2020

Drone survey of Tapuwae Inc

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Ngā Tokimatawhaourua Te waka,
Ko Kupe te tupuna nui rawa,
o Hokianga nui mai,
Maranga mai, Maranga mai,
He whakapapa aroha tenei,
Ki ngā tupuna, mātua, whanaunga
Aroha, aroha mai, ki ngā uri e tu atu nei.
Tēnā koutou e Ninihi, e Puhanga,
Ko Niniwa, Ko Āraiteuru, ngā Taniwha
Ngā Kaitiaki o Hokianga
Powhiri mai ki te ao Mārama.
Tēnā koutou, kia ora tatou katoa

Drone survey of Tapuwa Incorporation, Hokianga

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Ko wai Matou?

Tēnā koutou katoa,

My name is Glenn Aguilar, I am from the Philippines originally, and lead the Unitec GIS projects for hapū and community groups in the Northland area. On behalf of my team, Hema Wihongi, and my assistants Arielle and Gio, I want to thank the whānau & Tapuwae Incorporation for their kind hospitality and for inviting us to conduct a drone survey on the their area in July and September 2020, after challenging Covid-19 lockdowns. I attach my report, maps, technical brief and links to the data and models to support your environmental, social, and economic management of this special taonga.

Tēnā koutou, Tēnā tatou katoa

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Executive Summary

Background and Introduction

The area surveyed covers the land of Tapuwae Incorporated in Te Taitokerau, Aotearoa/New Zealand. As part of a rapidly changing landscape, Hokianga's changing natural and ecological characteristics require significant spatially relevant information to inform proper management and effective plans for the preservation and enhancement of the area's biological, social, cultural, and economic treasures. The changes in the landscape that impact features of the area underpin the need to build a geographic information system (GIS) that provides information including highly detailed imagery of the existing land cover and geological features, landcover and vegetation characteristics.

This mahi is aimed at developing detailed imagery for the description and characterisation of land cover providing relevant information and knowledge of the landscape. Flying a drone with high resolution imagery and processing in a GIS (Geographic Information System) resulted in maps of the area that allow one to closely visualize details of the ground and 3D models that allow interaction with the imagery.

This report covers the results of a drone survey conducted on the 10-12th July and a follow-up flight on 21st-23rd of September 2020. Highlights of the results refer to the maps developed and a detailed technical report at the end of the figures is included.

Results of the Survey and Analysis

A georeferenced mosaic or stitching of images in their proper locations is presented (Figure 1) with the area outlined in green covering the area of Block 1AB4 of Tapuwae Incorporated. For viewing the results of orthomapping at higher resolutions and facilitate the description of prominent characteristics, a map series subdividing the area into 42 Sections (a Section is labelled as Page in the figures) was created and outlined in yellow. Some differences in shade, shadows, hue, and obvious boundaries is noticeable because the survey was taken at different times of the day with varied light conditions. Some areas were also not accessible for the drone to cover due to unavailability of launching positions as well as limited flying hours resulting from unfavourable weather including rain and fog.

- **Sections 1, 2, 3, 4 and 5** cover the Northern area dominated by recently planted pine forests. Rows of growing very young pine are obvious from the imagery. Section 5 shows the upper area with growing small pines and the lower area recently harvested with significant remnants of logging operations. When zoomed in, very young individual trees are identifiable from their surroundings and can be counted if needed. A logging road separates the young pine with the recently harvested area in in Section 5 (Figures 2-6).
- **Sections 6**, **7 and 8** shows a significant area of manuka and kanuka to the area with an indigenous forest and manuka/kanuka stand in Section 6. Section 7 consists of replanted pine and the manuka/kanuka stand. Majority of Section 8 is outside of the boundary and only the lower left corner was covered by the drone (Figures 7-9).
- **Sections 9, 10, 11 and 12** cover mainly areas of harvested with no new planting. Pine forest with unharvested areas to the south, grassland in the running from the middle to the southeast corner and planted area in the northern part is shown in Section 12. (Figures 10-13).
- **Section 13** is dominated by grassland with patches of manuka/kanuka as well as ponds. This area also contains a road intersection, fenced areas and some cows grazing (Figure 14).
- **Sections 14 and 15** cover the eastern border of the land with newly planted pine, patches of manuka/kanuka together with areas of grassland are evident (Figures 15 and 16).
- **Sections 16, 17 and 18** is harvested pine with some patches of manuka/kanuka and grassland in the latter two pages (Figures 17 to 19).
- **Section 19** includes an indigenous forest stand in the upper section with manuka/kanuka and grassland covering the rest of the area (Figure 20).
- **Sections 20 and 21** are dominated by manuka/kanuka with some grassland in Section 20 and the lower portion of harvested forest at the upper section of Section 21 (Figure 21 and 22).
- **Sections 22 and 23** shows harvested forest and manuka/kanuka areas with some grassland in Section 23. The orthomosaic of the lower sections of both pages were not completed and NZ imagery was used instead to fill the gap. The differences in resolution and a comparison between the unharvested and harvested pine forest can be seen (Figure 23 and 24).
- **Section 24** contains unharvested pine (classified as exotic forest in the NZ landcover database) with grassland and manuka/kanuka areas (Figure 25).

- **Section 25** is dominated by grassland and covers the dairy farm area with a shed building and other built structures. A major junction with four roads, ponds, paddock boundaries and parts of the stream network are also shown (Figure 26).
- **Section 26** is over the eastern section of the farm with unharvested pine consisting the majority of the area. Grassland adjacent to the area of Section 25 is covered with a bridge crossing a stream flowing north to south (Section 27).
- **Sections 27, 28 and 29** are dominated by harvested pine areas that have not yet been replanted. Section 29 also contains grassland, patches of manuka/kanuka and unharvested as well as newly planted trees (Figures 28-30).
- **Section 30** borders the mangrove swamp to the east and contains grassland for the farm, harvested and harvested pine forests with a road running north to south (Figure 31).
- **Section 31** shows a pine forest at the western border of the area, grassland and farm areas in the middle and the mangroves in the southeastern section. This contains also the farmhouse and equipment garage with the main farm road, river and West Coast road (Figure 32).
- **Section 32** covers the unharvested pine north of the entrance to the farm, the mangrove area and river as well as the bridge on West Coast Road (Figure 33).
- **Section 33** contains the southwest border with the West Coast Road grassland and indigenous forest in the northern sections (Figure 34).
- **Section 34** shows patches of manuka/kanuka, grassland and growing planted pine at the eastern section (Figure 35).
- **Section 35** was only partly covered by the drone survey and show growing pines to the west of West Coast Road and a newly harvested area to the east of the Road. This area was higher than the launch site and although images were taken, an orthomap cannot be produced (Figure 36).
- **Section 36** covers part of the mangrove swamp, grassland, newly harvested pine and a stand still growing to the east. Majority of this section is above the launching site and could not be processed (Figure 37).
- **Sections 37-42** include areas beyond the ridge and could not be accessed by the drone to provide detailed imagery. Instead, imagery from LINZ with the highest resolution were included to complete the land cover classification and to compare changes in the landscape. With majority of these areas consisting of pine forest and indigenous forest in the southern sections, few changes over the landscape are expected to have occurred and consist mainly of harvesting activities (Figures 38-43).

Physical characteristics of the land

The survey provided information to characterise the physical characteristics of the land. The DEM (Digital Elevation Model) of the area and its contours show a mountainous nature with surrounding prominent ridges in the northern area as well as to the east, west and south of the land. There is a stream network that contributes to a river outlet at the mangrove area (Figure 44). The slope map shows steep values at the southern pine area, at the corner of the western section and some parts in the middle-eastern areas. Lower slope values or mainly flat land around the river and stream system are represented by green areas in Figure 45 which also indicates grassland where farming activity takes place. In terms of aspect (the direction that the land is facing), the ridges and streams delineate the changing aspects (shown as lines between different colours in Figure 46) with the North facing slopes in red and South facing slopes in blue while the East facing slopes are mainly green and the West facing slopes in yellow.

Roads, Vegetation and Land Cover Classification

Using the resulting high resolution orthmap, the existing polygon shapes in the Landcover Database of New Zealand (LCDB5.0) were modified to reflect the boundaries more accurately. The well-maintained road network was also developed by digitizing the polylines from the detailed orthomap (Figure 47).

Interactive models and animation

The resulting orthomap was published in ArcGIS online and the 2D map can be seen in the Map Viewer app. The high-resolution map provides the ability to distinguish structures and elements of the landscape such as fences and farm ponds as well as conditions of the grass at the time of the survey (Figure 48). The 3D model is also available in ArcGIS Online and viewed using the Scene Viewer that includes an interactive capability allowing zooming, rotation and changing the viewpoints. (Figure 49).

Animations or movies depicting a flight over the scene is also available for export and sharing. This movie creation ability provides a means to explore the 3D scene in unlimited ways, from different points of view

following paths that the drone cannot physically follow to zooming in to capture the increasing details of ground features. Screenshot of a generated move is shown in Figure 50. Additional uses of the 3D model include virtual or augmented reality applications where for instance, tourism related explorations of the area are provided and available online.

Applications and uses of the results

This is a large area with majority of the land cover consisting of pine forest areas at different stages of growth and harvest. For planning purposes, the 2D and 3D depiction of the landscape is useful as a basemap for overlaying other shapefiles such as access routes, danger points, sites of notable trees and vegetation and most important to inform management planning at all levels. A significant percentage of the area consists of pine forests in varying stages of growth and the resulting map provides information on the condition of each area. The high-resolution imagery can be used to count the number of trees, identify areas for weed control and provide information for planning. Significant farming activity is present, and the maps serve to provide relevant parameters such as estimates of farm carrying capacity, sediment loads, feed requirements and other important factors for effective farm practice. Manuka/kanuka and indigenous forest stands in the area also significant resources needing efficient utilization and even conservation.

Recommendations

Future flights repeated regularly over the area will provide a significant amount of time-based spatial information that includes for example, the rate of growth of planted pine and areas that may need replanting. With a growing pine forest, the height of the canopy can be monitored over time, data that may be relevant to carbon credit estimation. The orthomap can be used as a basemap to overlay other relevant information such as soil types, watersheds, drainage, flooding extent and even fire risk maps. Geographic diversity requires a diversity of responses, there is nevertheless great merit in sharing knowledge of common experiences in an endeavour to help identify and mitigate potential long-term impact on land use. For example, North Canterbury have had much success in growing hemp plants. The hemp plant has deep tap root systems, nitrogen fixing characteristics, 5 months to mature and harvest, and requires less water than other industrial crops an important factor in water conservation and protection of stream ecosystems in the Northland region. We recommend more research by Trustees and Kaitiaki to investigate increasing the bio and economic diversity of Tapuwae.

Figures

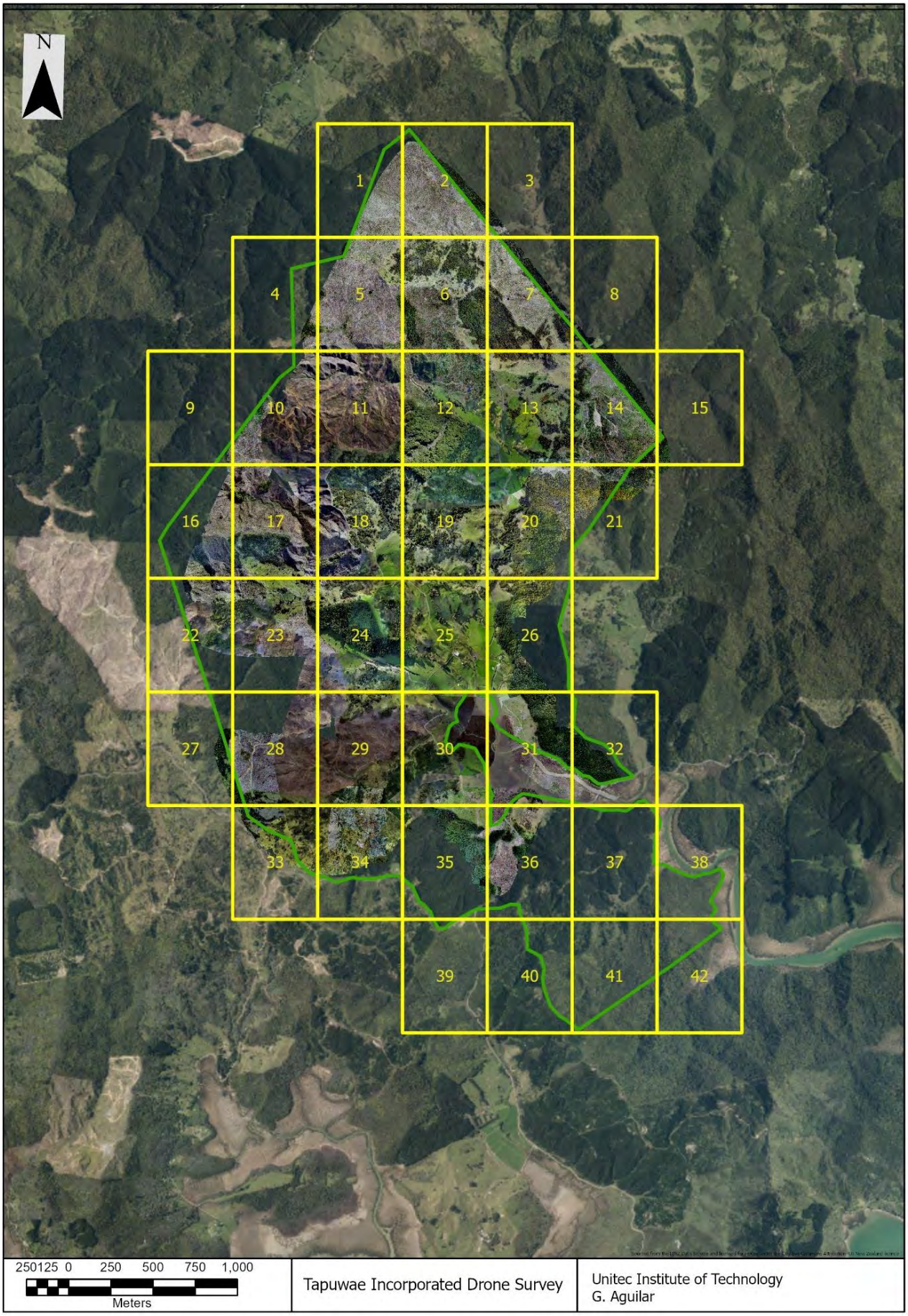

Figure 1. Overall map with individual sections.

Figure 2. Section 1 of the survey area.

Figure 3. Section 2 of the survey area.

Figure 4. Section 3 of the survey area.