Extent of land flooded and river erosion following Cyclone Debbie – April 2017

Abstract

An assessment of the extent of land flooded and river erosion following Cyclone Debbie in April 2017 was conducted using GIS resources alongside pre and post flood aerial photography of the Whakatāne District's main river systems. Key findings were that across all of the river systems which have a combined length of 170.1km, 92.6ha of land was lost to erosion and 5129.5ha of land was subject to inundation from river flooding. Flooding within and immediately surrounding Edgecumbe accounted for 1239.3ha (24.1%) of this land area.

Purpose

Significant riverbank erosion resulting in loss of river defence and pasture land was observed across many of the rivers in the Whakatāne District as a result of the Cyclone Debbie in April 2017. This project aims to quantify the extent of the erosion as well as gaining a better understanding of the area of river flooded land. This data will help understand the localised affect with landowners and the potential economic effect on the District from lost production and on going erosion control costs, re-grassing and fencing. Rivers included in the scope of the project are: Whakatāne, Waimana, Rangitāiki, Whirinaki and the Horomanga. Sections of these rivers that were excluded from the scope of the project were the indigenous forest portion of rivers, HEP areas and gorges where no primary sector activity was occurring. These areas are often not subject to significant change or flooding due to their land cover types and steep slope of the land. The combined length of these river project areas is 170.1km.

Method

As per figure 1 the rivers included in the scope of the project are: Whakatāne, Waimana, Rangitāiki, Whirinaki and the Horomanga. The combined length of river coverage is 170.1km.

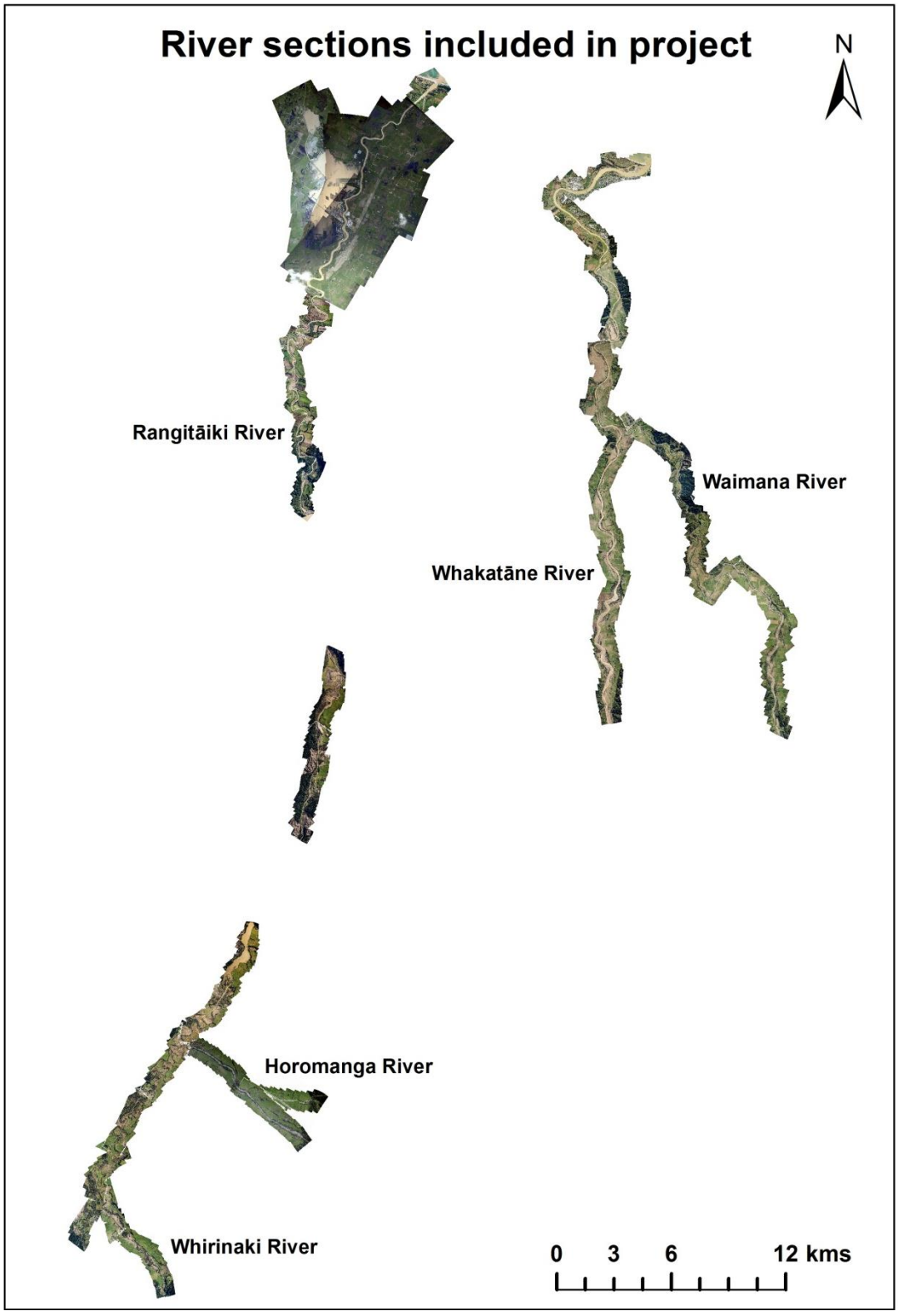

Figure 1: Project scope showing aerial photography from included river sections.

The post-flood aerial photography included in this study was flow between the 6th of April and the 10th of April 2017. Using ArcGIS under the coordinate system New Zealand Transverse Mercator the post-flood aerial photos were georeferenced. The aerial photography was georeferenced against 2011 satellite imagery which acted as the source of ground control points and basis for pre-flood comparison for the project (fig. 2).

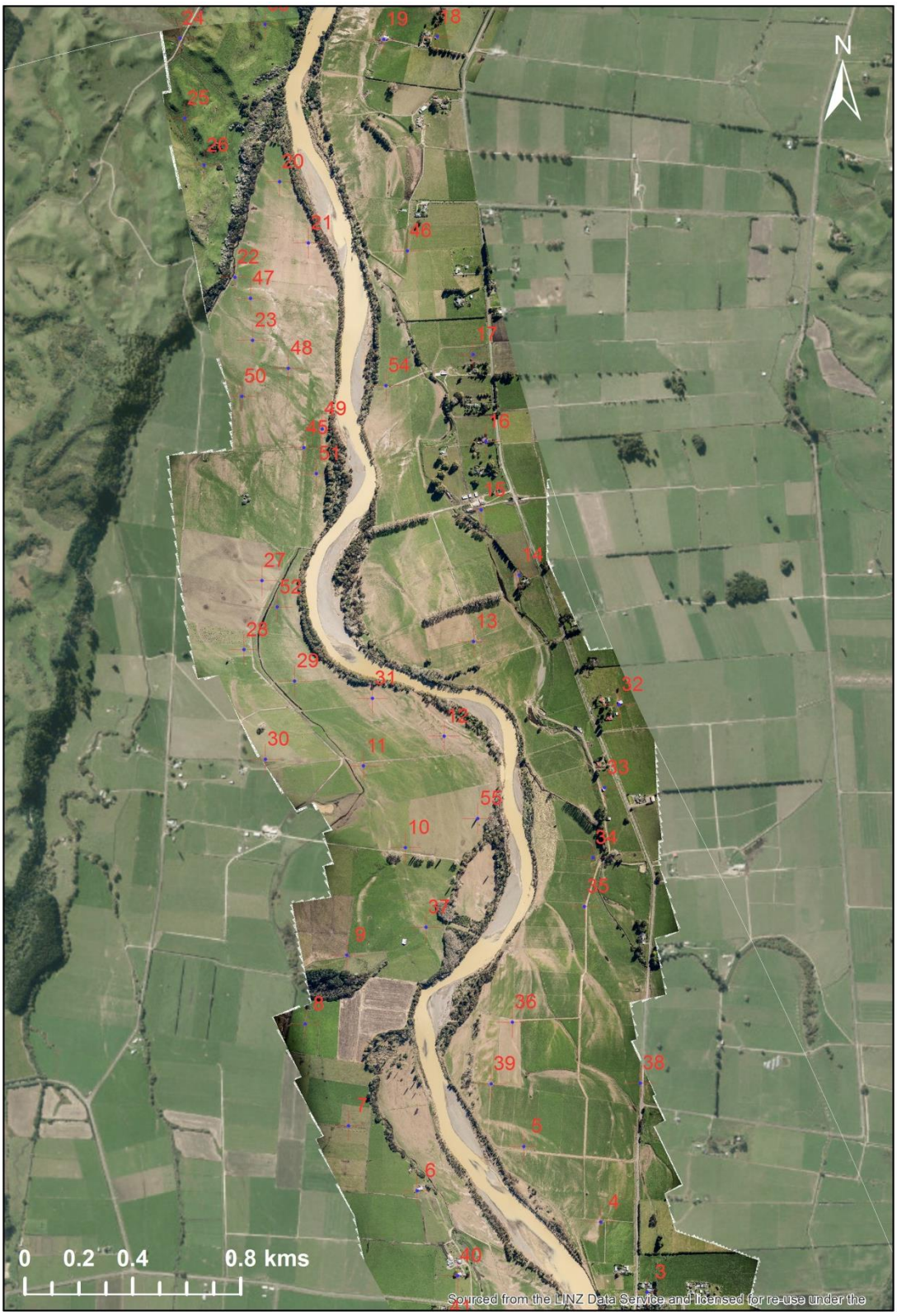

Figure 2: Georeferencing of aerial photography against satellite imagery using anthropogenic features as reliable control points where available.

Eroded sections of river were mapped using the edge of vegetation as a reference guide. The edge of vegetation is the most reliable and identifiable indication of a river bank over time. The sections of

erosion were then categorised into either pasture or vegetation depending on the type of land cover that was lost (fig. 3).

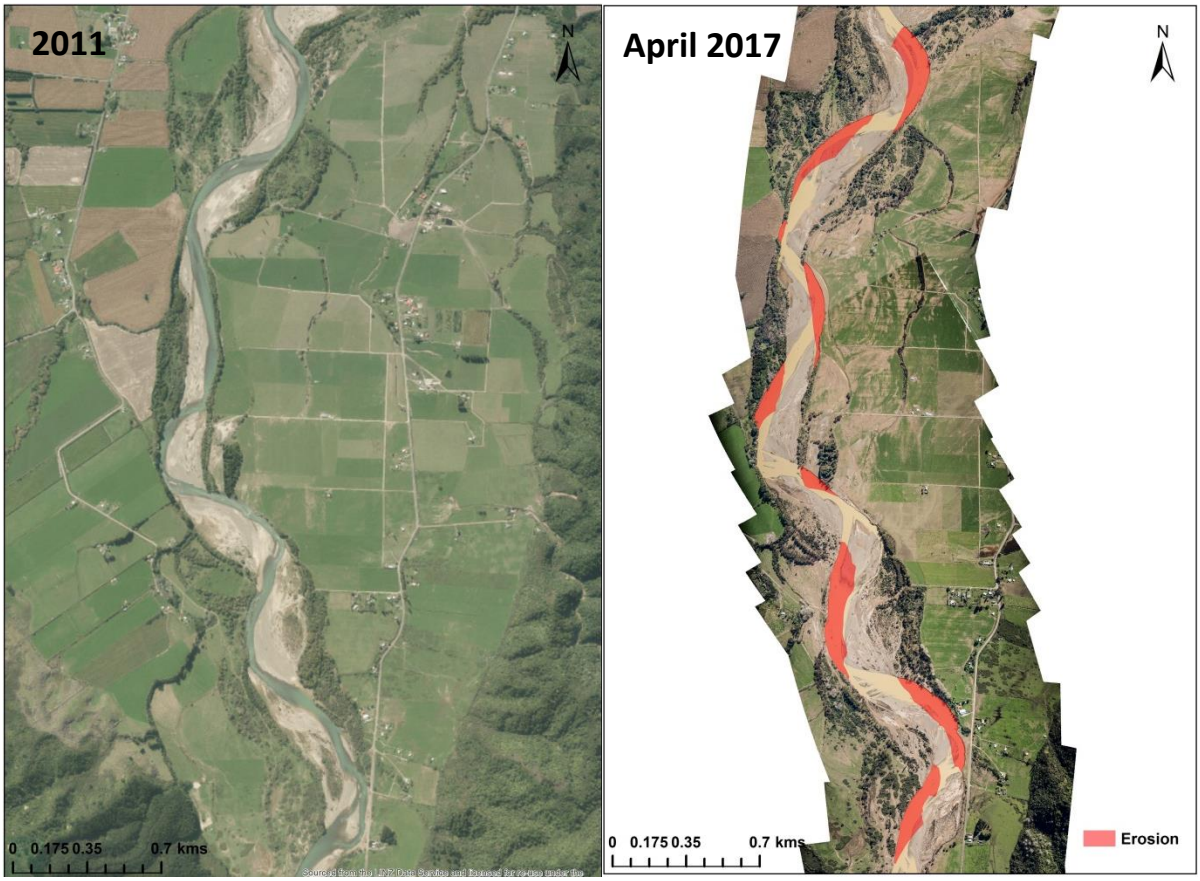

Figure 3: Eroded sections on the Whakatāne River shown against 2011 imagery (left) and post-flood aerial photography (right).

Land included in the mapping of flood extent was largely pasture and maize crop land (fig. 4); productive land cover types. Forestry and shrub land were not included as it was difficult to distinguish flood lines on this land cover type. In river islands were excluded from this study.

Figure 4: Flood extent on the Whakatāne and Waimana Rivers surrounding Tāneatua.

Errors and assumptions

The three key sources of potential error in this study are stitching error, rectification error and interpretation/user error.

The erosion identified in the project may have occurred over the years between 2011 and April 2017 and may be attributed to other weather events and not the stand alone events of the April 2017 Cyclones. This is an unknown factor as imagery is not available at more regular intervals.

In some sections of river that experienced significant erosion, accretion was also observed on opposing river banks (the river shifted); this accretion was not measured or included in the results because the land that was gained as a result of accretion is not in a useable form or space and will remain this way for many years before it can be of any benefit to the landowner.

Summary of results

Table 1: Erosion and flood extent by river.

River	Erosion (ha)	Flood Extent (ha)
Whakatane	33.6	1441.1
Waimana	33.6	1136.1
Rangitaiki	11.3	2173.2
Whirinaki	5.7	334.2
Horomanga	8.4	44.9
Total	**92.6**	**5129.5**

The total length of rivers covered by this project was 170.1km. Erosion measured along river banks inside the study area was 92.6ha. Of this eroded land, 7.66ha (8.3%) was pasture and 84.98ha (91.7%) was fringe vegetation.

The total flood extent surrounding the rivers in the study was 5129.5ha. 1023ha (19.9%) of this extent is attributed to the Edgecumbe flooding west of the Rangitāiki River, with a further 215.8ha (4.2%) attributed to Reids Canal, East of Edgecumbe.

Conclusions

Despite the eroded land being largely of vegetated land cover, this is still a significant loss to the land owners as many will have to replant fringe vegetation to prevent further erosion from stock as well as a means of reinforcing soil on river banks. The majority of this erosion was recorded in the upper reaches of the rivers where the rivers have not been straightened and subject to engineering.

The average dairy farm size in the Bay of Plenty based on 2014 DairyNZ statistics is 119ha. Hence a loss of 92.6ha is comparable to a large portion (77.8%) of the average farm. The amount of milk solids produced on a dairy farm in the year 2015/2016 was on average 1063kg of milk solids per hectare. With 2017's price of $6.50 per kg of milk solid from Fonterra, this 92.6ha of 'lost land' from erosion equates to a loss of $639,820 annually distributed across the district as a result of erosion. Flood extent has also had a significant financial impact on farmers across the district with many farms having been affected by silting as well as having large costs associated with re-grassing, fencing and stock

movement.

While much of the media attention from the April Cyclones that affected the Whakatāne District has been focussed on Edgecumbe, this project provides evidence that the damage was severe on a district-wide scale. Edgecumbe accounted for 19.9% of the District's river flooded land, however, much of the change observed in the rivers course is evident in the upper reaches of the Rangitāiki River beyond the Matahina Dam and likewise on the Whakatāne River above Tāneatua.

Reference documents

New Zealand Dairy Statistics 2014-15. (2015). [PDF] Available at: https://www.dairynz.co.nz/media/3136117/new-zealand-dairy-statistics-2014-15.pdf [Accessed 24 Jul. 2017].

Acknowledgements

This project would not have been possible without support from the BOPRC GIS team and their willingness to provide any advice or resource that was requested.