DOUCET®
SURVEY INC
UAV Services

What is a UAV?

Unmanned Aerial Vehicle (aka Drones, sUAS)

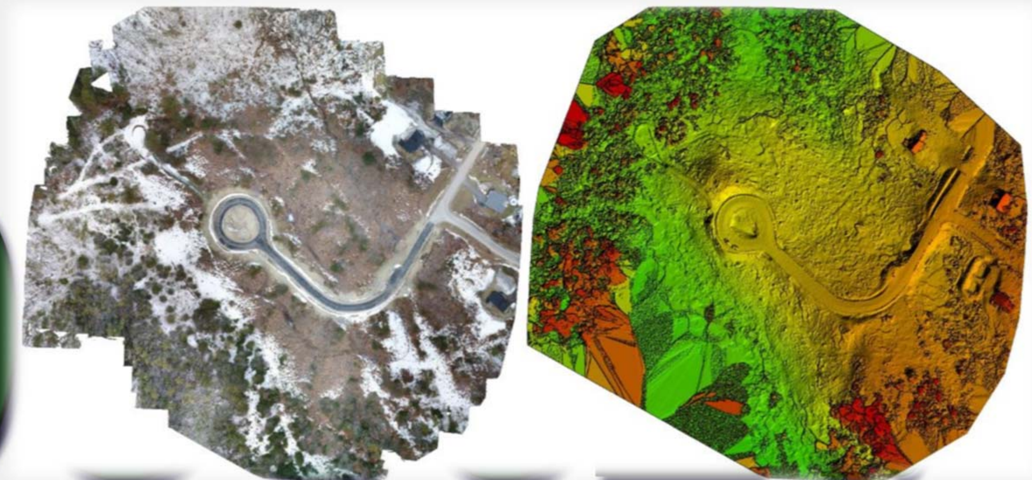
<u>Types of UAV's:</u>

Fixed Wing
- For large scale projects
- Longer flight times
- Can carry larger payloads
- Fixed camera

Rotary Wing
- Vertical take off and landing (VTOL)
- Hovering capability
- Shorter flight times (20-30 minutes)
- Camera gimble
- Easier to fly

Why UAV?

- Safety
- Speed
- Multiple output types
- Easy access to difficult locations
- Improved data density



What to look for in a UAV provider?

- Insured
- Certified
- Experienced

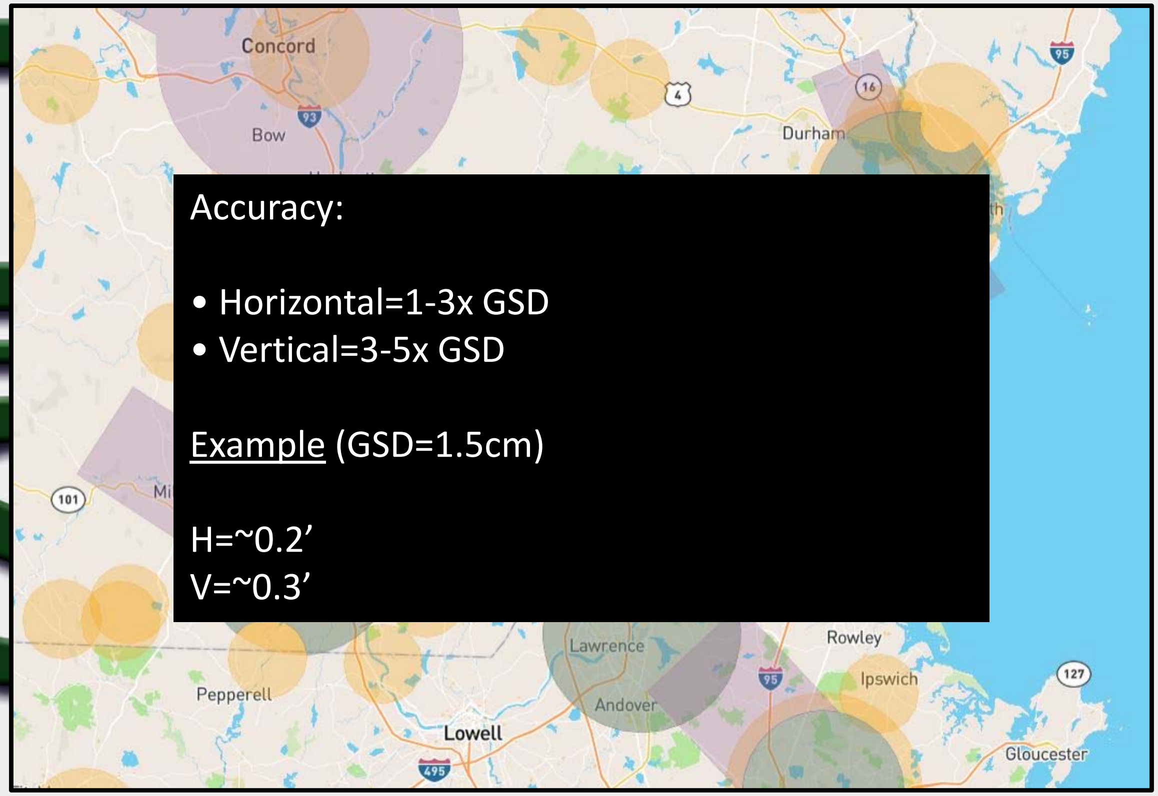
Restrictions & Accuracy

FAA Part 107:

- Aircraft < 55 lbs.
- (VLOS)
- Limitations over people
- Daylight-only operations
- Maximum altitude of 400 feet above ground level (AGL), or remain within 400 feet of a structure
- No operations from a moving aircraft
- No careless or reckless operations

Other Considerations:

- Vegetation
- Adequate takeoff & landing locations
- Battery power
- Location of site



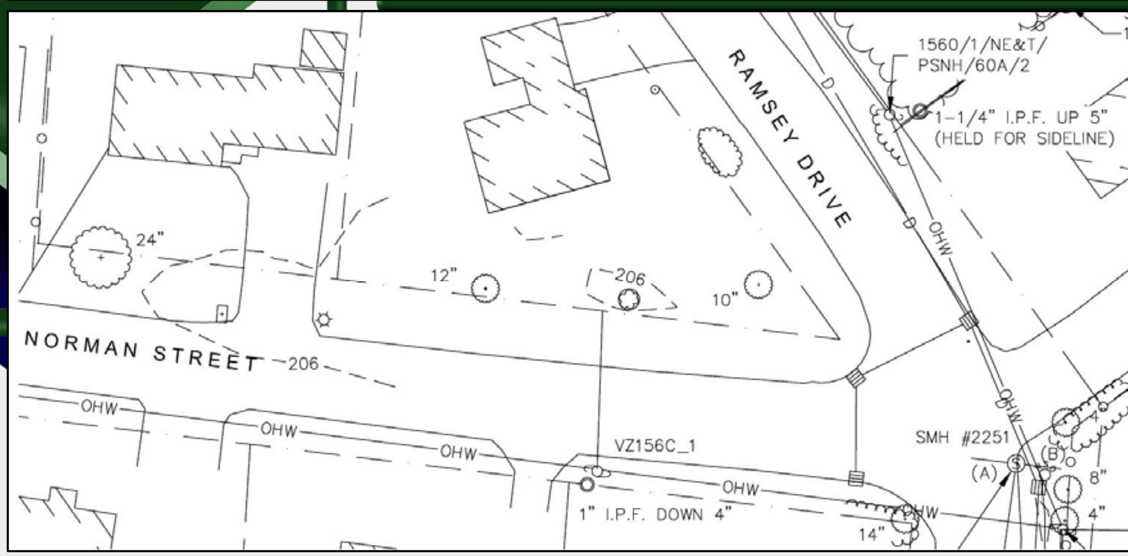
Accuracy:

- Horizontal=1-3x GSD
- Vertical=3-5x GSD

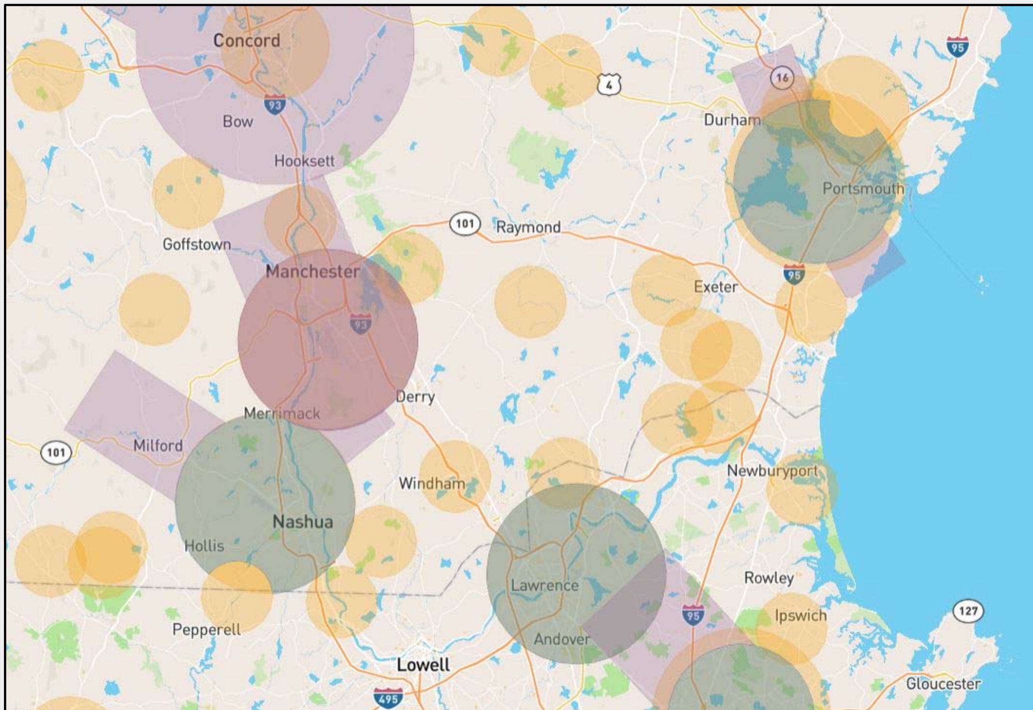
<u>Example</u> (GSD=1.5cm)

H=~0.2’
V=~0.3’

Standard Workflow & Procedures

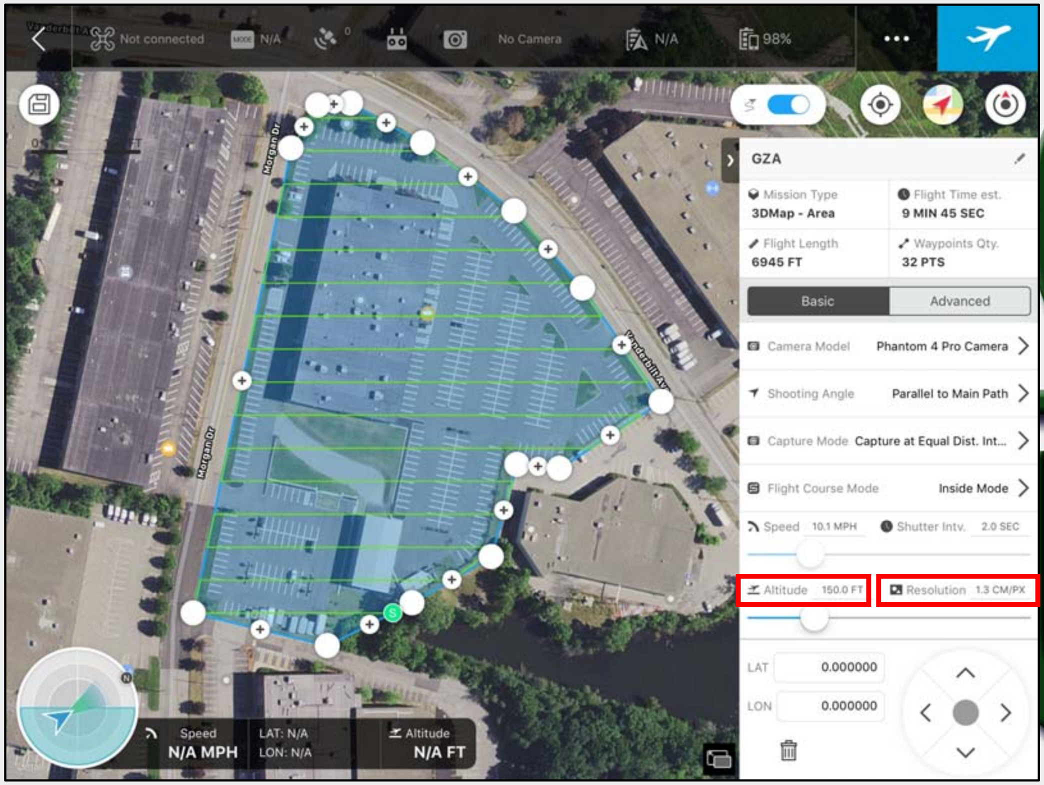


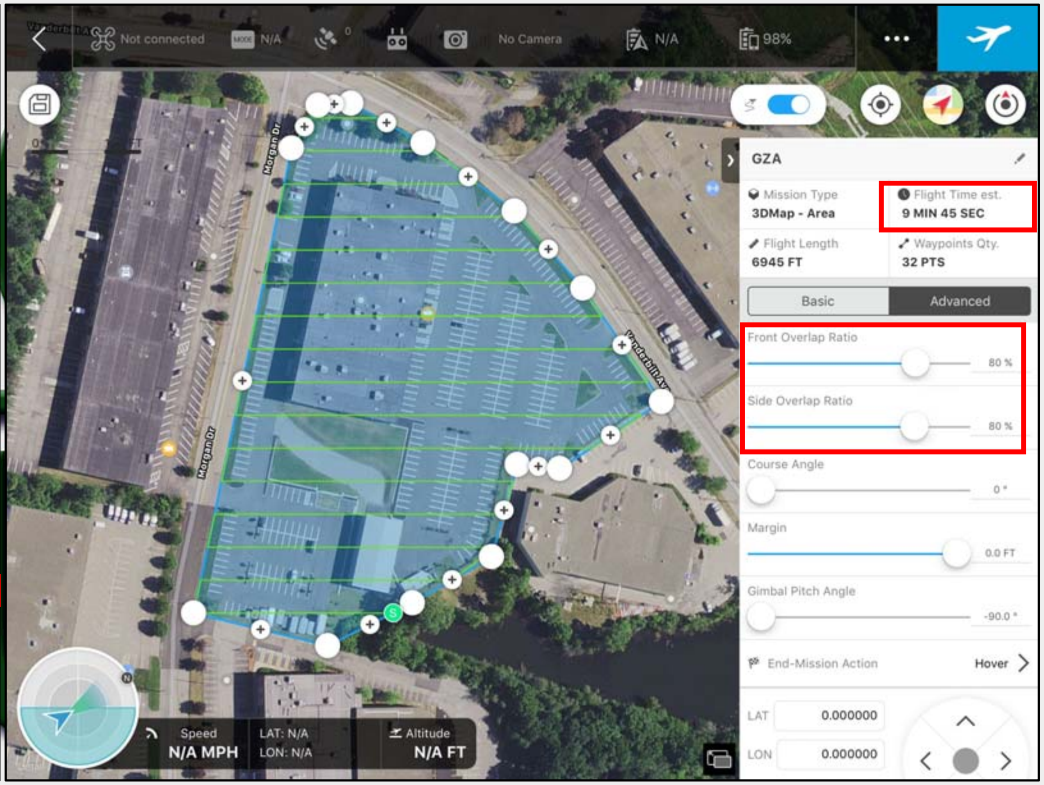
Review potential airspace restrictions



Investigate site conditions

Plan Mission





Check forecasted weather conditions and complete checklists; Equipment, pre-flight, on-site

Norwood, MA, USA | Search | Use my location

- [x] Max Wind (mph): 15 | Wind Altitude (feet) 150 | [x] Min Temperature (°F): 20 | [x] Adjust For Wind Chill
- [x] Max Precip Prob (%): 5 ? | [ ] Max Cloud Cover (%): 75 | [x] Min Visibility (miles): 5
- [x] Min GPS Sats Visible: 8 | GPS Elevation Mask (°): 5 ? | [x] Include GLONASS Sats
- [x] Min Est. GPS Sats Locked: 12 ? | [x] Max Kp: 5 ?
- [x] Show Daylight Hours Only | [ ] Show Cloud Base (subscribers only) | [ ] Show Max Wind Altitude (subscribers only)

Wind mph | Altitude feet | Temperature F | Visibility miles

Location: Norwood, MA, USA map »

Warning: 1 DJI NFZ nearby, check the map for details.

Current Conditions as of Tuesday 2017-06-06 18:46 EDT

Time	Wind	Wind Chill	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
18:46	16 mph	44°F	100%	100%	5 miles	19	2	17.3	no

Tuesday 2017-06-06: sunrise 05:08, sunset 20:18

Time	Wind	Wind Chill	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
19:00	15 mph	44°F	74%	100%	5 miles	17	2	15.6	no
20:00	15 mph	44°F	74%	100%	5 miles	17	2	15.2	no

Wednesday 2017-06-07: sunrise 05:08, sunset 20:19

Time	Wind	Wind Chill	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
06:00	8 mph	47°F	4%	92%	6 miles	16	1	14.8	yes
07:00	9 mph	51°F	3%	83%	7 miles	17	1	16.1	yes
08:00	11 mph	53°F	2%	76%	7 miles	18	1	17.3	yes
09:00	11 mph	56°F	1%	70%	8 miles	20	1	18.4	yes
10:00	11 mph	58°F	0%	56%	8 miles	18	1	16.7	yes
11:00	12 mph	61°F	0%	37%	10 miles	17	1	15.9	yes
12:00	12 mph	63°F	0%	21%	10 miles	18	1	16.6	yes
13:00	11 mph	65°F	0%	10%	10 miles	17	1	15.7	yes
14:00	11 mph	67°F	0%	6%	10 miles	15	1	14.7	yes
15:00	10 mph	68°F	0%	4%	10 miles	18	1	16.7	yes
16:00	9 mph	69°F	0%	4%	10 miles	17	1	16.3	yes
17:00	7 mph	70°F	0%	1%	10 miles	19	2	17.7	yes
18:00	5 mph	66°F	0%	1%	10 miles	20	2	18.1	yes

Doucet Survey Inc.-UAV Checklist

Prior to flight

- Check forecast for temp., wind, visibility, etc. (KP index should not be above 5)
- Place batteries, controller and iPad on charge
- Empty SD card
- Check for firmware updates
- Review FAA Sectional Chart and AirMap
- Confirm that FAA Registration stickers are still intact
- Check propellers for wear

Day of flight

- Verify weather conditions
- Inventory equipment and pack case
  - Aircraft
  - SD card
  - Remote controller (confirm that it's fully charged)
  - Batteries (confirm that it's fully charged)
  - iPad
  - 12" cable from iPad to controller
  - Insurance card
  - FAA Registration Card
  - Propellers (plus spare set)
  - Harness
  - Sun shield
  - Binoculars
  - Lens filters
  - Manuals

At site

- Confirm weather conditions
- Check for interferences (metal surfaces, wires, steel towers, etc.)
- Check for obstacles (buildings, trees, poles, etc.)
- Check for potentially dangerous situations (people, dogs, etc.)
- Check aircraft & propellers for wear/cracks

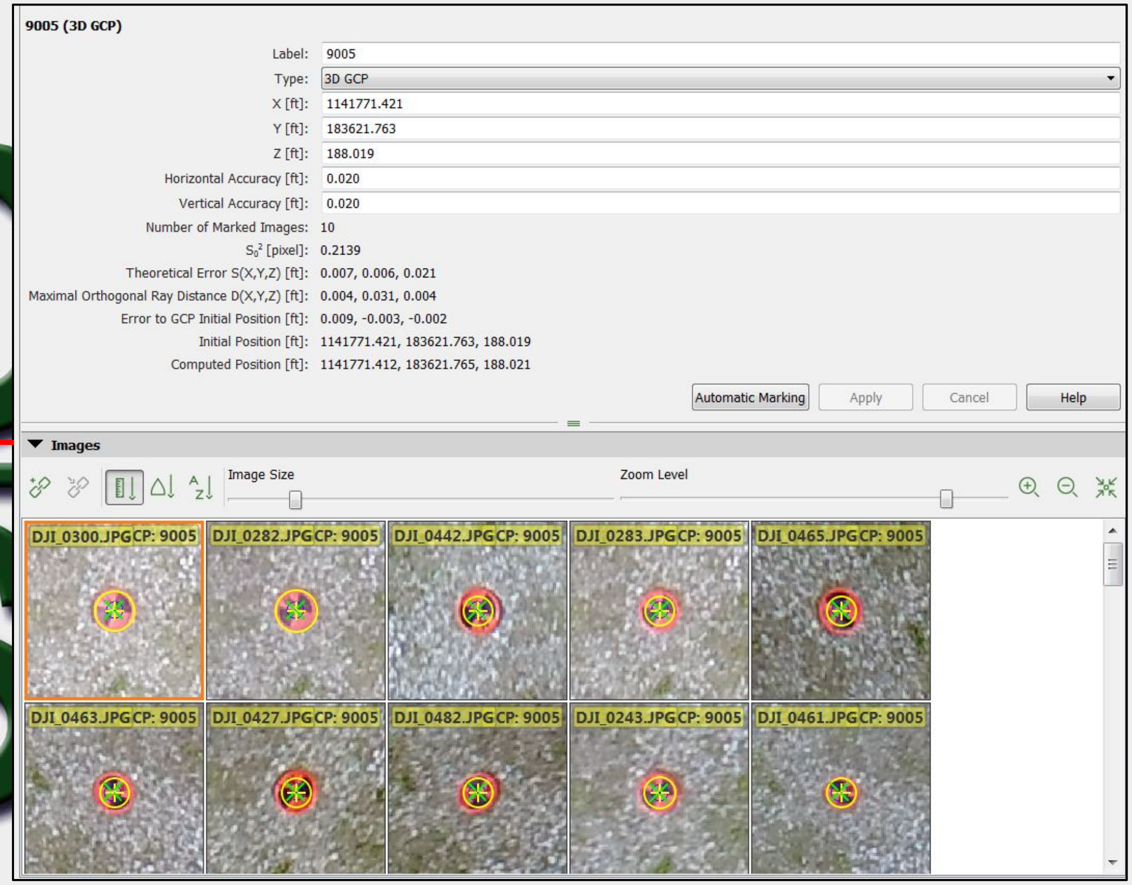
Prepare the aircraft

- Remove the gimble guards (both the soft gray one and the hard plastic one)
- Ensure that SD card is inserted properly
- Install filter if one is needed
- Install propellers
- Insert battery
- Make sure gimbal can move unobstructed
- Place on level surface

Set Survey-quality Ground Control Points (GCP)

Fly Mission

Process Data



QAQC

Quality Report

Generated with Pix4Dmapper Pro version 3.1.23

Important: Click on the different icons for:

- Help to analyze the results in the Quality Report
- Additional information about the sections

Click here for additional tips to analyze the Quality Report

Summary

Project	5067 brentwood
Processed	2017-05-24 21:18:01
Camera Model Name(s)	FC6310_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	1.14 cm / 0.45 in
Area Covered	0.0482 km^2 / 4.82 ha / 0.0186 sq. mi. / 11.9166 acres
Time for Initial Processing (without report)	01h:50m:54s

Quality Check

Images	median of 49204 keypoints per image	
Dataset	470 out of 470 images calibrated (100%), 89 images disabled	
Camera Optimization	0.06% relative difference between initial and optimized internal camera parameters	
Matching	median of 15179.1 matches per calibrated image	
Georeferencing	yes, 6 GCPs (6 3D), mean RMS error = 0.029 ft	

Geolocation Details

Ground Control Points

GCP Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]	Projection Error [pixel]	Verified/Marked
9001 (3D)	0.020/ 0.020	-0.007	-0.014	-0.018	0.207	7 / 7
9003 (3D)	0.020/ 0.020	-0.004	0.006	0.022	0.180	4 / 4
9005 (3D)	0.020/ 0.020	0.009	-0.003	-0.002	0.577	10 / 10
9007 (3D)	0.020/ 0.020	-0.002	0.000	-0.151	0.042	2 / 2
9008 (3D)	0.020/ 0.020	-0.009	0.003	0.099	0.081	2 / 2
9009 (3D)	0.020/ 0.020	-0.001	0.004	0.051	0.410	4 / 4
Mean [ft]		-0.002323	-0.000474	-0.000084		
Sigma [ft]		0.005780	0.006655	0.077504		
RMS Error [ft]		0.006230	0.006672	0.077504		

0 out of 4 check points have been labeled as inaccurate.

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]	Projection Error [pixel]	Verified/Marked
9002	0.0200/0.0200	0.0105	0.0070	-0.1635	0.3861	5 / 5
9004	0.0200/0.0200	-0.0232	-0.0107	-0.0157	0.6838	8 / 8
9006	0.0200/0.0200	0.0564	0.0549	-0.1286	0.1280	3 / 3
9010	0.0200/0.0200	0.0334	0.0588	0.0729	0.2548	6 / 6
Mean [ft]		0.019274	0.027495	-0.058730		
Sigma [ft]		0.029405	0.030039	0.093605		
RMS Error [ft]		0.035159	0.040722	0.110504		

Example Project #1

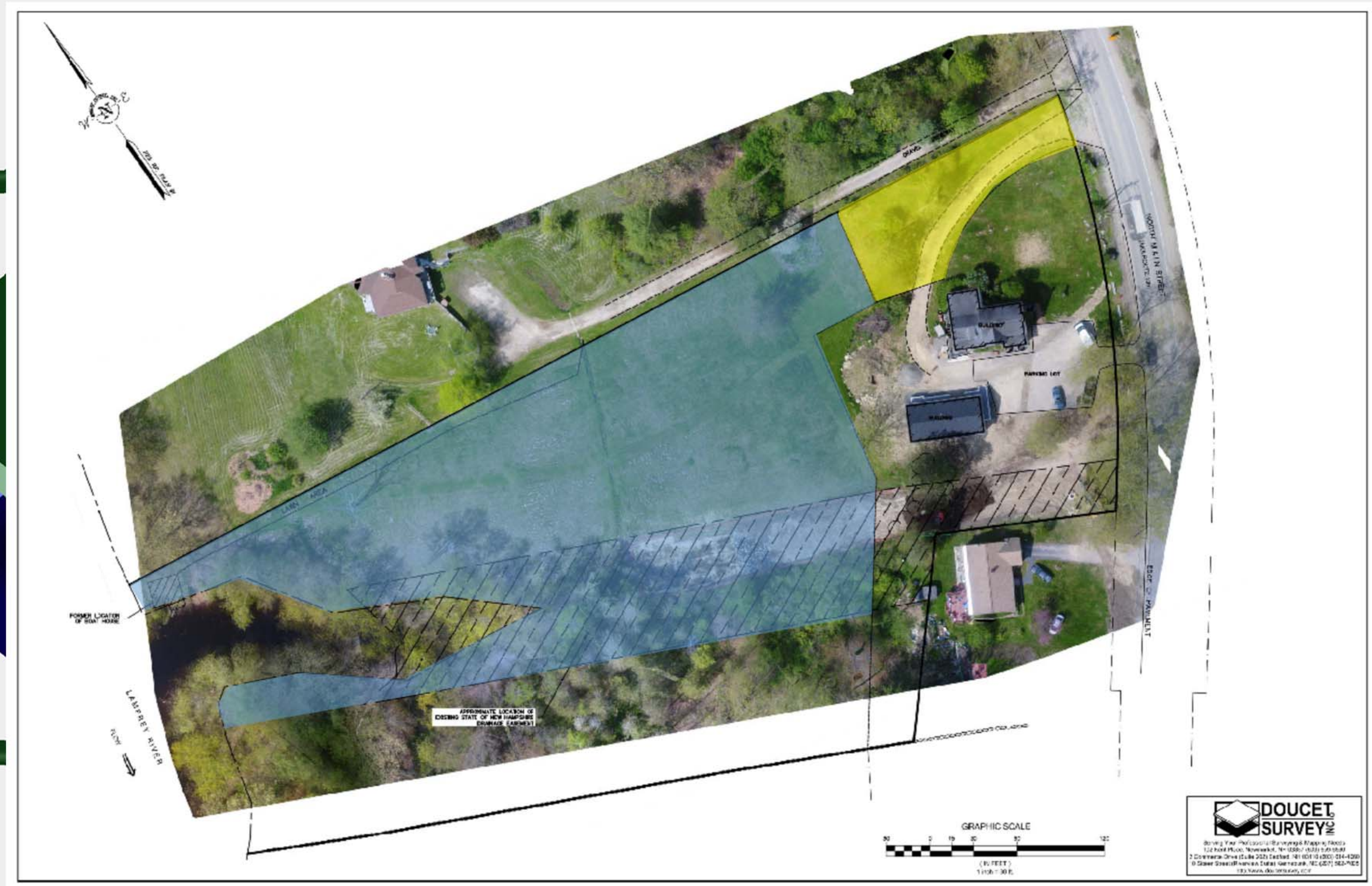
Orthomosaic Photos

Individual Photos

Example Project #1

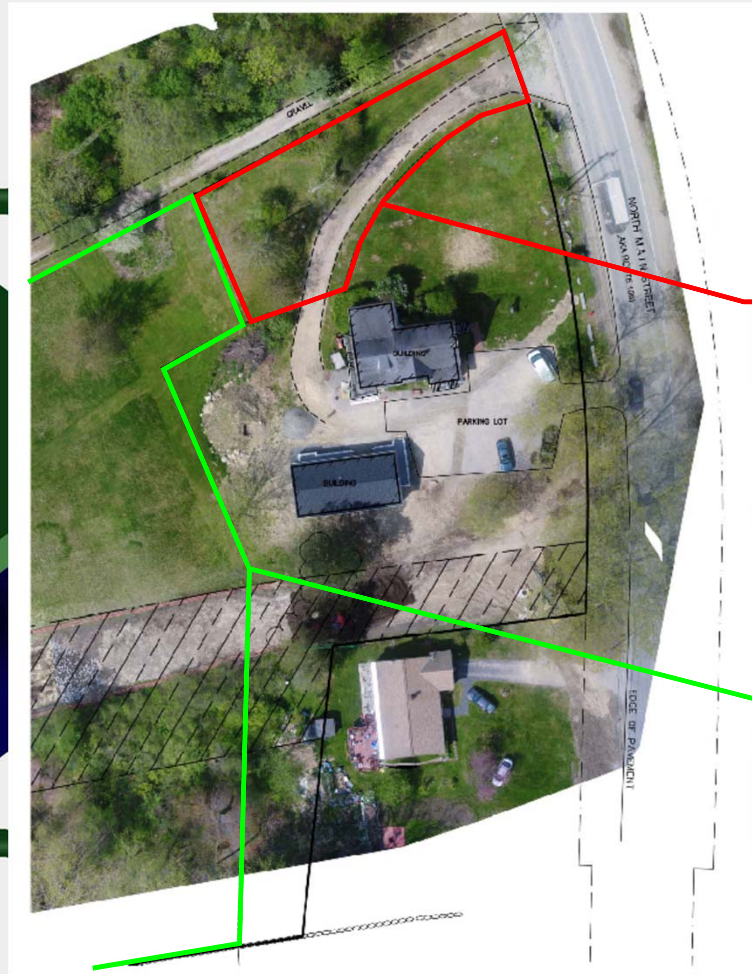
Add existing property lines, easement, site features

Example Project #1



Add proposed easements

Example Project #1



Proposed Parking & Access Easement- Include Driveway, Exclude Buildings

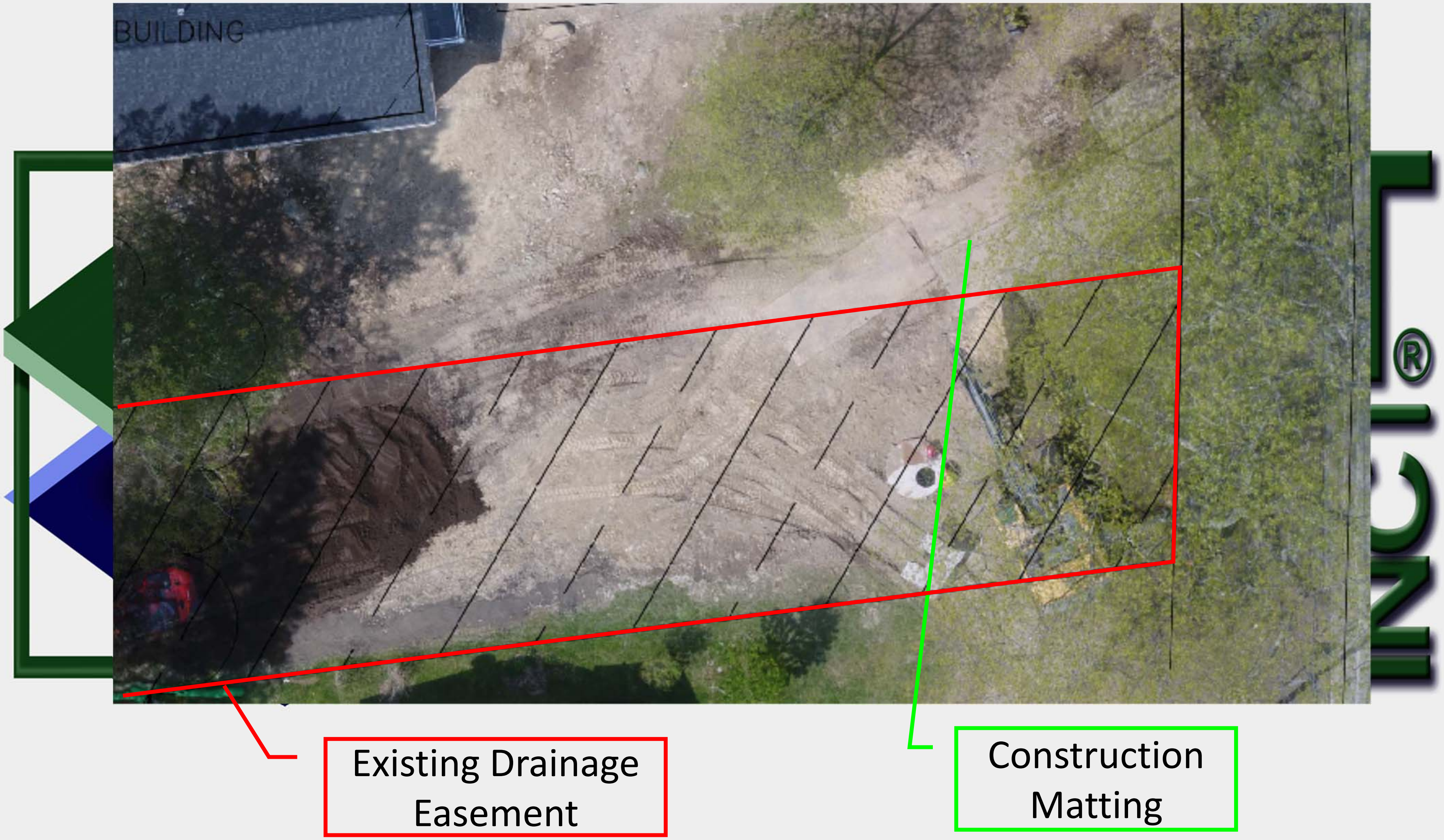
Proposed Park Easement-Exclude buildings & debris pile

Planning tool

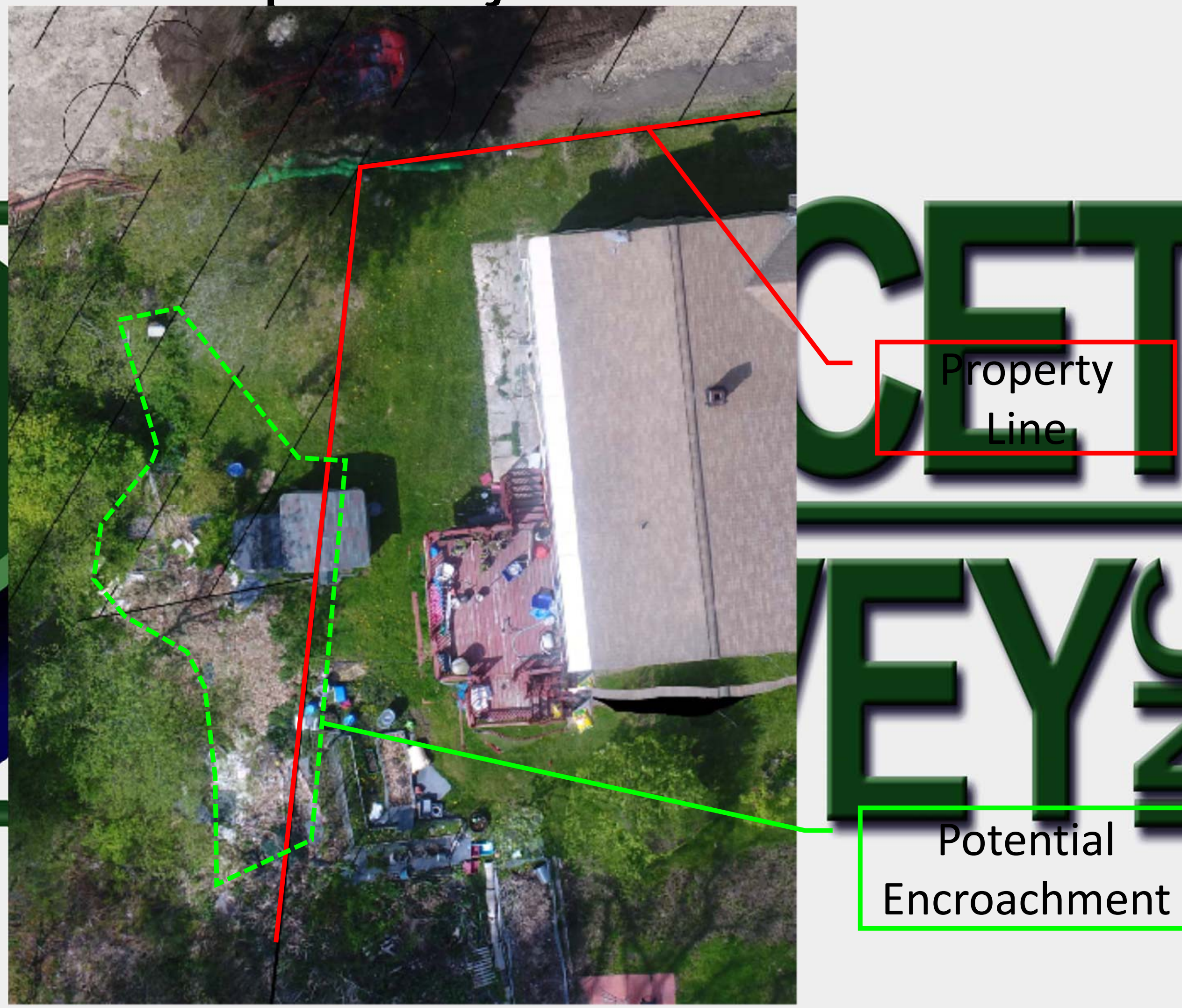
Example Project #1

Identify potentially problematic areas

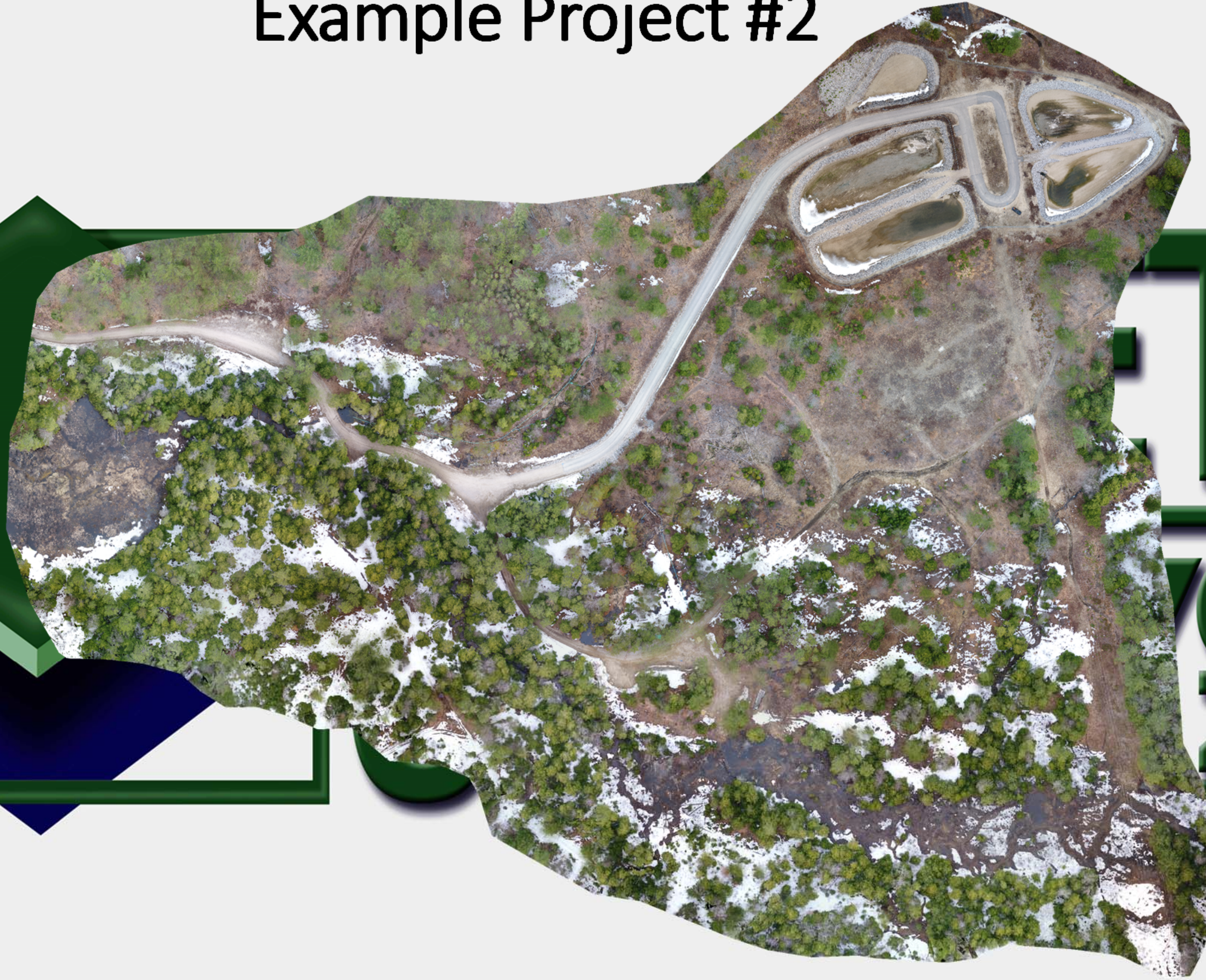
Example Project #1



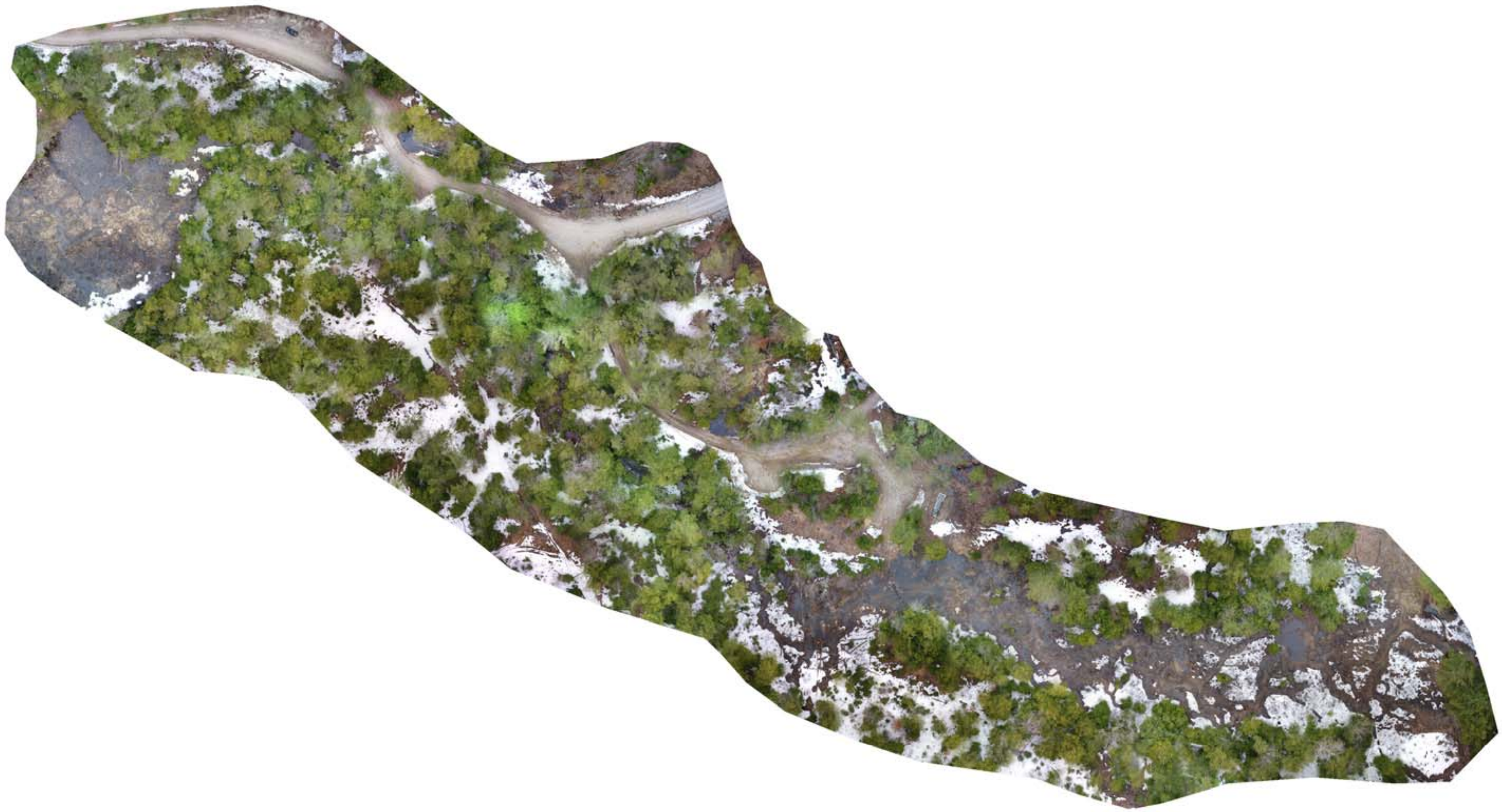
Example Project #1



Example Project #2

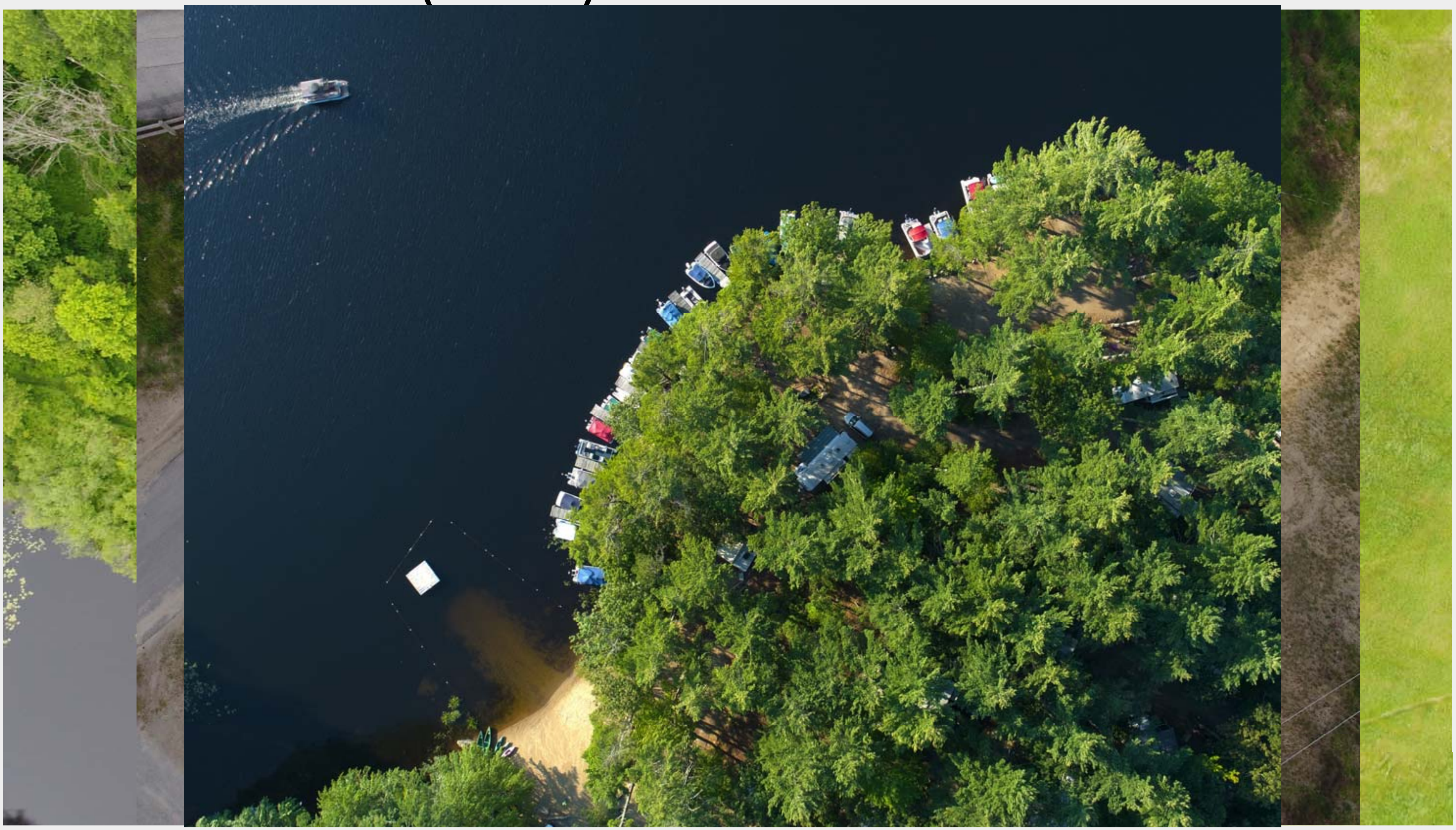


Example Project #2



Example Project #2

Overhead Photos (Nadir)



Overhead Photos (Oblique)

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Bedford
New Hampshire

Newmarket
New Hampshire

Kennebunk
Maine