

Cooper Aerial UAV - Flight Specifications



M300 & M350

L1 & L2 24mm Dual Capture (LiDAR & Images)

Front & Side Overlap: 66%
200' AGL
23.2 MPH at 2 second capture rate
15.5 MPH at 3 second capture rate
GSD: L1 1.67cm L2 1.63cm

Alternate: Heavy Tall Trees
300' AGL
34.8 MPH at 2 second capture rate
23.2 MPH at 3 second capture rate
GSD: L1 2.51cm L2 2.44cm

P1 24mm

Front & Side Overlap: 66%
350' AGL
40.6 MPH at 2 second capture rate
27.0 MPH at 3 second capture rate
GSD: 1.95cm



Mavic 3 Enterprise

M3E 24mm

Front & Side Overlap: 66%
200' AGL
24.5 MPH at 2 second capture rate
16.3 MPH at 3 second capture rate
GSD: 1.62cm

The above recommended flight parameters are the “*Sweet Spot*” for each of the sensors shown to balance the Horizontal/Vertical Accuracy, Flight Time, and minimize Post Processing Time.

The maximum number UAV images per project site is around 1000 images and/or 200+/- Acres. Anything above that, it is more effective to use manned aircraft both in cost, resource management and processing time.



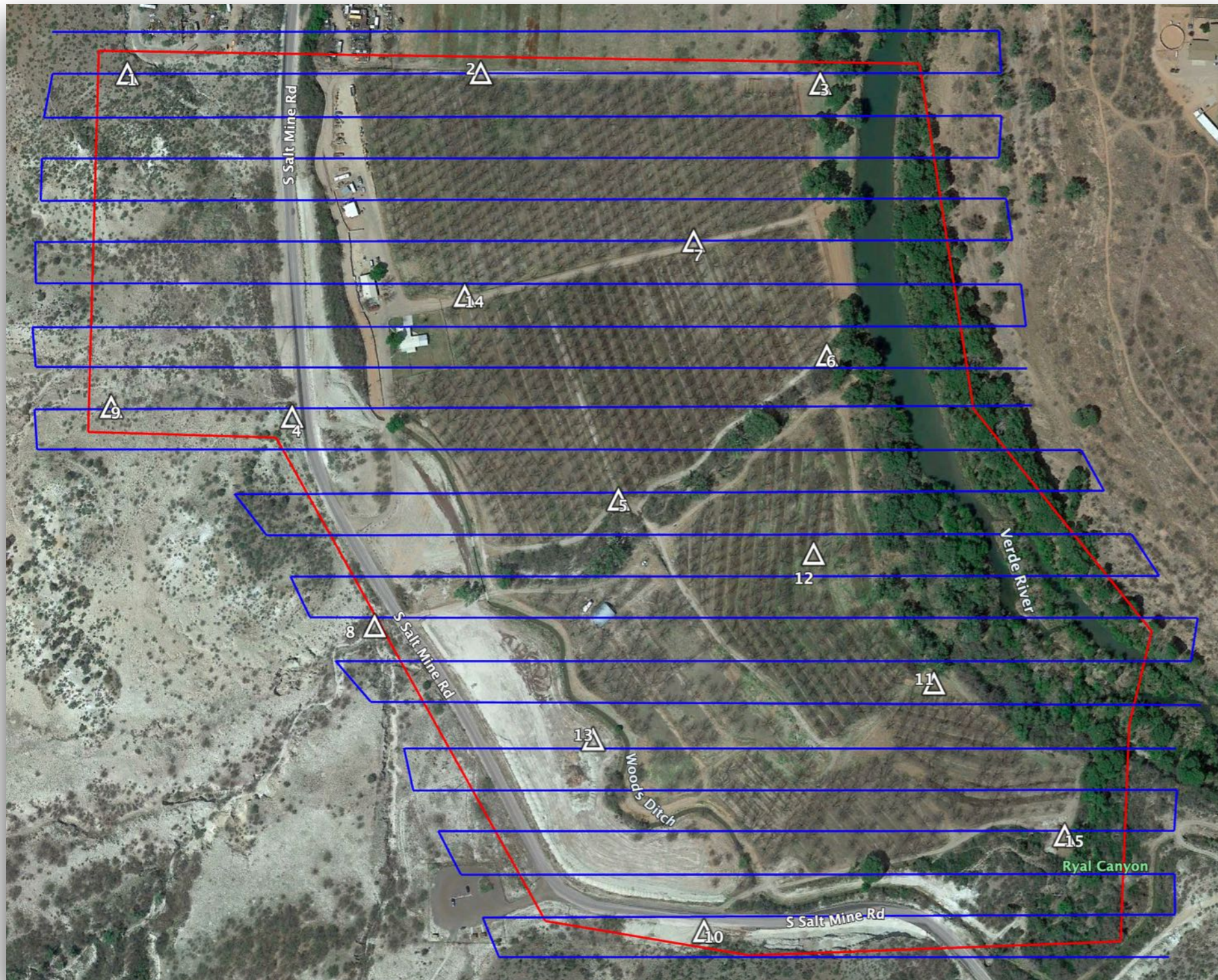
Wingtra

RX1R II 35mm

Front & Side Overlap: 66%
400' AGL
40 MPH
Capture rate: 1.6 seconds
GSD: 1.57cm

Online FREE Flight Parameter app for several sensors: <https://www.cc4w.net/webapp/cooper.html>

Cooper Aerial UAV - Flight Lines



Extend the flight lines out past the mapping limits at least by one to two images. As the UAV turns, it should be outside of the mapping limits.

A Waypoint Mission can be useful for irregular shaped project sites.

The maximum number images per project site is around 1000 images and/ or 200+/- Acres. Anything above that, it is more effective to use manned aircraft both in cost, resource management and processing time.

Jim Crume PLS, MS, CfedS, RP (UAV Manager)



Cooper Aerial UAV - GCPs



Cooper Aerial will provide a panel layout in a KMZ file that will provide the best aerial triangulation solution for the sensor being used.

Targets can be moved within a 20' distance as needed to avoid obstacles not shown on Google Earth.

The number of panels and location are critical to a good solution.

NOTE: All set targets must be covered by the UAV Flight Lines.

Jim Crume PLS, MS, CfedS, RP (UAV Manager)



Cooper Aerial UAV - GCPs & PIDs



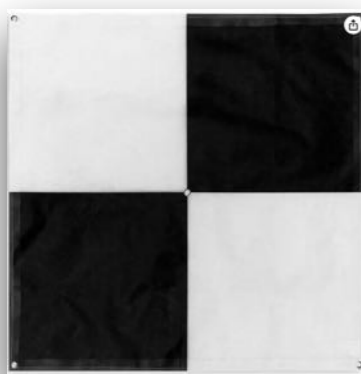
Targets should be set prior to the flight.

Targets should be at least 10" in diameter colored black and white. They can also be painted on the concrete or other hard surface.



Paint marks on concrete work well.

12" square targets, colored black and white.



NOTE:

Targets and PIDs need to be in an open area that is visible from the UAV capturing images.

DO NOT set them under trees, overhangs, under power lines, etc.

If they cannot be seen from the air, then they cannot be used.



Outer corner of a parking strip.



Turning point/corner between two distinct types of surfaces.



Corner point of a basketball court.



Intersection of two surfaces/turning point.



Painted arrow along a pedestrian/bicycle path.



Road shoulder ground feature.

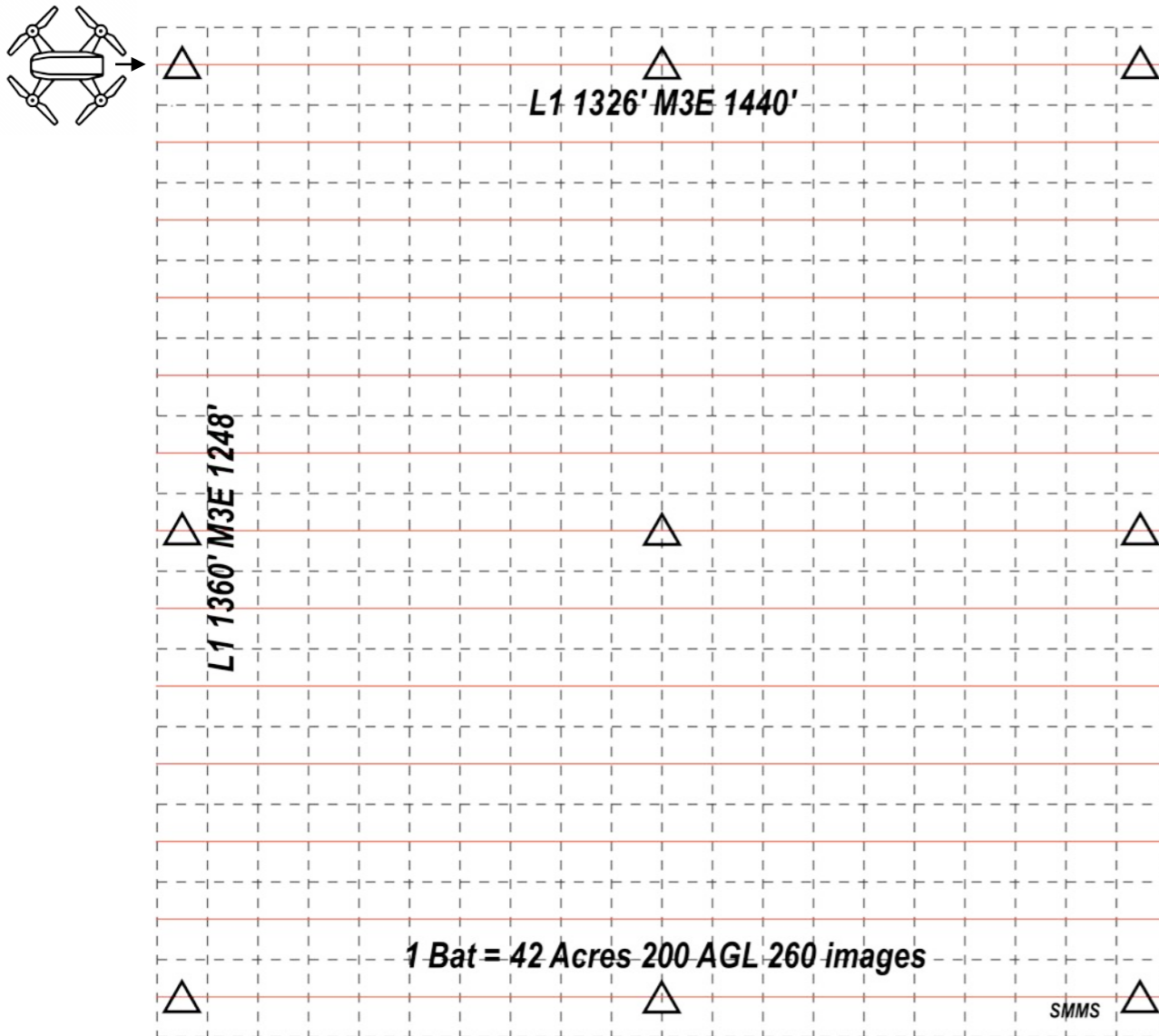
Should the flight be completed before the targets are set, then Photo Identifiable (**PIDs**) points will be needed.

We will need Close Up and Distance photographs of the survey equipment set up on the control.

Cooper Aerial UAV - Map Scale vs Contour Intervals vs GCP (RTK vs Direct Levels relationship)

There is a direct relationship between flying height (AGL), the mapping scale, contour intervals and # of GCPs needed.

1' contours are typically the most requested from design engineers. Should 1/2' contours be requested, then that will change the flight specifications and costs more to produce the deliverables.



Typical GCP layout and flight lines shown (in red) with image neat area (dashed).

Sensor	Ground Sample Distance (cm)			
	150' AGL	200' AGL	300' AGL	400' AGL
M3E	1.22 cm	1.62 cm	2.44 cm	3.25 cm
L1	1.25 cm	1.67 cm	2.51 cm	3.34 cm
L2	1.22 cm	1.63 cm	2.44 cm	3.25 cm
P1 (24mm)	0.83 cm	1.11 cm	1.67 cm	2.23 cm
P1 (35mm)	0.57 cm	0.76 cm	1.14 cm	1.53 cm
Wingtra (35mm)	0.59 cm	0.79 cm	1.18 cm	1.57 cm

Approximate # of Ground Control Points per acre for 1' contours (1), (2)

Sensor	150' AGL	200' AGL	300' AGL	400' AGL
M3E	Acres x 0.4	Acres x 0.2	Acres x 0.1	Acres x 0.05
L1	Acres x 0.4	Acres x 0.2	Acres x 0.1	Acres x 0.05
L2	Acres x 0.4	Acres x 0.2	Acres x 0.1	Acres x 0.05
P1 (24mm)	Acres x 0.2	Acres x 0.1	Acres x 0.1	Acres x 0.04
P1 (35mm)	Acres x 0.2	Acres x 0.1	Acres x 0.1	Acres x 0.04
Wingtra (35mm)	Acres x 0.2	Acres x 0.1	Acres x 0.1	Acres x 0.04

- (1) Minimum of 5 GCPs, one in each corner and one in the middle of the mapping limit
- (2) Adjust as needed for the mapping limit boundary shape

Scale vs Contour Intervals vs GSD (cm)

Mapping Scale	Contour Interval	GSD (cm)
1"=10'	1/2' (1)	1.47
1"=20'	1'	1.68
1"=30'	1'	2.11
1"=30'	1'	2.53
1"=40'	2'	2.95
1"=40'	2'	3.39

Sweet Spot
Most requested

- (1) For 1/2' contours, GCPs elevations need to be measured with 0.01' accuracy. No RTK.

Cooper Aerial UAV - Deliverables

Primary Deliverables
xxxx_3D_Surface.dwg (Civil 3D 2020) (Contours)
xxxx_3D_Surface_2010.dwg (AutoCAD 2010) (Contours)
xxxx_2D_topo.dwg (Civil 3D 2020) (2D Planimetrics)
xxxx_ortho.jpg (Raster)
xxxx-ortho.jgw (World File)

Optional Deliverables
xxxx_3D_topo.dwg (Civil 3D 2020) (3D Planimetrics)
xxxx_3D_surface.XML (Text)
xxxx-geo.tif (DSM) (Raster)
xxxx_DTM.dwg (Breaklines only)
xxxx_dpc.las (Dense Point Cloud unclassified)
xxxx_groundonly.las (Dense Point Cloud ground)
Custom Translation
Panorama
Video

Deliverables:

Primary UAV deliverables are as follows:

- 3D smart surface file in Civil 3D (Contours and Breaklines)
- Autocad 2010 version for those that do not have Civil 3D (Contours and Breaklines)
- 2D Autocad planimetric file
- Orthomosaic in JPG format with world file

Optional Deliverables:

See the table to the left for optional deliverables at an additional cost.

Cooper Aerial UAV - Resources



“FUN WITH DRONES”

Surveying Mathematics and Survey Mapping Made Simple

Web Apps - Books - eBooks www.cc4w.net

You fly, we will process.

Contact: emily@cooperaerial.com or jcrume@cooperaerial.com

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