

# OTAKAIRANGI WETLAND AERIAL MAPPING

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## Otakairangi Wetland Aerial Mapping – June 2016

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# 1. Introduction

Otakairangi wetland is a Government Purpose Wildlife Management Reserve (GPWMR) covering c.265.9 ha of remnant peat bog on the Hikurangi floodplain, located 18km northwest of Whangarei City.

Flightworks was engaged by the Whangarei office of the Department of Conservation to provide the following:

1. High quality aerial mapping which identifies and locates royal fern within the Otakairangi GPWMR.
2. Point Cloud of the Otakairangi GPWMR including fly over and 3D interaction.
3. Description and spatial mapping of vegetation types within the Otakairangi GPWMR.

At the time Flightworks became involved in the project the last known royal fern (*Osmunda regalis*) site had been controlled with herbicide. Therefore, no live royal fern was available to provide a reference to help detect other royal fern in the aerial imagery of the wetland. However, it was decided that there was value in grid-searching the aerial image for any suspected weeds (including royal fern) and providing gps waypoints for checking in the field.

## 2. Method

This aerial mapping project for the Otakairangi wetland involved 5 stages:

1. Aerial drone grid-flight survey.
2. Photogrammetry processing to produce orthomosaic and point cloud.
3. Grid search of orthomosaic for suspected weeds.
4. Definition of vegetation types from orthomosaic.
5. Creation of a virtual fly-through of the point cloud.

### 2.1. Aerial drone survey

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The aerial survey was undertaken over two days (16<sup>th</sup>-17<sup>th</sup> June 2016). A remotely-controlled, multirotor aerial drone was fitted with a 24mp resolution Sony nex camera to record nadir photos. A 'lawnmower' grid flight pattern with 80% forward and 75% side overlap of photos was flown at ~120m altitude (above ground level) over the wetland vegetation within the reserve boundary (see Figure 1). The wetland vegetation extending onto private property to the north east of the reserve was also included.

### 2.2. Photogrammetry processing

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Aerial nadir photos from the flights were processed in Pix4D photogrammetry software. An orthomosaic image and point cloud were produced for the entire wetland, and exported as .tif and .las files respectively. The orthomosaic image was then clipped to tidy its edges and reproduced as a jpg2000 file (.jp2) in QGIS software to reduce its size for easier handling in GIS.

### 2.3. Suspected weeds from the orthomosaic

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A 25m x 25m grid was set up in QGIS software over the project area, labelled on its x axis: "a,b,c..." and y axis: "1,2,3...". Each grid square over the entire wetland was searched at 1:250 scale for any plant suspected as a weed, and any found were marked with a waypoint and a short note made in the attributes to describe it.

Royal fern (*Osmunda regalis*) was the focus for the weed search, but there were no known royal fern sites to reference in the aerial image before searching the wetland. Sites of suspected royal fern were assessed based on our knowledge of the plants appearance in June.

The weeds, gorse, blackberry and sweet reedgrass were dominant in parts of the wetland and edges and these were mapped as part of vegetation types, or their presence was noted. Pampas occurs on higher ground around the wetland and drain edges, and was noted as a component of the 'bracken fernland', 'Manuka-silver fern-gorse-shrubland' and 'Reed sweetgrass grassland'. Where individual pampas plants were found outside these vegetation types they were given a specific waypoint.

## 2.4. Vegetation types from the orthomosaic

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Vegetation type communities were mapped from the aerial orthomosaic image at 1:1,000 scale based on the Atkinson (1985) methodology. Ground-truthing of the vegetation types was not undertaken for this project but we relied on a previous Landcare Research survey (Clarkson et al 2015) to provide additional species information to that discernible from the aerial imagery.

Vegetation type community boundaries were based on the canopy vegetation characteristics that could be observed from the aerial image. Where there was a relatively indistinct boundary between vegetation types (e.g. between the Manuka shrubland and Fernland communities) a boundary line was drawn where a change in the dominant species was discernible and the community on each side of the boundary line differed sufficiently to be mapped as separate communities.

Farm tracks and drains were not given a mapping unit.

## 2.5. Virtual fly-through of point cloud

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The point cloud created by the Pix4d software has an associated mesh layer that joins the points of the cloud together, creating a more realistic representation. A virtual fly-through video of the point cloud was choreographed with DoC input to create an overview of the wetland. This video was supplied as a .mp4 file. The mesh layer was supplied as an .fbx file, which can be used to set up interactive 3D model on websites such as [www.sketchfab.com](http://www.sketchfab.com).

## 3. Results

The GIS data including the orthomosaic image, point cloud, vegetation type layers and potential weed waypoints are provided as shape files. A metadata document accompanies the GIS data. All GIS data is provided in NZTM2000 coordinate reference system. A flythrough of the 3D mesh model created from the point cloud is provided as a .mp4 video file. A selection of oblique aerial photographs are also provided.

### 3.1. Orthomosaic image and point cloud

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There were 1,584 aerial nadir photos used in the photogrammetric process to create the orthomosaic image and point cloud. The orthomosaic image has a pixel resolution of 3.58cm. The point cloud had an average density of 80.59 points per m<sup>3</sup>. The image was trimmed to a footprint of 312ha encompassing the wetland and some of the neighbouring land (see Figure 1). The final image has some slight distortion at the edges beyond the wetland boundary.

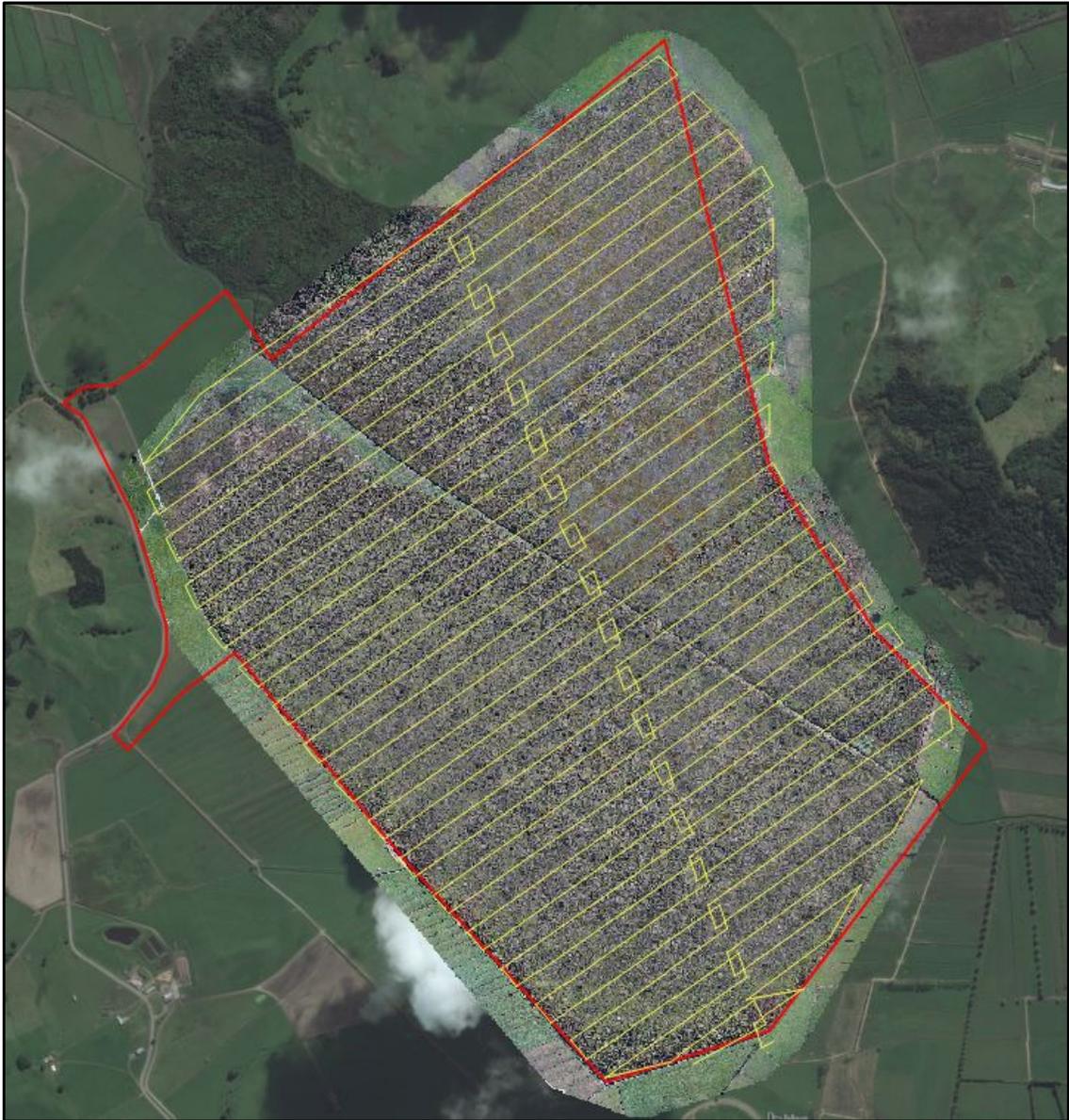


Figure 1: Otakairangi wetland orthomosaic over Bing imagery, flight plan (yellow), title (red).

## 3.2. Suspected weeds

Seventy four suspected weed sites were identified and each marked with a waypoint as a 'suspected or known weed' or a 'potential royal fern' (see Table 1, Table 2 and Figure 2). The file names for these waypoints are: *Potential Royal Fern sites.shp*, and *Suspected or known weed.shp*.

None of these were positively identified as royal fern (*Osmunda regalis*). However it was assumed that any royal fern would be autumnal brown, therefore any other similarly brown vegetation (e.g. bracken) particularly near drains was highlighted for further checking in case it harboured royal fern.

Waypoints were made for 'suspected weeds' when they were unable to be identified but looked sufficiently different or out of place in the surrounding vegetation to raise suspicion. The majority of the suspected weed points are near the wetland edge or main drain which is helpful for future checking of these sites on the ground.

A tree privet (*Ligustrum lucidum*) had been seen in the wetland near the drain (B. Herbert pers. comm.), but this was not detected in the orthomosaic.

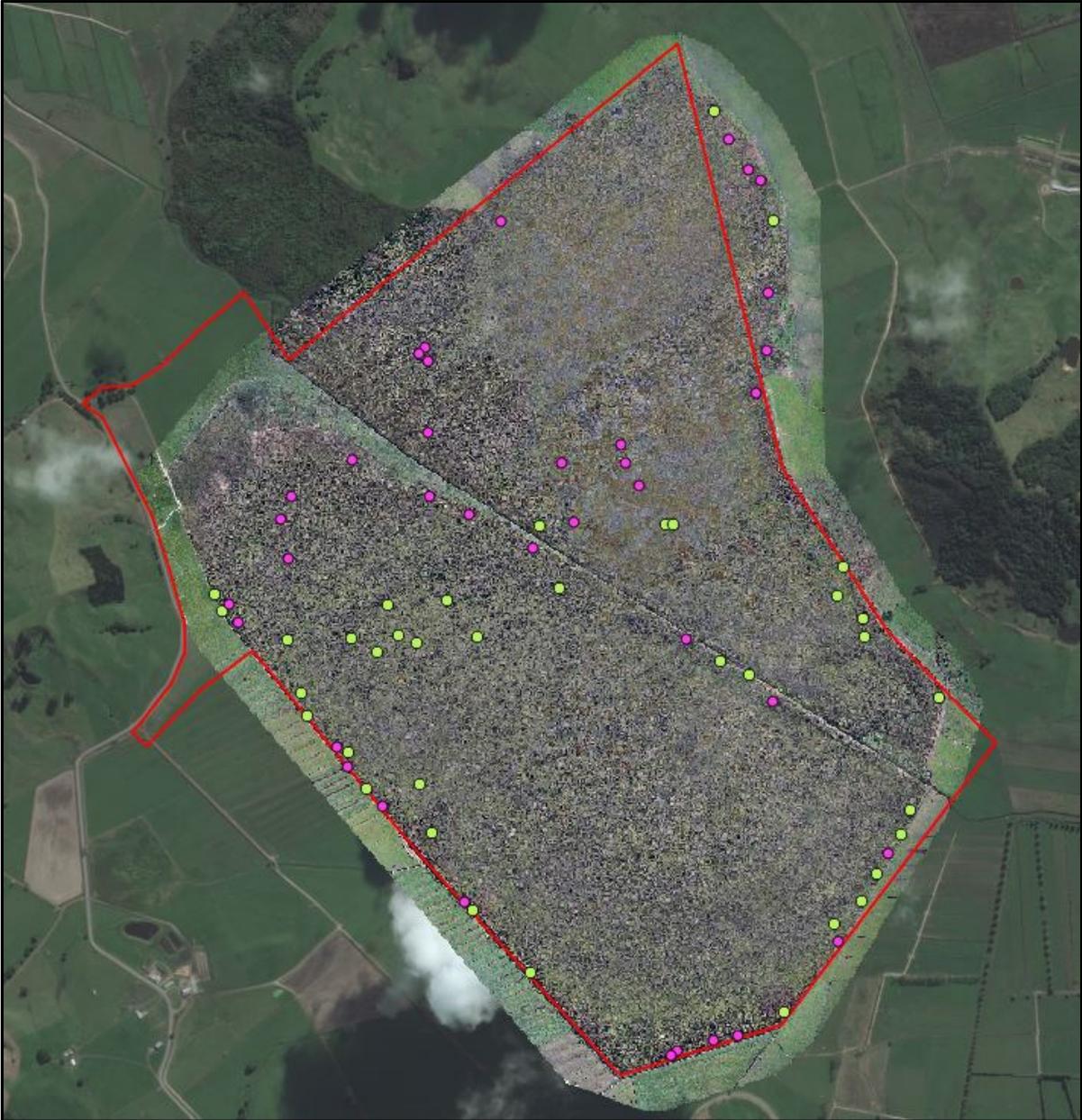
**Table 1: Waypoints of suspected or known weeds**

Waypoint	Weed	Notes
1	Pampas	Lone pampas
2	Gorse?	Appears to be gorse, but worth checking.
3	Unknown	Unsure what this tree is.
4	Unknown	Check this veg.
5	Unknown	Is this a lone cabbage tree or flax?
6	Unknown	This shrub looks a little bit different.
7	Pampas	Lone pampas
8	Unknown	This tree looks a bit different.
9	Pampas	Lone pampas
10	Unknown	Check this tree and others in the area
11	Unknown	Dead looking tree looks different.
12	Unknown	This appears to be a patch of gorse and or bracken
13	Unknown	Looks like bracken, could be drier area susceptible to weeds
14	Unknown	Unusual dark brown patch
15	Unknown	Suspicious brown plant
16	Unknown	Different coloured plant
17	Unknown	Dead wheki?
18	Unknown	Unusual tree, Olearia?
19	Pampas	Pampas
20	Pampas	Pampas
21	Unknown	Brown patch of vegetation that is different to surrounding.
22	Gorse?	Single gorse?
23	Pampas	Two pampas
24	Pampas	Pampas
25	Unknown	Have closer look at this from channel
26	Unknown	Check brown patches
27	Pampas	Two pampas
28	Pampas	Lone pampas

29	Pampas	Lone pampas
30	Pampas	Two pampas
31	Pampas	Lone pampas
32	Unknown	Dying flax?
33	Pampas	Two pampas
34	Pampas	Lone pampas
35	Unknown	Check this tree
36	Unknown	Dead tree?
37	Unknown	Unidentified green plant in drain

**Table 2: Waypoints of potential royal fern sites**

Waypoint	Notes
1	Appears to be gorse, and/or bracken
2	Check this brown plant
3	Check this site, may just be bracken fern
4	Is this bracken fern?
5	Unusual brown plant, Royal Fern?
6	Bracken patch?
7	Bracken patch?
8	Bracken fern only?
9	Brown fern?
10	Check for Royal fern
11	Check for Royal fern
12	Bracken fern only?
13	Dead bracken fern?
14	Brown bracken in 25m diameter?
15	Bracken only in this 50x50m area?
16	Bracken fern only?
17	Brown bracken fern only in this 50x50m area?
18	Brown bracken fern only in this 50x20m area?
19	Brown bracken fern only 10x10m?
20	Bracken fern only in 10x10m?
21	Unidentified brown plant
22	Brown bracken fern only in this 50x20m area?
23	Bracken fern only?
24	Bracken fern only?
25	Check dark brown patches along drain edge
26	Bracken only in this 20x20m area?
27	Bracken area, check for Royal fern hiding
28	Bracken fern 50m diameter, check for Royal Fern
29	Bracken only?
30	Check brown patches along drain for Royal fern
31	Check bracken for Royal fern
32	Check edge of bracken for Royal fern
33	Check bracken edge for Royal fern
34	30x20m Bracken?
35	Check edge of bracken for Royal Fern
36	Check edge of bracken for Royal Fern
37	Large area bracken fern



**Figure 2: Otakairangi wetland orthomosaic over Bing imagery, reserve property title boundary (red), suspected or known weed sites (pink) and potential royal fern sites (green).**

### 3.3. Vegetation types

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There were 11 vegetation types that were able to be identified and mapped from the aerial image:

#### WETLAND VEGETATION

**Blackberry scrubland** - dominated by blackberry (*Rubus fruticosus* agg.), with rushes, sedges and swamp coprosma (*Coprosma tenuicaulis*).

**Fernland** - scattered manuka (*Leptospermum scoparium*) and swamp coprosma over tangle fern (*Gleichenia dicarpa*), wire rush (*Empodisma robustum*), *Machaerina teretifolia*, *Schoenus brevifolius* and scattered *Carex* species. Small patches of reed sweetgrass (*Glyceria maxima*) and other exotic grasses were present.

Note that this vegetation type includes the two following types identified by Clarkson et al (2015), but these could not be distinguished between in the aerial imagery:

- tangle fern fernland; and
- *Machaerina teretifolia*/tangle fern sedgeland.

**Harakeke flaxland** - dominated by harakeke-flax (*Phormium tenax*) with scattered wheki (*Dicksonia squarrosa*) and manuka. In some areas near the central and boundary drains reed sweetgrass, pampas (*Cortaderia selloana*), sedges and grasses are also present.

**Manuka shrubland** - manuka and swamp coprosma over tangle fern, rushes and sedges and the occasional wheki tree fern and flax. Note it was difficult to distinguish between manuka and swamp coprosma in the aerial imagery. Small patches of reed sweetgrass and other exotic grasses were present. Note this vegetation type includes the two following types identified by Clarkson et al (2015), but these could not be distinguished between in the aerial imagery:

- manuka/tangle fern fernland; and
- manuka/tangle fern-wire rush fernland.

**Raupo reedland** - dominated by raupo (*Typha orientalis*) with rushes, swamp coprosma, manuka and blackberry present.

**Reed sweetgrass grassland** - includes reed sweetgrass, native bindweed (*Calystegia sepium*), sedges and un-grazed pasture grasses. Includes some gorse (*Ulex europaeus*) and pampas.

**Wheki/manuka-harekeke shrubland** - characterised by wheki together with manuka and harakeke-flax, mixed with tangle fern, swamp coprosma, and sedge species. Small patches of reed sweetgrass and other exotic grasses where present.

#### TERRESTRIAL VEGETATION

**Bracken fernland** – dominated by bracken fern (*Pteridium esculentum*). This community occurs on raised drier land around the edges of the wetland. Gorse and pampas are also present.

**Manuka-silver fern-gorse-shrubland** – a mix of predominantly gorse, manuka and silver fern (*Cyathea dealbata*) on the edges of the wetland. Pampas can be present.

**Pasture grassland** – grazed pasture grasses surrounding the wetland.

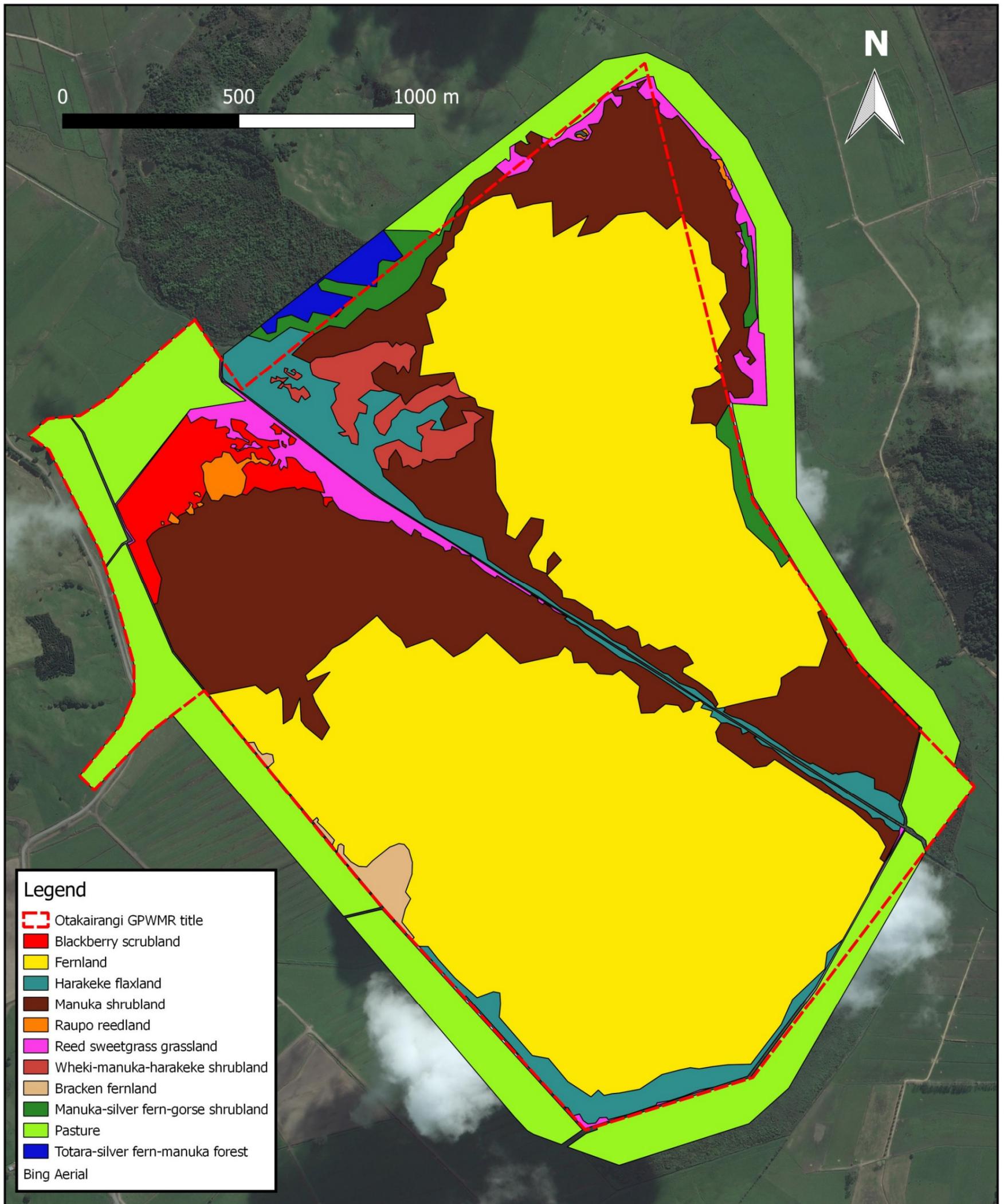
**(Totara)/silver fern-(manuka) forest** - totara (*Podocarpus totara*) over silver fern and manuka on the hillslope at the northern end.

Table 3 presents the area coverage of each vegetation type described above, and Figure 3 shows the vegetation types over the orthomosaic image for Otakairangi wetland.

**Table 3: GIS file name and area (ha) of mapped vegetation types for Otakairangi Wetland**

Vegetation Type	GIS file name	Area (ha)*
Blackberry scrubland	Blackberry scrubland.shp	5.8861
Fernland	Fernland.shp	153.5302
Harakeke flaxland	Harakeke flaxland.shp	14.0216
Manuka shrubland	Manuka shrubland.shp	65.8630
Raupo reedland	Raupo reedland.shp	1.1080
Reed sweetgrass grassland	Reed sweetgrass grassland.shp	6.5541
Wheki/manuka-harekeke shrubland	Wheki manuka harakeke shrubland.shp	4.6546
Bracken fernland	Bracken fernland.shp	1.6760
Manuka-silver fern-gorse-shrubland	Manuka Silver fern gorse shrubland.shp	4.6179
Pasture grassland	Pasture.shp	55.4618
(Totara)/silver fern-(manuka) forest	Totara silver fern manuka forest.shp	1.9434

\* area of the vegetation type within the orthomosaic image, not the title boundary.



Map: Otakairangi wetland vegetation types	Scale: 1:10,000 @ A3	
Project: Otakairangi wetland aerial mapping, June 2016	Datum: NZGD2000	
Client: Department of Conservation	Projection: NZTM2000	<i>Disclaimer: The primary information sources must be consulted to ascertain the usability of the information for legal, engineering, or surveying purposes.</i>
	Date flown: 16-17 June 2016	
	Drawn by: HK, 29 July 2016	

Figure 3: Vegetation types for Otakairangi Wetland.

## 4. Discussion

The aerial photography produced orthomosaic imagery with 3.58cm resolution. This provided enough detail to determine major vegetation types but did not allow for individual species recognition within the sedge and rush communities. Similarly, swamp coprosma was difficult to distinguish from manuka. A higher resolution orthomosaic may improve our ability to identify a greater range of plant species, but there will always be short, cryptic or sub-canopy species that cannot be detected using this mapping technology. Close-up, high resolution photographs could be taken to help with individual species identification e.g. the circular patches of golden vegetation within the 'Fernland' vegetation type.

The suspected weed way points are generally around the periphery of the wetland or along the main central drain. These sites can be checked by foot on the ground or could be surveyed together with harder to reach sites using close-up photography from a drone.

It is recommended that if any live royal fern sites are confirmed, that it is used as a reference to search for other potential royal fern sites located in the current orthomosaic. Another aerial survey using the same or higher resolution imagery to visually search for royal fern could also be considered. This could also be combined with a spectral analysis as another tool for helping detect any remaining royal fern.

## 5. Bibliography

- Atkinson, I. 1985: Derivation of vegetation mapping units for an ecological survey of Tongariro National Park North Island, New Zealand. *New Zealand Journal of Botany* 23:361-378.
- Clarkson, B., Bartlam, S., Price, S. 2015 Living Water – Opportunities for Restoration: Hikurangi floodplain. Landcare Research Contract Report 2383 pg 60-64.