



Parks
Canada

Parcs
Canada

Canada

Water Soldier Detection Using UAVs in Trent-Severn Waterway

Great Lake Restoration Initiative

Developing best practice guidance for early detection of invasive aquatic plants in inland lakes

February 7, 2023



Water Soldier





Program Overview



Detection and Rapid Response

First wild occurrence in North America
Spot treatments
Established Working Group

2008 to 2011



Research

Biology / Life History
Control techniques
Surveillance

2012 to 2016



Policy Development

Legislative tools for prevention
Education and outreach
(industry, public/citizens)

2012 to present



Management and Control

Development of integrated management plan
Large-scale treatments

2014 to present



Without control, water soldier will spread





Without control, water soldier will spread





Without control, water soldier will spread





Without control, water soldier will spread

September 2015





Post-treatment control

July 2016





Post-treatment control





Post-treatment control

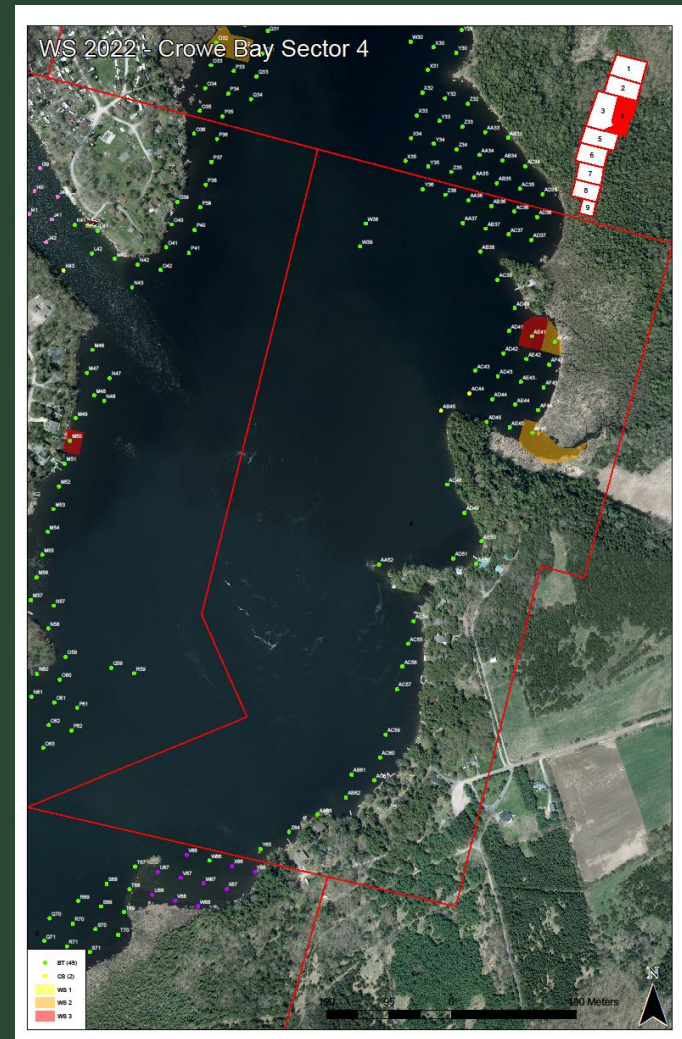
July 2018





Monitoring and Treatment

- Point intercept monitoring at 50 m resolution
- ~50 km stretch of Trent River
- 3 dedicated crews; 6-7 weeks
- Diquat treatment in early October
- 2 airboats with crews; 4 days

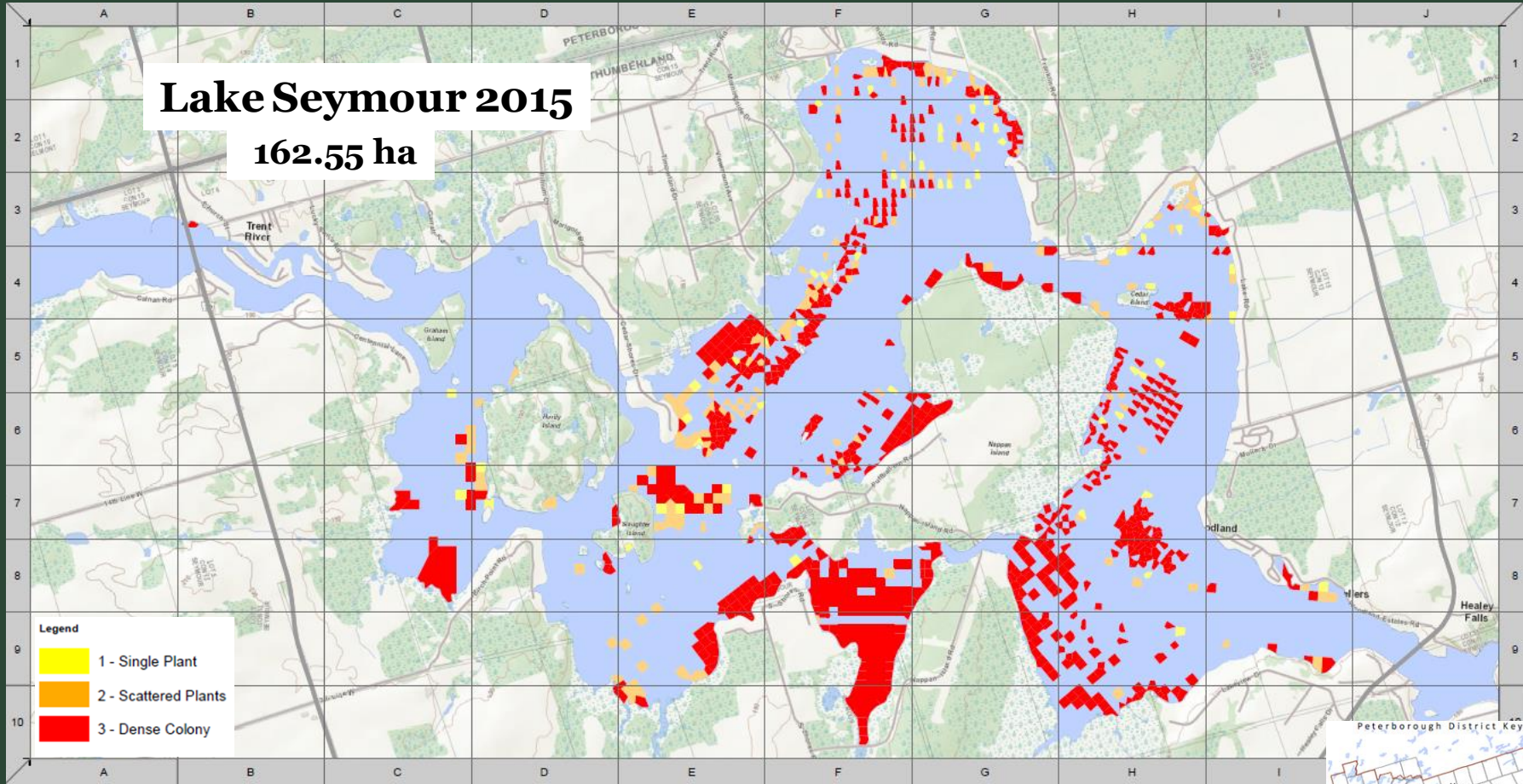


Lake Seymour 2015

162.55 ha

Legend

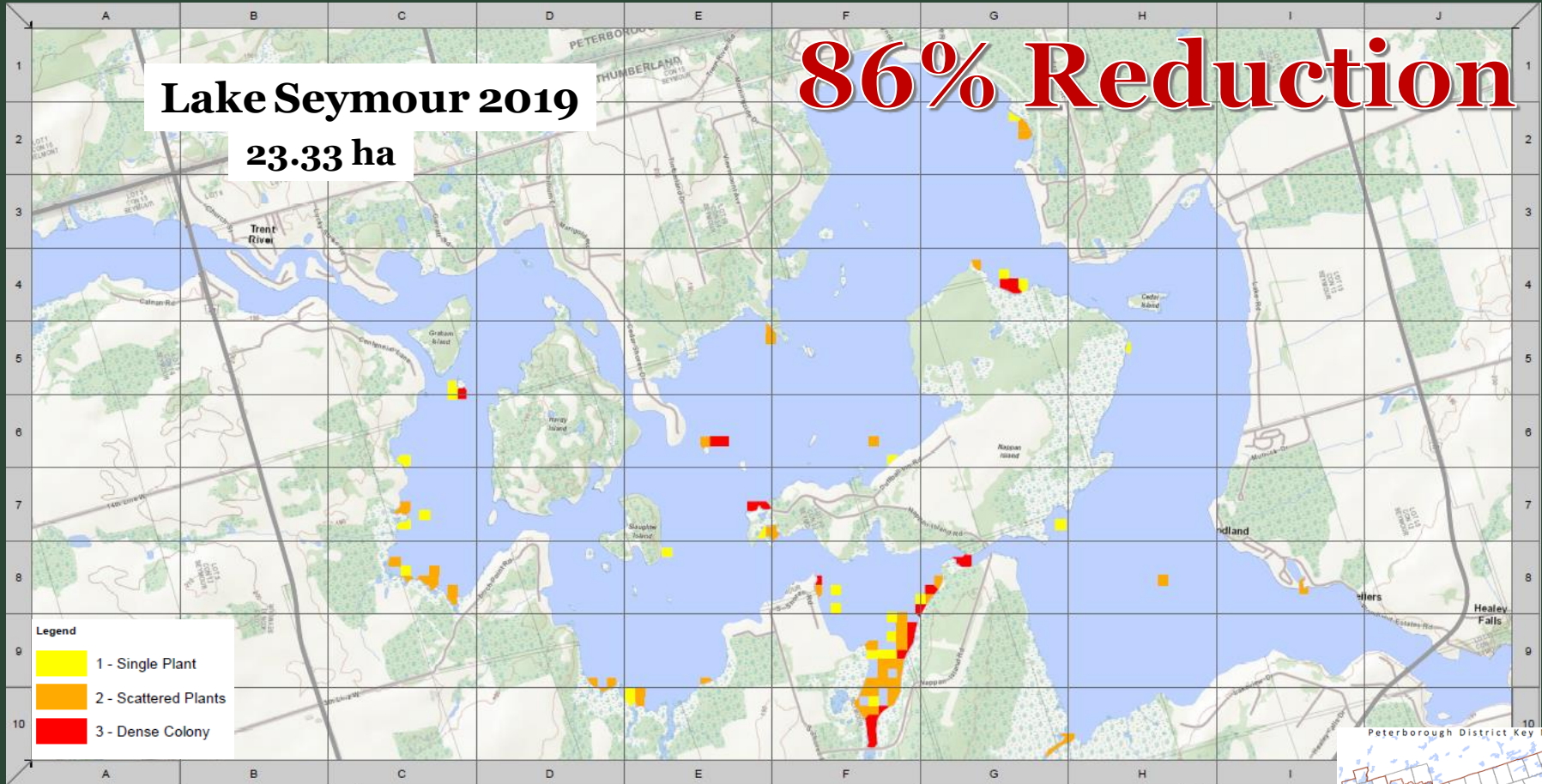
- 1 - Single Plant
- 2 - Scattered Plants
- 3 - Dense Colony



Lake Seymour 2019

23.33 ha

86% Reduction



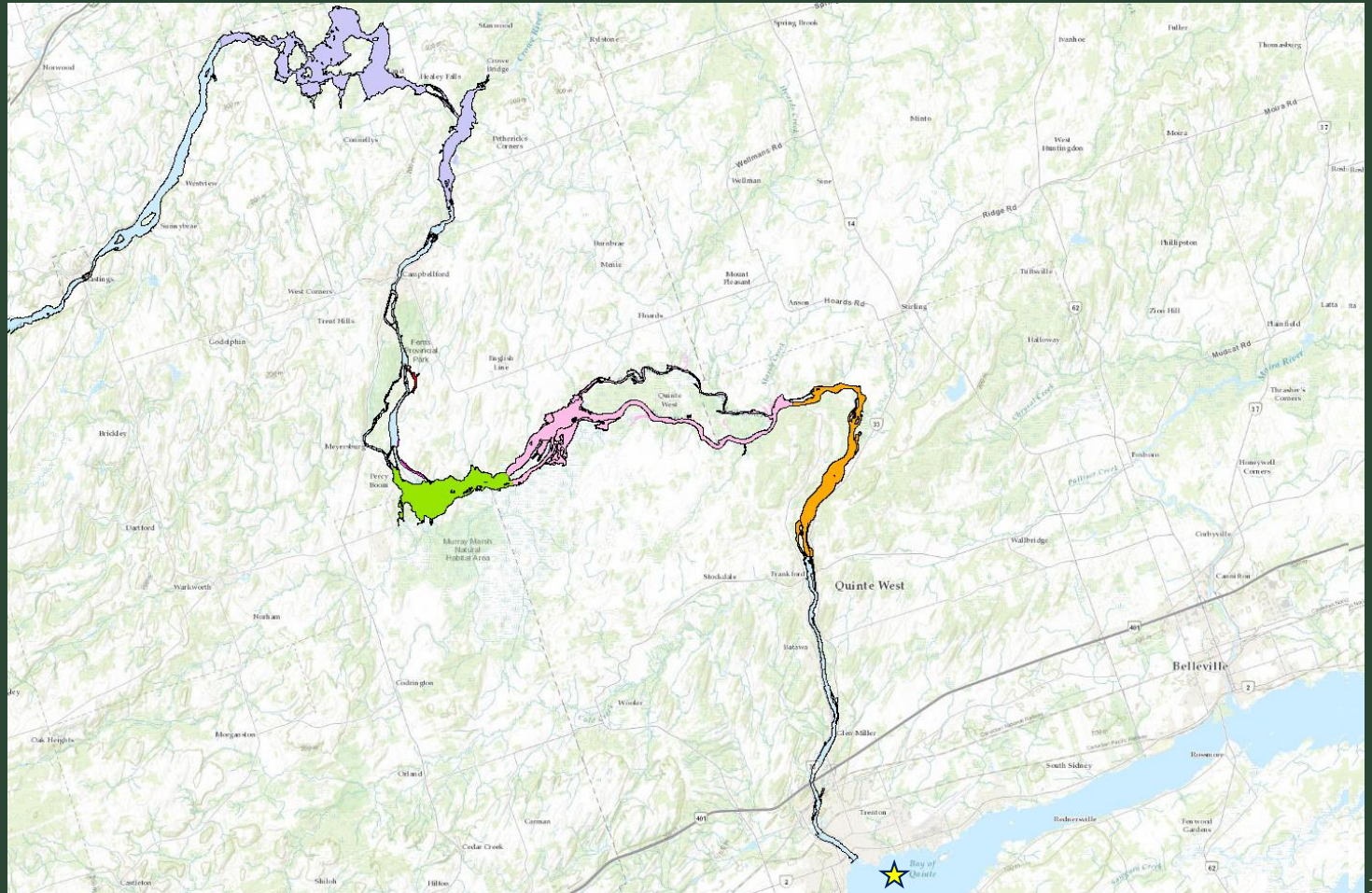
Legend

- 1 - Single Plant
- 2 - Scattered Plants
- 3 - Dense Colony





- 2014 Seymour Lake and Crowe Bay
- 2015 Percy
- 2017 Wilson Island
- 2018 Glen Ross
- 2019 Hagues Reach
- 2021 Bay of Quinte
- 2022 Meyers





2020 – Drone Pilot Project

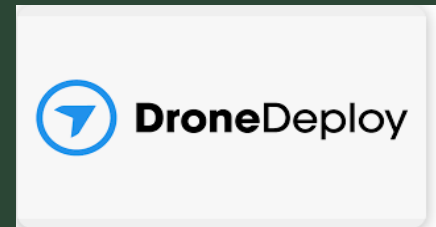
- PCA interested in using drones to find WS in boat inaccessible areas
- Pilot project - testing and assessment of automated flights, imagery creation and desktop water soldier identification
- Used existing PCA owned drones, purchased monthly subscription to Drone Deploy to produce imagery and reviewed imagery in ArcMap 10.x



DJI Phantom 4 (Standard)



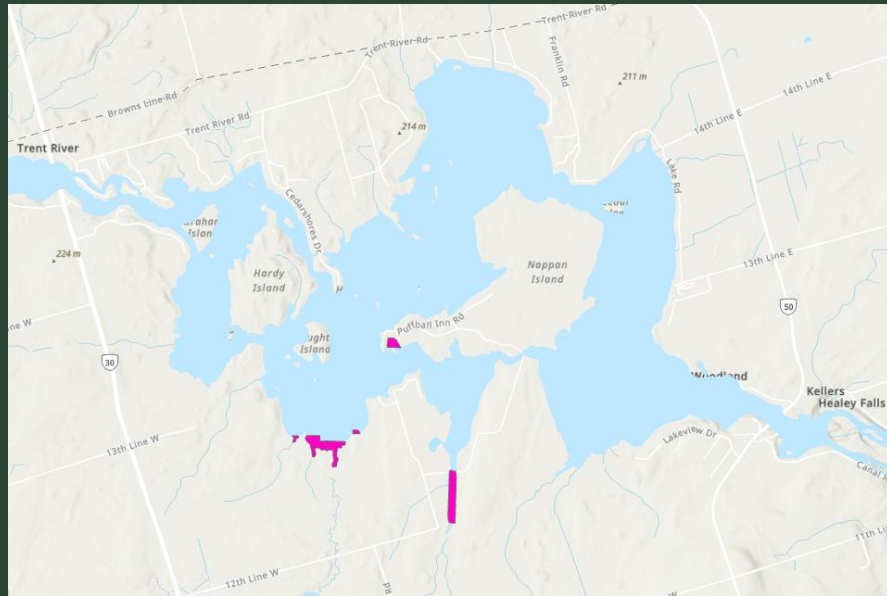
DJI Mavic Pro 2



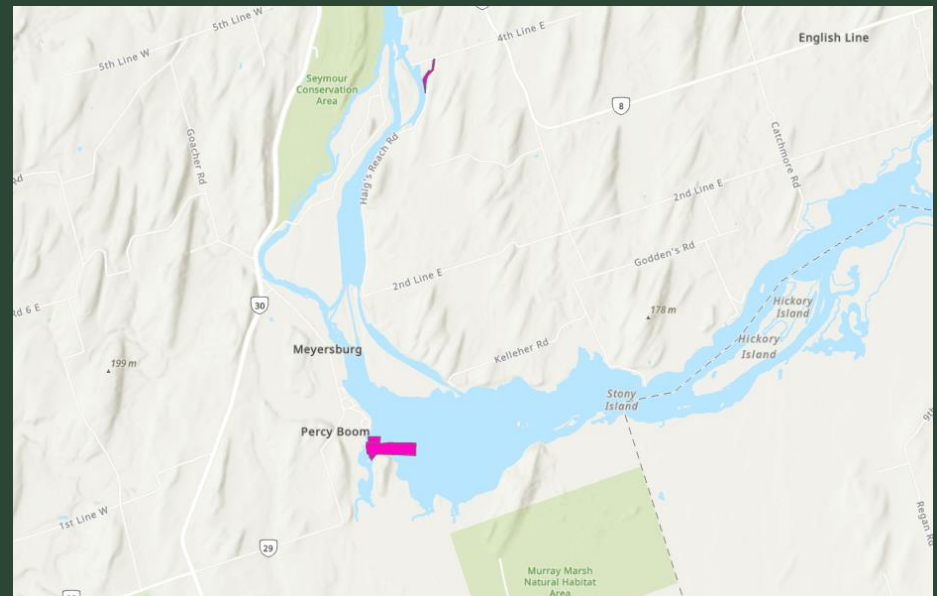


- PCA piloted WS drone work in 2020 – covered 23.5 ha
 - Land and boat operations

Seymour Lake



Percy Reach and Hagues Reach





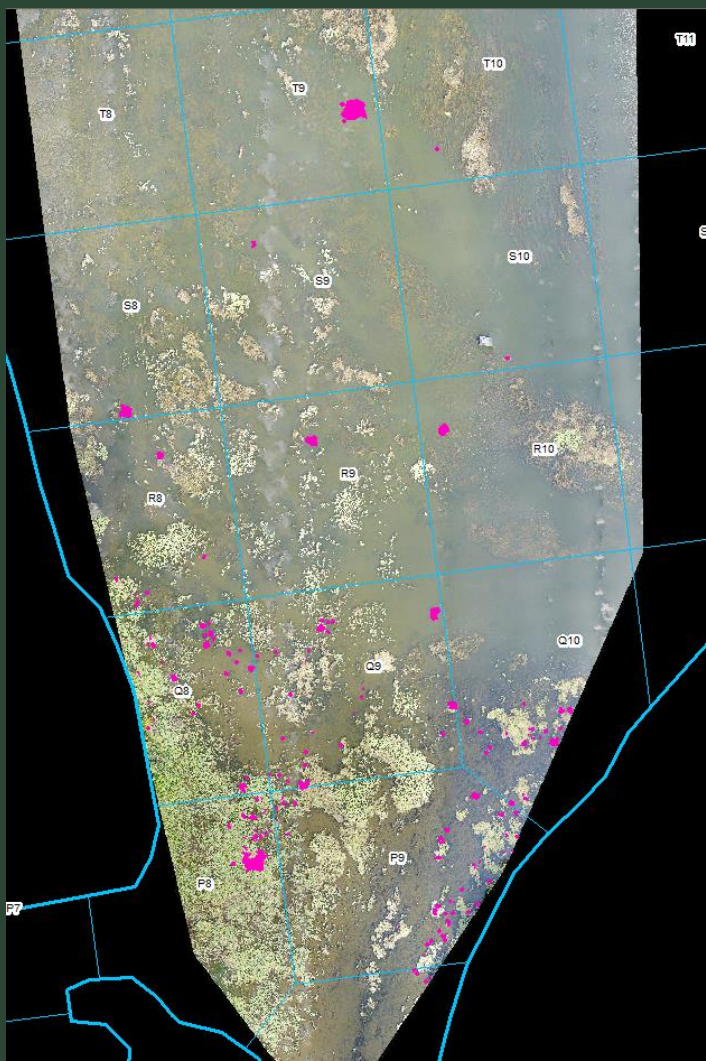
Sample Imagery 2020



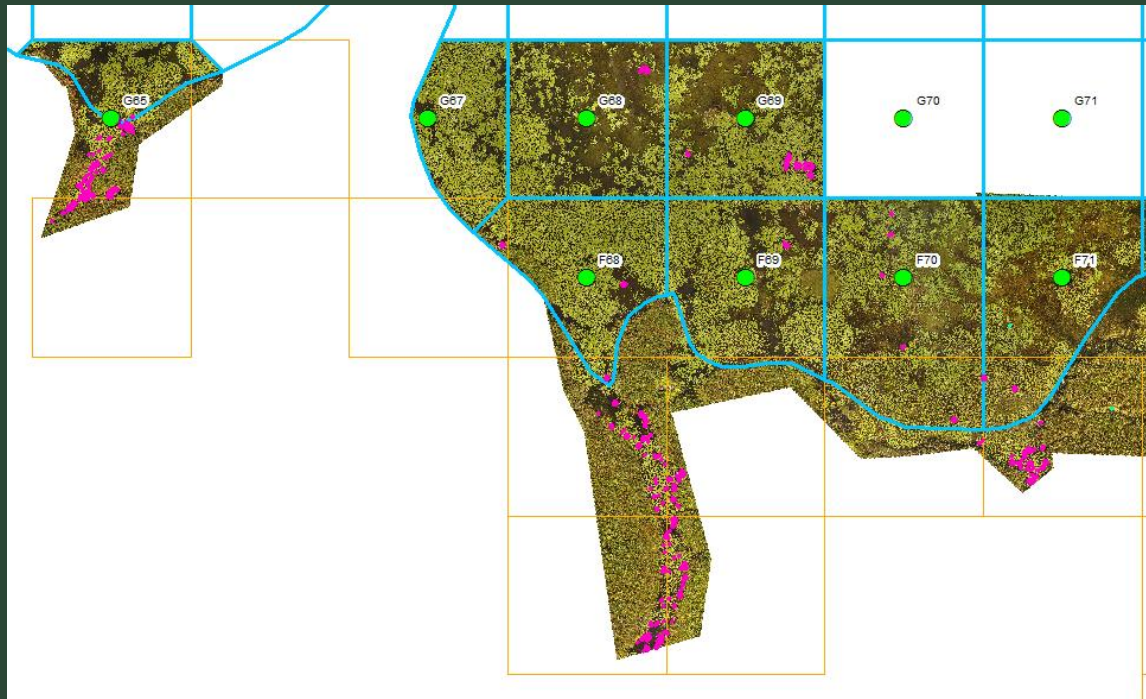


Desktop Identification of Water Soldier





Integration of drone Water Soldier identification with grid monitoring





2021 – Expansion of Drone work

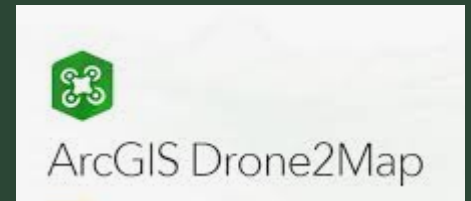
- Partnered with Environment and Climate Change Canada (ECCC) and Ministry of Environment, Conservation & Parks (MECP) to efficiently cover larger areas
- Partners had larger drones with better cameras (including multi-spectral) – possible to fly higher without compromising resolution
- also used PCA owned ArcGIS Drone2Map and ArcMap 10.x



eBee Drone (fixed wing)



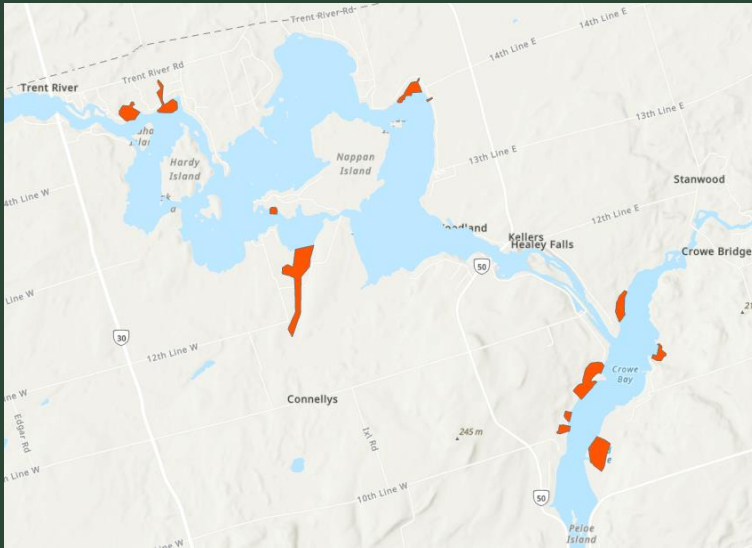
DJI Matrice 300



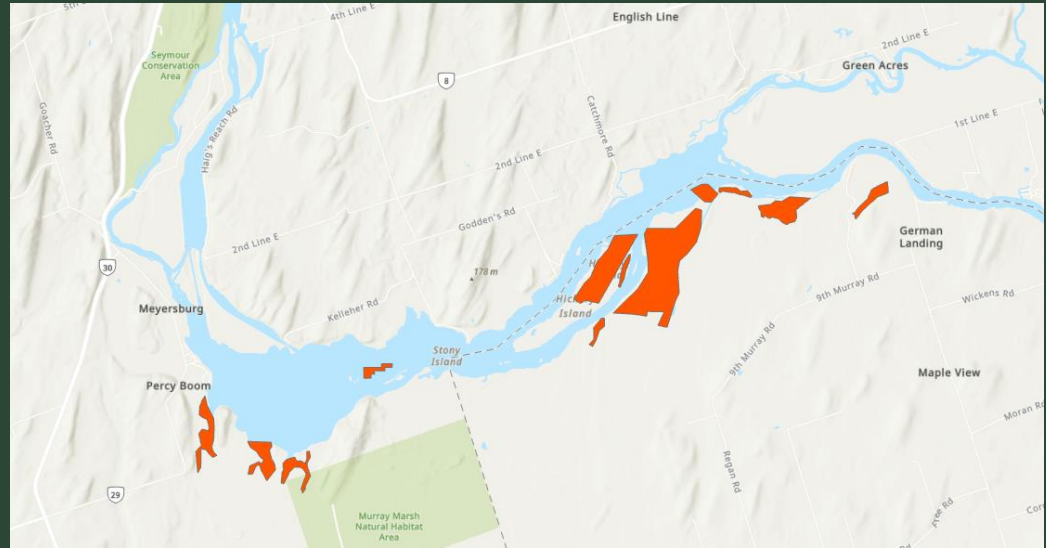


- Covered ~52.5 ha with PCA drone equipment and staff
- ECCC and Ebee drone (land based) ~165.5 ha covered
- MECP and Matrice 300 drone (boat based) ~36.5 ha covered

Seymour Lake & Crowe Bay

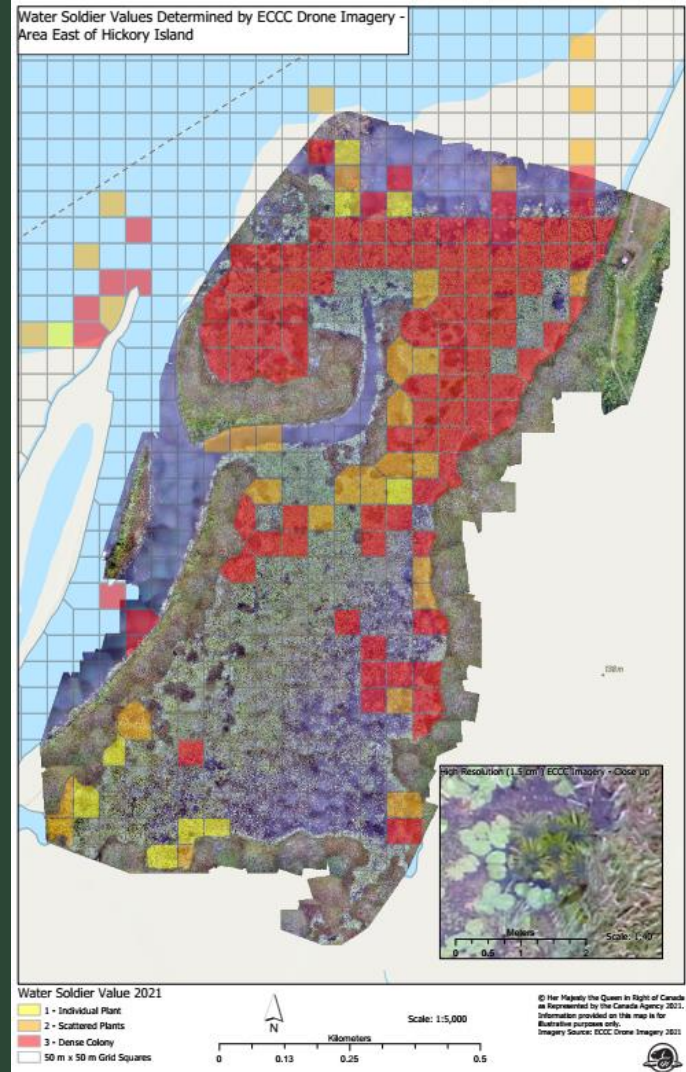


Percy Reach & Hickory Island





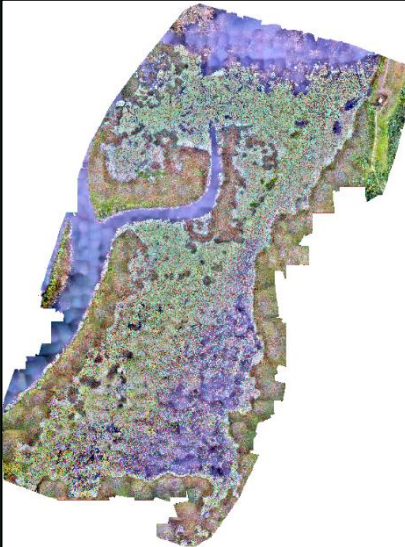
- High resolution required for this project – identifying to the individual plant level
- 0.4 inch/pixel or 1.0 to 1.5 cm resolution
- Height of drone flight limited by the resolution
 - Phantom 4: 80 feet
 - Mavic Pro 2: 120 feet
 - Ebee: 220 feet
 - Matrice 300: 400 feet



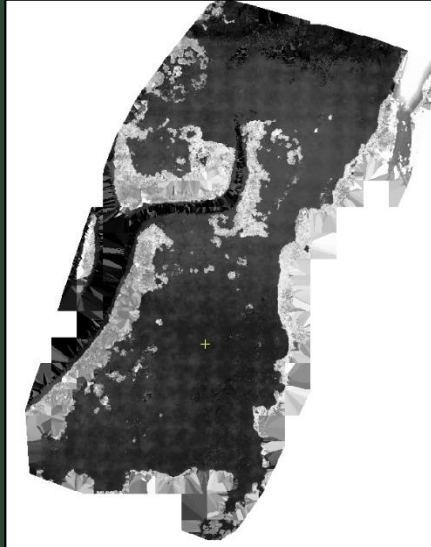


Flight Area C1 – Product Preview

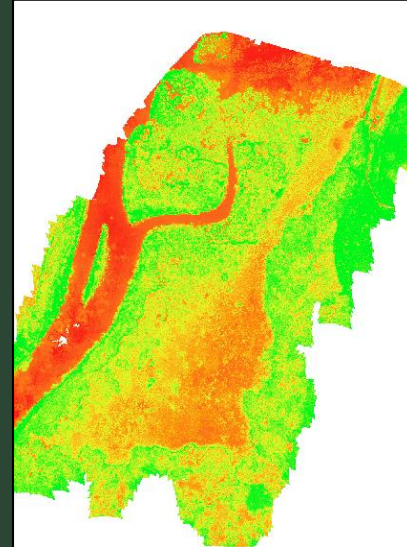
RGB Orthomosaic (SODA)



DSM (SODA)



NDVI (Sequoia)





2022 – Focus on Upstream Infestation

- Continued Water Soldier (WS) monitoring using PCA and MECP resources
- Focused on Seymour Lake - the upper most area of infestation
- Used PCA Drone and MECP drone, purchased Pix4D for imagery stitching and continued analysis in ArcMap 10.x



DJI Mavic Pro 2



DJI Matrice 300

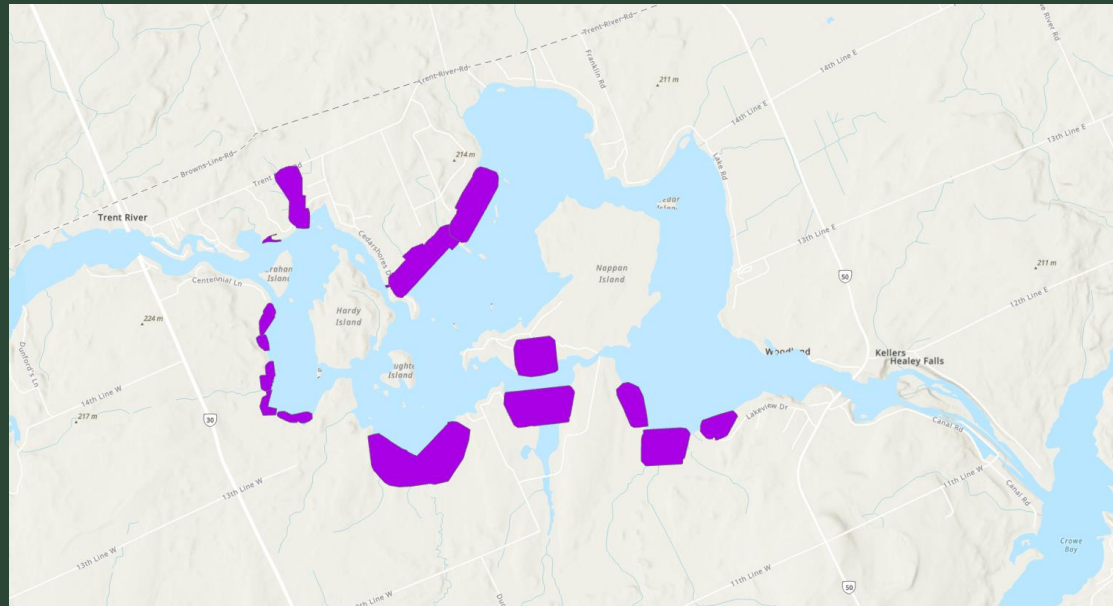




WS drone work in 2022 – covered total of 158.5 ha

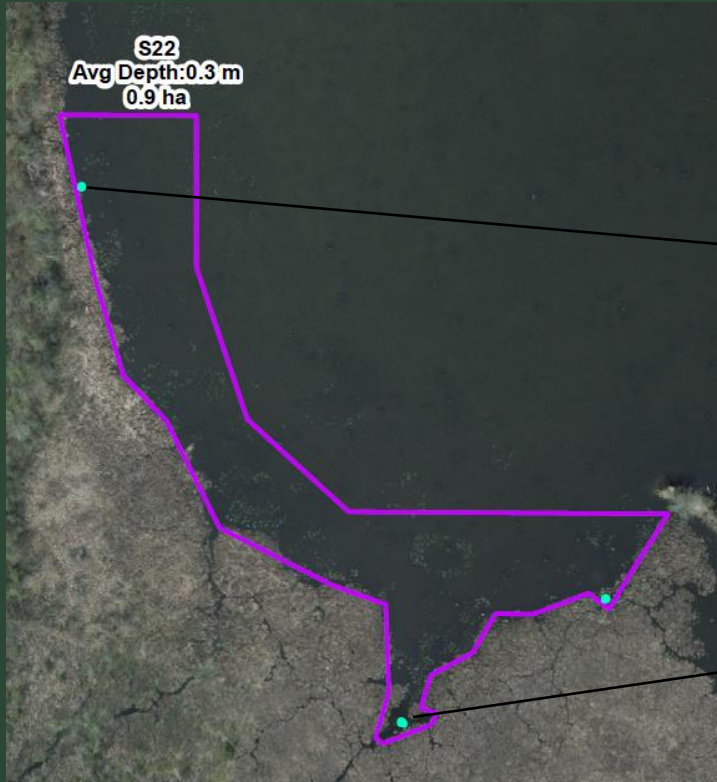
- Flew earlier in the season than previous years
- MECP 149.8 ha
- PCA 9.7 ha

Seymour Lake



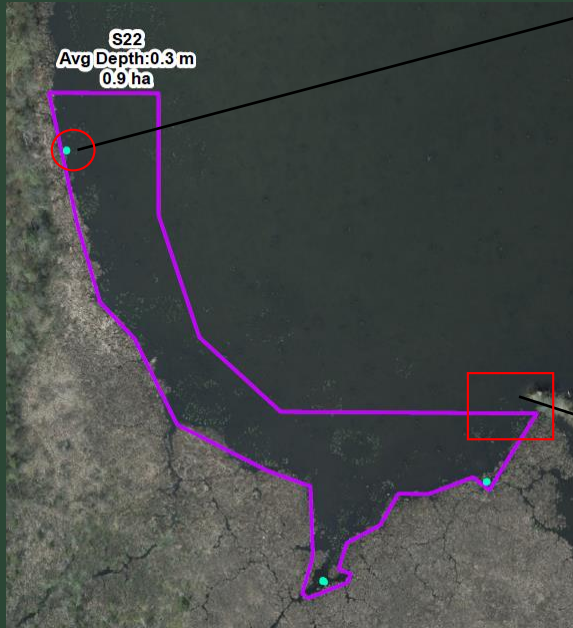


Low confidence Water Soldier ID



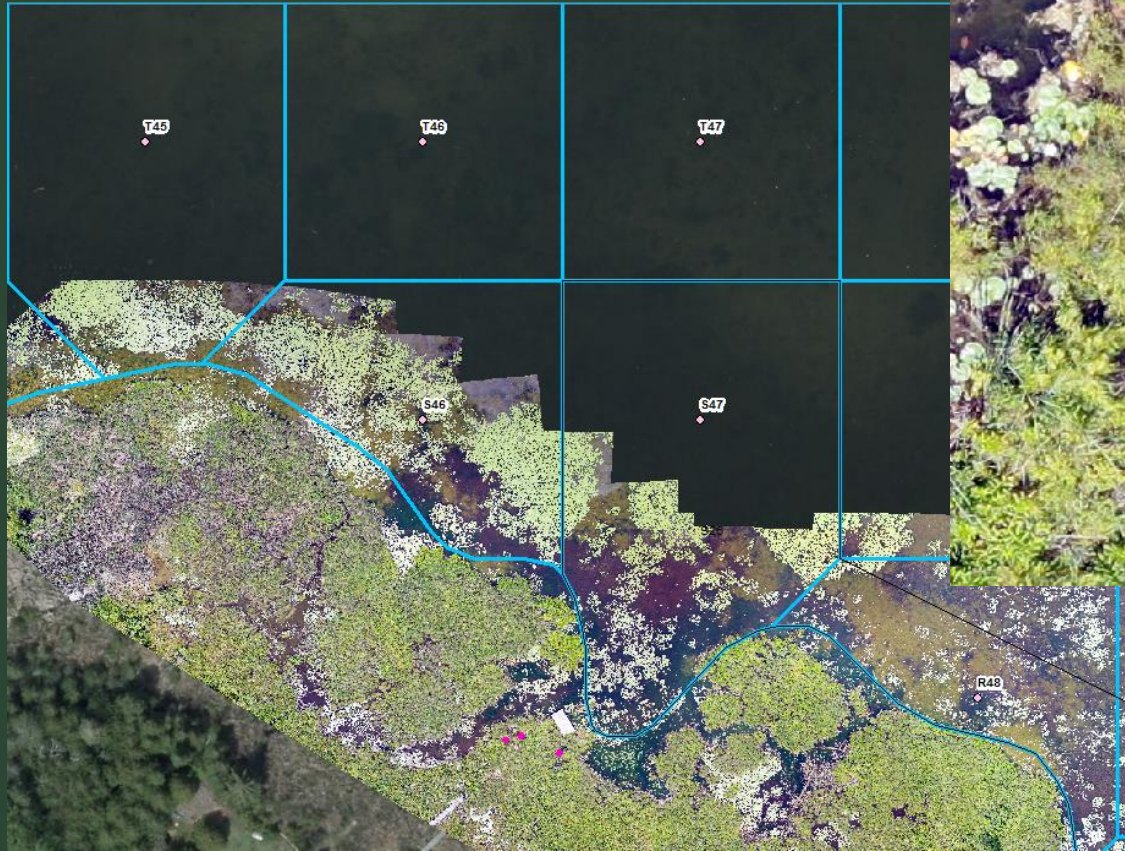


Ground Truthing



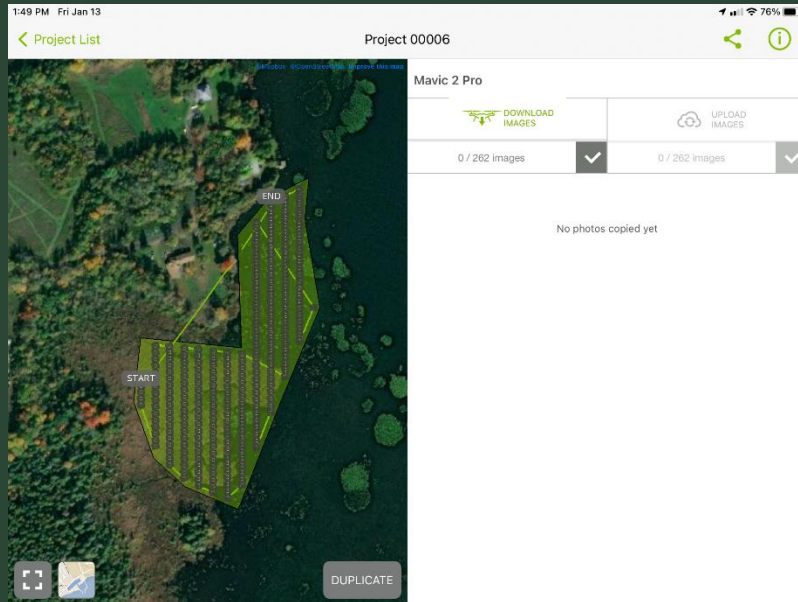


Using Drones to Double Check





Challenges with Logistics



- **Site selection**
 - Limited Federal land
 - Landowner collaboration



Challenges with Logistics

- **Flying from water**
 - Flying from boats
 - Splitting boat time for UAV and boat surveys
- **Limitations**
 - Depth of water soldier
 - Timing of survey
 - Weather, water quality and surface distortion, other veg
 - Ground Control Points





Challenges with Data

- **Processing/Collection**
 - Software – Drone Deploy, Drone2Map, Pix4D
 - Better resolution = lower flight altitude and more photos larger processing time
- **Storage**
 - Large storage needs
- **Review**
 - Manually analyses is time consuming





Needs for the Future

- **Automation of Imagery Analysis**
 - Need for Multi-spectral camera
 - Explore using object-based imagery analysis and deep learning



Thank you

