# Here Comes The Sun

Remote sensing of vegetation cover to inform WSUD asset management

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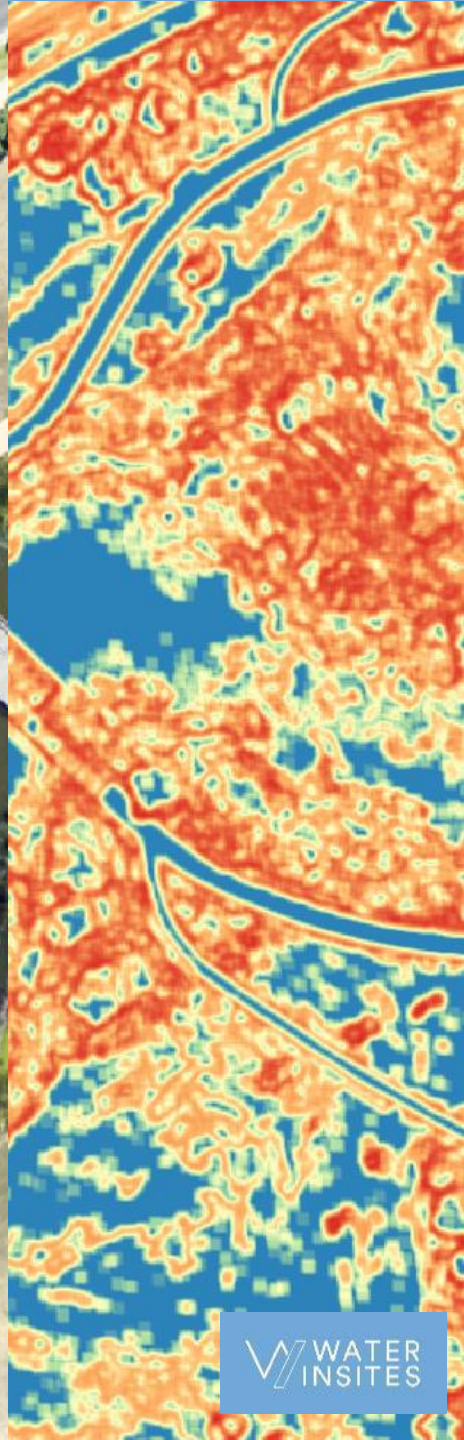

Introduction. Who we are.

What questions are we hoping remote sensing may help answer.

Available techniques.

Pilot study.

Accuracy of results.

What else is being solved by remote sensing.

## What questions are we hoping remote sensing will help answer?

First…some previous context and acknowledgement of work to date:

Work done by Melbourne Water, WAVE tool (previous SWVic preso)

Work done by GHD

Work done by research groups

# What questions are we hoping remote sensing may help answer.

Treatment performance of constructed wetlands

**“vegetation cover, specifically emergent macrophyte cover, is critical to the performance of constructed storm-water treatment wetlands”**

From ‘Identifying critical inundation thresholds to maintain vegetation cover in stormwater treatment wetlands’. Robertson et al. 2018

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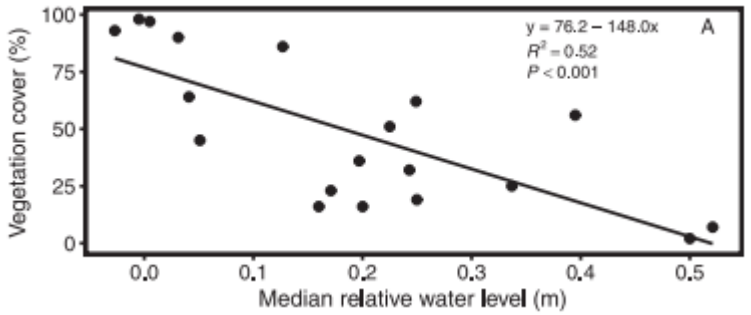



*also a strong relationship between median water level and vegetation cover*

## What questions are we hoping remote sensing may help answer.

Sediment accumulation in sediment ponds

A review of recent findings from a survey of 580 sediment ponds by a team with Water4Good for MWC showed that:

**using remote sensing to determine where vegetation is very high (>80%) may be able to help identify sediment basins that are likely in need of being cleaned-out**

## What questions are we hoping remote sensing may help answer.

**high vegetation cover is a likely predictor for good asset function in wetlands**

**high vegetation cover is a likely predictor for poor asset function in sediment ponds (or that it needs to be cleaned)**

## Available techniques

**Vehicles:** UAVs, planes, satellites

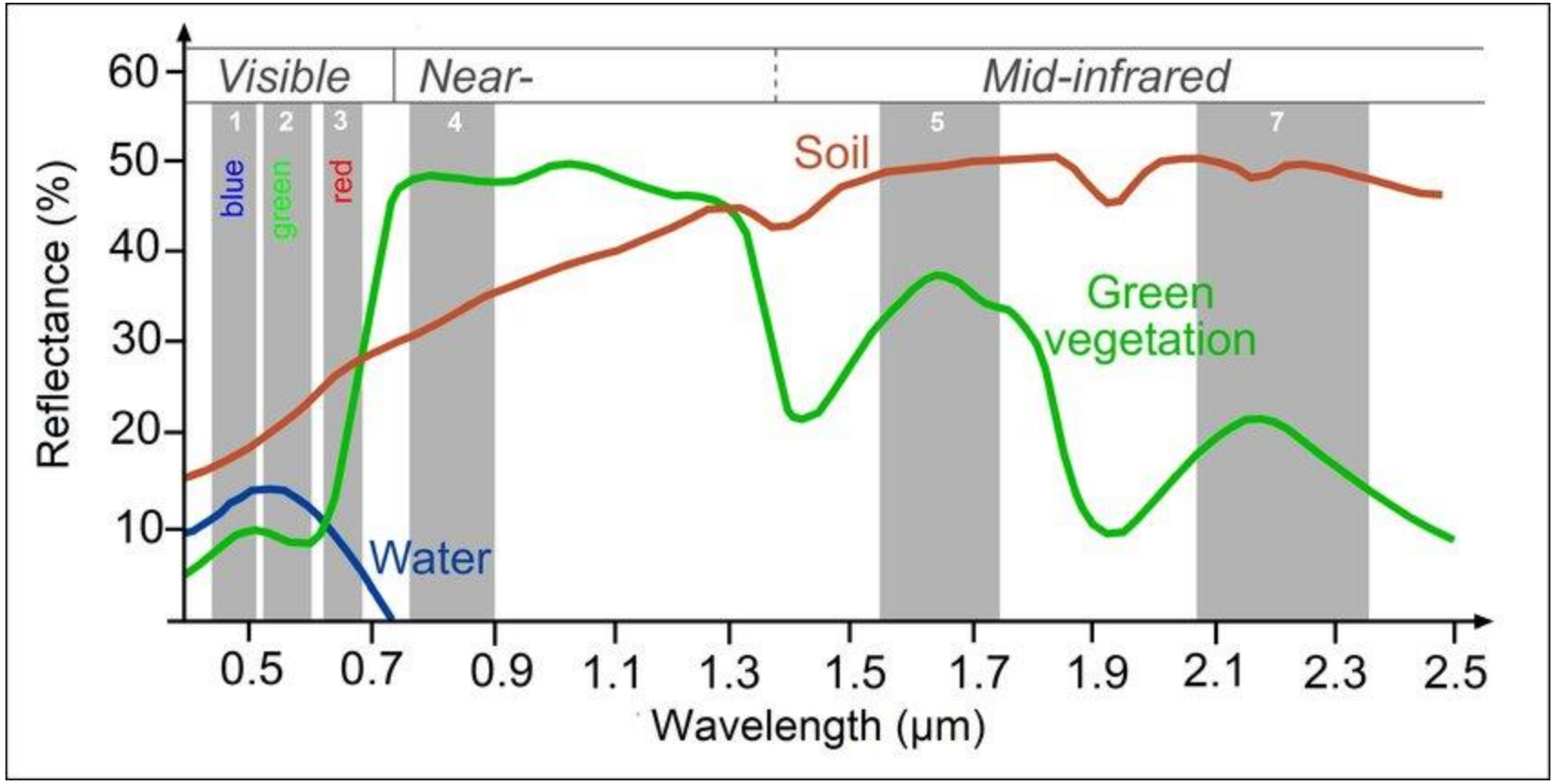
**Imagery:** RGB, multispectral, hyperspectral, lidar, SAR

**Processing:** Indices, Supervised Classification, AI

Pleiades Neo

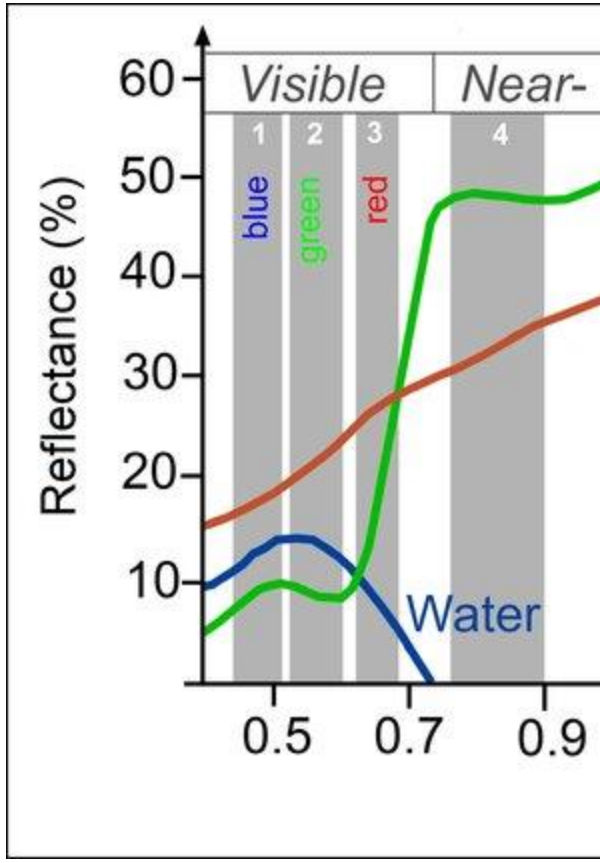
1.2m GSD
(M-SPECTRAL)

Source: UP42 platform




Multi-spectral (satellite products)

Source: SEOS project (http://www. seos-project.eu/home.html.)




Green vegetation

Soil

NIR (satellite, and maybe aerial/UAV products)

Source: SEOS project (http://www. seos-project.eu/home.html.)

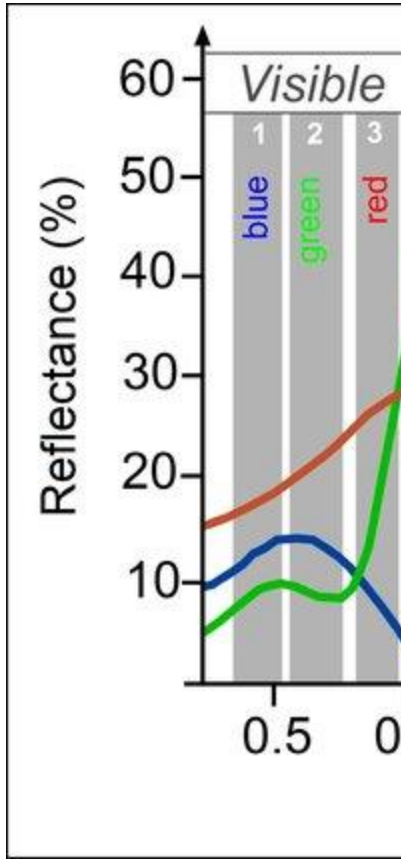
Pleiades Neo Satellite Image:

Displaying 3 band image of:

Green: 530-590 nm
Red: 620-690 nm
Near-infrared: 770 – 880 nm

Pansharpened

Source: UP42 platform




Soil

Green vegetation

Water (if turbidity is low)

RGB (readily available through many products)

Source: SEOS project (http://www. seos-project.eu/home.html.)

## Pilot study

What sort of results for vegetation cover classification can we expect using RGB only imagery?

What if we pair the RGB data with (free) lower resolution satellite data for NearIR?

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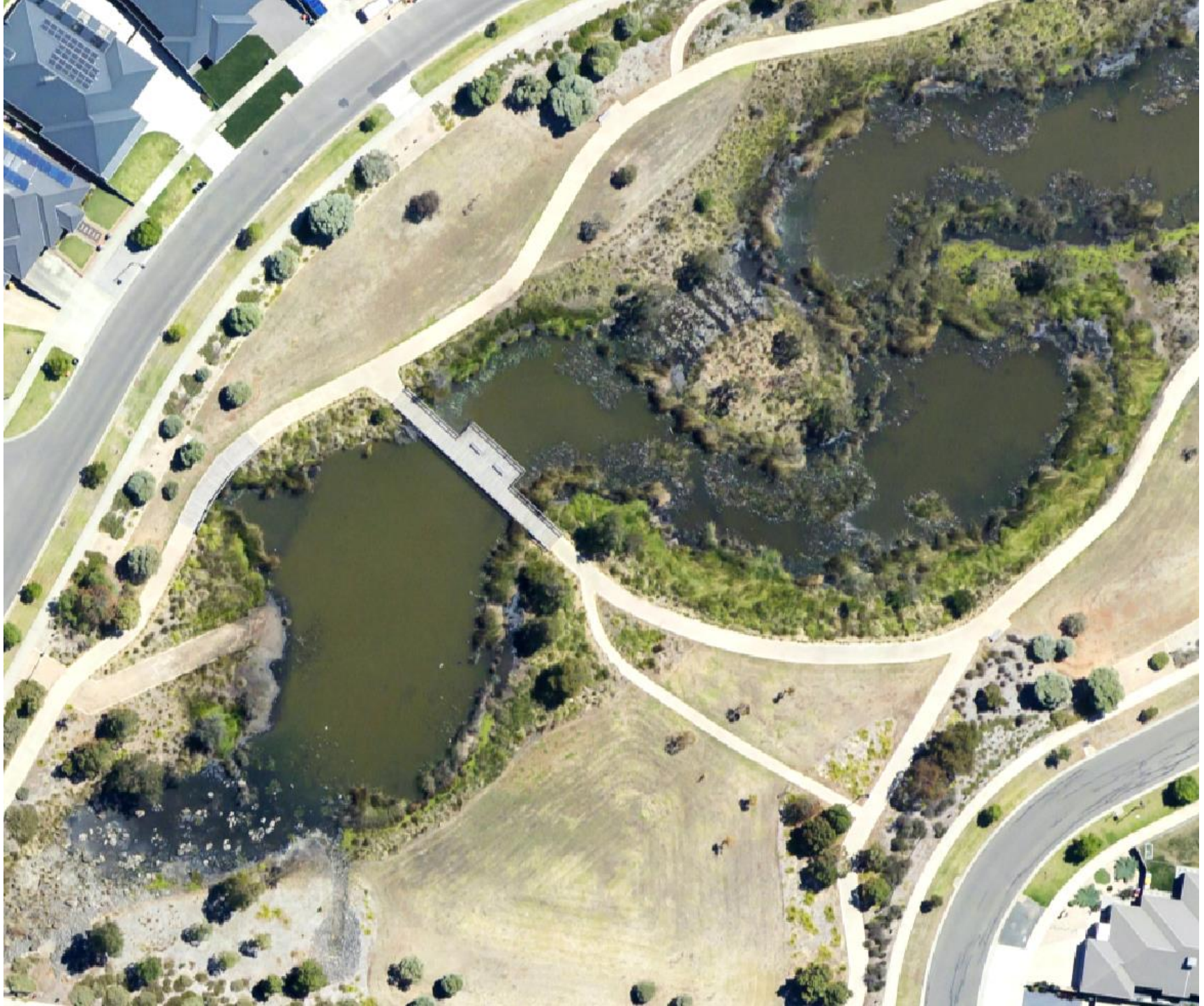
Some trialling of fast and low-cost remote sensing methods has been completed by WI as part of broader asset management projects with Melbourne Water and City of Greater Geelong

When zoomed out this looks like there is nice clear separation of classes, however

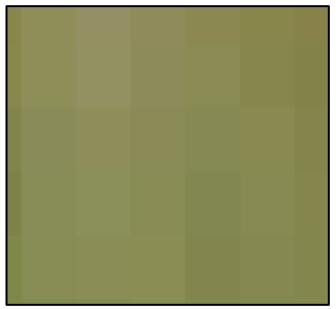


Grand Lakes, Lara.
Source: Metromap

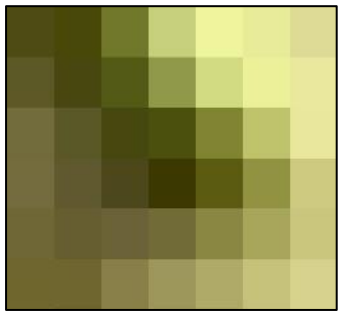
# Image Analysis - Pixel Classification

Water

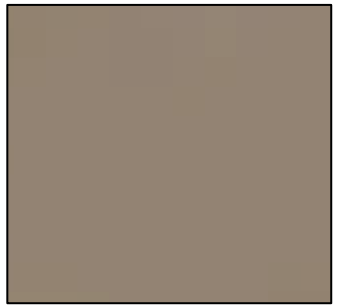
Tree



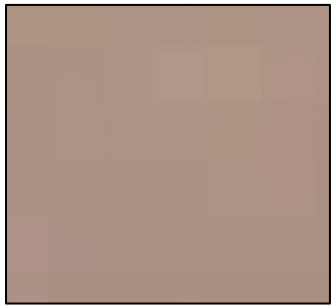
Grass



Algae



Water



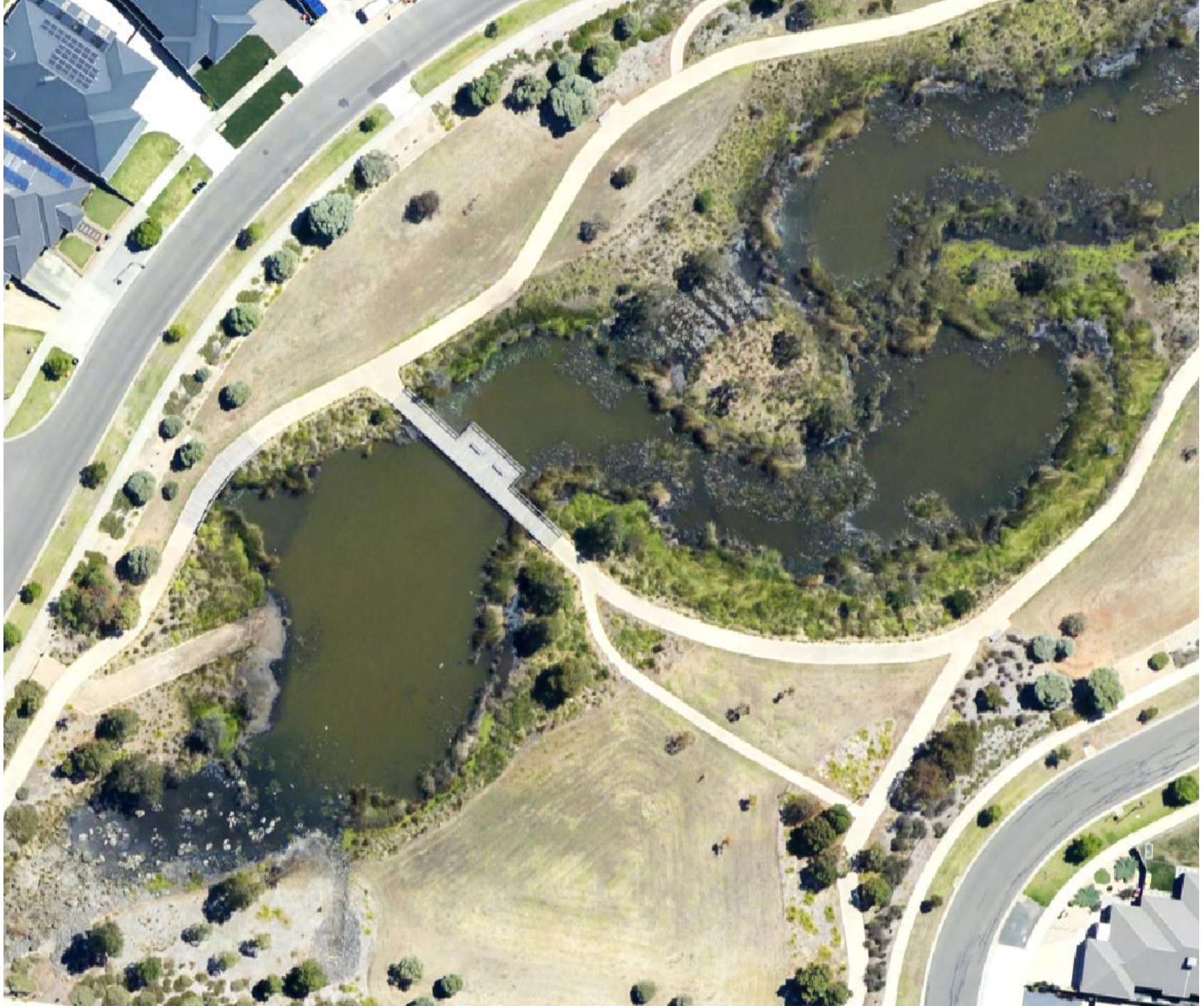
Crush Rock

Concrete Path

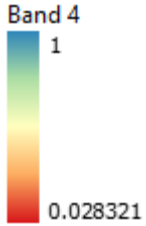
Glare

Approx
2mx2
m

What about image texture?

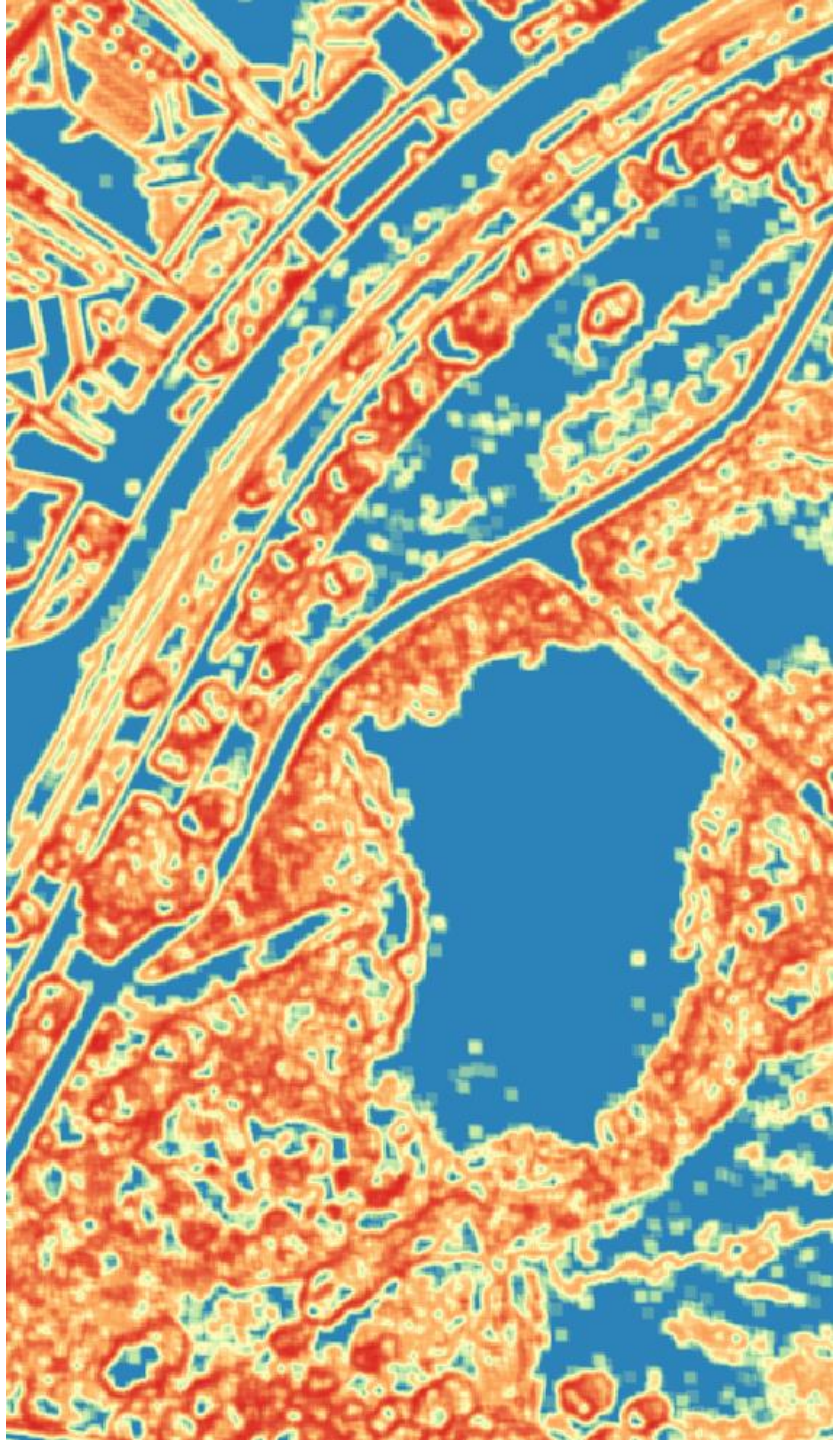


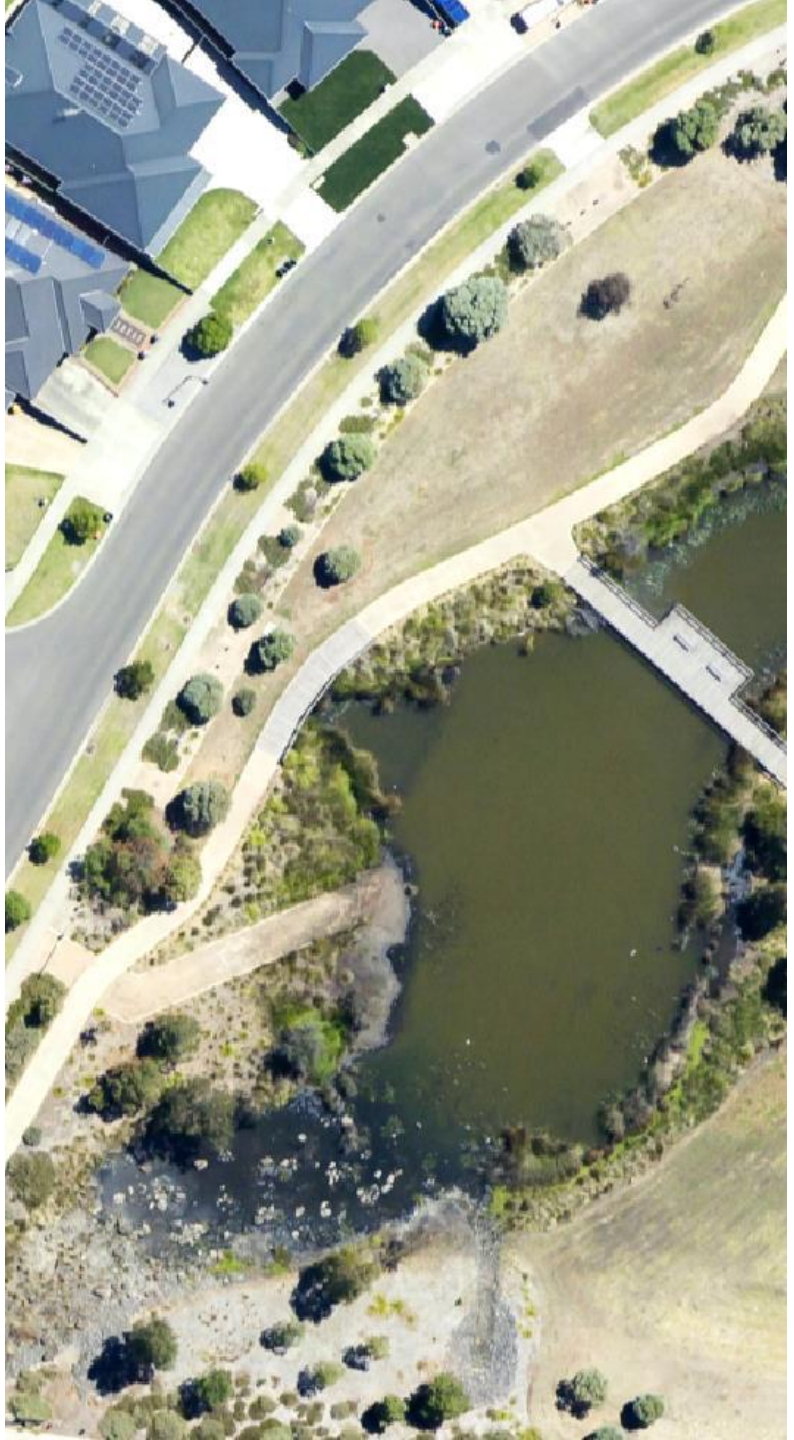
Texture values



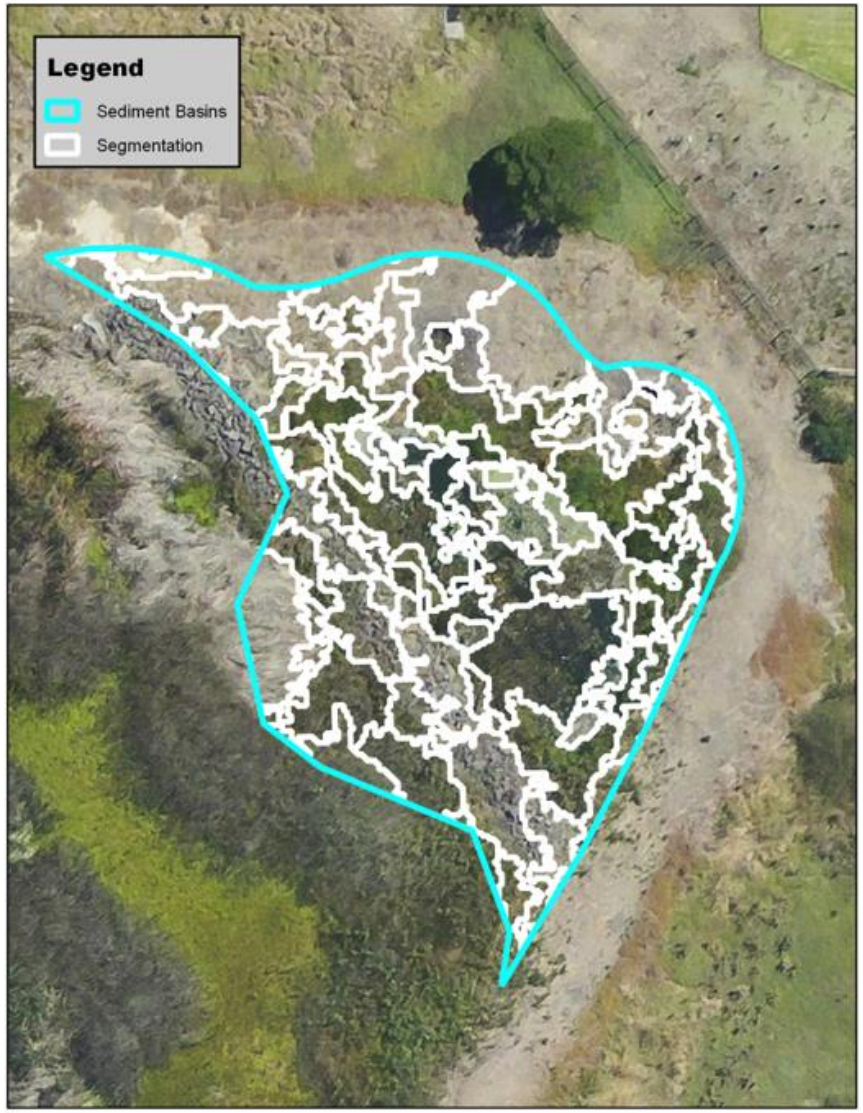

Great for identification of water, but values are similar for open water, paths and roads.

Issues with glare





# Object Based Image Analysis (OBIA)
## Segmentation






Metres
GDA 2020 MGA Zone 55

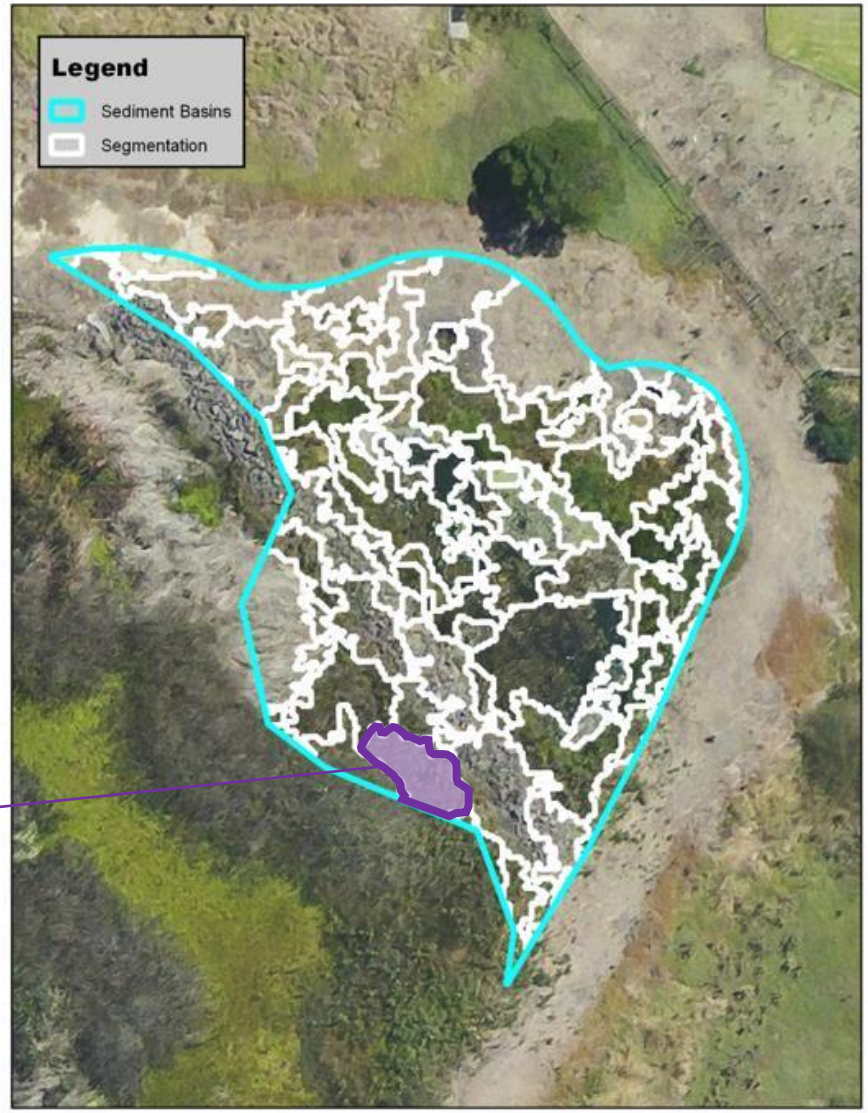
Title: Remote Sensing Classification

# Object Based Image Analysis (OBIA)

## Attribute Calculation

For each segment, we then calculate:

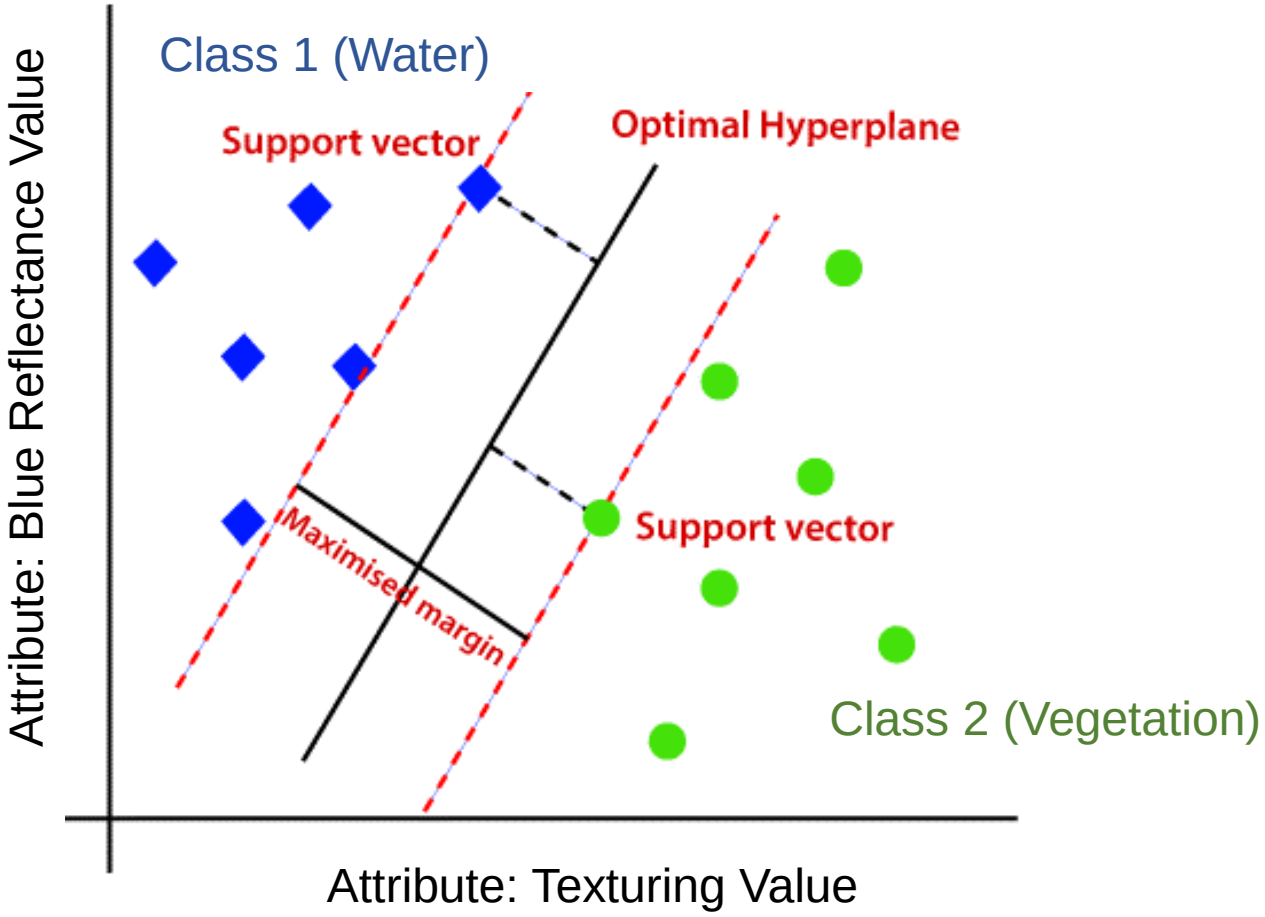
- Average Red reflectance value
- Average Blue reflectance value
- Average Green reflectance value
- Average texturing value
- …etc




Title: Remote Sensing Classification

# Object Based Image Analysis (OBIA)

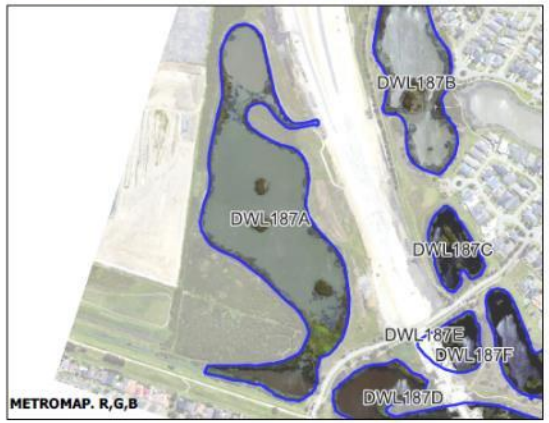
## Supervised Classification. SVM

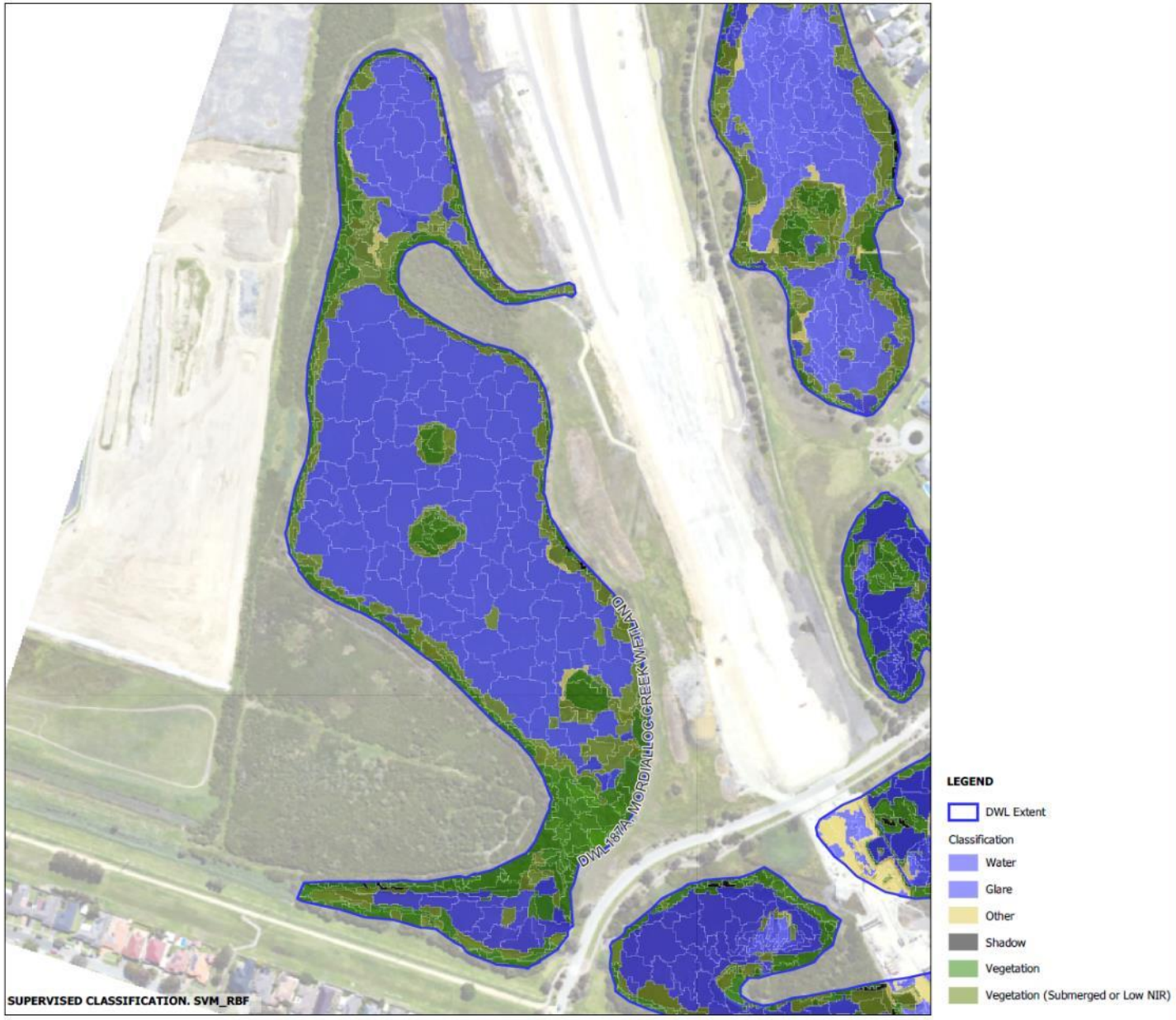



How many classes (ie. different surface types) should we try to classify?

https://www.analyticsvidhya.com/blog/2021/10/support-vector-machinessvm-a-complete-guide-for-beginners/

# Classifier Output


# Preliminary Results

## Confusion Matrix

Actual Class (Validation data)

Classifier output

| | Water | Glare | Vegetation1 | Vegetation2 | Shadow | Other |
|---|---|---|---|---|---|---|
| Water | **138** | 0 | 6 | 2 | 14 | 2 |
| Glare | 0 | **259** | 0 | 8 | 0 | 3 |
| Vegetation1 | 17 | 0 | **293** | 29 | 13 | 0 |
| Vegetation2 | 0 | 2 | 0 | **76** | 0 | 5 |
| Shadow | 0 | 0 | 4 | 0 | **111** | 3 |
| Other | 9 | 0 | 0 | 10 | 0 | **10** |

Overall accuracy, RGB only

80-85%

# Preliminary Results

RGB only



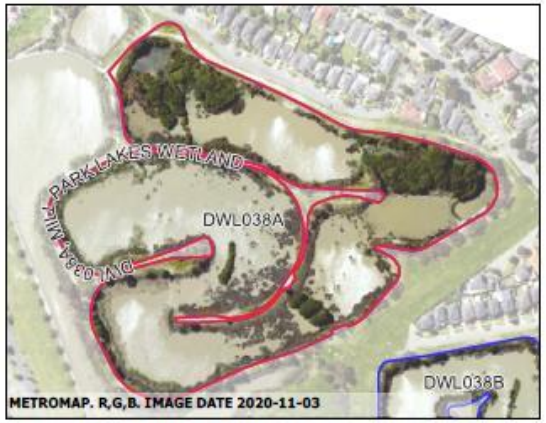
Overall accuracy

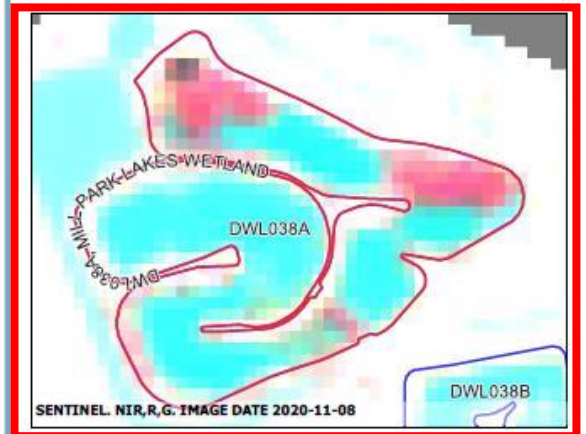
80-85%

RGB only


# Preliminary Results

NIR

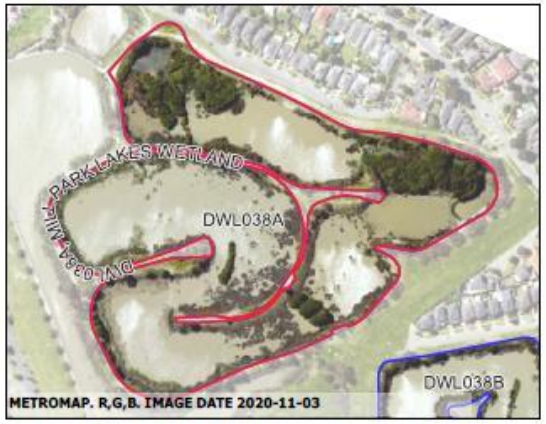





# Preliminary Results

NIR


Overall accuracy

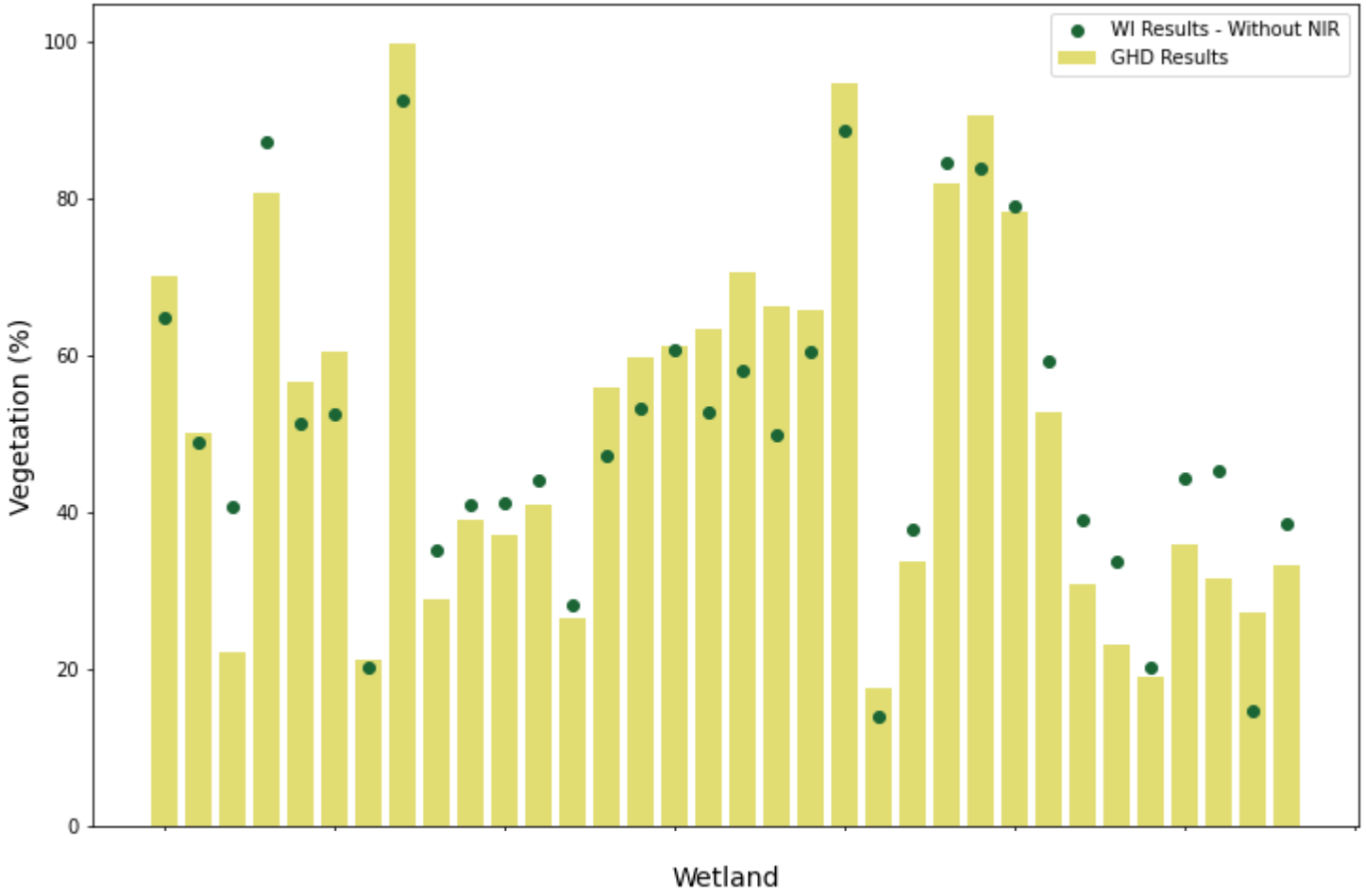
90%+

With NIR (10m, Sentinel)


## Preliminary Results

Comparison with 2020 GHD remote sensing project
Focus on comparison of vegetation cover only

RGB only




Average difference
(35 assets)
**-0.4%**

Average absolute difference
**6.5%**
(all differences are treated as positive numbers)

## Preliminary Results

Comparison with 2020 GHD remote sensing project
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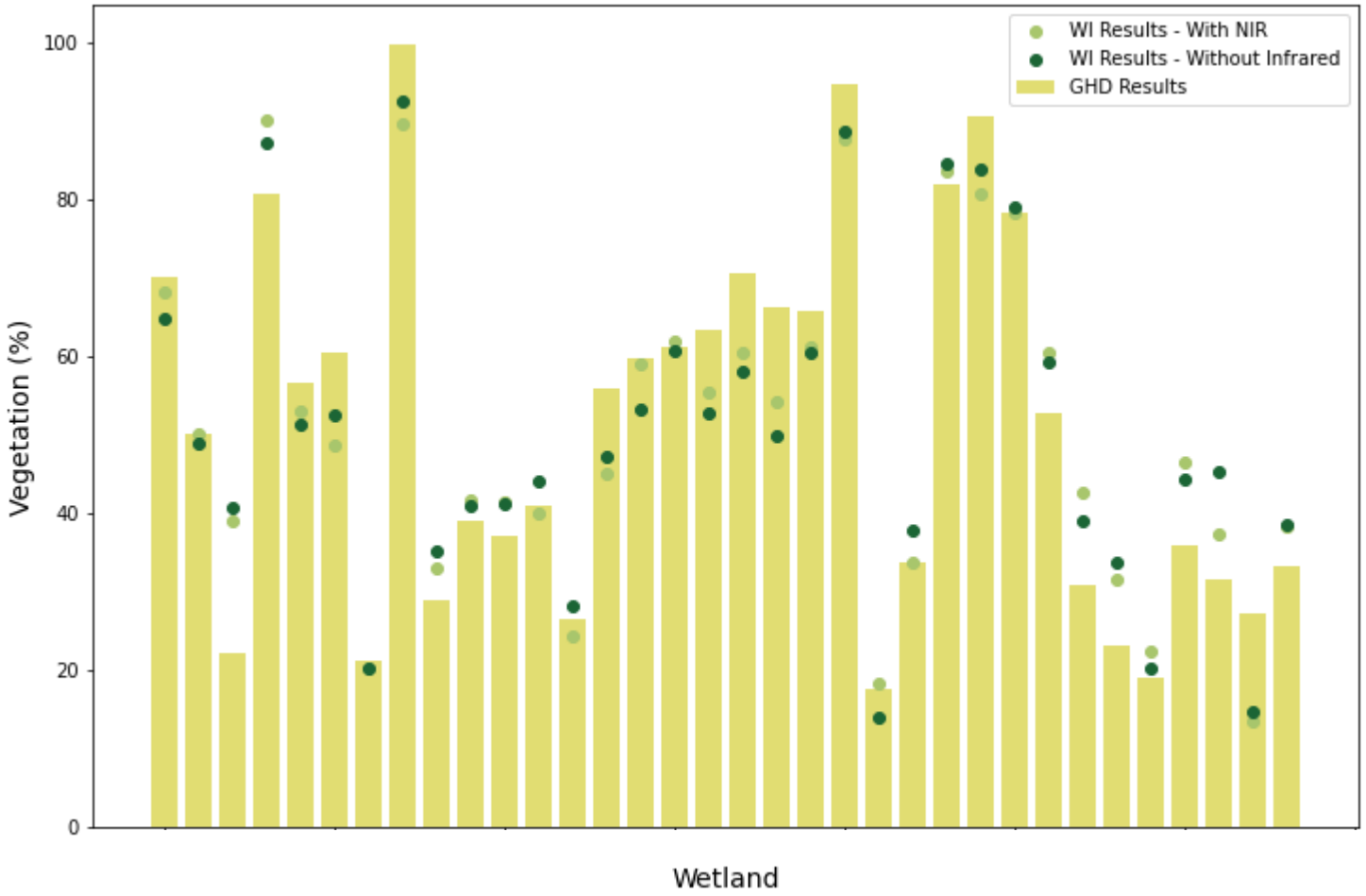
NIR




Average difference
(35 assets)
**-1.2%**

Average absolute difference
**5.4%**
(all differences are treated as positive numbers)

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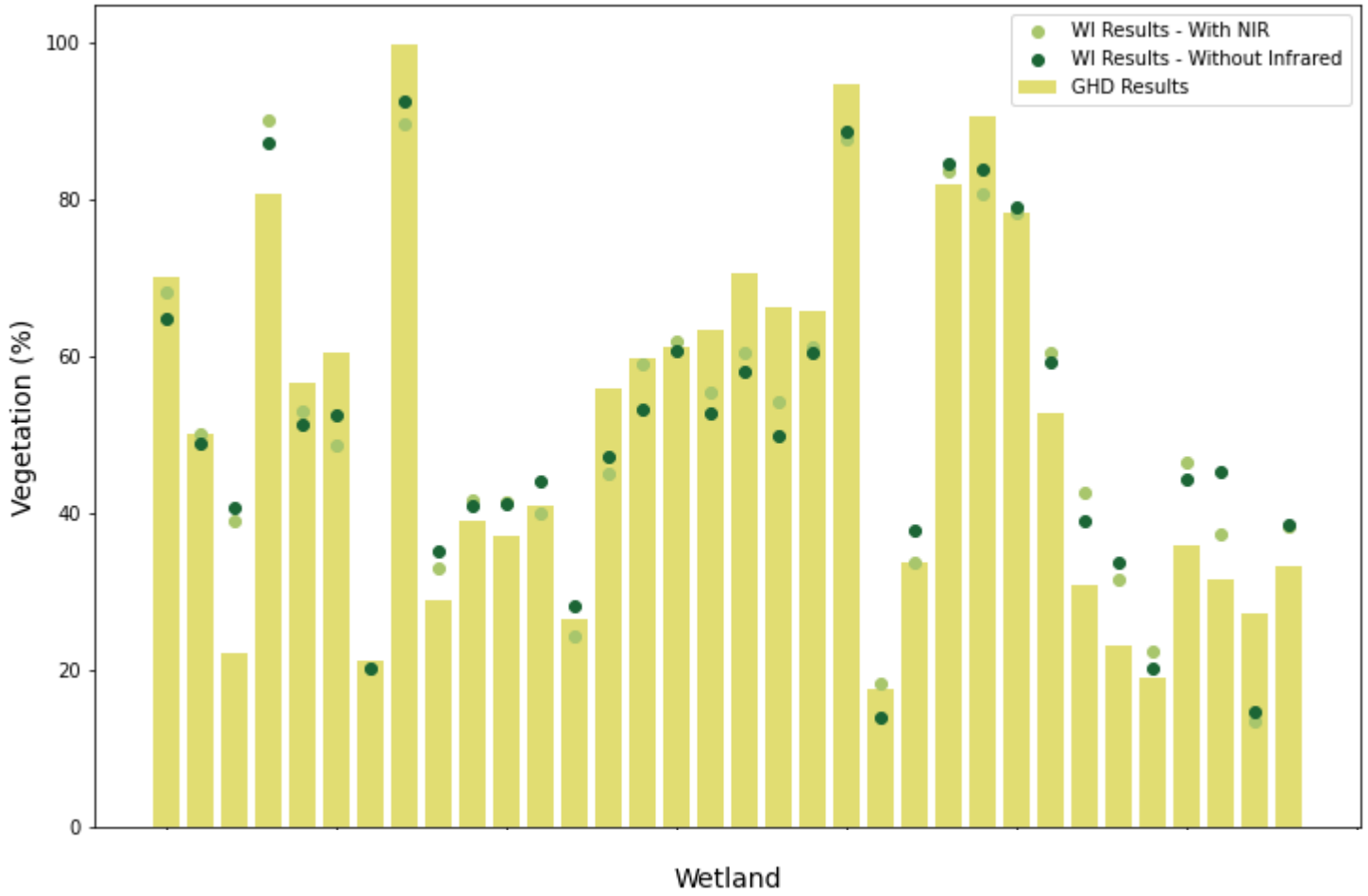
Comparison with 2020 GHD remote sensing project
Focus on comparison of vegetation cover only

NIR

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Veg/water separation is therefore good using either method

Use of NIR data provided a more reliable classification

## Available techniques

It is difficult to do a full summary of all options and their pros and cons but some quick comments include:

1. **Hi-res satellite imagery is likely to provide the best data for remote sensing analysis of vegetation and water.**

Data with high recency or high spatial resolution can be expensive

2. **UAV imagery with multi-spectral cameras is also able to provide excellent data for remote sensing**

Unfeasible over large asset numbers

3. **There are now a large number of products that can provide high resolution and high recency aerial imagery (Nearmap, Metromap etc).**

These are generally limited to RGB only

4. **The aerial imagery provides may be starting to offer NIR data and/or AI (deep learning) classification products. Our review indicated the AI products may have good accuracy for building and impervious analyses, but were not so good for water/veg delineation.**

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## Summary

RGB imagery paired with 10m NIR data is a good balanced approach where the focus is vegetation cover assessment

Provides possibility for high temporal and spatial resolution, low cost

NIR and/or lidar likely to increase in availability over the coming years which will boost accuracy.

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More broadly:

<20 assets – training a classifier is maybe not worthwhile
>50 assets – efficient and repeatable way to conduct this type of analysis

# Other examples of remote sensing

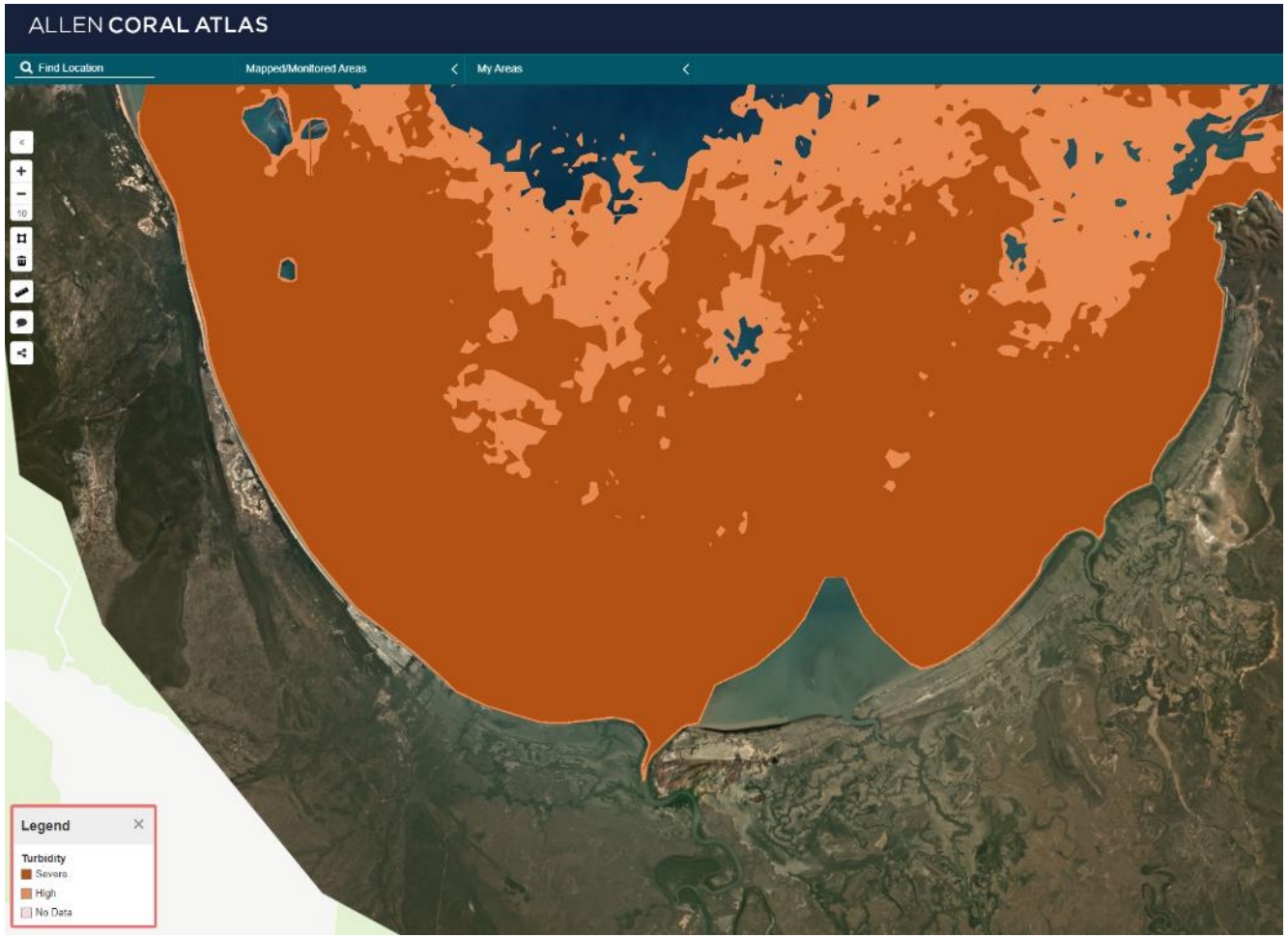
## Phragmites identification. Austin, USA


Pix4Dfields LCI index run through the advance layer visualization feature to highlight affected areas

Source: https://www.pix4d.com/blog/drone-mapping-spraying-invasive-species/

# Other examples of remote sensing

## Turbid water inflows to areas of coral reef. Qld, AUS




https://allencoralatlas.org/atlas/?l=crwbaa,planet,planet_2020&g=aca#11.36/-14.4731/-215.1992

# Thankyou and questions