

Drones & Engineering

in Survey, Inspection and Construction



M&E Consultants

Soil & Water Engineering Solutions

Trent Street, PE
Joe Mathis, EIT, RePL

Applications

Survey

- Initial
- Supplement LiDAR
- Final

Inspection

- Operation and Maintenance
- Downstream Breach Study Evaluations
- Inaccessible Areas
- Up to date Mapping and Site Tracking

Construction

- Quantity and Quality Check
- Vegetation Check
- Site Layout and Placement Location

Rules and Regulations

Federal Aviation Administration

- 14 CFR part 107, the small Unmanned Aircraft System (UAS) rule

<https://www.faa.gov/uas>

Becoming a Pilot

To be eligible

- 16 years of age
- Able to read, write, speak, and understand English
- Be in a physical and mental condition to safely fly a UAS

Study and Pass Knowledge Test

Register through FAA Integrated Airman Certificate and/or Rating Application system (IACRA)

Register Drone with FAA

FAADroneZone

https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot

M&E's Drone

DJI Phantom 4RTK

- Operating Time: 20 – 30 minutes per Battery
- Operating Speed: 30+ mph
- Weight: 3 lbs
- Centimeter-level Positioning System

Camera

- 1 inch CMOS sensor
- 20 megapixel
- Format: jpeg (picture), mov (video)



<https://enterprise.dji.com/phantom-4-rtk/specs>

M&E's Drone

Remote Controller

- 5.5-inch Screen
- Android System

Intelligent Flight Battery

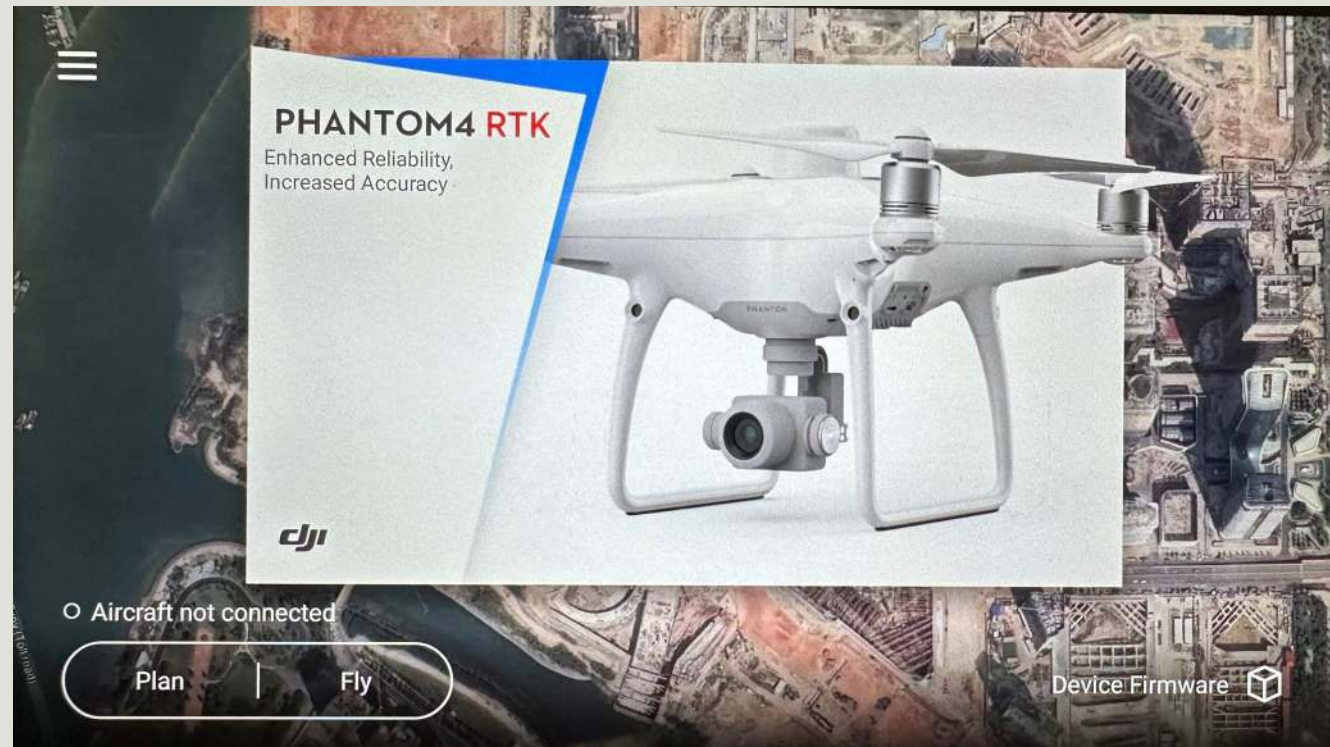
- Lithium
- 15.2 volts
- 20 – 30-minute life



<https://enterprise.dji.com/phantom-4-rtk/specs>

Flight

Manual vs Planned



Flight Preparation

CHECKLIST

DRONE SURVEY CHECKLIST

Mission Planning

- ☐ Check Airspace Restrictions
- ☐ Check for TFRs
- ☐ Check Weather Forecast
- ☐ Obtain authority to fly over site
- ☐ Check system for updates
- ☐ Create flight path
- ☐ Save flight path
- ☐ Coordinates in DMS and Meters

Preflight Inspection

- ☐ Airframe (suitable for flight)
- ☐ Battery (no swelling or damage)
- ☐ Propellers (no cracks or chips)
- ☐ Motors
- ☐ Camera & Gimbal (Remove Gimbal)
- ☐ Controller

Packing

- ☐ Aircraft
- ☐ Flight batteries (charged)
- ☐ Controller (charged)
- ☐ Memory Cards
- ☐ Propellers
- ☐ Ground Control Points
- ☐ Survey Equipment (if needed)
- ☐ Operation Checklist

Flight Prep

- ☐ Power on controller & aircraft
- ☐ Ensure SD card has enough space
- ☐ Check connections
- ☐ Select mission type
- ☐ Ensure altitude is right for terrain
- ☐ Upload mission and start
- ☐ Controller Antennas up
- ☐ RTK enabled (if connected to base)

Site Prep

- ☐ Check site for major obstructions
- ☐ Check weather
- ☐ Set ground control points
- ☐ Survey ground data as needed

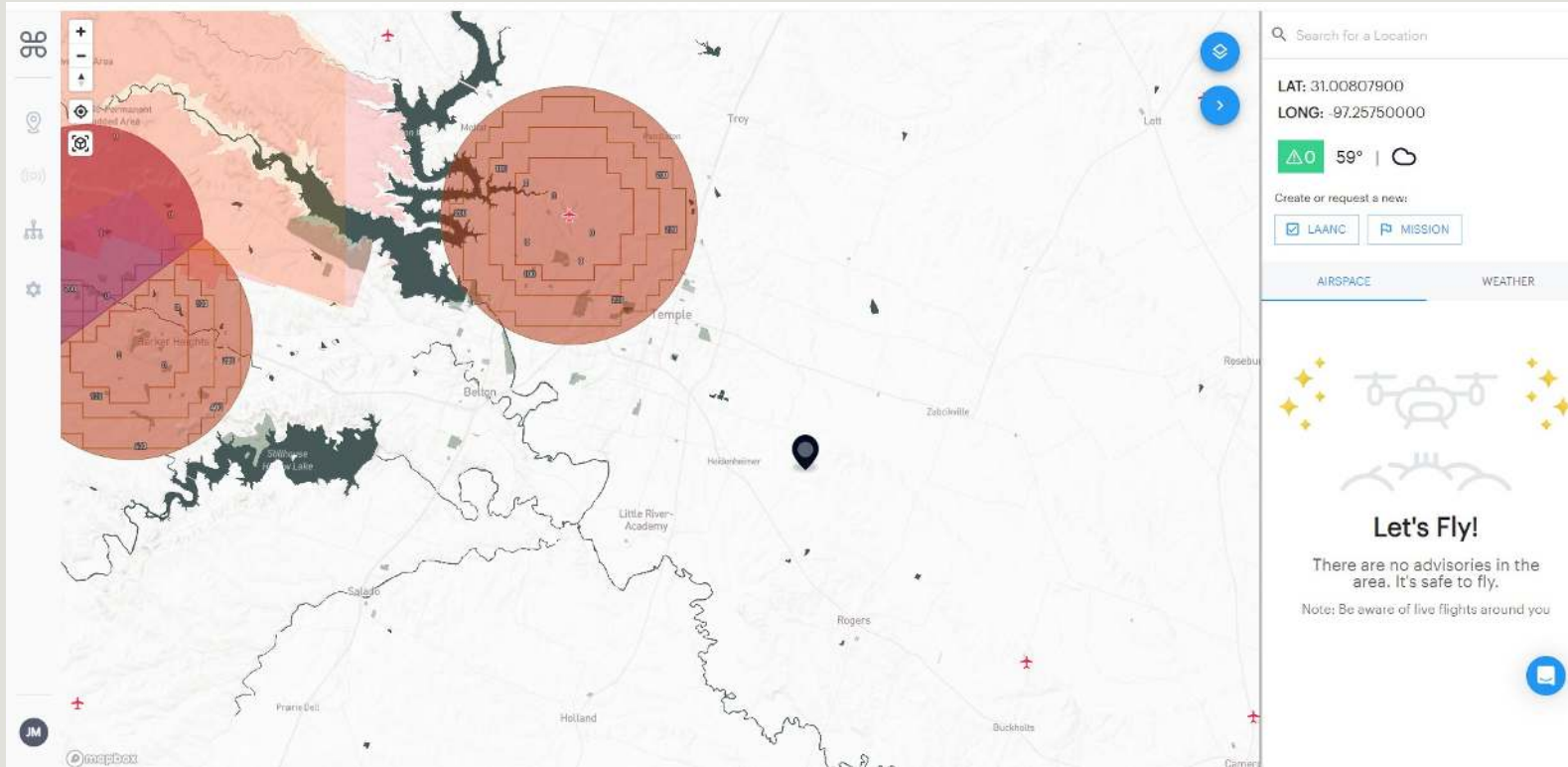
After Flight

- ☐ Power down & Stow all equipment
- ☐ Log flight information in flight logs

Flight Preparation

Job Location

- Airspace
- Active Restrictions
- Low Altitude Authorization and Notification Capability (LAANC)



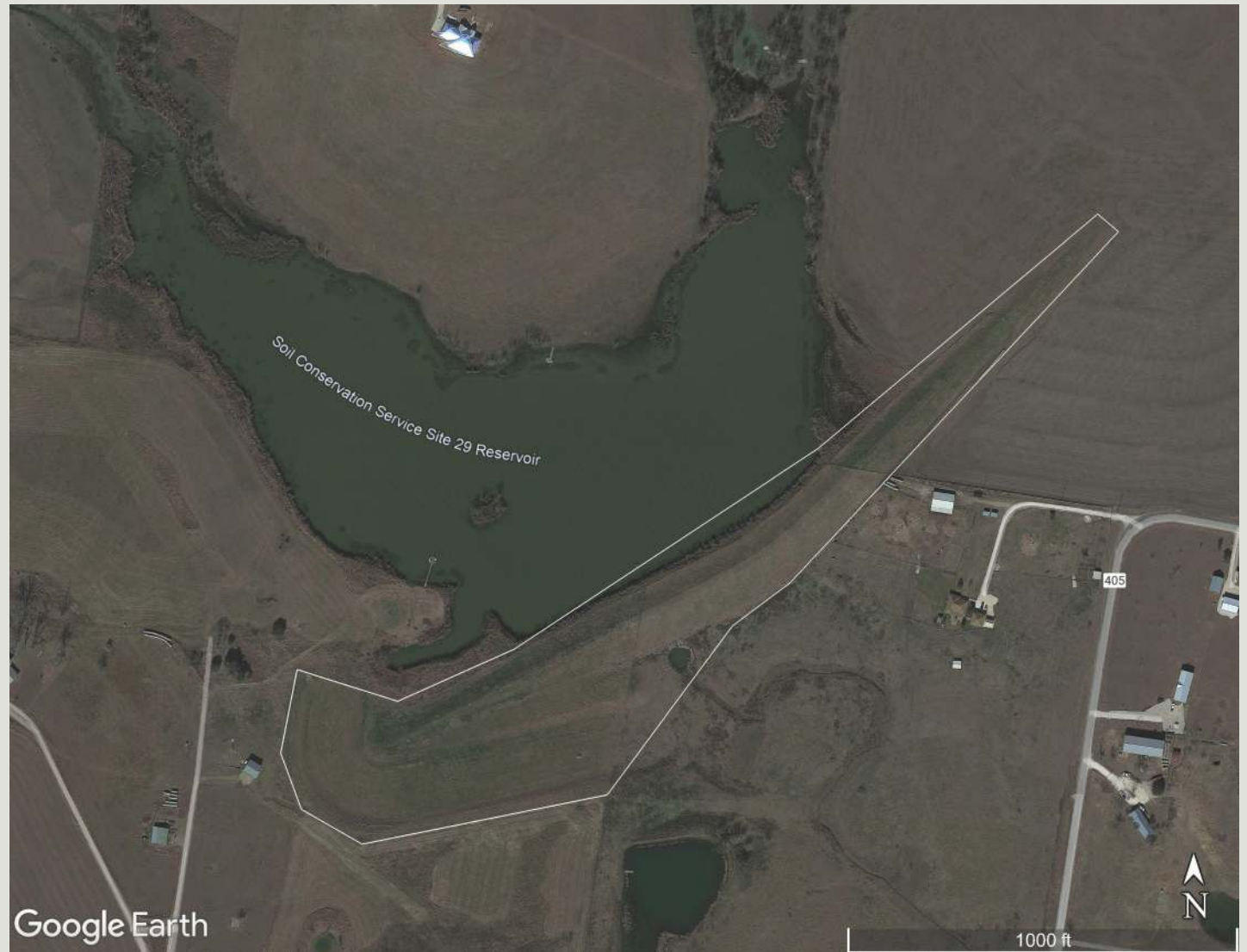
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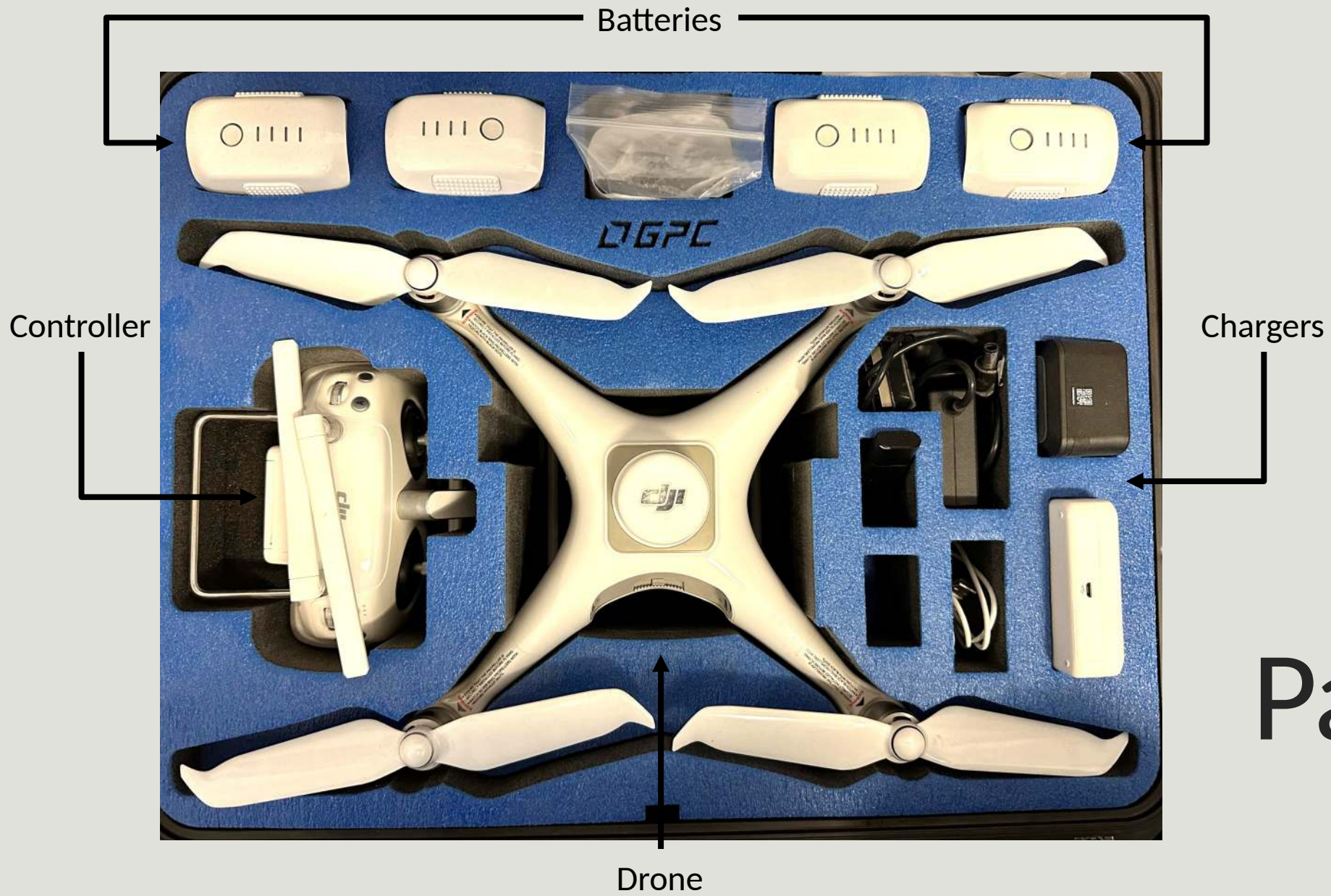
Flight Preparation

Google Earth

Export as KML

Import into Controller





Packing



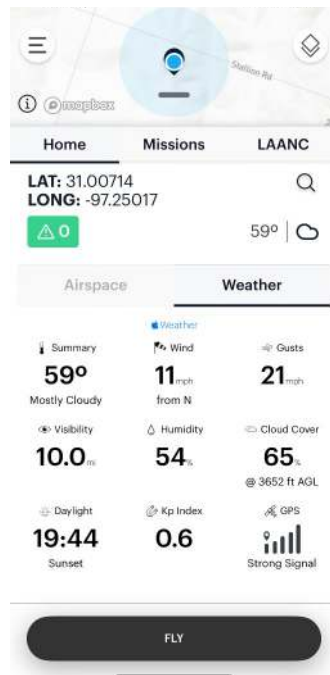
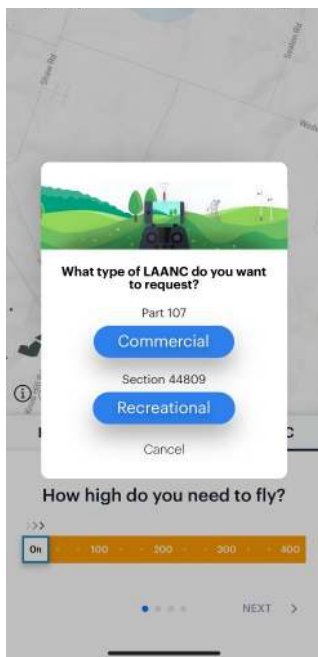
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WARNING

Survey Marker
DO NOT MOVE!

Ground Control Points (GCP)



Site Preparation

Major Obstructions

- Power Lines
- Trees

Weather

Set Base Station

Set and Record GCPs

Preflight Inspection

Drone

- Suitable for Flight

Battery

- No swelling or damage

Propellers

- No Cracks

Motors

Camera and Gimbal

- Remove gimbal Cover

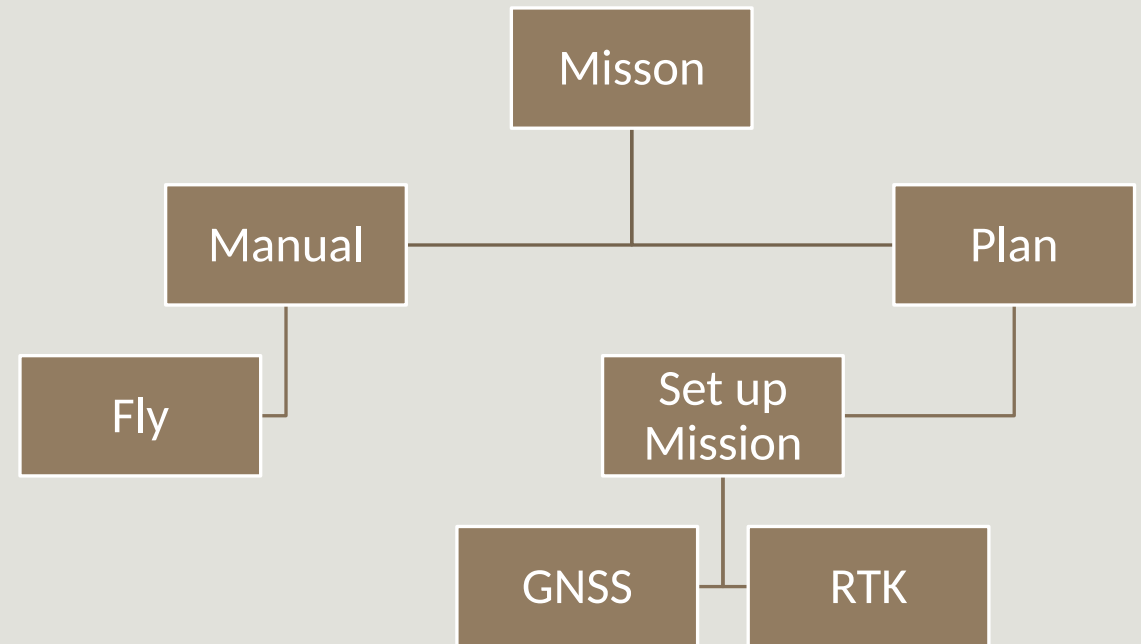
Controller

Flight Preparation

Check Connections

Mission Type

- Manual or Planned
- Real Time Kinematic (RTK)
- Global Navigation Satellite System (GNSS)





Set up Mission

Using KML as Boundary

Adjust Boundary if needed

Set Flight Parameters

- Height
- Overlap

Connect to RTK

GNSS

Used without Base

Uses GPS+GLONASS+Galileo

Accuracy

- Vertical 1.5 cm + 1 ppm
- Horizontal 1 cm + 1 ppm

<https://enterprise.dji.com/phantom-4-rtk/specs>

RTK

Connects to Trimble Base Station

- NTRIPCaster Connection
- RTCM Compatibility

Ties Drone directly to control point

Accuracy

- Vertical <1 cm
- Horizontal <1 cm

Flight Log

Pilot	Date	Project	Weather	Start Time	End Time

After
Flight

LOG FLIGHT
INFORMATION

Post Processing

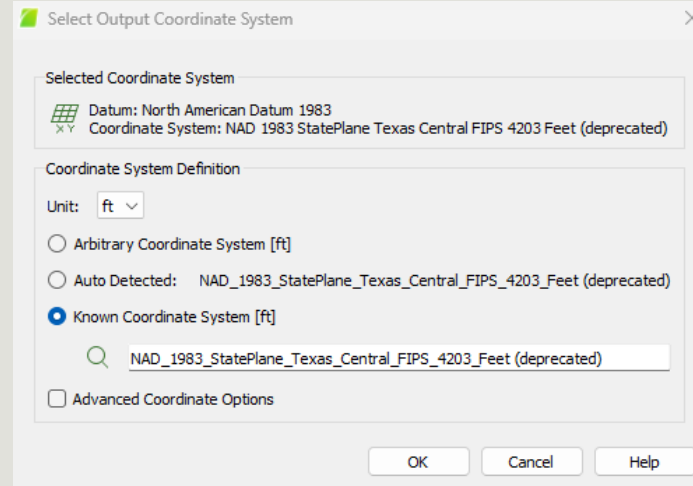
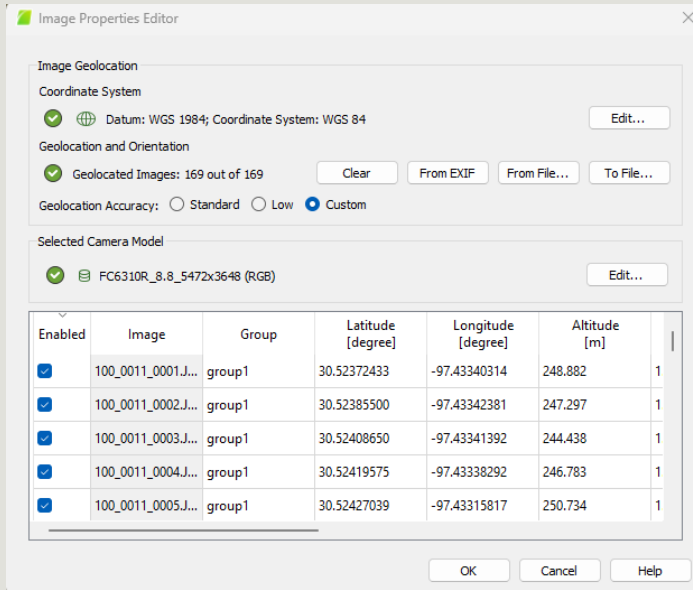
Map Production

- Pix4D
- Stitch photos
- Point Cloud
- 3D Textured Mesh
- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)
- Contours
- Google Earth KMZ
- Geotiff Orthomosaic



<https://www.pix4d.com/>

<https://www.pix4d.com/product/pix4dmapper-photogrammetry-software/>

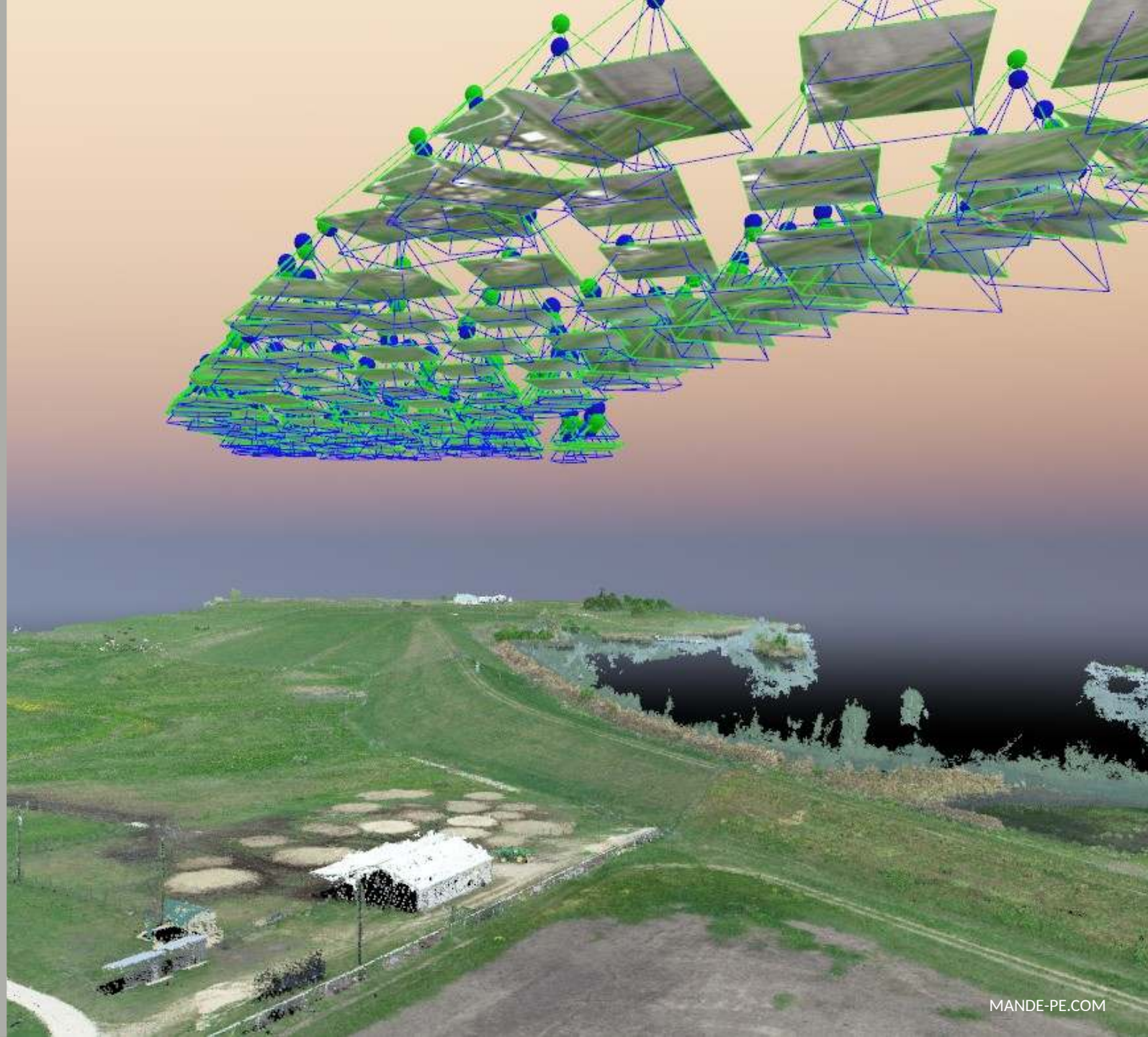


Pix4D Mapper

INITIAL

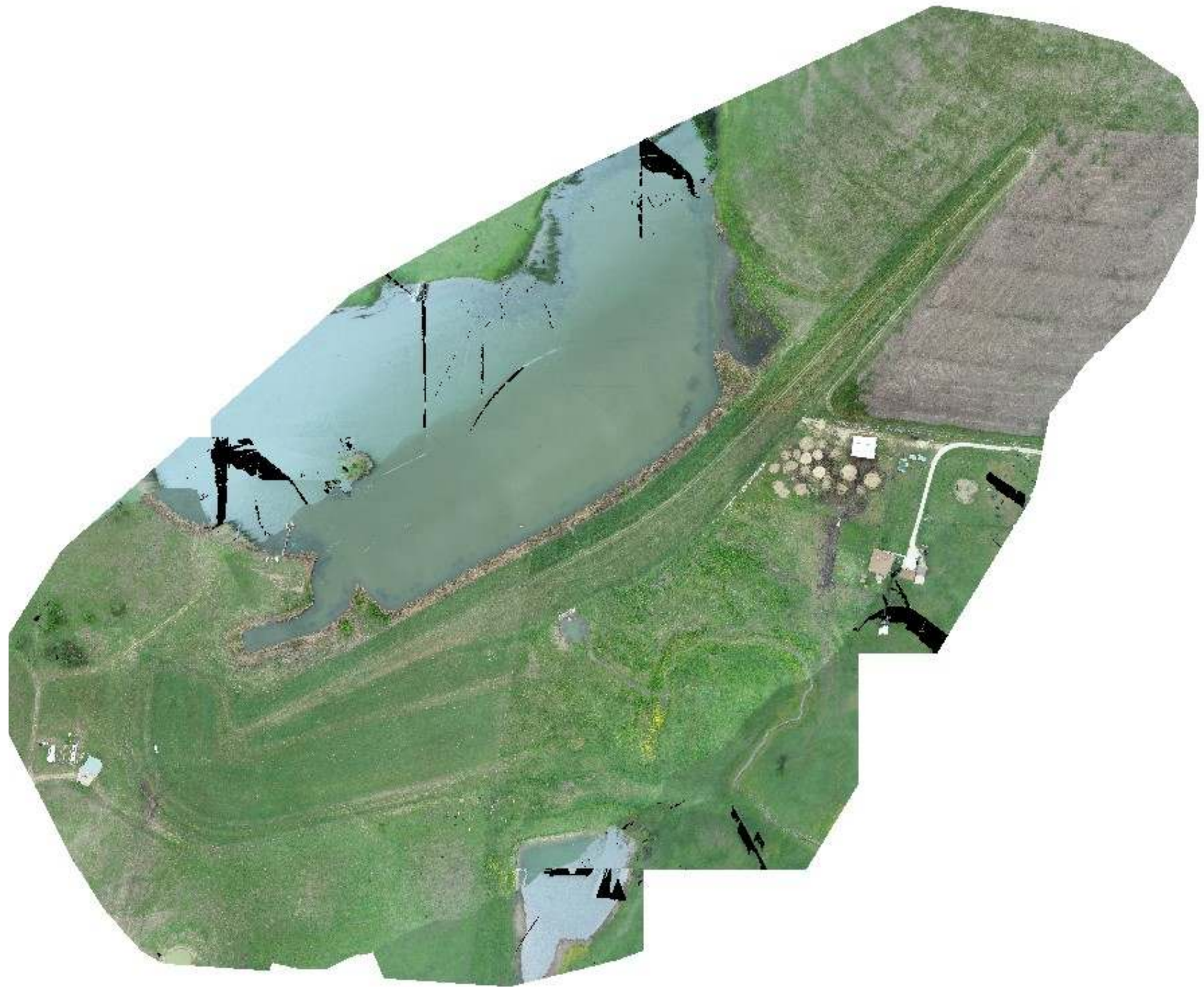
Pix4D Mapper

POINT CLOUD



Pix4D Mapper

Orthomosaic



Survey

PROS

Time Saving
Cost Effective
Cover Large Areas
Inaccessible Areas

CONS

Dense Vegetation
Trees
Water
Weather



Survey

Project: Eanes Lake

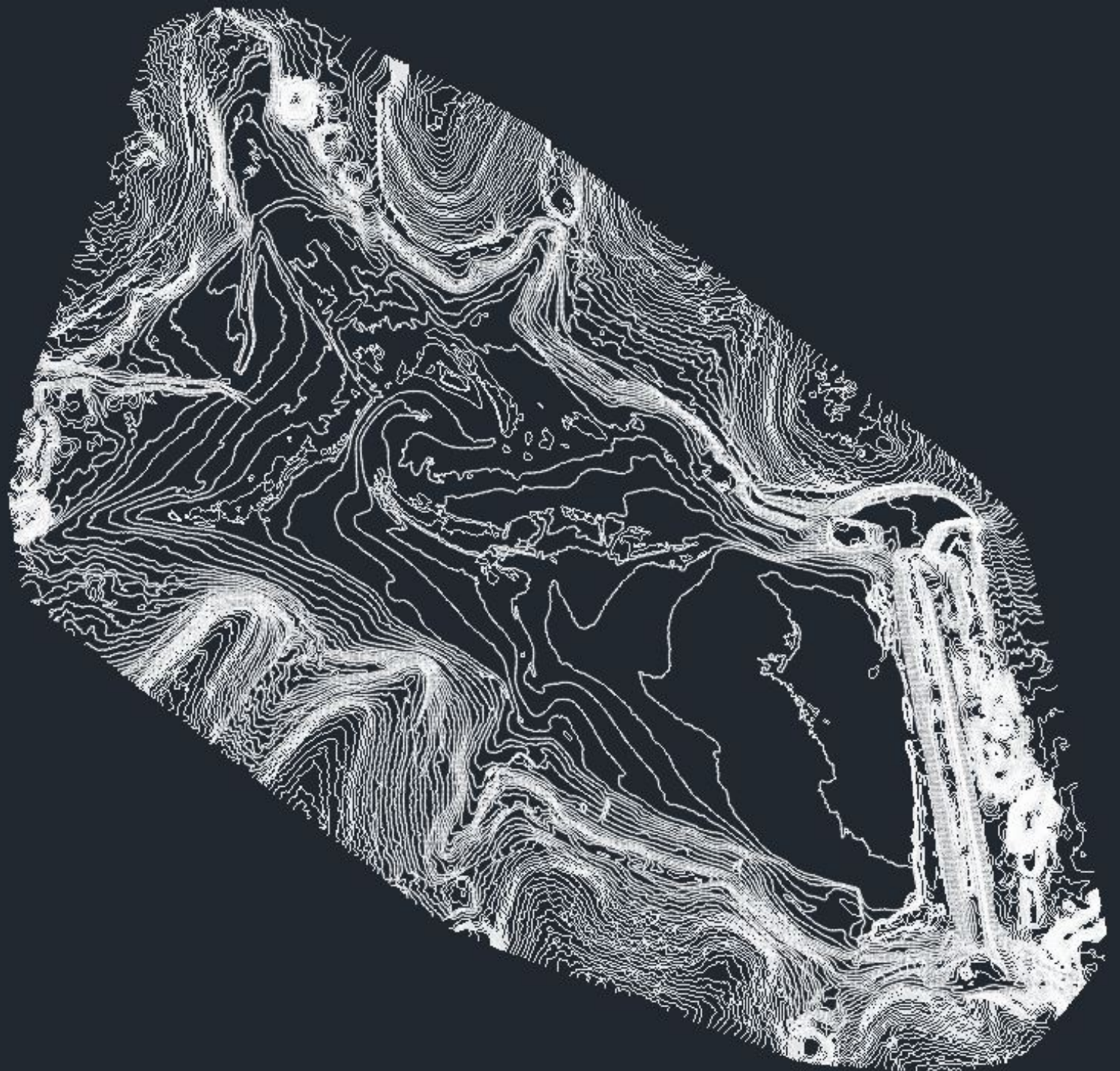
Area: 135 ac

Goal: Produce contours of dried lake bottom for implementing into LiDAR and to produce a Stage Storage Curve for H&H modeling.

Survey

Contours Produced at 1ft Internals

Generated from a Digital Surface Model (DSM) and Digital Terrain Model (DTM)



Inspection

PROS

Time Saving

Cover Large Areas

Inaccessible Areas

More Detailed and Up to date Map

Picture Detail and Clarity

CONS

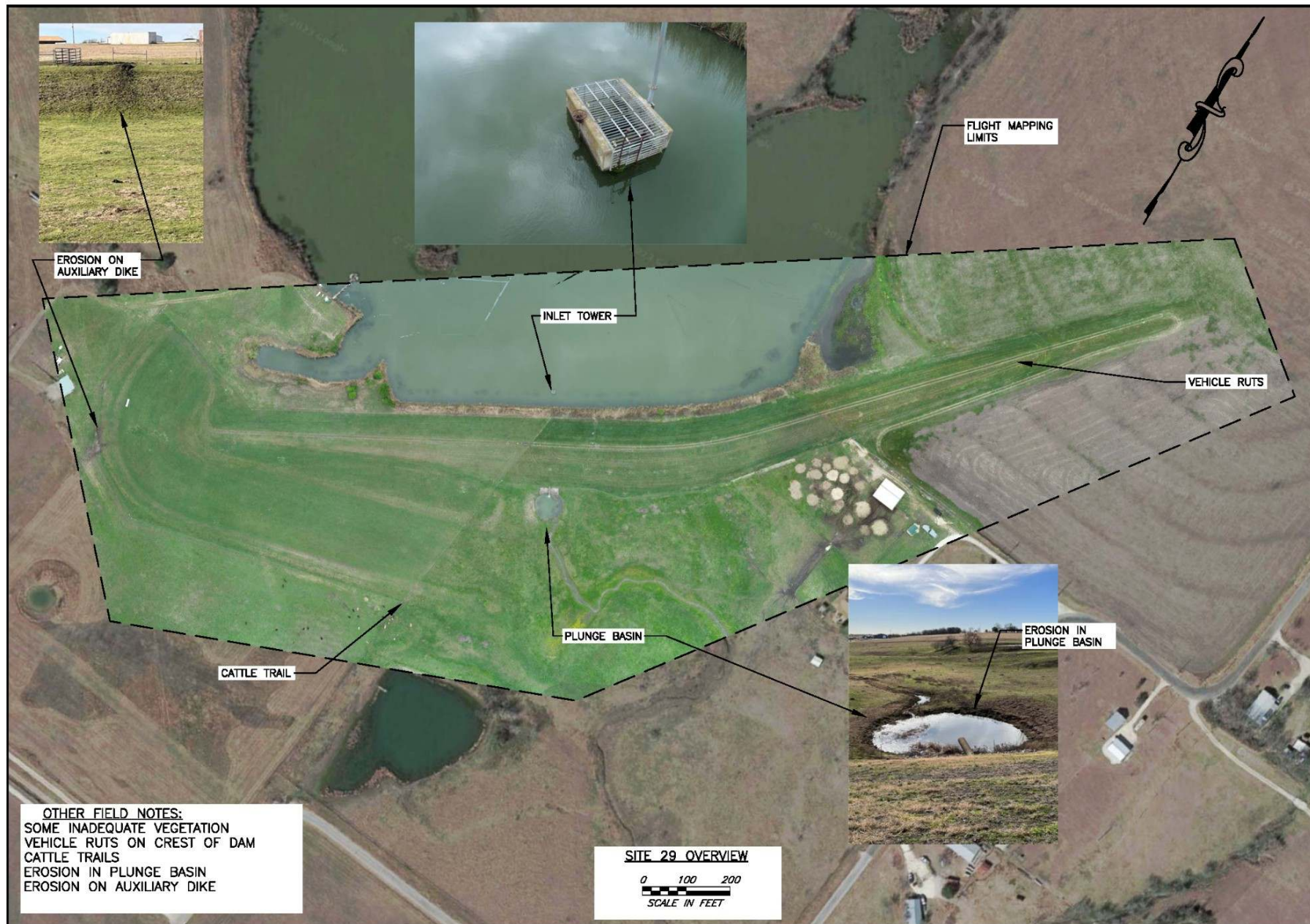
Weather

Inspection

Project: Lower Brushy Creek Operation & Maintenance Inspections

All Lower Brushy Creek WCID Watershed Dams

Goal: Conduct annual O&M inspections, Rank Dams and Provide Aerial Map with current deficiencies.



2023 DAM INSPECTION MAP
 FLOOD REMEDIATION STRUCTURE SITE 29
 UPPER BRUSHY CREEK WATERSHED
 IN
 WILLIAMSON COUNTY, TEXAS



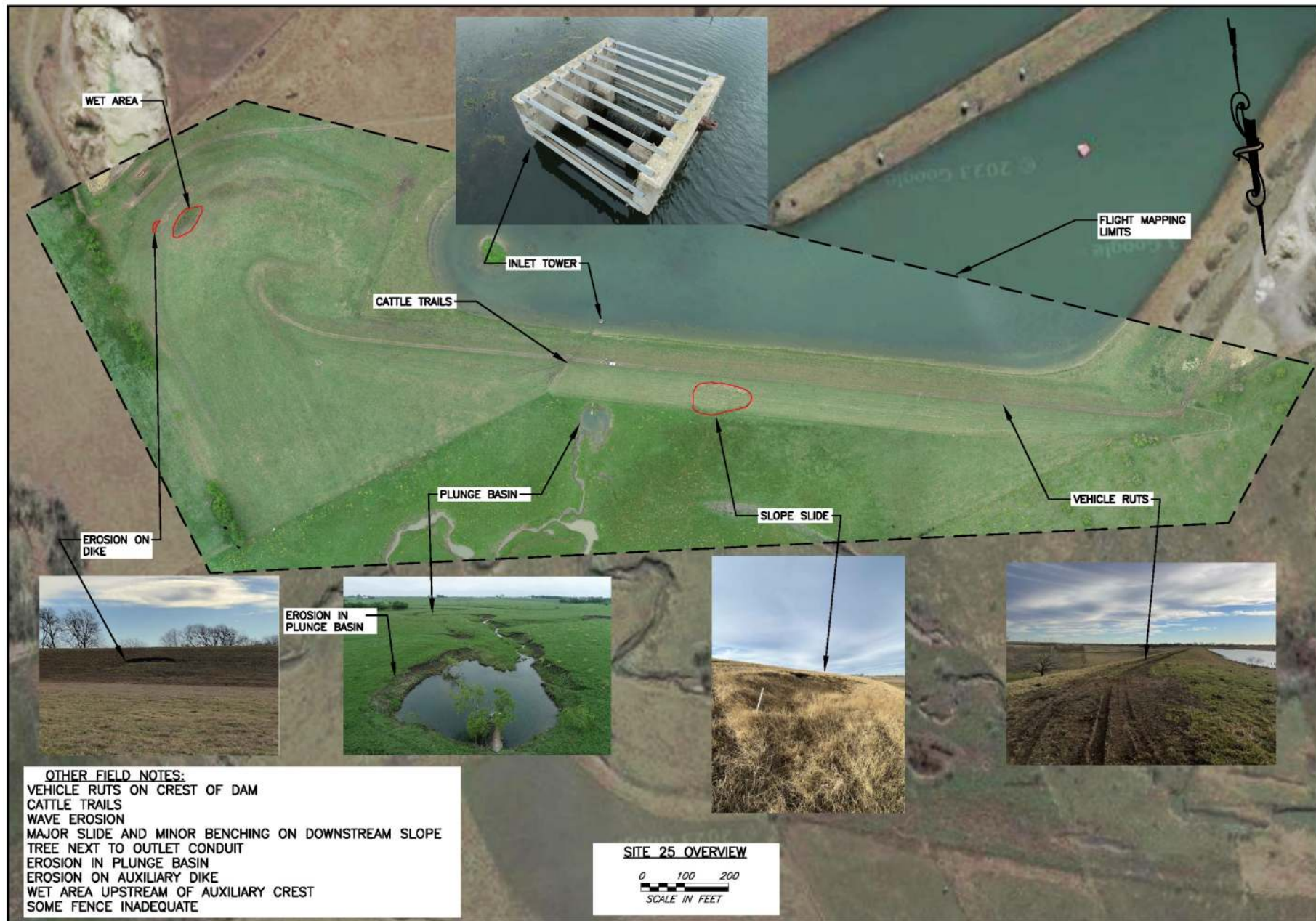
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 P.O. BOX 8
 DENVER, TX 76533
 (254) 965-9103, 9104 (FAX)



F-4324

SITE

29



OTHER FIELD NOTES:
 VEHICLE RUTS ON CREST OF DAM
 CATTLE TRAILS
 WAVE EROSION
 MAJOR SLIDE AND MINOR BENCHING ON DOWNSTREAM SLOPE
 TREE NEXT TO OUTLET CONDUIT
 EROSION IN PLUNGE BASIN
 EROSION ON AUXILIARY DIKE
 WET AREA UPSTREAM OF AUXILIARY CREST
 SOME FENCE INADEQUATE

SITE 25 OVERVIEW

0 100 200
 SCALE IN FEET

2023 DAM INSPECTION MAP
 FLOOD RETENING STRUCTURE SITE 25
 UPPER BRUSHY CREEK WATERSHED
 IN
 WILLAMSON COUNTY, TEXAS



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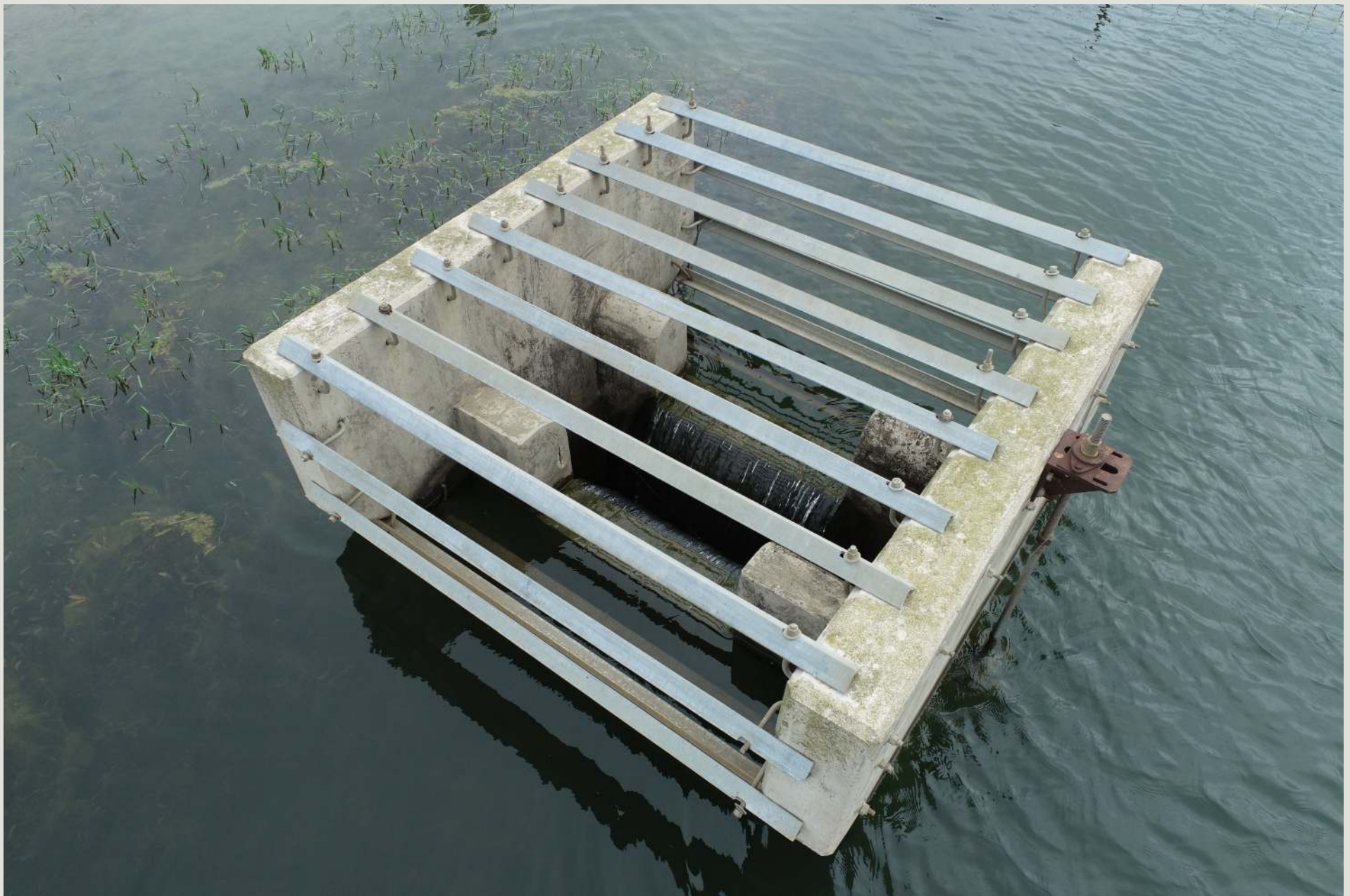
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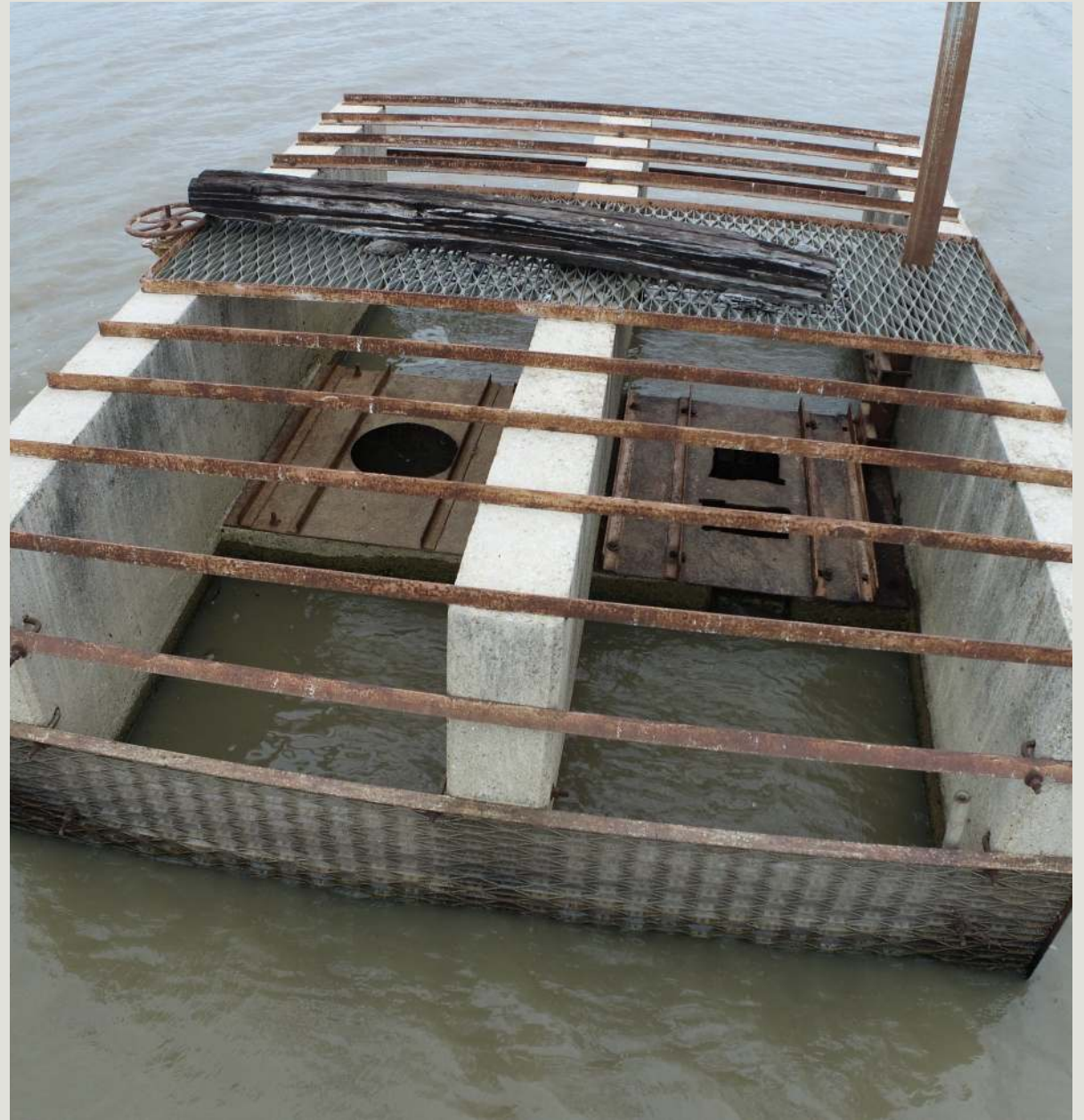
25











Construction

PROS

Time Saving

Vegetation Check

Fewer Cross Sections

Layout

CONS

Weather





VEGETATION
SITE 15 3.2 ACRES
SITE 16 2.1 ACRES

PLAN VIEW SITE 15 & 16
50' 0 50' 100'
SCALE IN FEET

DESIGNED BY: BJS
DRAWN BY: JAM
CHECKED BY: BJS
FILE NAME: FB-FBI-2016-06-2-009
DATE PLOTTED: 5/1/2016

SITES 15 & 16 VEGETATION
FLAT BANK/STEEP BANK REPAIR PROJECT
IN
FORT BEND COUNTY, TEXAS



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REVISIONS		
DATE	APPROVED	TITLE

SHEET
2







Conclusion



Very Useful



Not Applicable in all
Situations



Another Tool in the
Toolbox

References

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