# The “Bathy-drone”
## For
# Underwater Survey and Mapping

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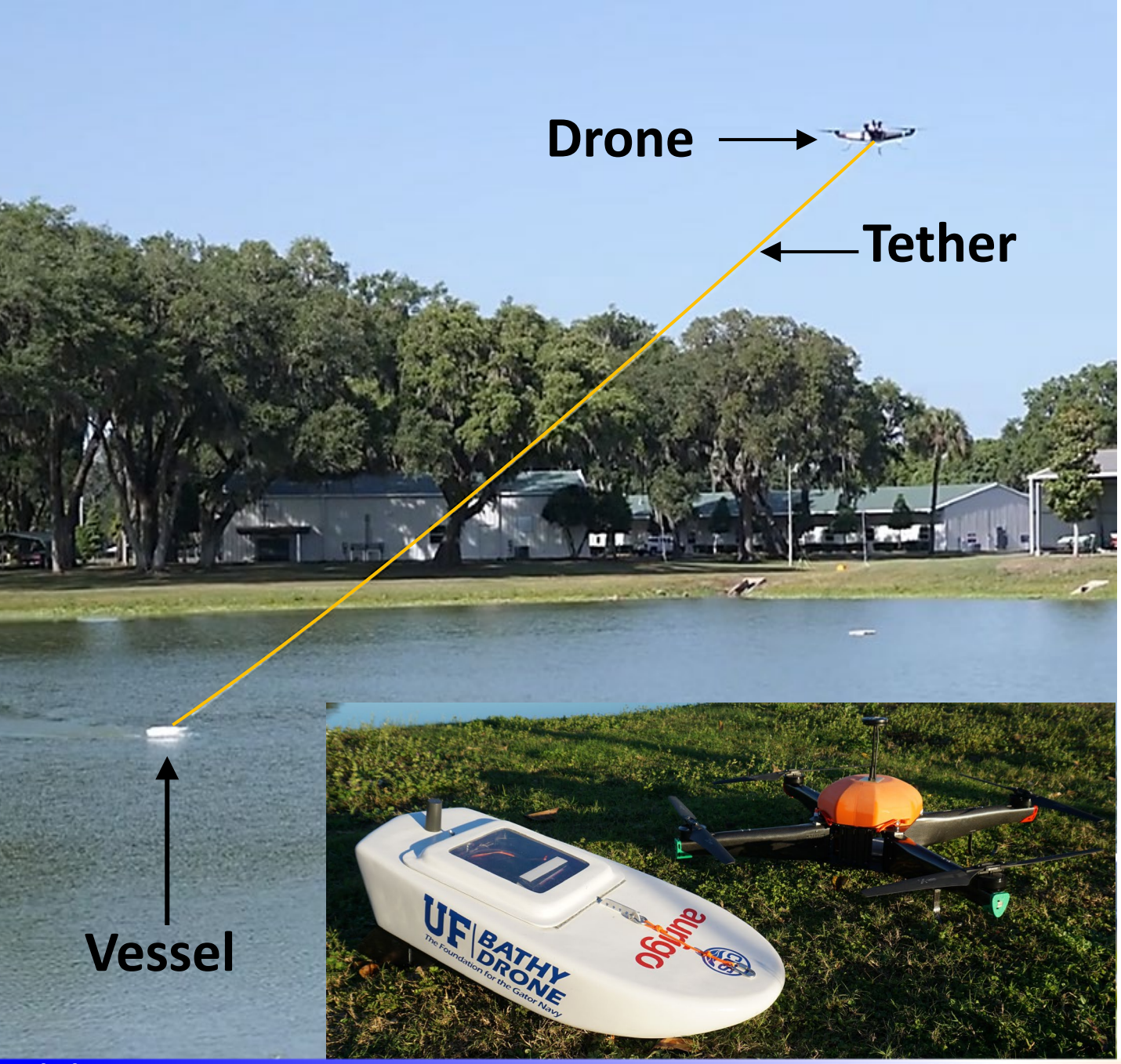






# Attributes

- Records down and side scan
- Provides bathymetry and bottom hardness
- Can fly to location of survey
- Easy to transport
- Fast setup time
- You never have to get wet
- Speeds up to 15 mph
- Works in swift currents and winds
- Performs precise raster patterns
- Drone agnostic
- Can be used for object detection
- Can scan 10 acres in a single charge (30 min)
- IMU, RTK GNSS sensors
- Active rudder control for precise patterns
- Fully autonomous and programable
- Works in turbid water
- Floating vegetation does not clog propellers
- So far, alligators have ignored it ☺

# Bathy-drone System



# UF Drone for Bathymetry, Water Sampling, Soil Hardness

In January 2023, Florida removed our DJI drone fleet without replacing them. Comparable drones cost more than $50k and are less capable and suited for dragging our vessel.  So……we built our own

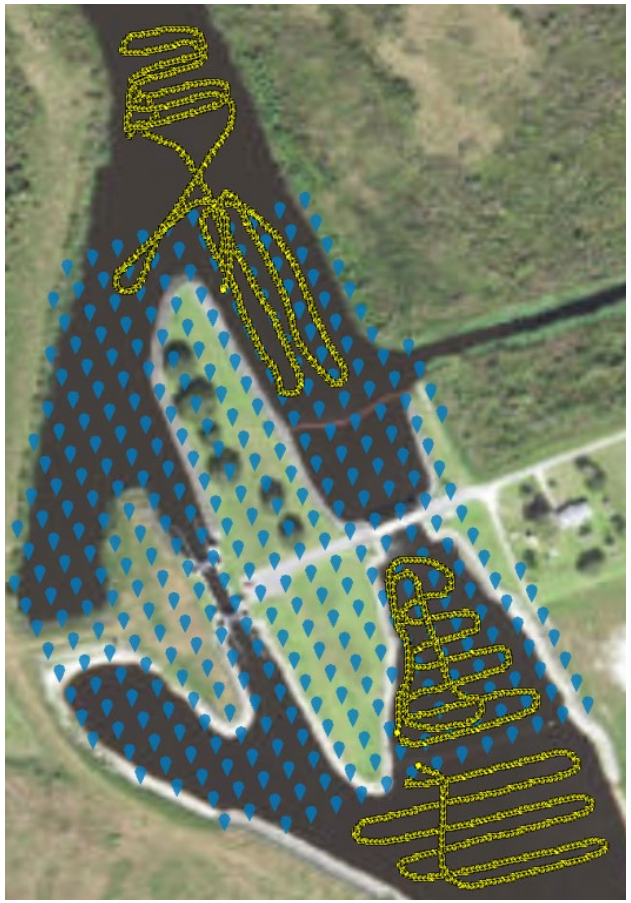
- 1.3 times longer duration
- 20-lbs payload
- Smaller packable volume (1/3 of DJI M600)
- More robust landing gear
- Control over the software (open source)
- RTK GPS
- No warrantees voided when flying over water
- Less expensive

# Try to do this with a boat

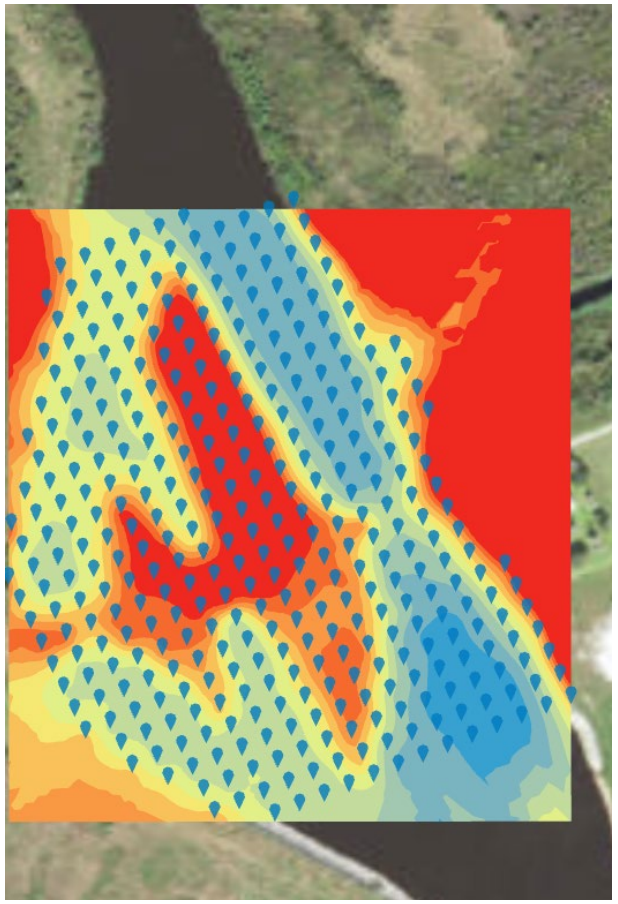
# Kissimmee river canal S65A Lock SFWMD

- Flew over buoys, and steep embarkment
- Close inspection of lock infrastructure
- No lock operational downtime
- Reduced field operator risk
- Four missions were sequentially flown, sight-unseen

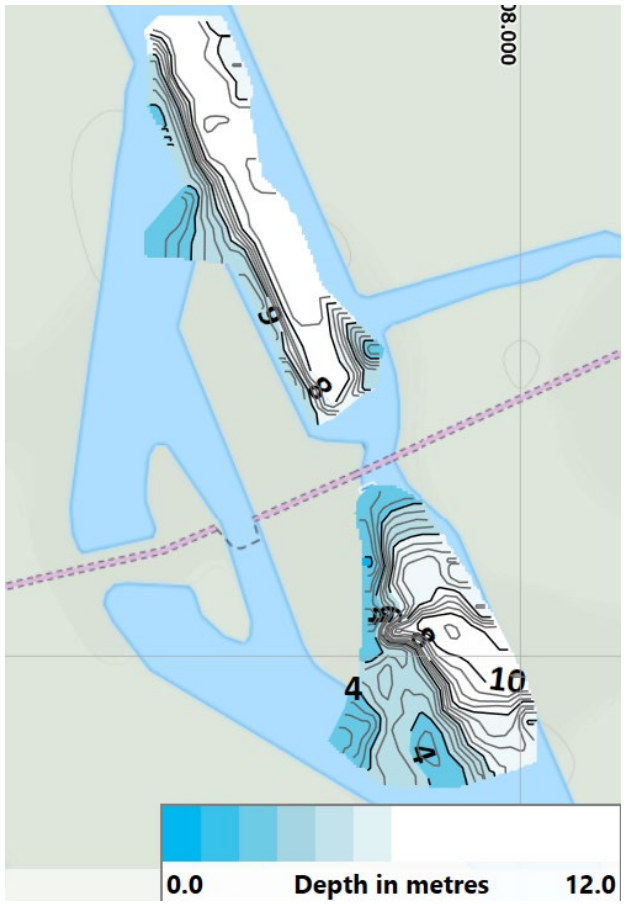

# Motivation for Development of CONOPS



Kissimmee River S65A Canal Lock Data provided by SFWMD (Blue Pins)superimposed with Bathy-Drone Transects (yellow)



Kissimmee River S65A Canal Lock Data provided by SFWMD (Blue Pins) interpolated



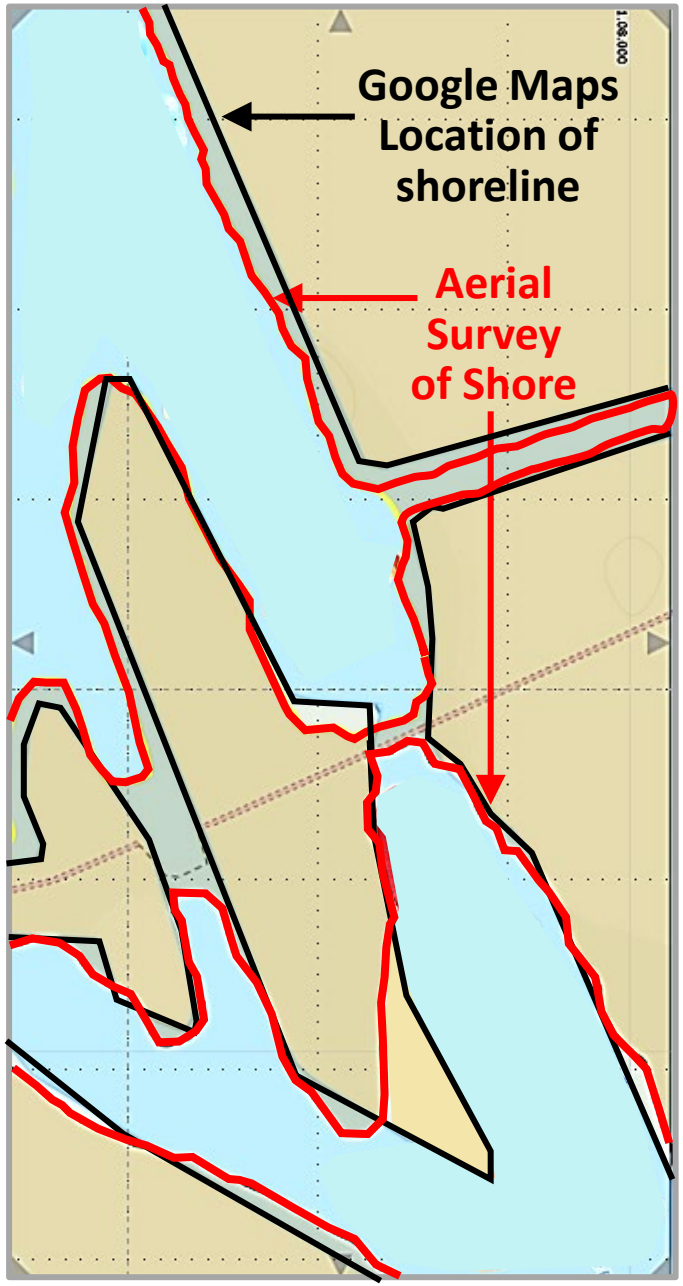

Bathy-Drone data interpolated on Reefmaster software

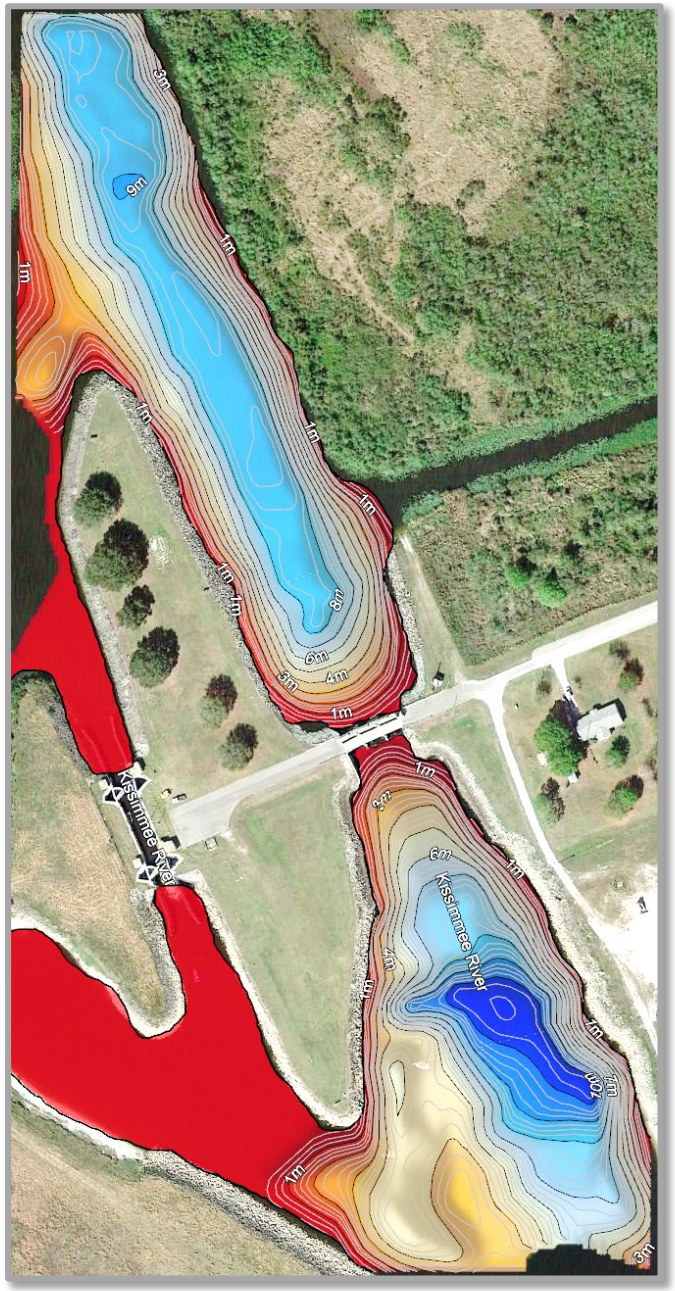
Bathy-Drone data interpolated on ArcGisPro and superimposed on transects

# Concept of Operations (CONOPS) Steps

1. Drone-based aerial photogrammetry
2. AI-based shoreline detection algorithm
3. Autonomous path planning
4. Bathy-drone survey
5. Merge shoreline data with sonar data
6. Plot contours

**Kissimmee River S65A Canal Lock**



# Automated Water Edge Detection and Path Planning

**Photogrammetry** from Aerial Images

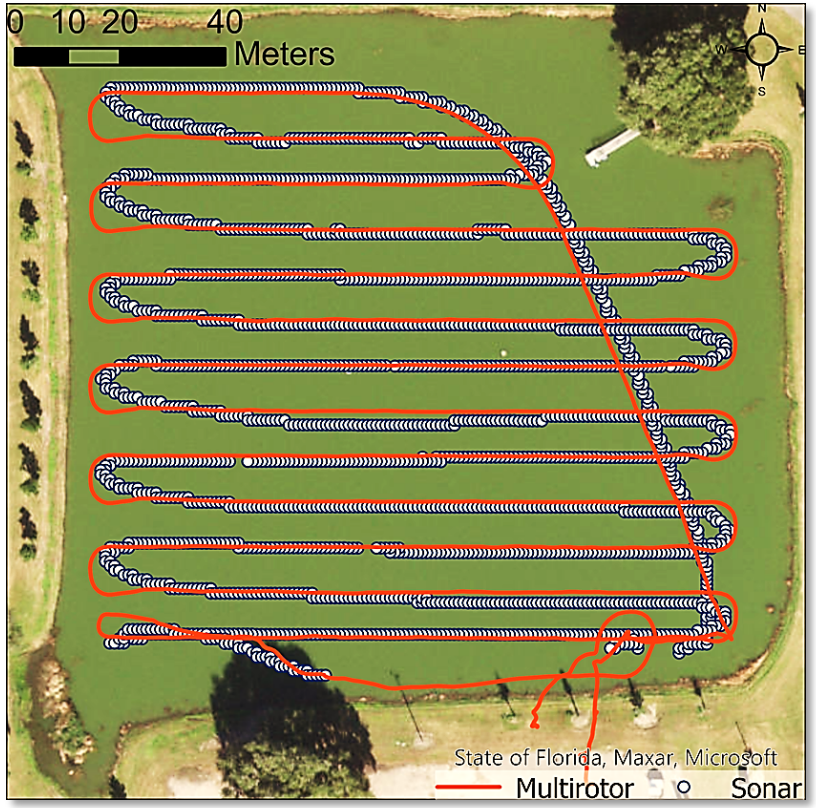
**Select Water Body** of Interest

**Fast Segment Anything Model** (FastSAM)

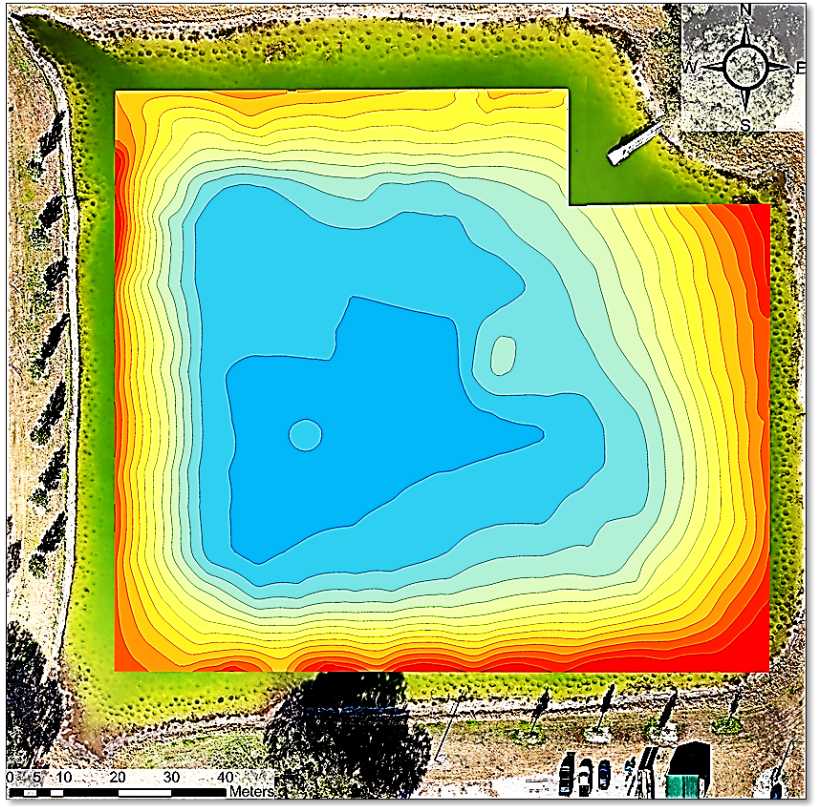
**Polygon Extraction:** Users can edit polygons on UI based on their needs


**Automated Path Planning**

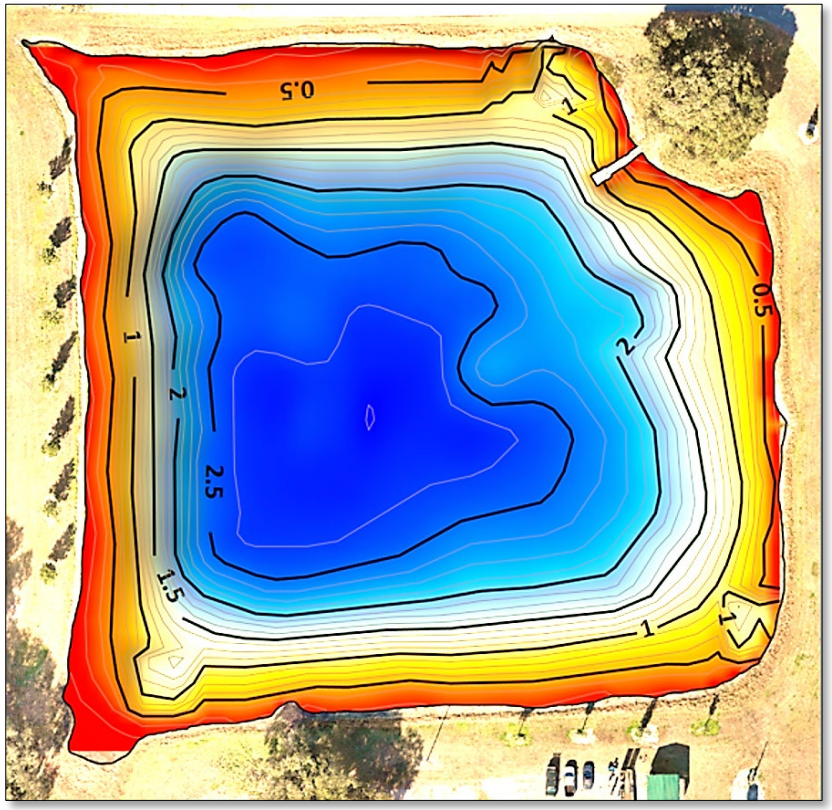
# Shoreline Interpolation Results




Drone and vessel paths

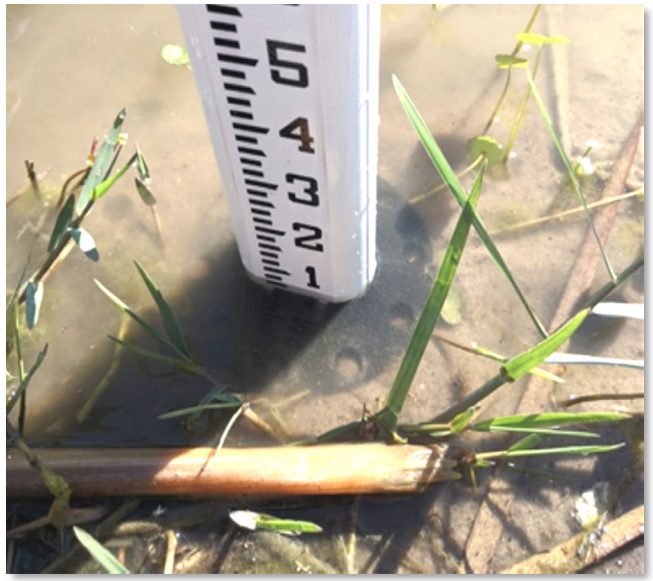


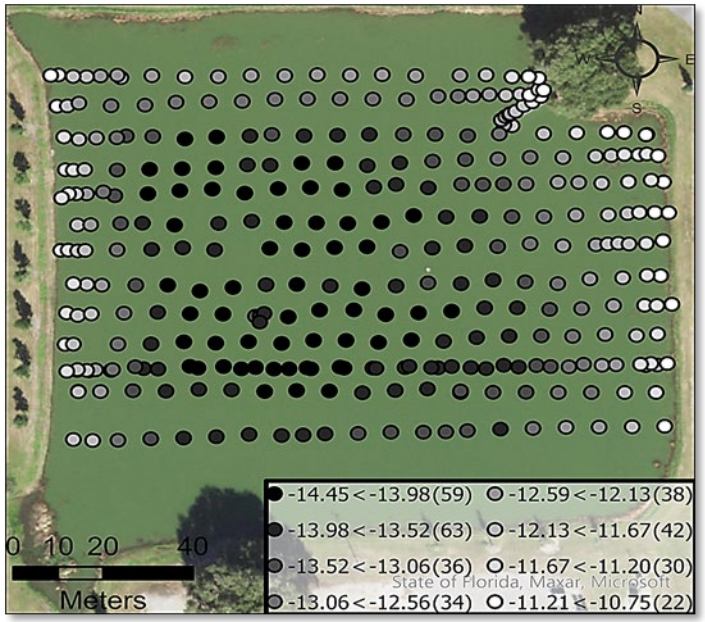

Interpolation between soundings

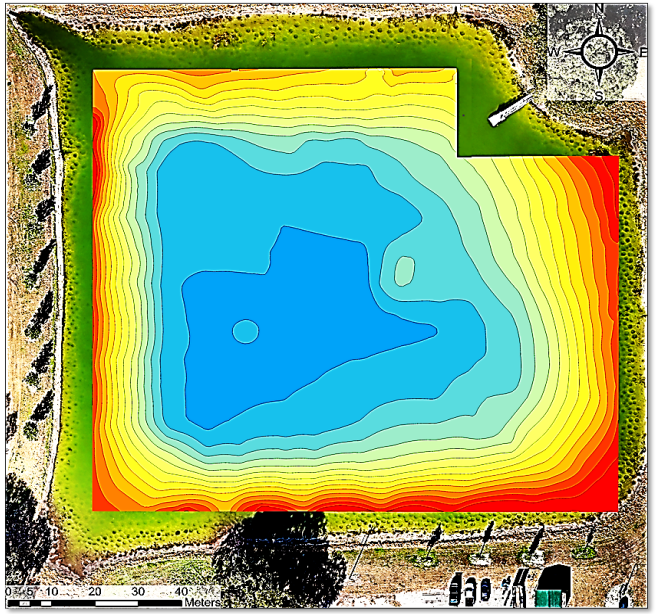


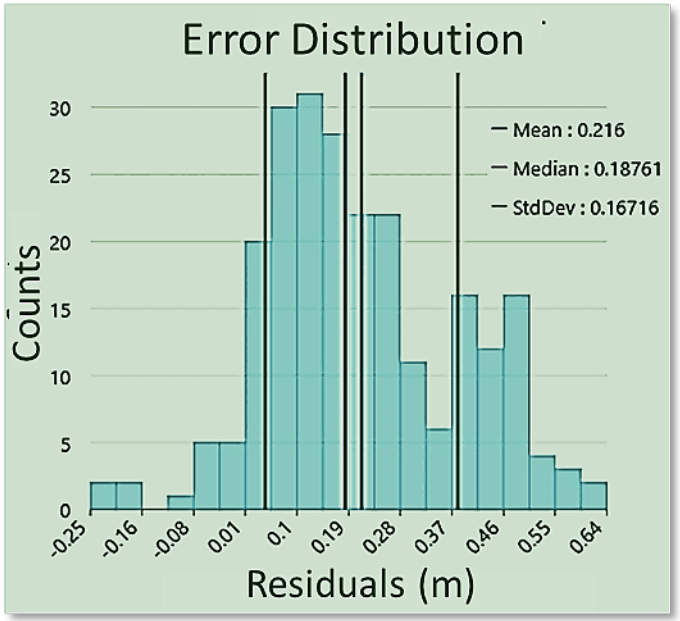

Implementation of the CONOPS

# Ground Truth using Level-pole RTK GPS

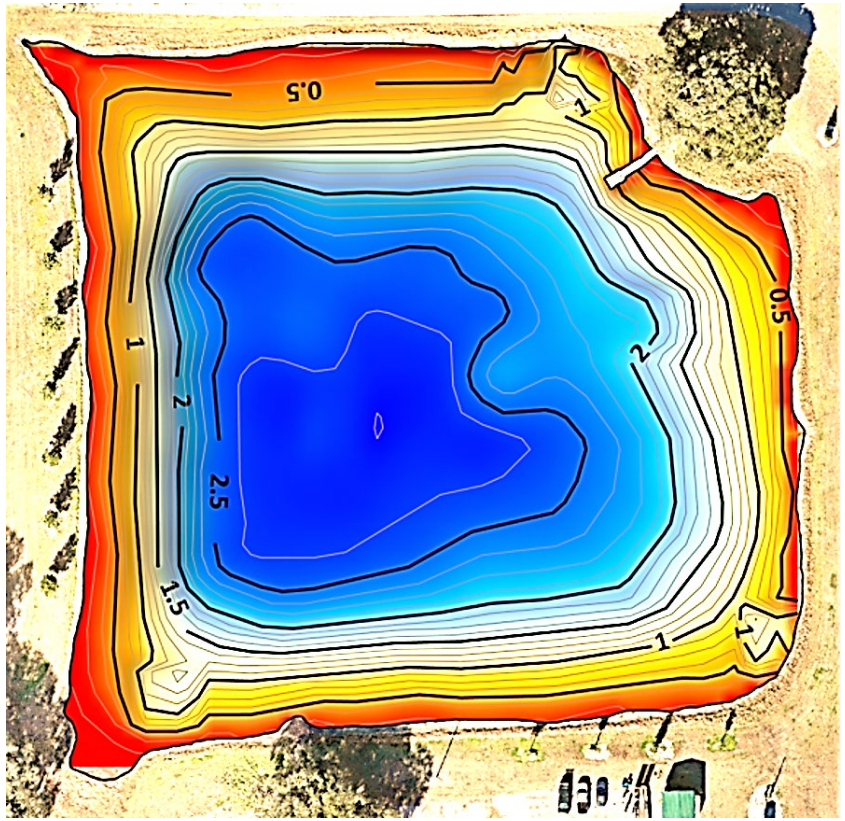


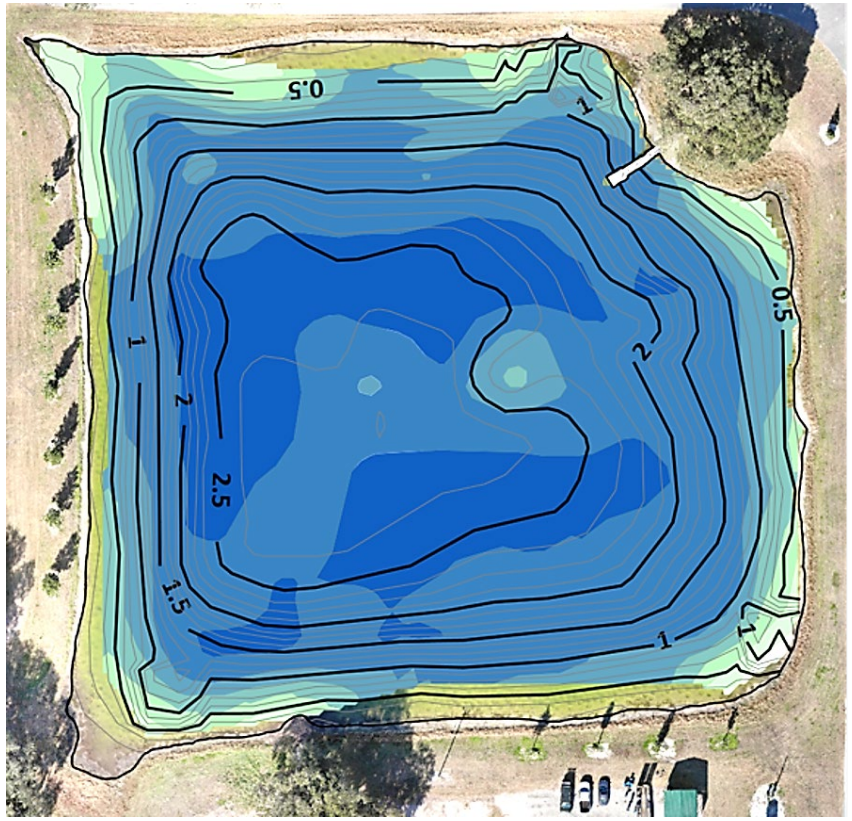



# Bottom Hardness Contours




Interpolation between soundings including shoreline Isobaths (m)




**Qualitative** bottom hardness from a composite echo return superimposed on Isobaths (m)

- We are currently planning to calibrate the bottom hardness data using cone penetrometer experiments.
- By selecting locations dispersed between hard and soft bottoms we will be able to produce **quantitative** hardness contour maps

# Future Applications

- Nearshore applications where traditional methods are challenged
- Civil engineering preconstruction and inspection applications
- Canal and lock inspection
- Ship-to-shore and gap-crossing surveys
- Retention pond volume surveys
- Shipping channel and boat basin inspection
- Coral and artificial reef surveys
- Post-storm sediment deposition and erosion documentation
- Beach nourishment projects
- Fish population monitoring
- Sea grass documentation