Large, deep-seated landslides in the Whanganui/Rangitikei Hill Country

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Committee

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Why Large Landslides?

Clockwise from top left: The Tiniroto landslide (Beetham et al., 2002; Massey, 2010). The Rangitikei Landslide (Poroa Complex). Landslides from Cyclone Gabrielle (Dawson Bliss, 2023)

Background – Large Landslides in New Zealand

Left, the Taihape landslide (Massey, 2010). Right, topographic map of the Green Lake Landslide (Hancox & Perrin, 2009)

Erosion Control

- Erosion and sedimentation rates over time from these large landslides also remain poorly accounted for.

- Is erosion over time consistent?

Fuller et al., 2019

Landslide in the Poroa Complex, with undercutting by the Rangitikei River.

Research Summary and Objectives

1 Obtain absolute age dates for a range of large, deep-seated landslides in the Whanganui-Rangitikei Region.

2 Compare landslides using morphometric variables and use these variables along with absolute ages to develop a landslide dating tool.

3 Use the morphometric tool to spatially predict landslide ages and estimate long term average rates of erosion
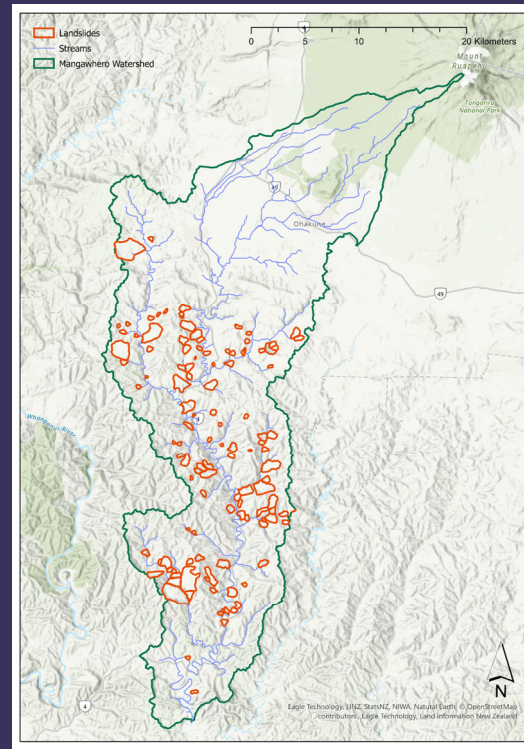
Aim:

- My PhD project aims to contextualise the evolution of palaeo-landslides in the Whanganui-Rangitikei Region and assess causal links between the palaeoenvironment and landslide activity, as well as quantify rates of sediment delivery.

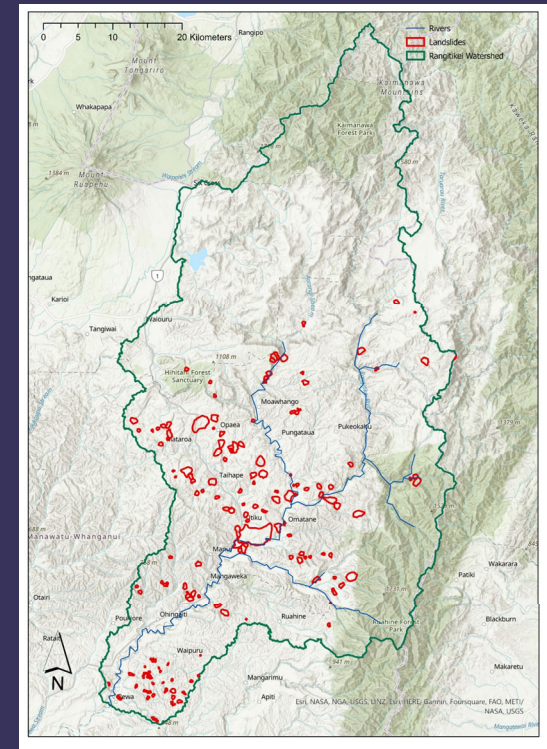- This is achieved through three key objectives.

Study Area: Three Key Catchments
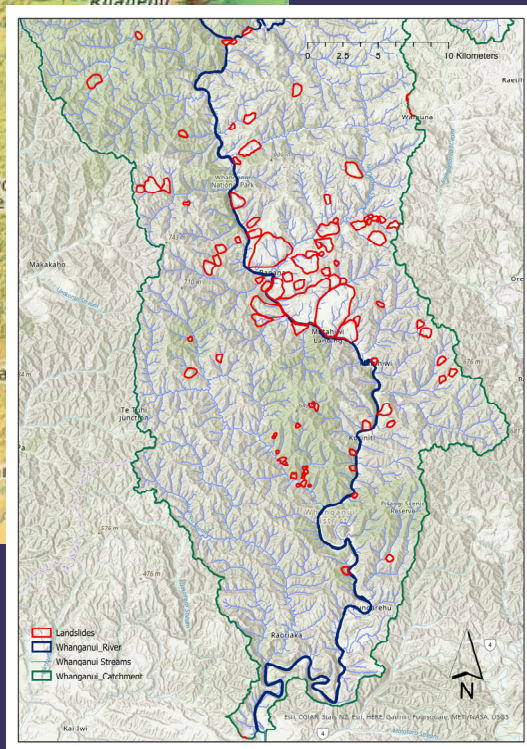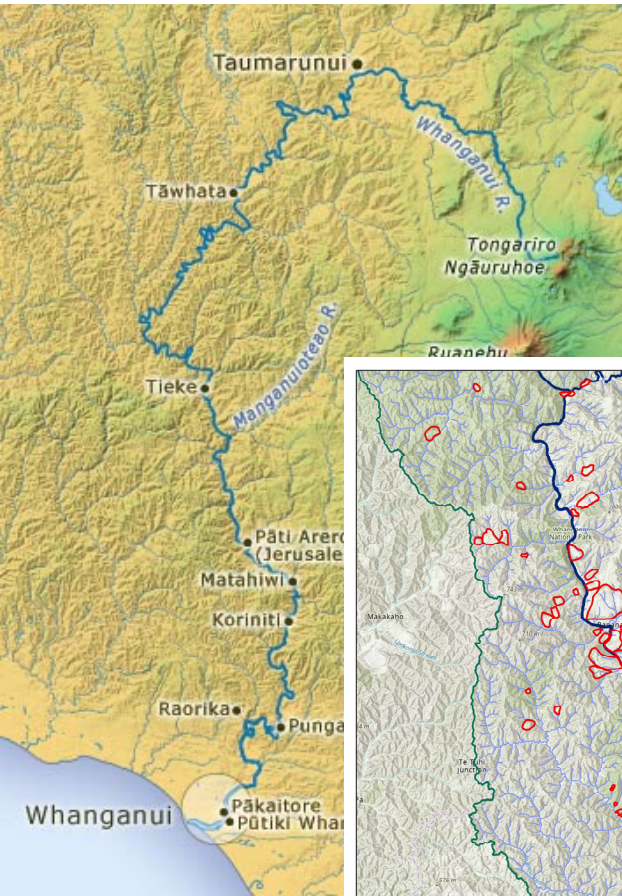
Whanganui Catchment

Mangawhero/Whanghaeu Catchment
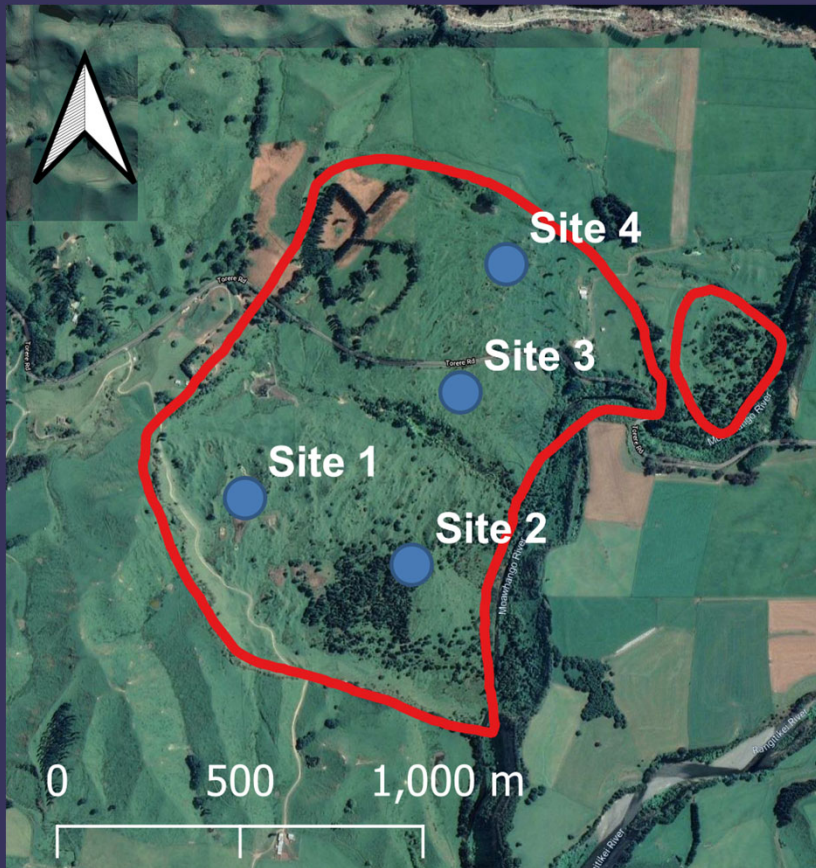
Rangitikei Catchment

Landslides adapted from Forrest et al., (2021)

Cores

- Small lakes form in the hummocky depressions of landslide deposits.

- Absolute ages will be obtained from organic matter, extracted from cores from these lakes.

- Key sites targeted: E.g., large landslides, coupled with river systems, a variety of ages.
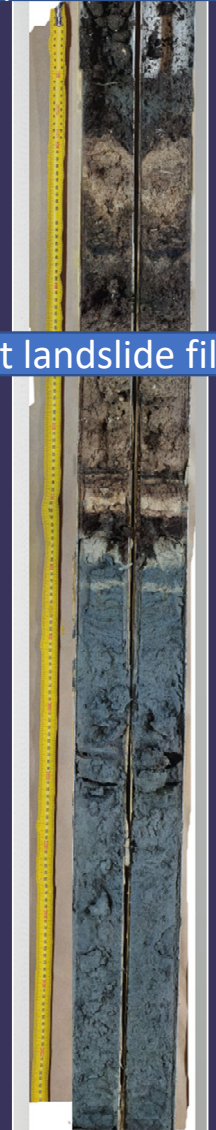
Cores

Torere Road Landslide, and coring sites.

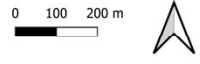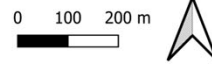| Radiocarbon Ages for Select Sites		
Site 1 – Radiocarbon ages	Site 2 – Radiocarbon ages	Site 4 – Radiocarbon ages
994 ± 20 BP	1217 ± 16 BP	50 ± 17 BP
994 ± 20 BP	1723 ± 18 BP	

Top of Core (0m)

Post landslide fill

Base of Core (1.5 m)

Example of an "Old" Landslide

Example of an "Young" Landslide

Morphometric Features of Landslides.

- Key idea that the difference in landslide age can be assessed via morphometric interpretation.

- DSM used to produce morphometric variables for absolute age dated landslides. These variables include Terrain Ruggedness Index, slope angle, curvature, drainage network development.

- These data will then be combined with the absolute age data. E.g., Topographic Roughness Index will be compared with absolute ages and verified.
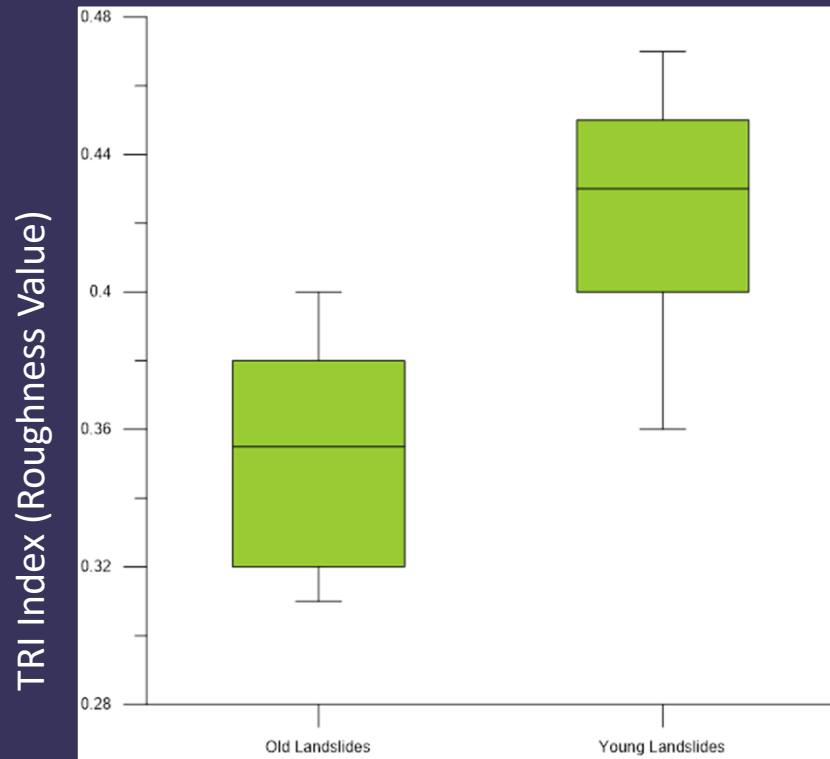
Morphometrics – Trial Data

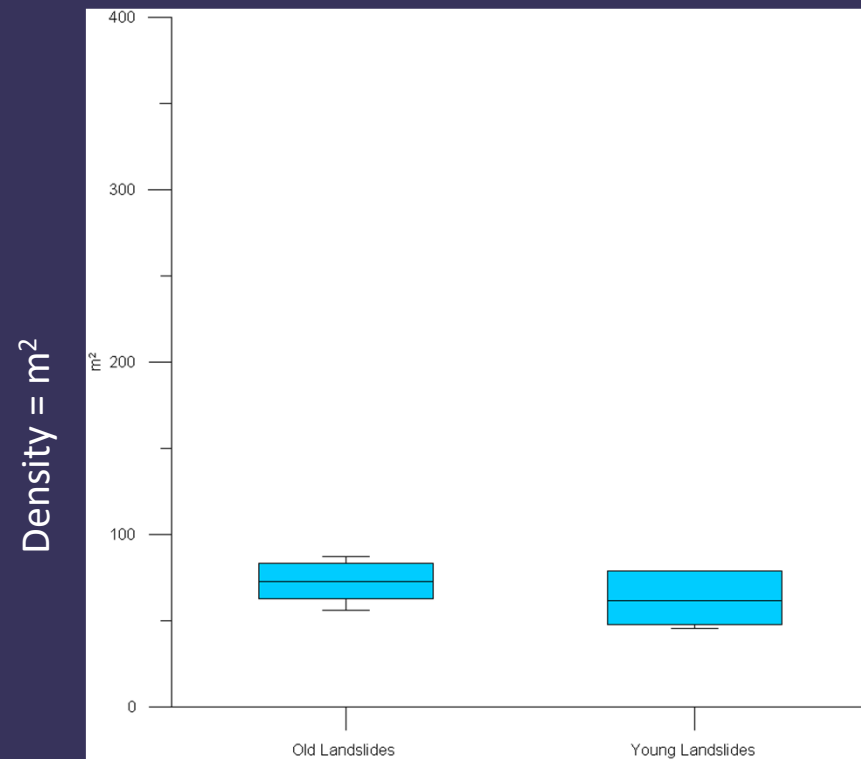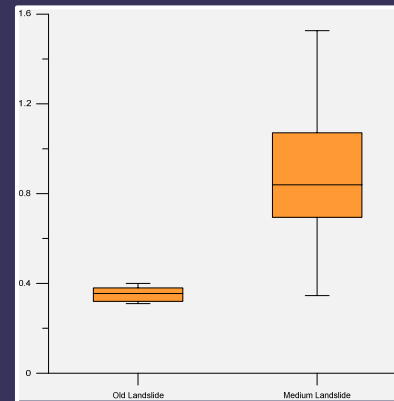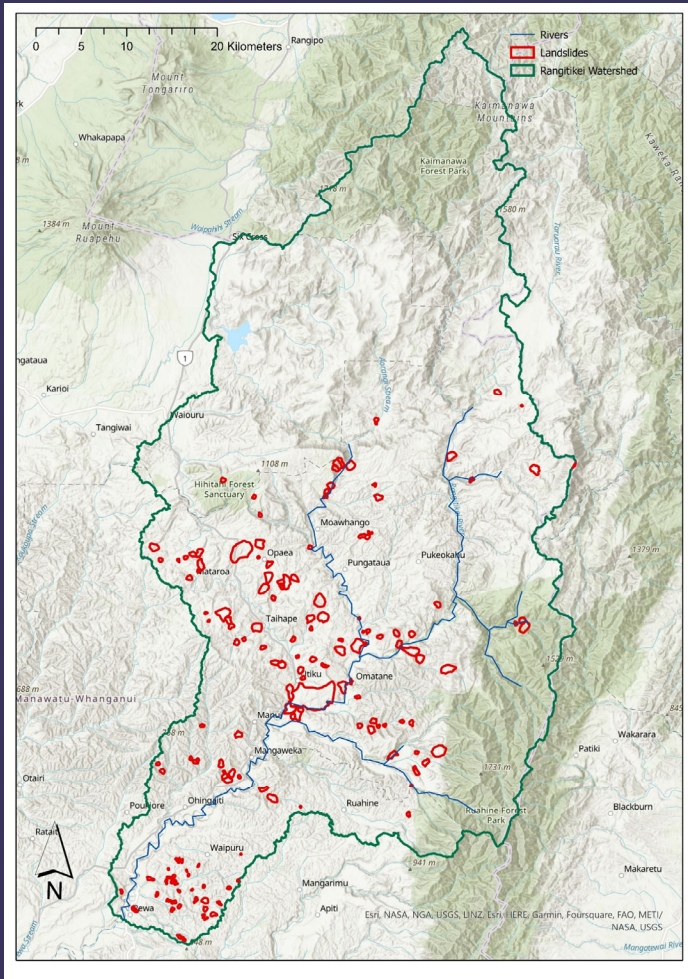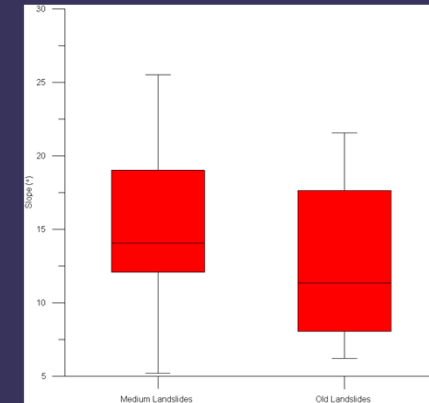Figure 1: Terrain Ruggedness Index (mean) p = 0.008.

Figure 2: Drainage Network (Averaged and Normalized) p = 0.02.

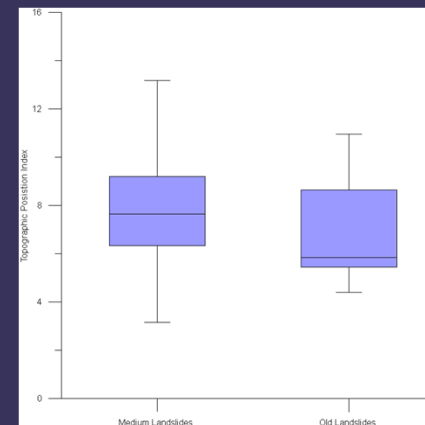Boxplot of morphometric analysis for key landslides: Old vs Young landslides (sample size of 14 landslides total).

Morphometrics - Rangitikei Catchment

Terrain Ruggedness Index (mean) p= 0.42

Slope (mean) p= 0.42

Topographic Position Index (SD) *p = 0.16*

Boxplot of morphometric analysis for key landslides: Medium vs Old Landslides (estimated age) sample size of 75 landslides total from the Rangitikei Catchment.

Future Work: Development of Sediment Budget

- Use of age data from previous work to calculate sedimentation rates.

- Paleo-reconstructions to determine rates of sedimentation, using QGIS software. Applied on a regional scale, starting with catchments.

- Data to go towards improving understanding of long-term sedimentation rates, and impact of landslides on catchments.

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