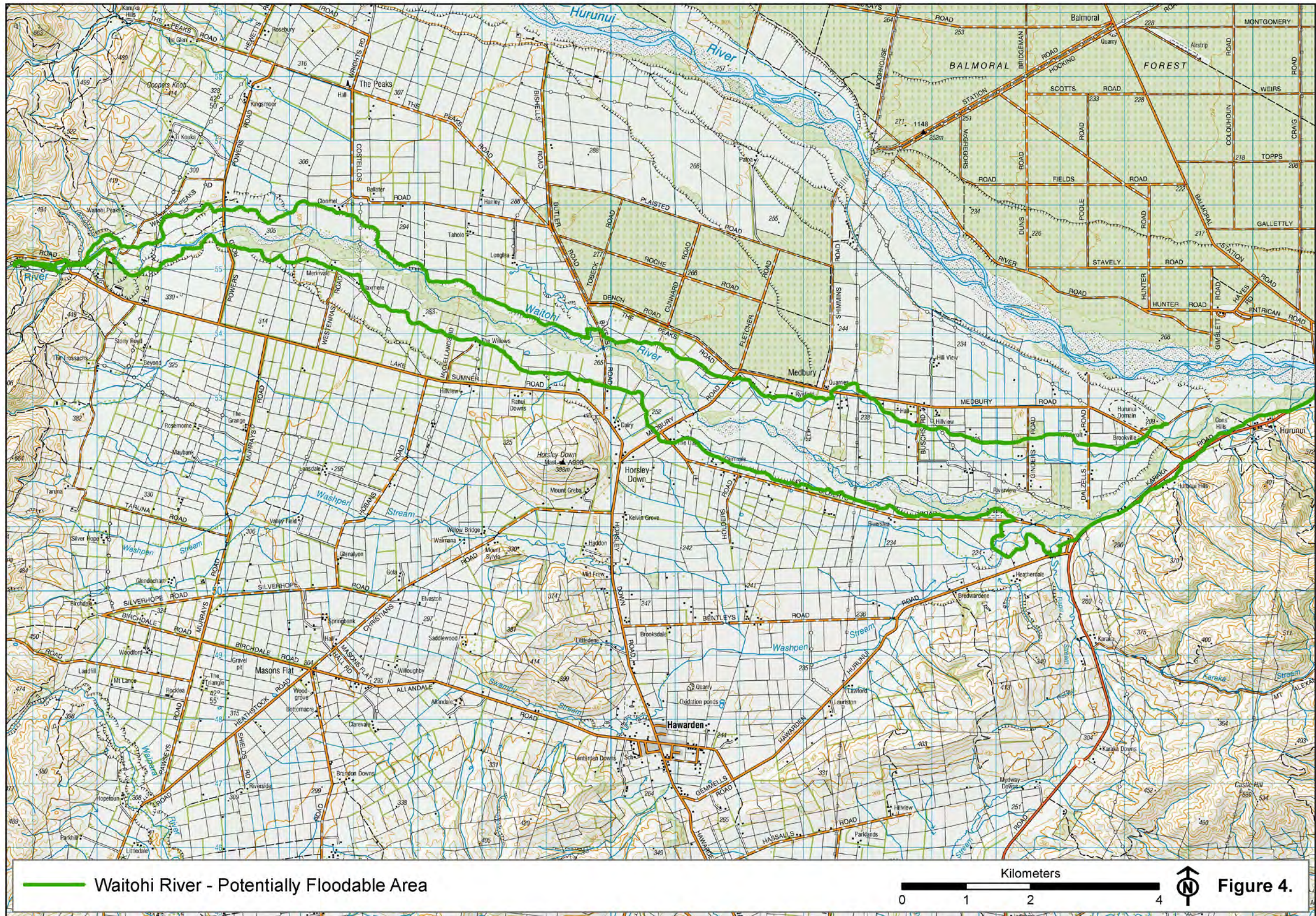
Appendix 1: Figures

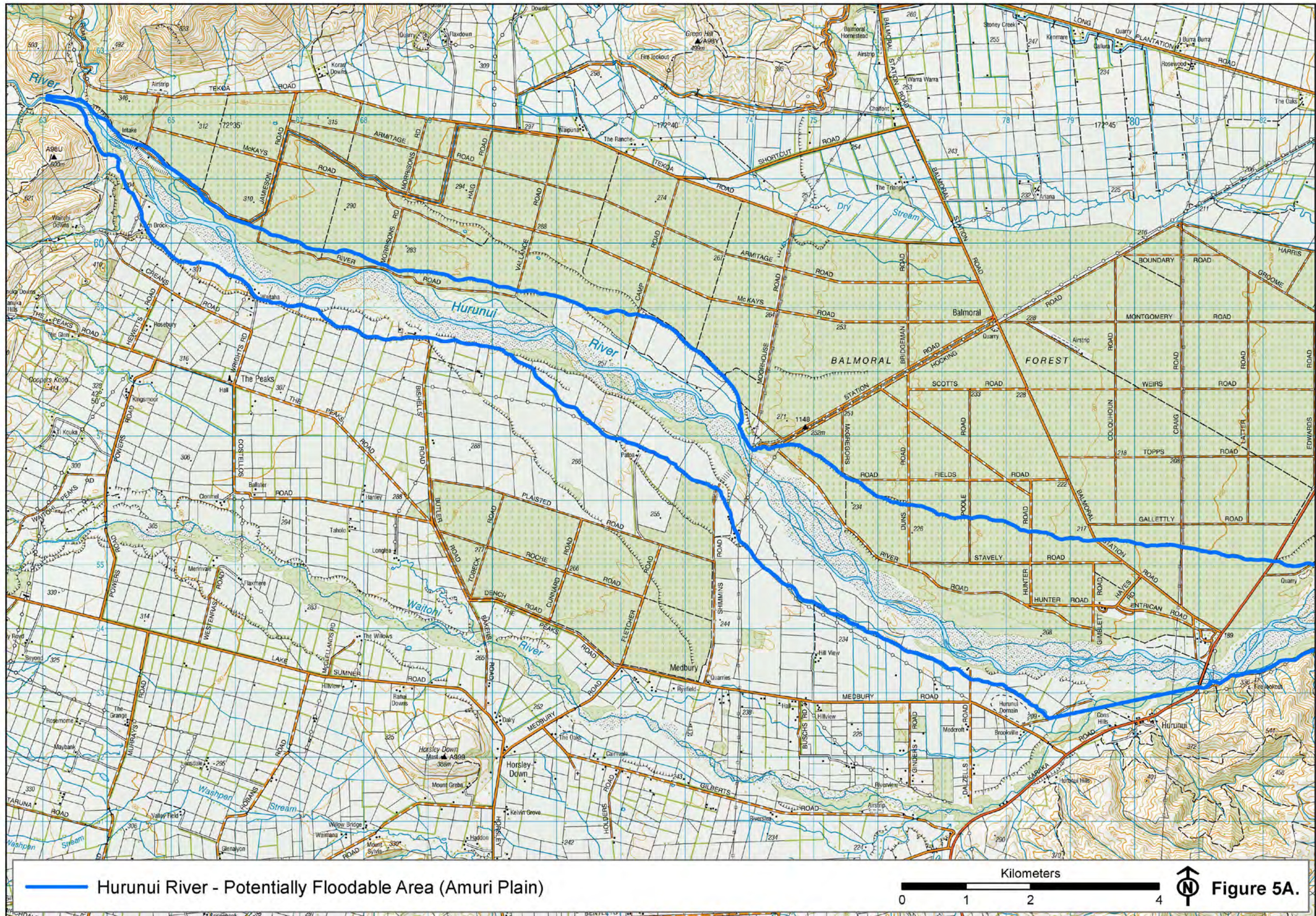
- Figure 1: Kowai River – Potentially Floodable Area
- Figure 2: Waipara River – Potentially Floodable Area
- Figure 3: Blythe River – Potentially Floodable Area
- Figure 4: Waitohi River – Potentially Floodable Area
- Figure 5A & B: Hurunui River (Amuri plain) – Potentially Floodable Area
- Figure 6: Hurunui River (Lower Hurunui) – Potentially Floodable Area
- Figure 7: Pahau River – Potentially Floodable Area
- Figure 8: Waiau River (Hanmer Plain) – Potentially Floodable Area
- Figure 9A & B: Waiau River (Emu/Amuri Plains) – Potentially Floodable Area
- Figure 10: Waiau River (Spotswood/Parnassus) – Potentially Floodable Area
- Figure 11: Mason River – Potentially Floodable Area
- Figure 12: Hanmer River – Potentially Floodable Area
- Figure 13: Conway River – Potentially Floodable Area
- Figure 14: TV3 video footage – Harleston and Ashworths Roads – 31 July 2008 (Photograph)
- Figure 15: Harleston Road – Land < 4.2 m.a.m.s.l.
- Figure 16: Coastal Strip – Areas Subject to Ponding (Harleston Road)
- Figure 17: TV3 Video Footage – Leithfield Beach – 31 July 2008 (Photograph)
- Figure 18: Leithfield Beach – Land < 2.80 m.a.m.s.l.
- Figure 19: Coastal Strip – Areas Subject to Ponding (Leithfield Beach)
- Figure 20: TV1 Video Footage – Amberley Beach – 31 July 2008 (Photograph)
- Figure 21: Amberley Beach – Land < 2.85 m.a.m.s.l.
- Figure 22: Coastal Strip – Areas Subject to Ponding (Amberley Beach)
- Figure 23: Newcombes Road area – 31 July 2008 (Photograph)
- Figure 24: Operative District Plan Flood Hazard Areas (Newcombes Road)
- Figure 25: Coastal Strip – Areas Subject to Ponding and/or Flooding from the Kowai River (Newcombes Road)
- Figure 26: Cheviot - Ponding Area
- Figure 27: Motunau River Flood Hazard Area – Modified to remove areas of high ground
- Figure 28: Ponding in Waipara Borrow Pit – 31 July 2008 (Photograph)
- Figure 29: Waipara Borrow Pit – Ponding Area

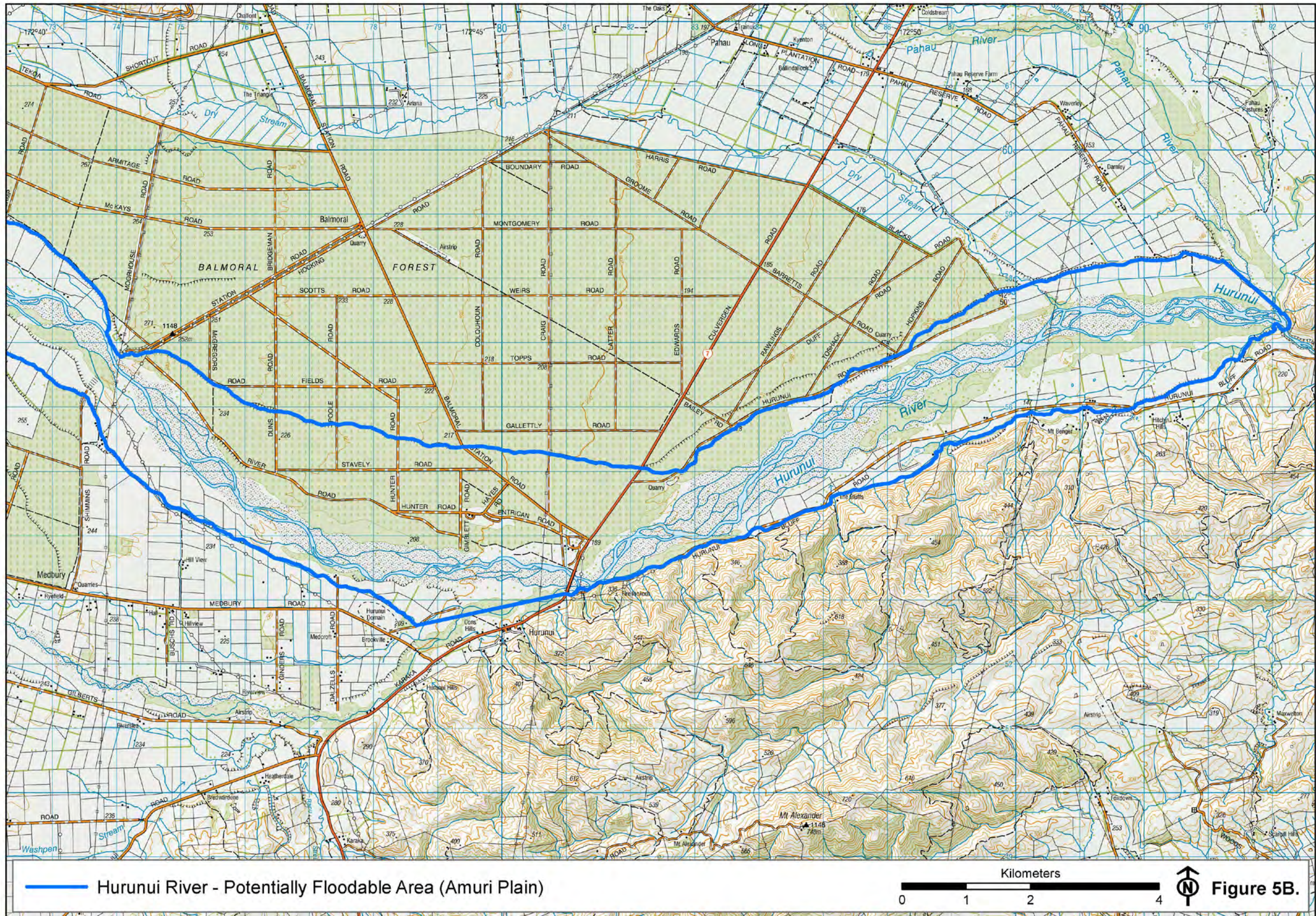




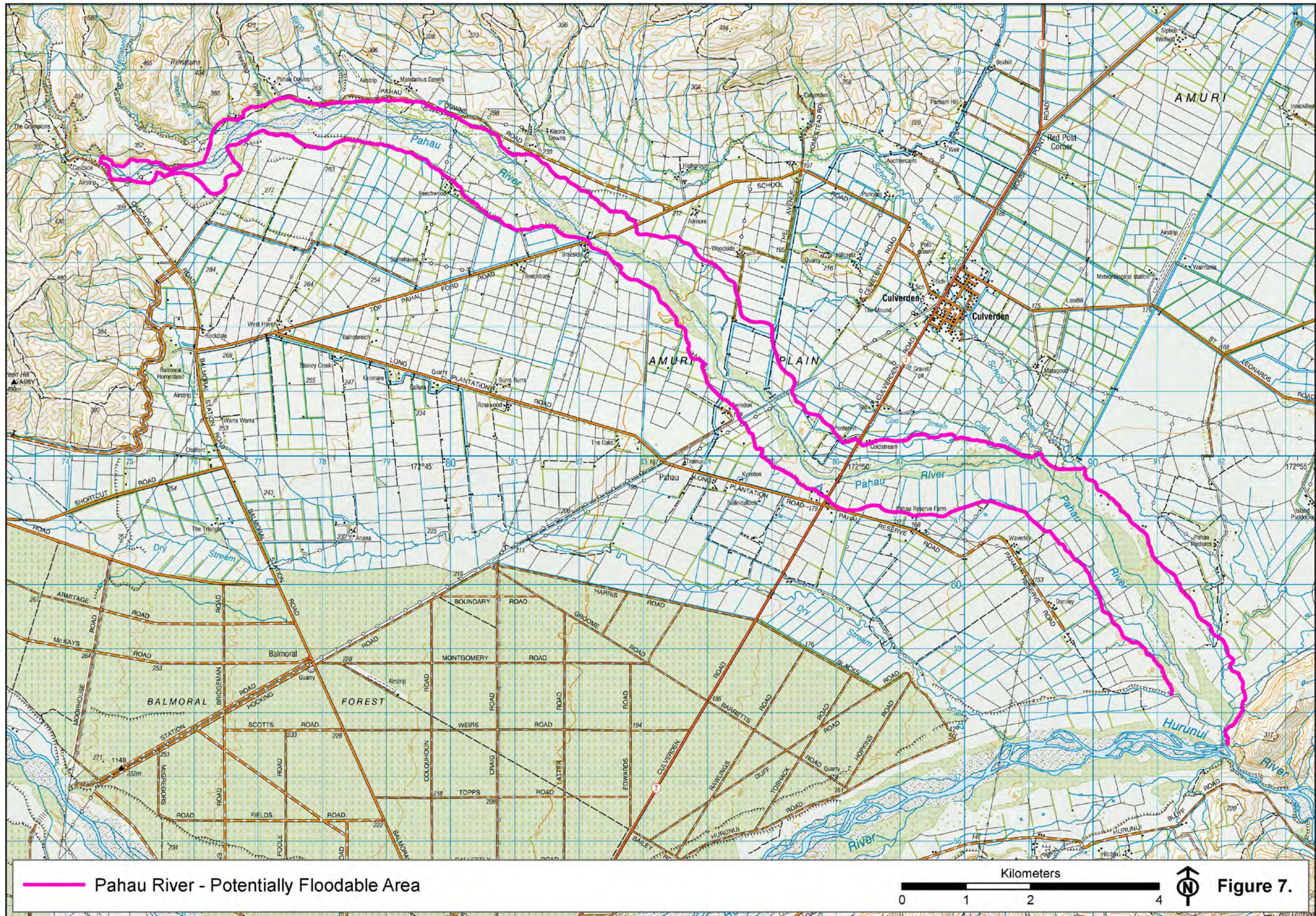


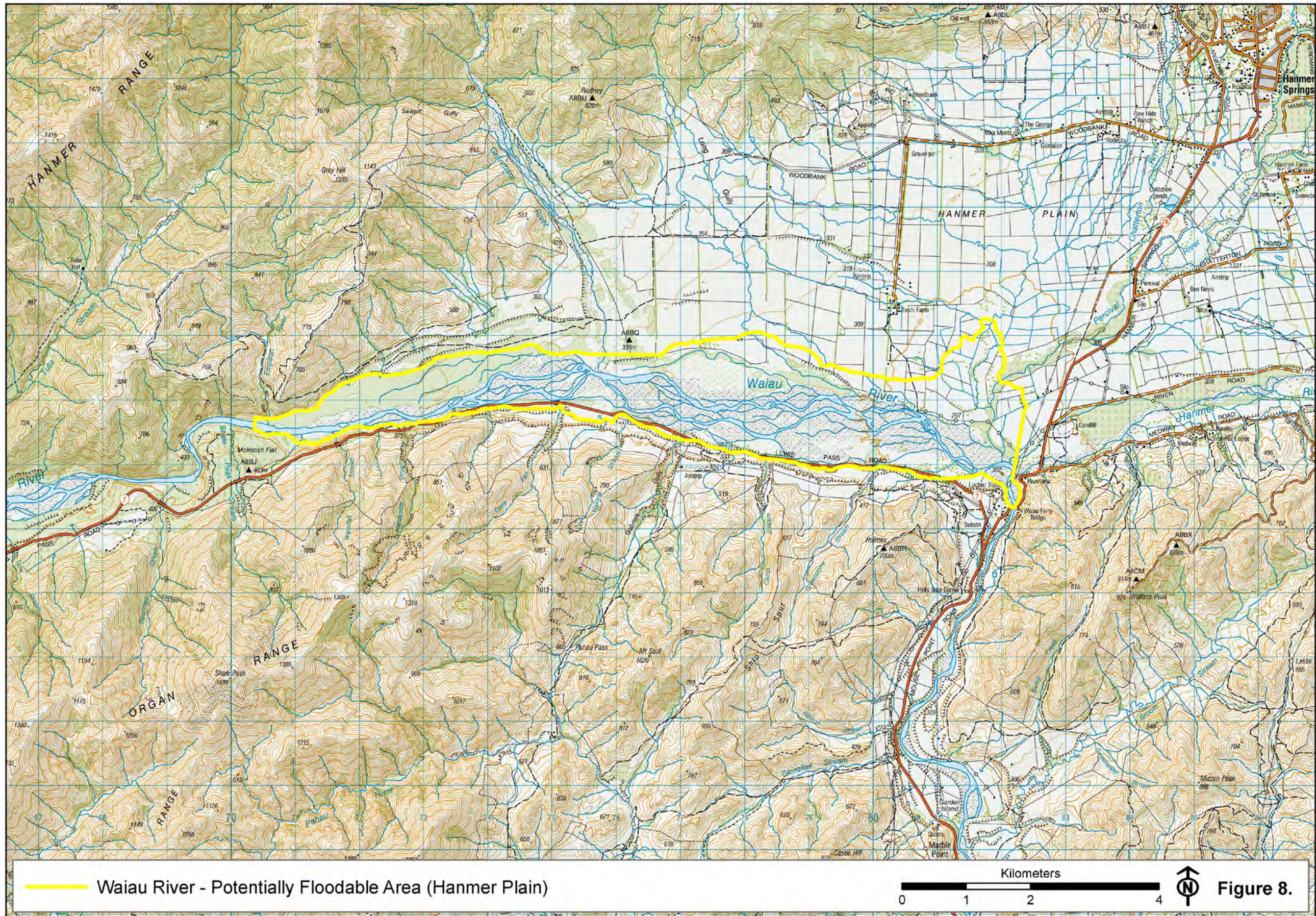


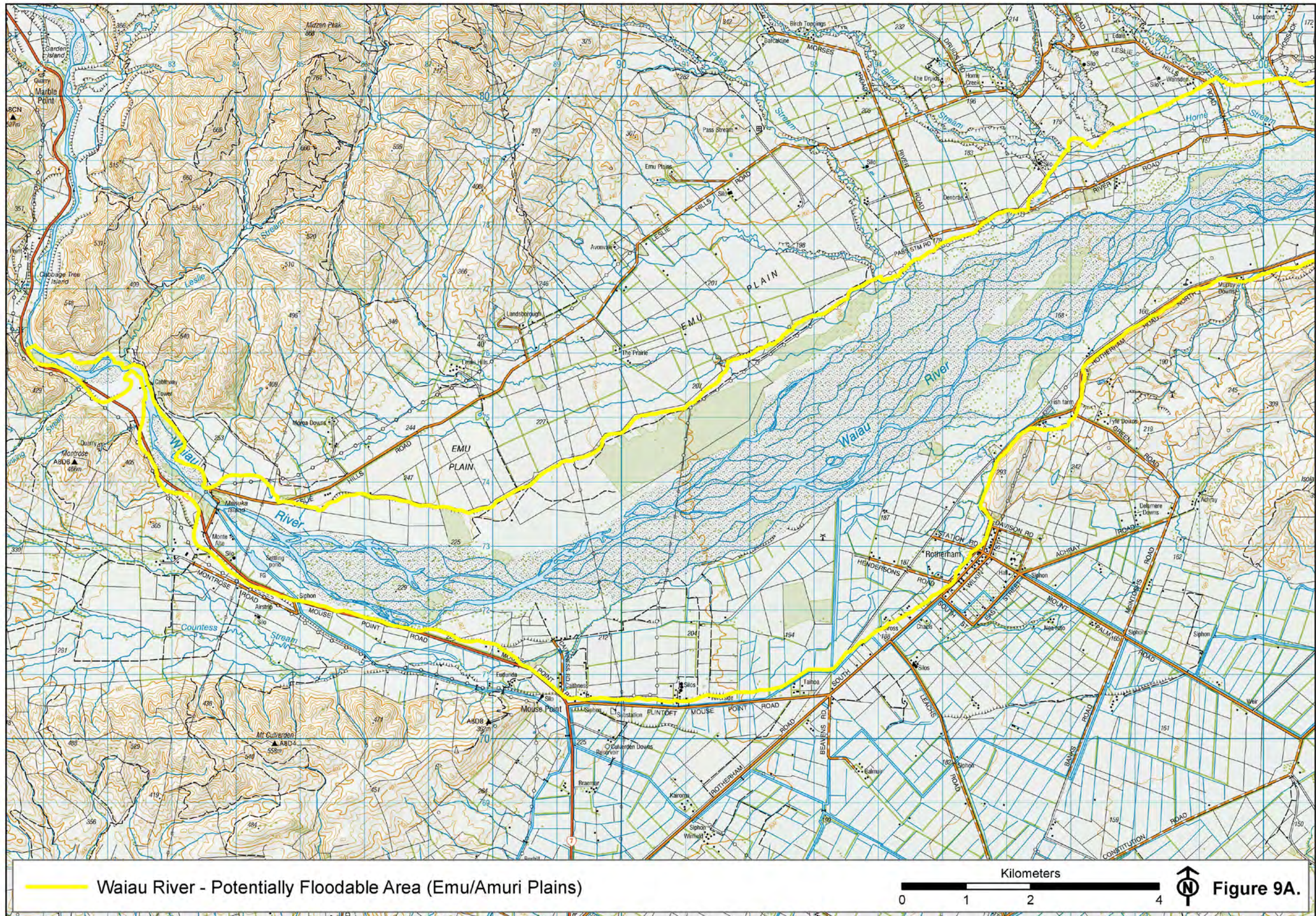


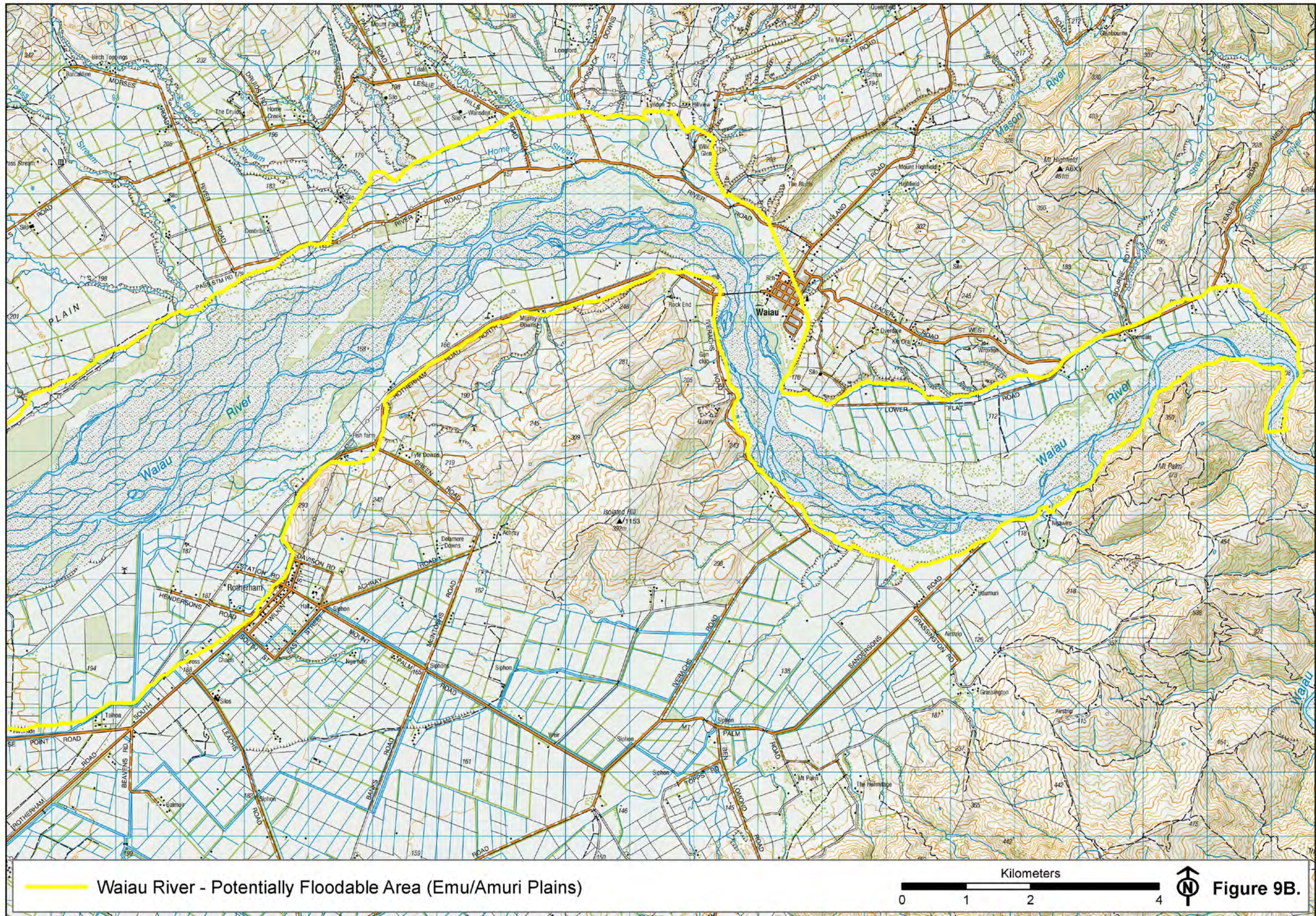


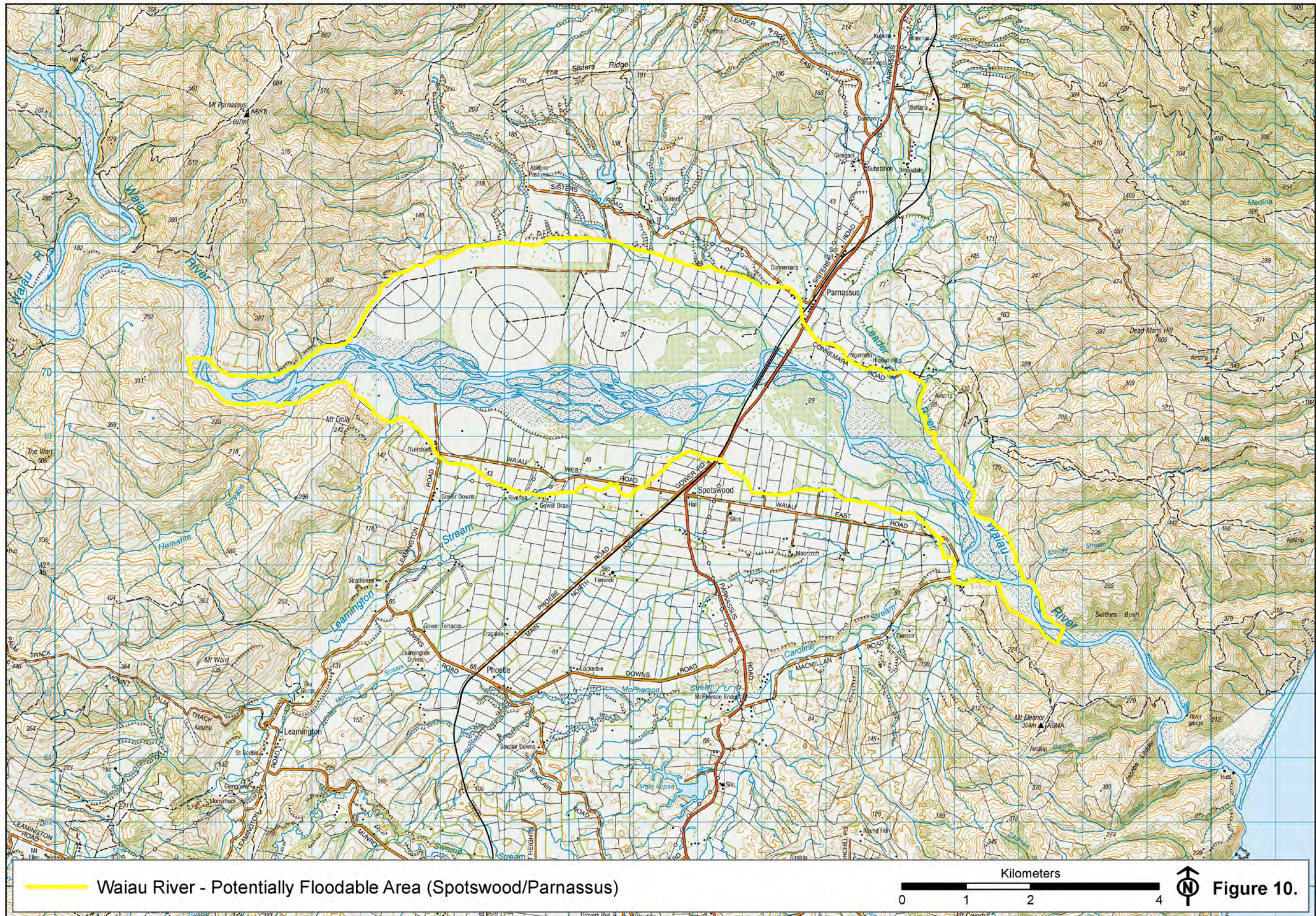


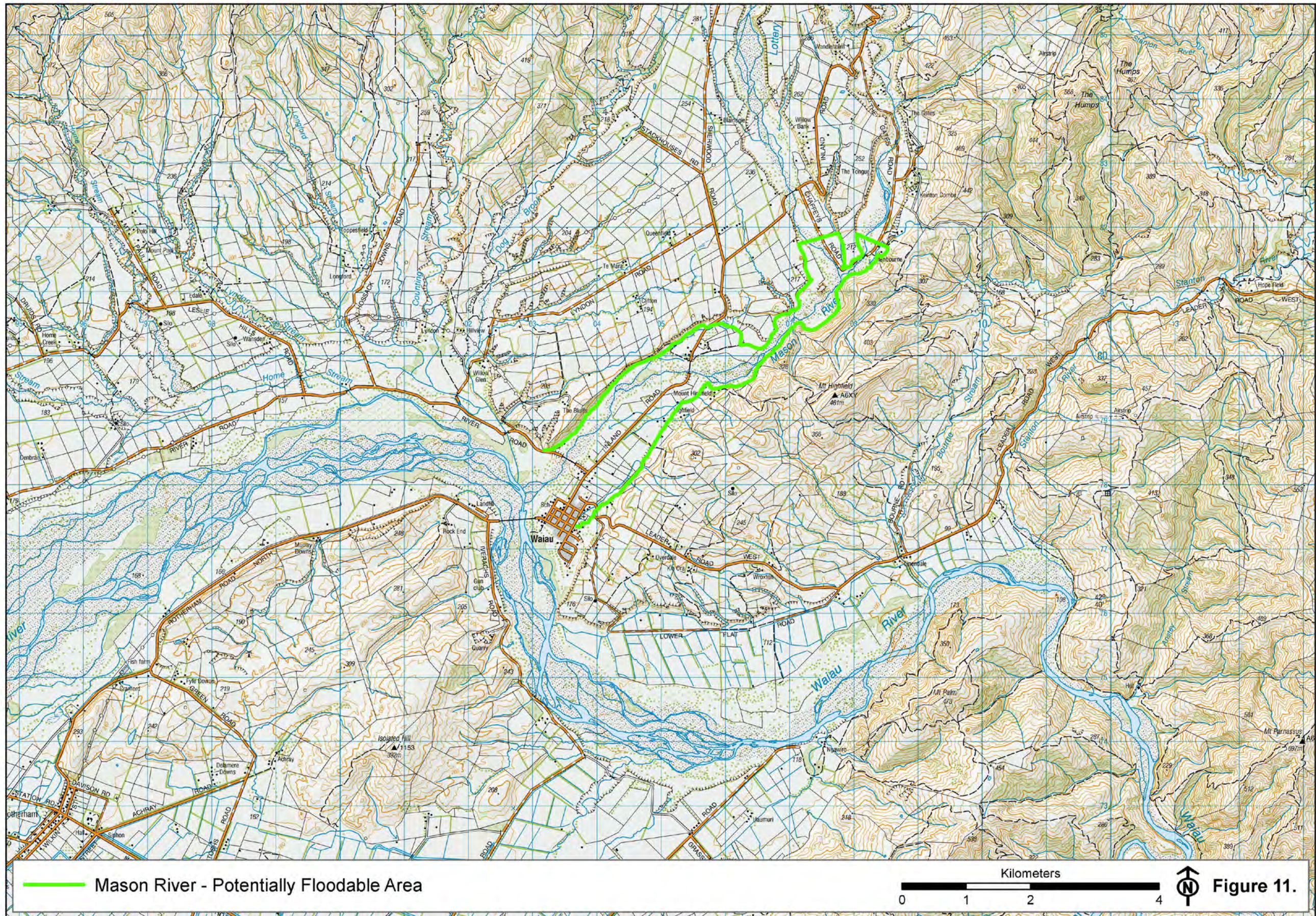


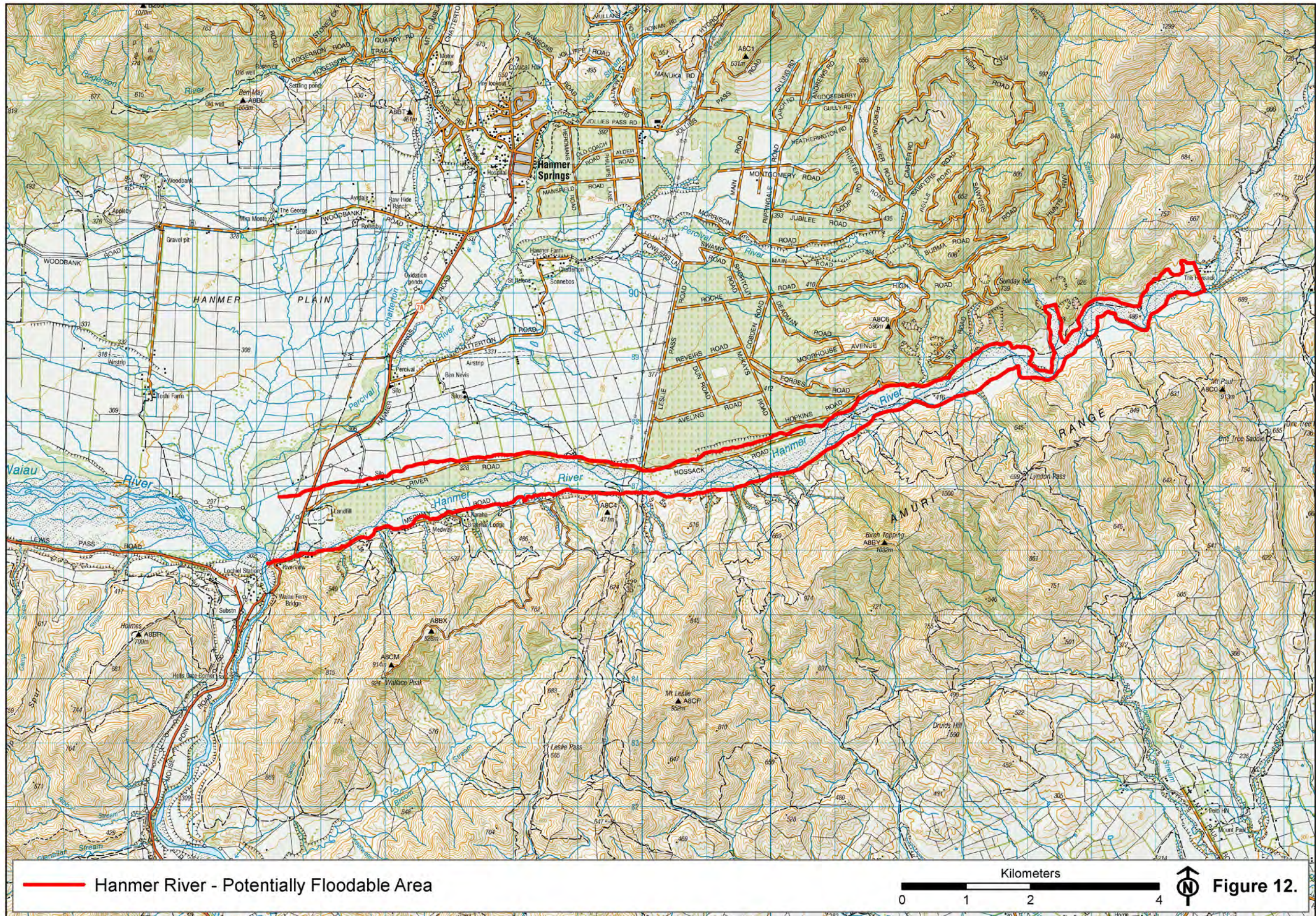












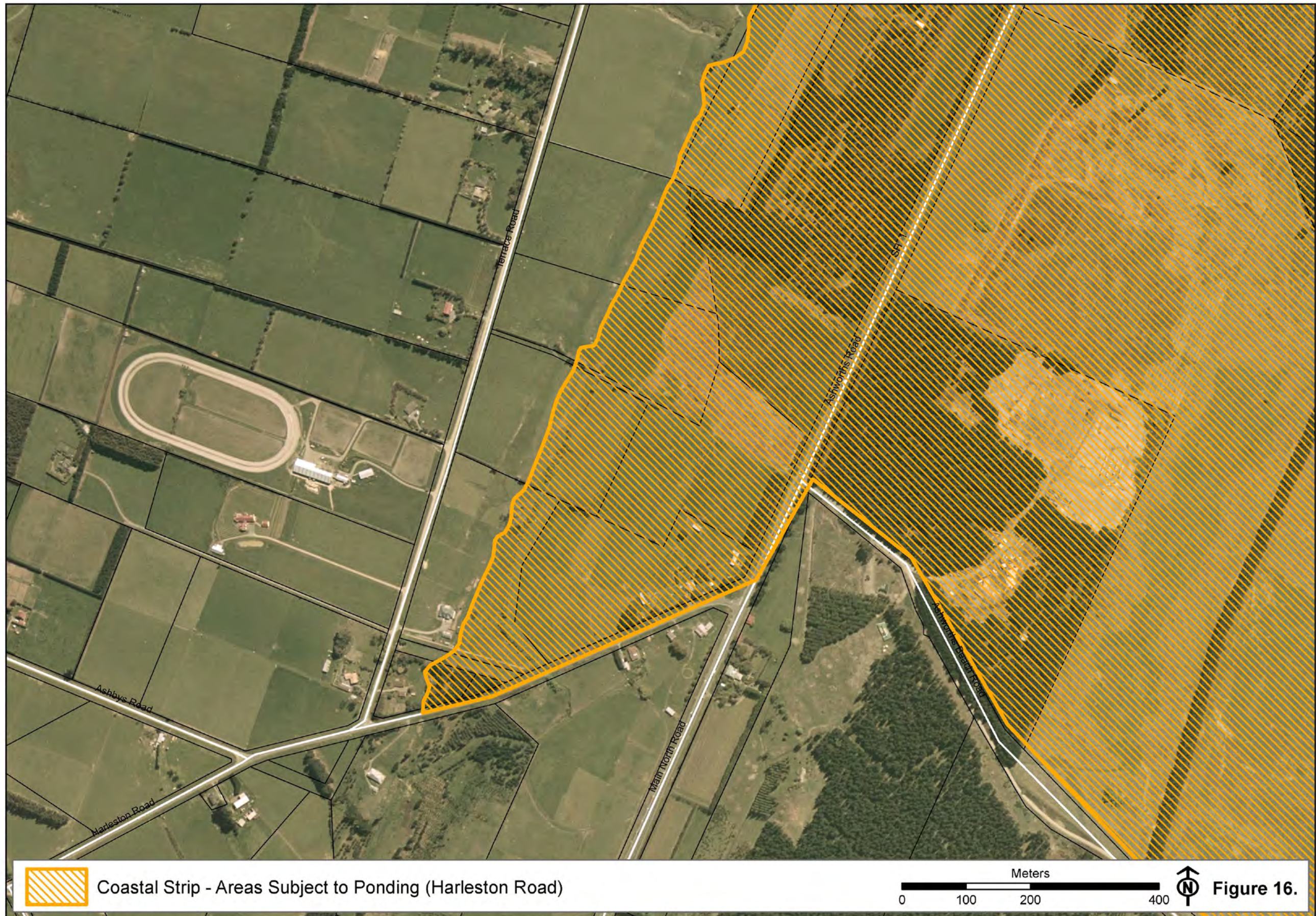




TV3 Video Footage - Harleston and Ashworths Roads - 31 July 2008.

Figure 14.







TV3 Video Footage - Leithfield Beach - 31 July 2008.

Figure 17.



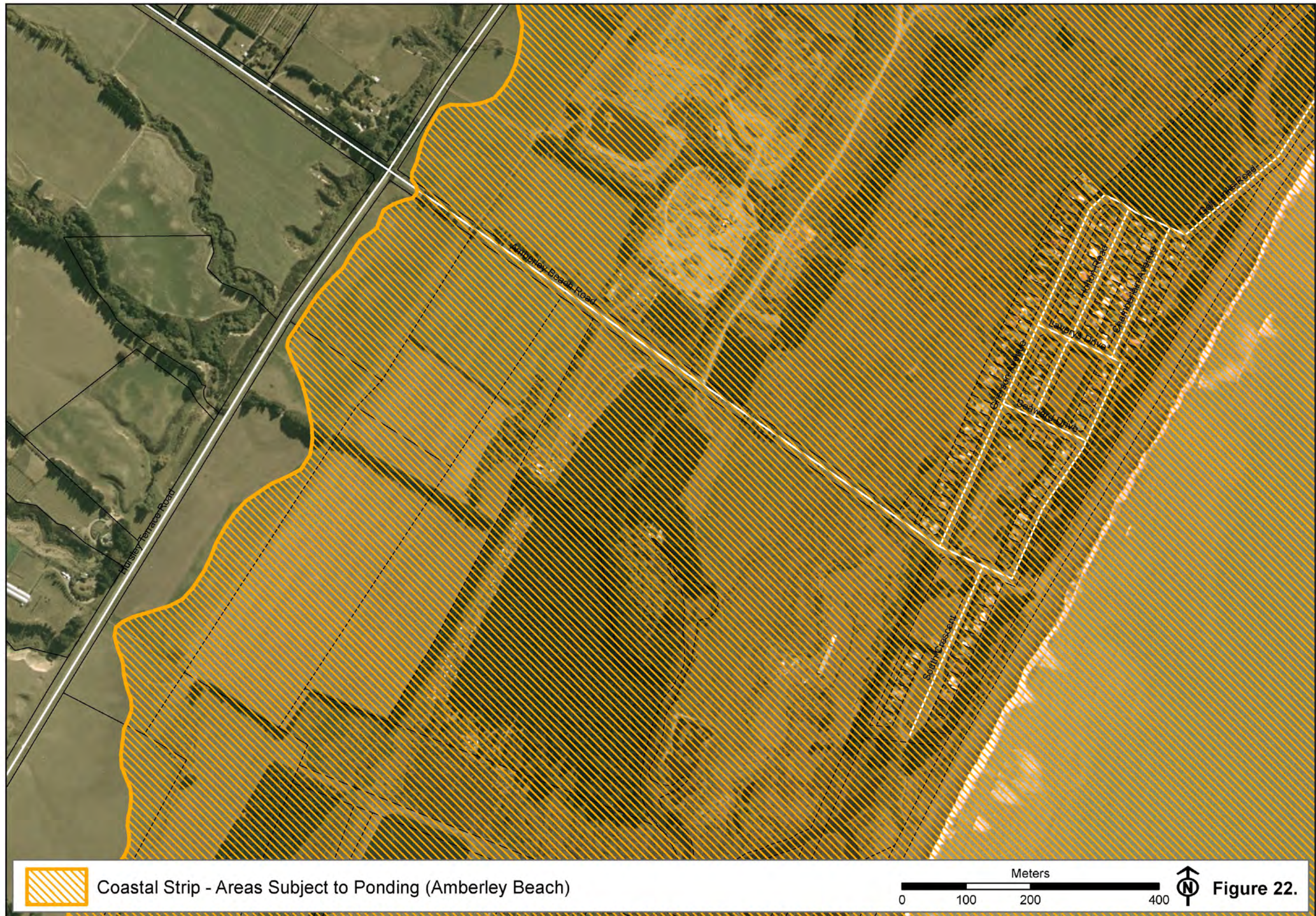




TV1 Video Footage - Amberley Beach – 31 July 2008.

Figure 20.

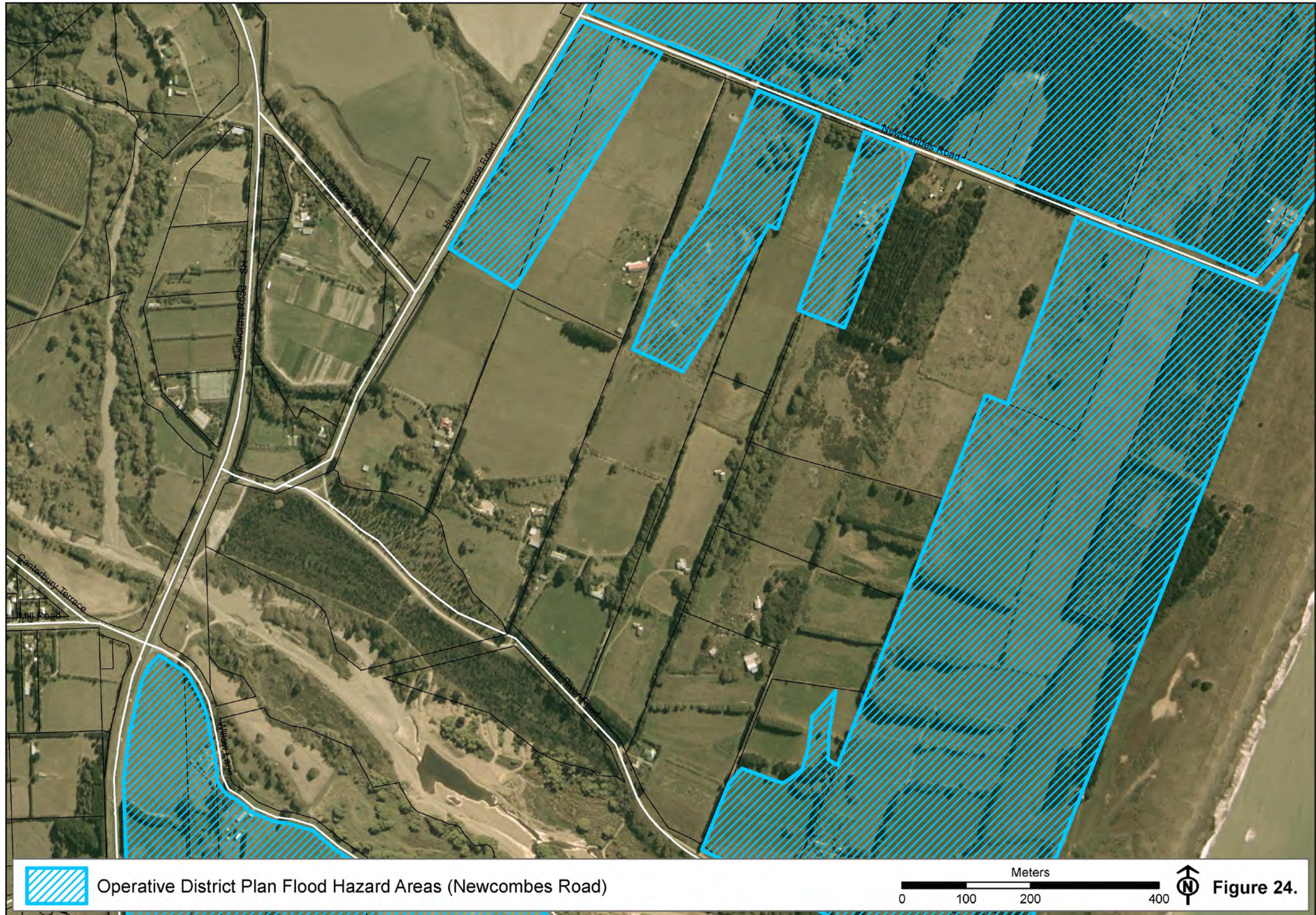


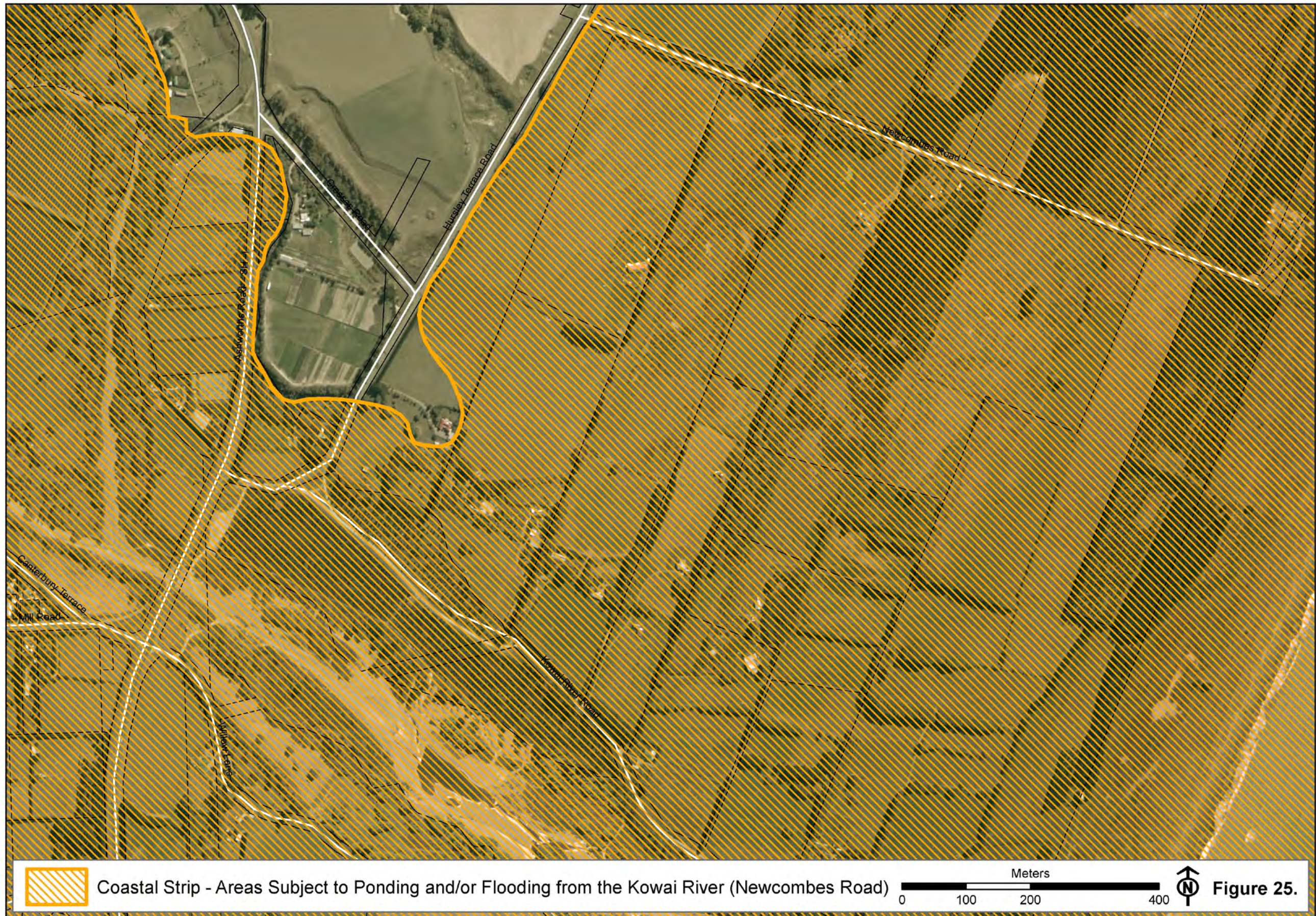




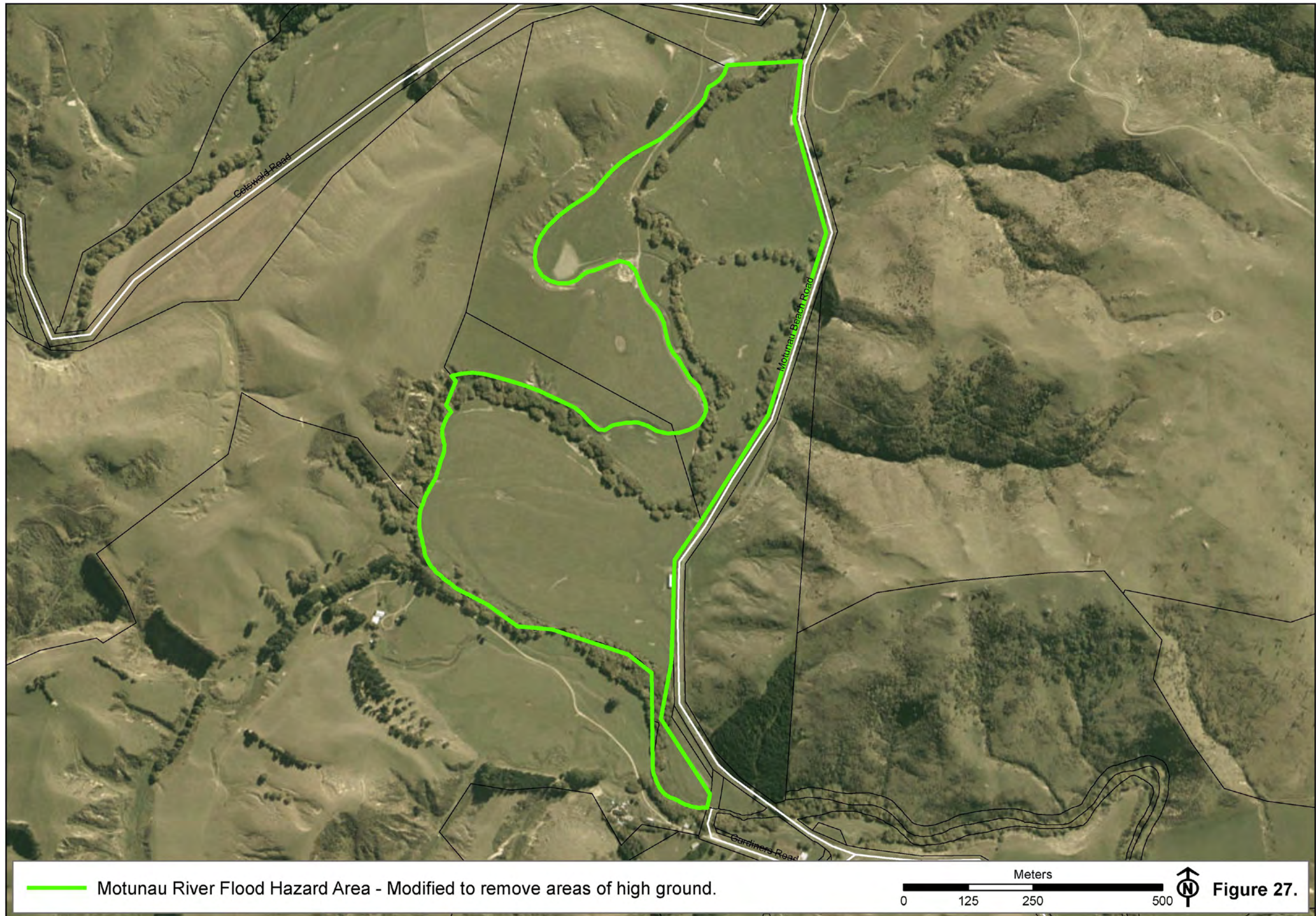
Newcombes Road Area - 31 July 2008.

Figure 23.











Ponding in Waipara Borrow Pit - 31 July 2008.

Figure 28.

