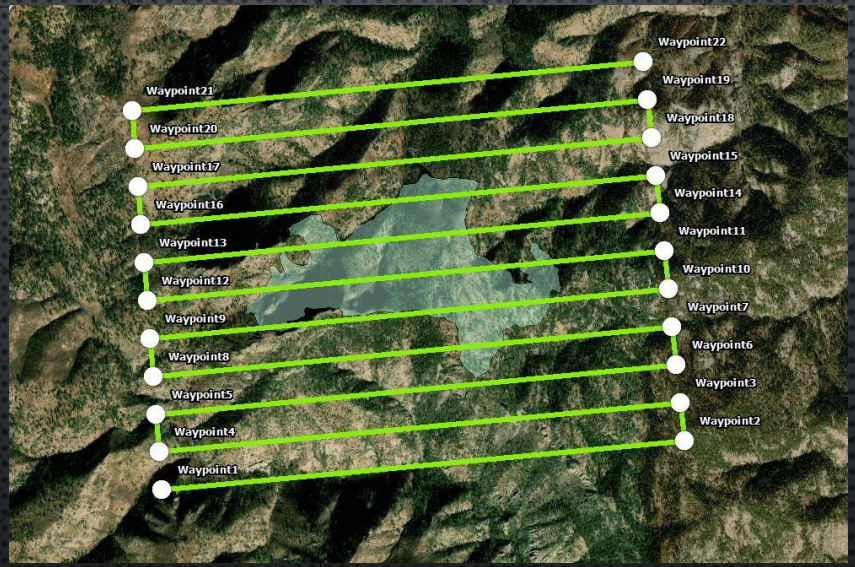
TRANSECT PLANNING



OBJECTIVES

- Demonstrate the use of the Object Distance Spreadsheet
- Build a flight plan using Mission Planner
- Export the flight plan in a usable format

ITEMS AND SOFTWARE NEEDED FOR THIS PROCESS

- Microsoft Excel
- Object Distance Spreadsheet
- Mission Planner
- ArcGIS
- Python script capability
- The Slyder python script

OBJECT DISTANCE SPREADSHEET

- Calculates flight line spacing based on altitude above highest point in flight area
- Calculates Camera trigger time interval
- Good planning leads to good data
  - Determine the elevation of the highest point in the flight area
  - Determine altitude to be flown
- Demonstrate

OBJECT DISTANCE SPREADSHEET

	A	B	C	D	E	F	G	H	I	J
1	**Camera Model:**	**FLIR Duo EO**			**<----Select Sensor with Drop-Down**					
2										
3	**Camera/Lens Parameters**		**Units:**	**Formula Notes:**						
4	Width in Pixels	4000	pixels							
5	Height in Pixels	3000	pixels							
6	Image Sensor Width	7.6	mm							
7	Image Sensor Height	5.7	mm							
8	Pixel Size	0.001900	mm/pix	Image Sensor Width / Width in Pixels						
9	Lens Focal Length	11	mm							
10										
11	**Imagery Collection Parameters**					**Area of Intrest (AOI)**		**Units:**	**Formula Notes:**	
12	**Flying Speed**	**9**	**mph**			**AOI Width**	**400**	**feet**		
13	Flying Speed	4.02	m/sec			AOI Width	121.92	meters		
14	Flying Speed	7.82	knots			**AOI Height**	**400**	**feet**		
15	**Flight Height (AGL)**		**feet**			AOI Height	121.92	meters		
16	Flight Height (AGL)	45.72	meters			AOI Area	3.7	US acres		
17	Imagery GSD	0.0079	m/pix	Pixel Size * Flight Height / Lens Focal Length		Number of Flight Lines in AOI	12		AOI Width / Flight Line Spacing	
18	Imagery GSD	0.790	cm/pix			Number of Images per Flight Line	16		AOI Height / Distance Between Images	
19	Capture Interval	2.00	sec	Distance Between Images / Flying speed		Estimated Number of Images	192		Flight Lines in AOI * Images per Flight Line	
20	Minimum Required Shutter Speed 1/	1500	sec	1/3 Pixel of Movement During Exposure		Estimated Survey Time	0:06:24	hh:mm:ss	Number of Images * Capture Interval	
21										
22	**Image Footprint Size**									
23	Footprint Width	31.59	meters	Width in Pixels * GSD (m)						
24	Footprint Height	23.69	meters	Height in Pixels * GSD (m)						
25	Footprint Width	103.64	feet							
26	Footprint Height	77.73	feet							
27										
28	**Overlap and Sidelap**									
29	**Overlap**	**66**	**%**	Recommended Value of 66% (RedEdge-M 75%)						
30	Distance Between Images	8.06	meters	Footprint Height * (100-Overlap)/100						
31	Distance Between Images	26.43	feet							
32	**Sidelap**	**66**	**%**	Recommended Value of 66% (RedEdge-M 75%)						
33	Flight Line Spacing	10.74	meters	Footprint Width * (100-Overlap)/100						
34	Fligth Line Spacing	35.24	feet							

Created by the BLM NOC Geospatial Section

Contact Mark Gapinski with questions (mgapinski@blm.gov)

= Values change with selected sensor

= Parameters to enter

= Values of note

Ideal Camera Settings for Stereo Image Collection	
Camera Mode	Shutter & Aperture Priority
Focus Distance	Infinity
Shutter Speed	1/2500 or Faster
F-Stop (Aperture)	F 5.0 - F 8.0
ISO	100 - 1000

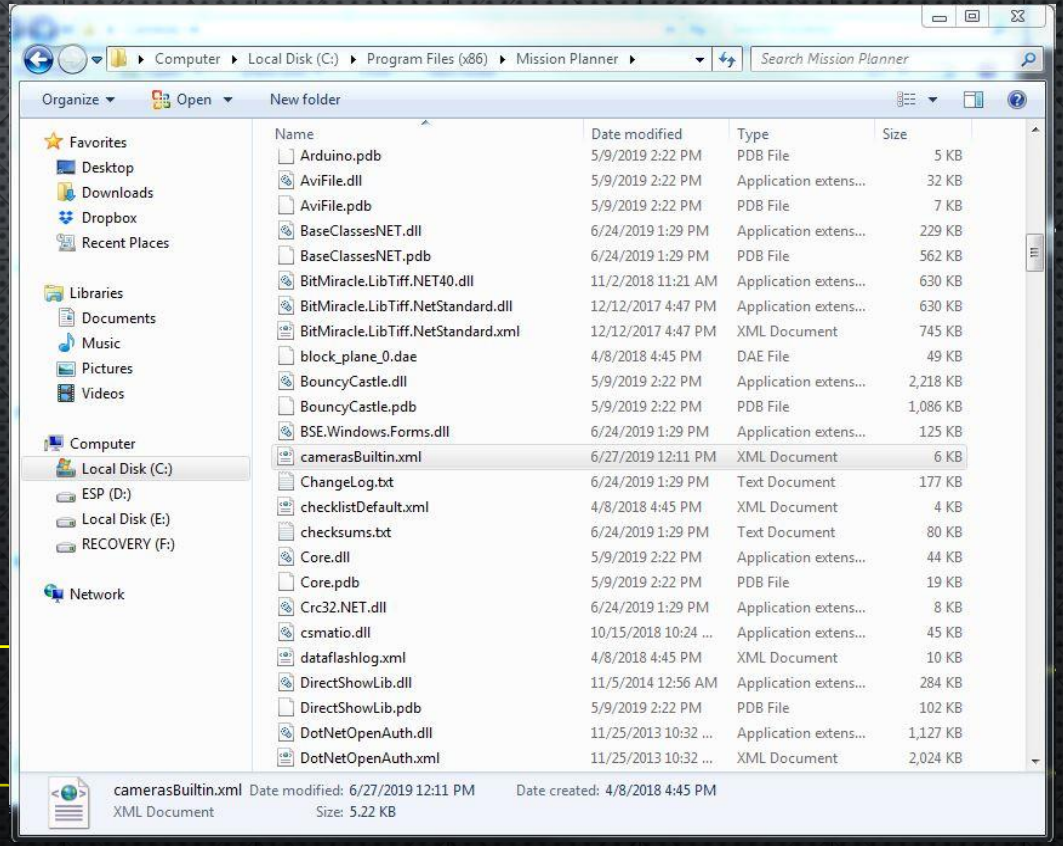
Direction of Camera in Flight

MISSION PLANNER

- Developed to build flight plans for autopilots using Ardupilot firmware
- A kml or kmz of the fire perimeter is needed before starting this process

MISSION PLANNER PREPARATION

- Camera profiles need to be made for the FLIR Duo lenses
- Navigate to this folder
- Open highlighted file with Notepad



MISSION PLANNER PREPARATION

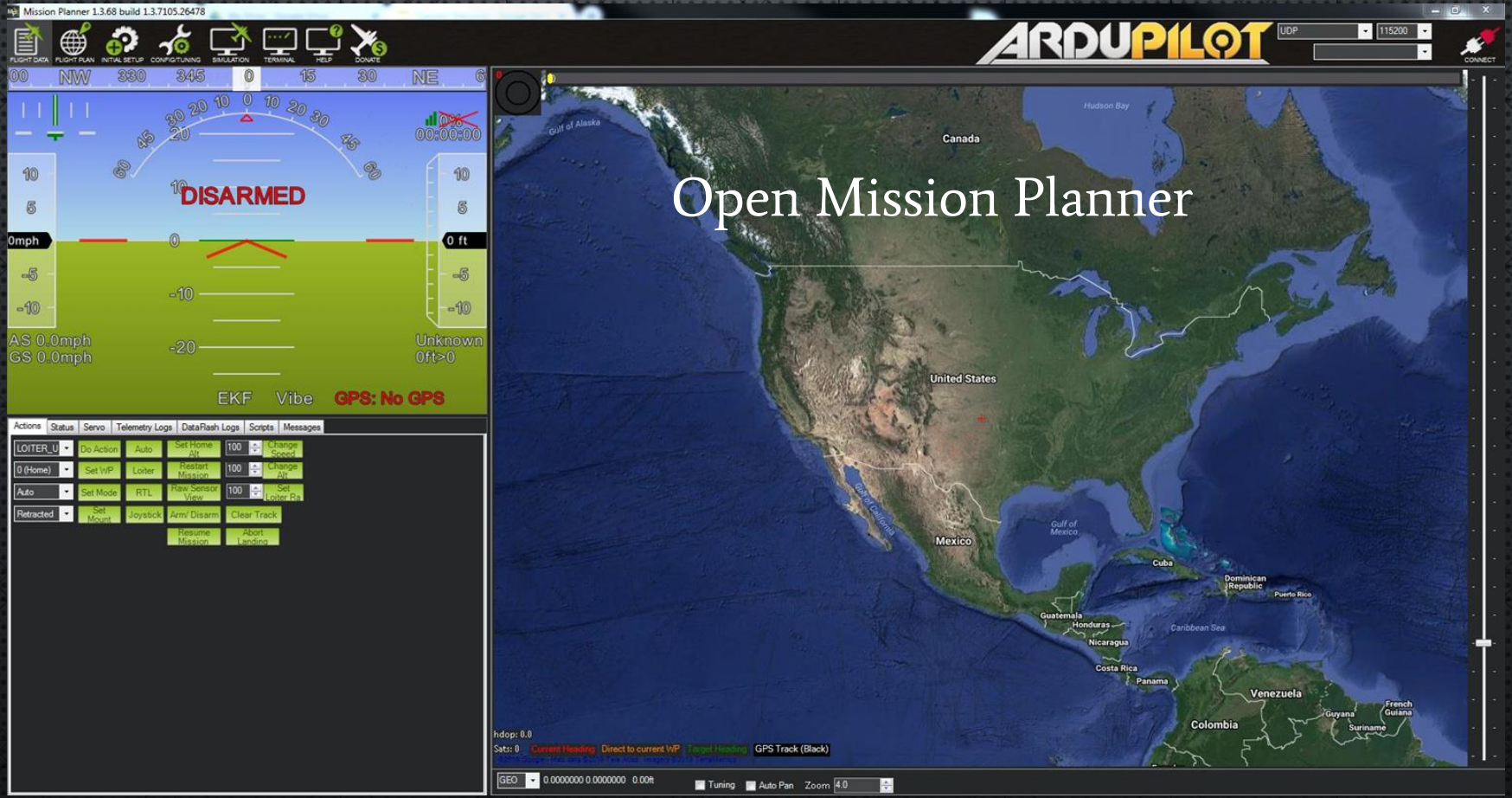
- Camera profiles need to be made for the FLIR Duo lenses
- Navigate to this folder
- Open highlighted file with Notepad
- Make edits to match last 4 cameras
- Save

camerasBuiltin.xml - Notepad

File Edit Format View Help

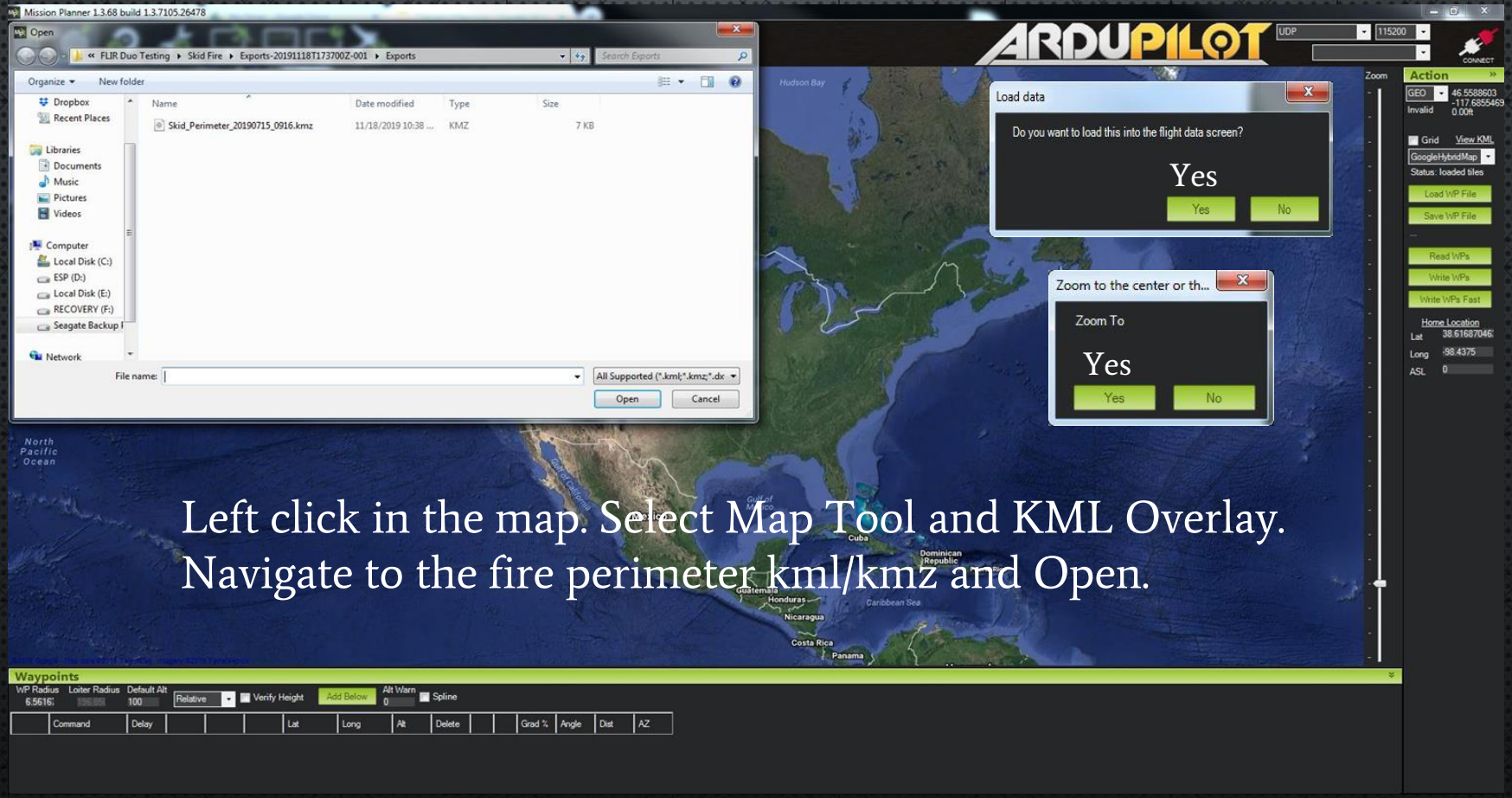
```
    <name>Ricoh GR2</name>
    <flen>18.3</flen>
    <imgh>3264</imgh>
    <imgw>4928</imgw>
    <senh>15.6</senh>
    <senw>23.7</senw>
  </Camera>
  <Camera>
    <name>FLIR Duo EO</name>
    <flen>11</flen>
    <imgh>3000</imgh>
    <imgw>4000</imgw>
    <senh>5.7</senh>
    <senw>7.6</senw>
  </Camera>
  <Camera>
    <name>FLIR Duo IR 13mm</name>
    <flen>13</flen>
    <imgh>512</imgh>
    <imgw>640</imgw>
    <senh>8.7</senh>
    <senw>10.88</senw>
  </Camera>
  <Camera>
    <name>FLIR Duo IR 19mm</name>
    <flen>19</flen>
    <imgh>512</imgh>
    <imgw>640</imgw>
    <senh>8.7</senh>
    <senw>10.88</senw>
  </Camera>
  <Camera>
    <name>FLIR Duo IR 25mm</name>
    <flen>25</flen>
    <imgh>512</imgh>
    <imgw>640</imgw>
    <senh>8.7</senh>
    <senw>10.88</senw>
  </Camera>
</Cameras>
```

MISSION PLANNER



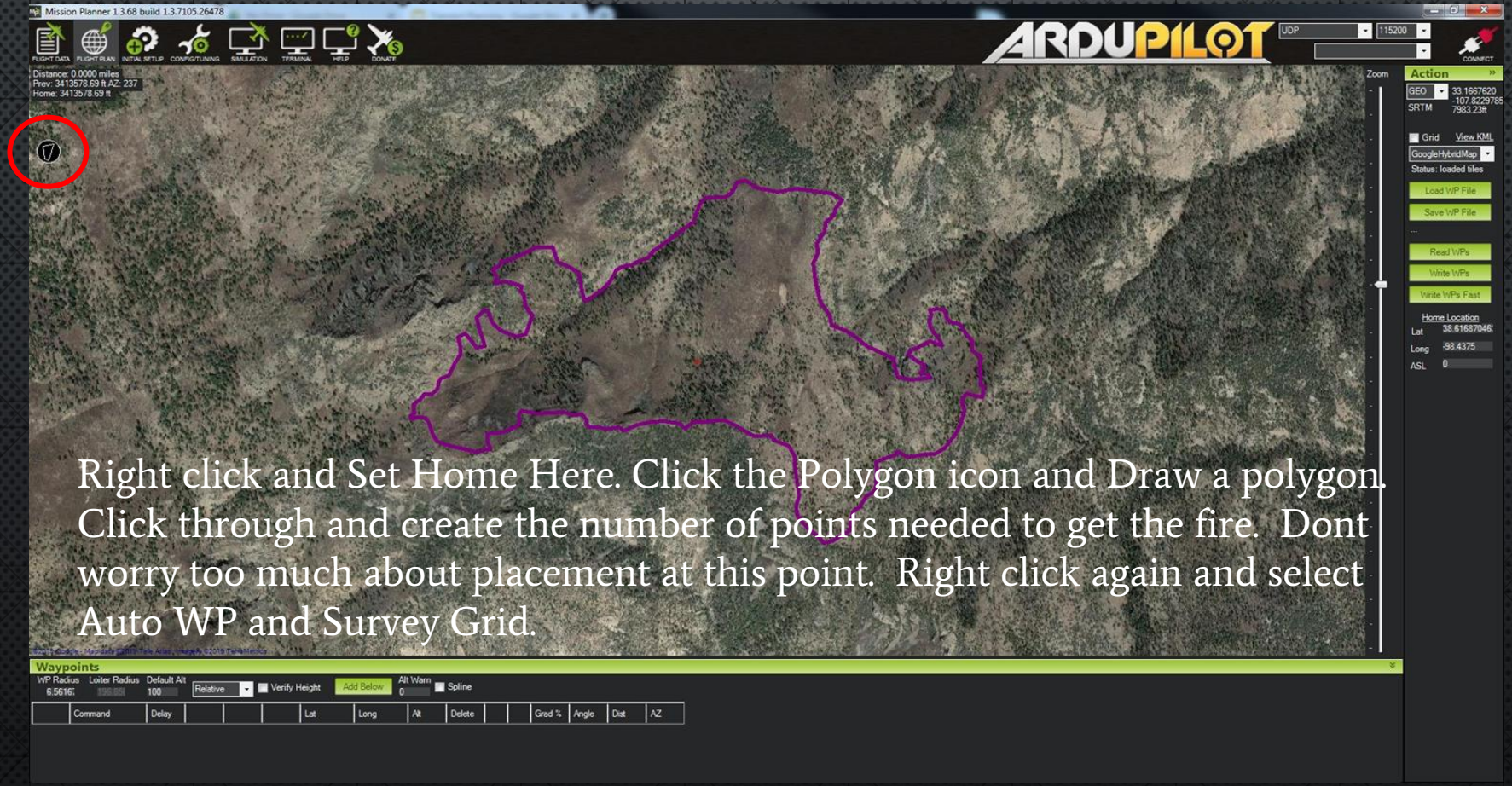
MISSION PLANNER

MISSION PLANNER



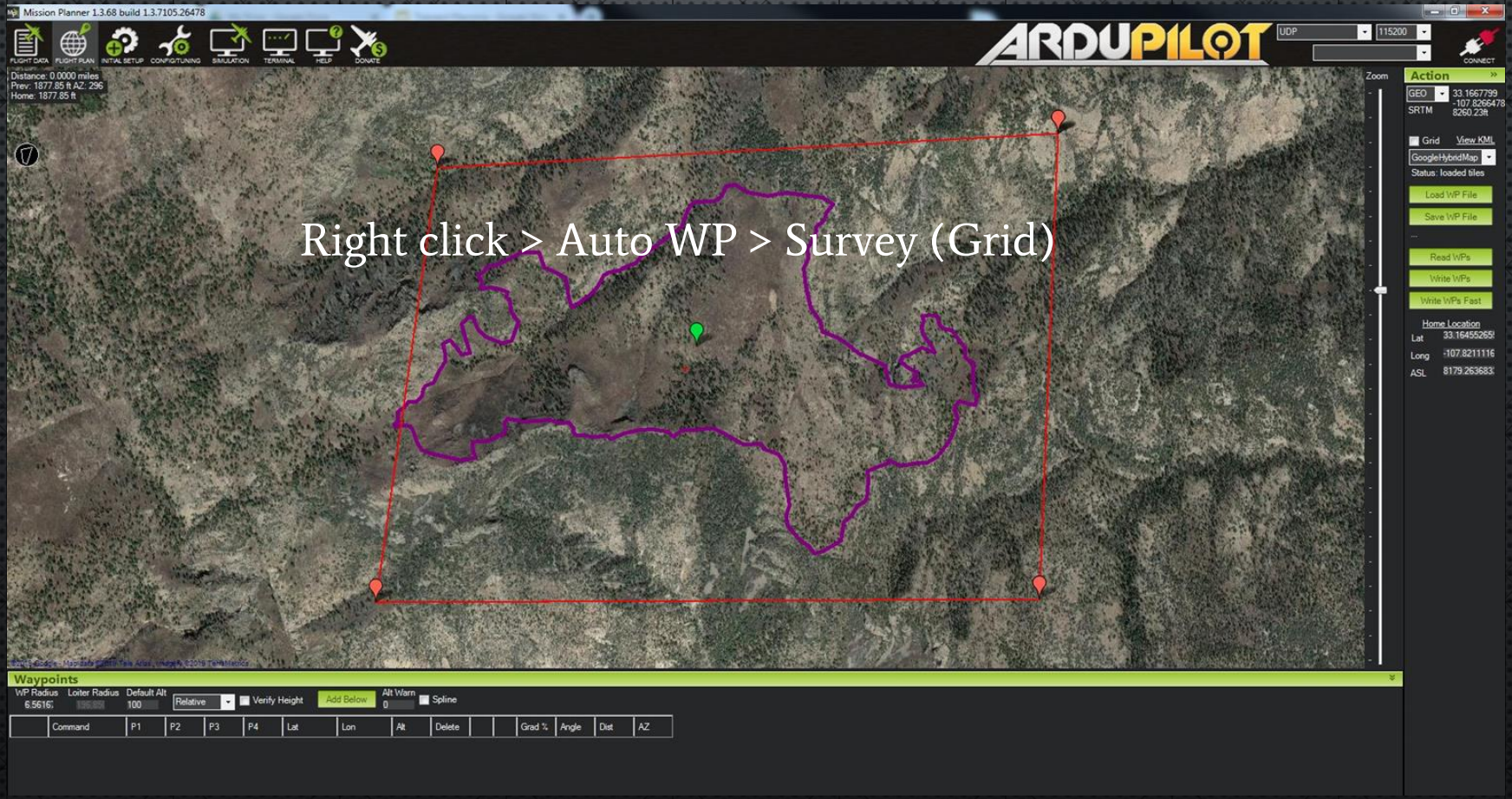
Left click in the map. Select Map Tool and KML Overlay.
Navigate to the fire perimeter kml/kmz and Open.

MISSION PLANNER



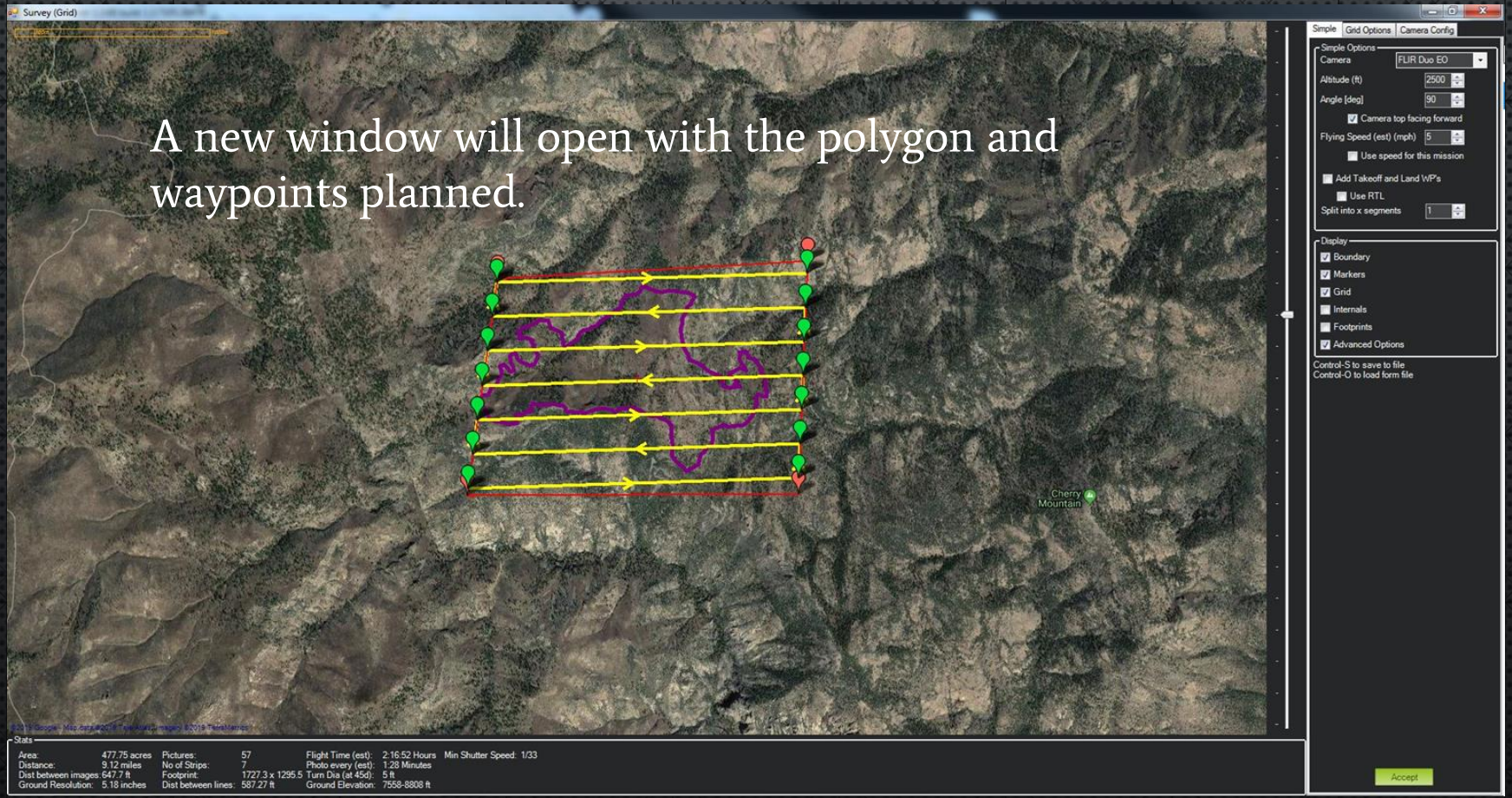
Right click and Set Home Here. Click the Polygon icon and Draw a polygon. Click through and create the number of points needed to get the fire. Dont worry too much about placement at this point. Right click again and select Auto WP and Survey Grid.

MISSION PLANNER



Right click > Auto WP > Survey (Grid)

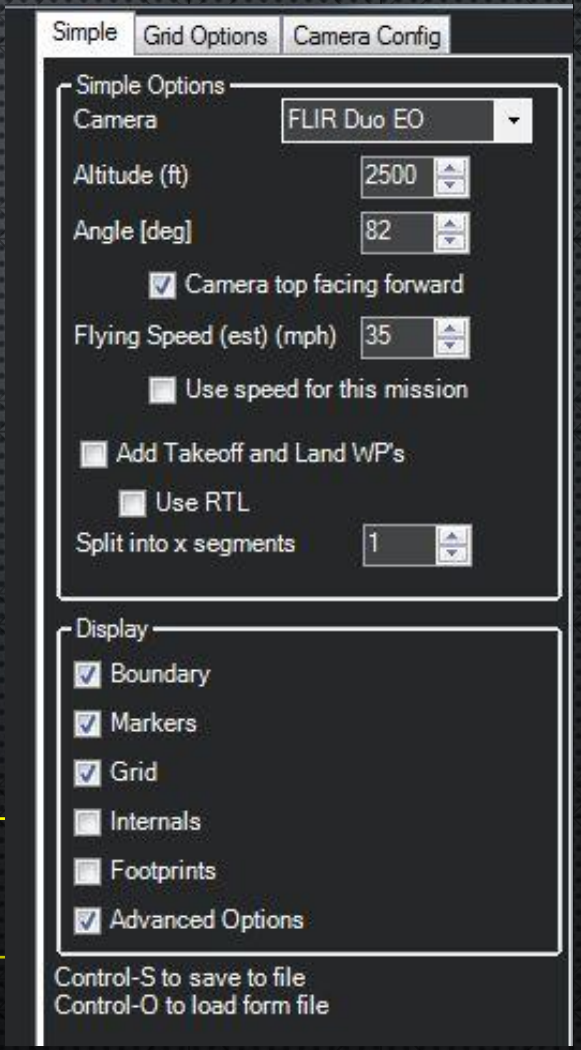
MISSION PLANNER



A new window will open with the polygon and waypoints planned.

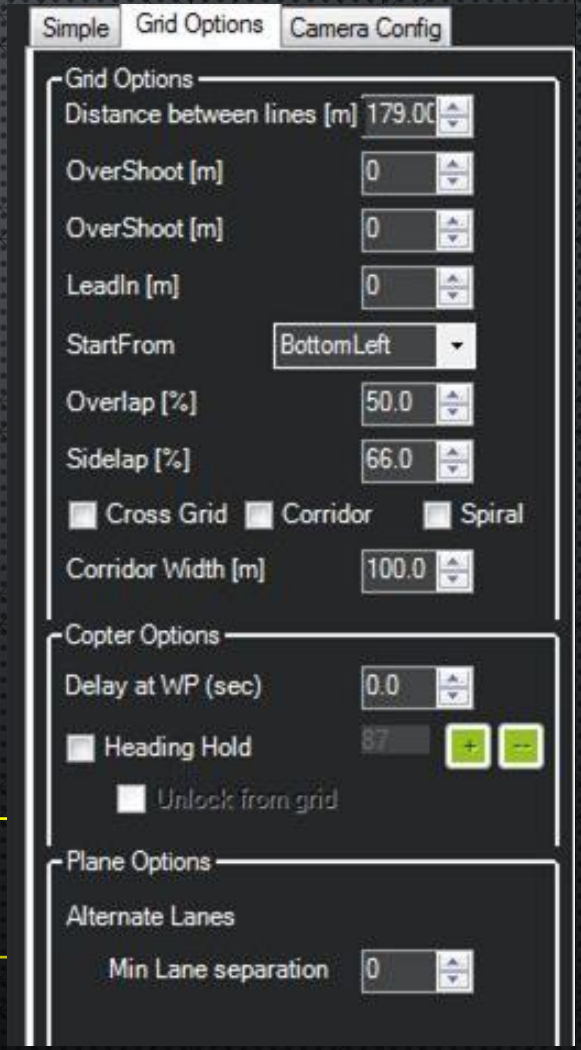
MISSION PLANNER

Set parameters to match the needs of the mission. Select camera from drop down menu and set Altitude. Leave Angle until after polygon adjustment. Flying speed is acquired from flight crew.

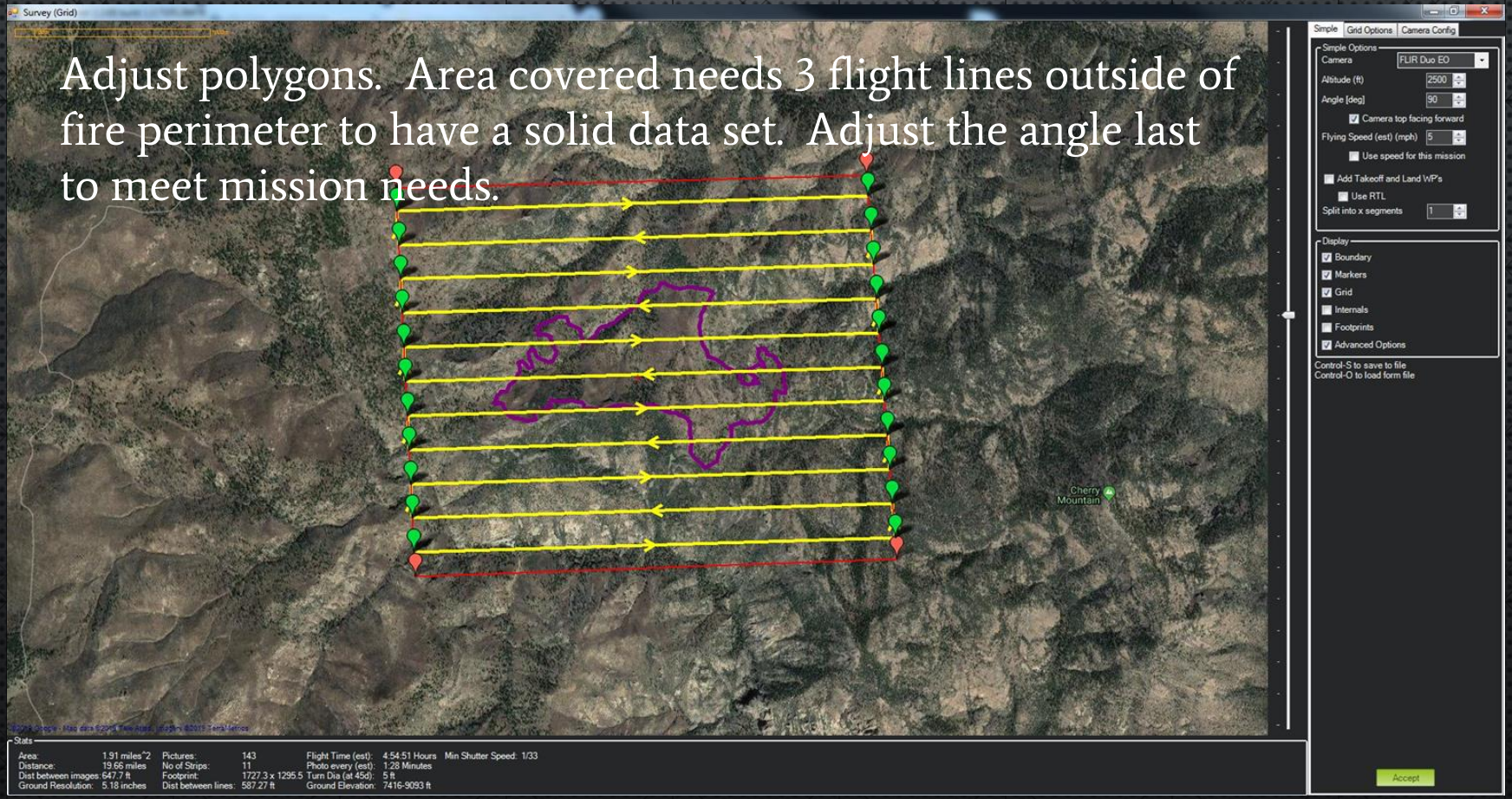


MISSION PLANNER

Set Overshoot and LeadIn to 0 and Sidelap to 66%.



MISSION PLANNER



Adjust polygons. Area covered needs 3 flight lines outside of fire perimeter to have a solid data set. Adjust the angle last to meet mission needs.

MISSION PLANNER

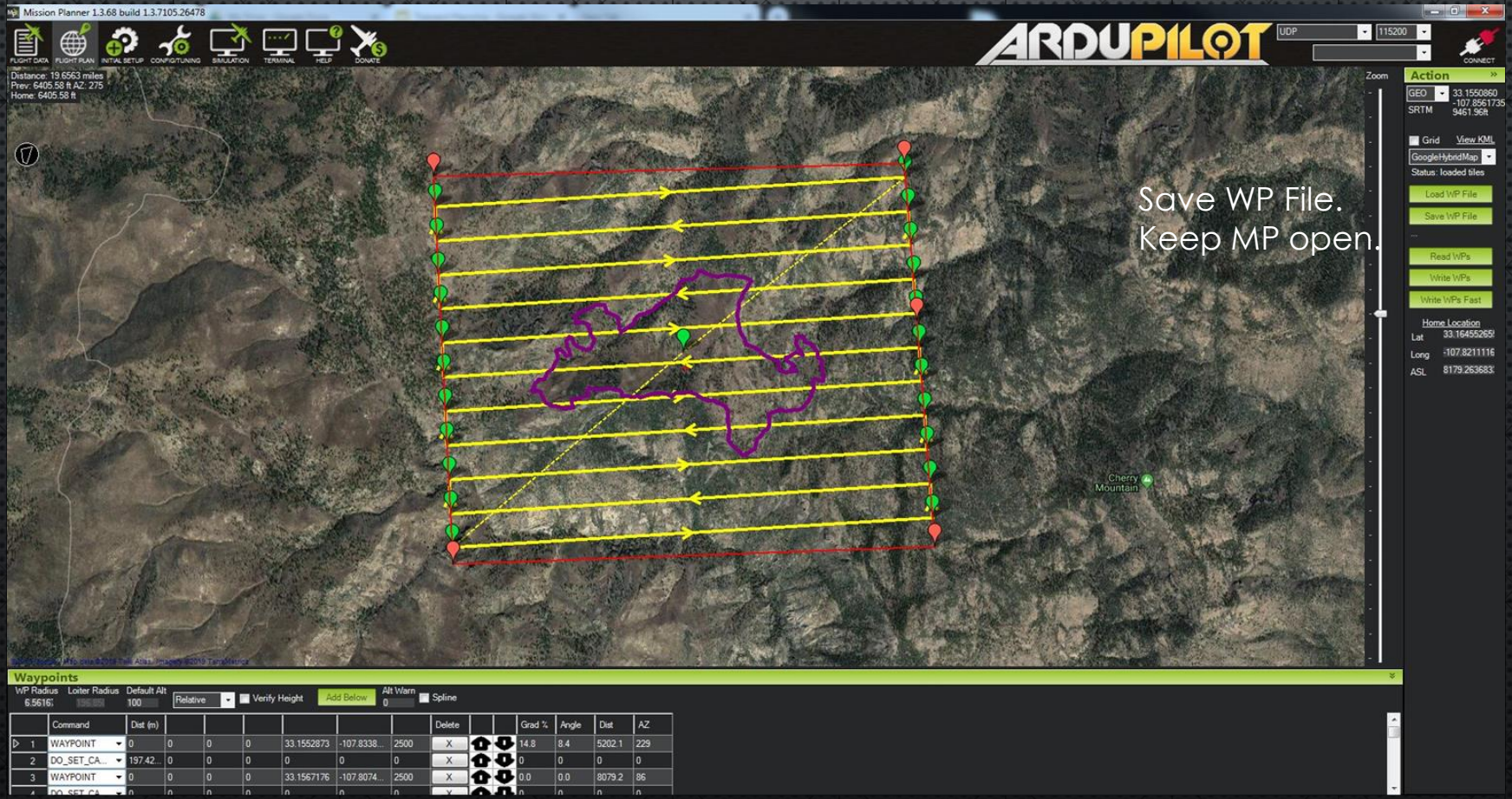
In the bottom right of the window is good information on the flight as it is planned. Note the number of pictures, flight time est, ground resolution and dist between flight lines.

Click Accept when completed

Stats

Area:	1.91 miles^2	Pictures:	143	Flight Time (est):	42:10 Minutes	Min Shutter Speed:	1/237
Distance:	19.68 miles	No of Strips:	11	Photo every (est):	12.62 Seconds		
Dist between images:	647.7 ft	Footprint:	1727.3 x 1295.5	Turn Dia (at 45d):	234 ft		
Ground Resolution:	5.18 inches	Dist between lines:	587.27 ft	Ground Elevation:	7389-9101 ft		

MISSION PLANNER



Save WP File.
Keep MP open.

MISSION PLANNER OUTPUT

Name	Date modified	Type	Size
class.waypoints	11/18/2019 11:51 ...	WAYPOINTS File	4 KB

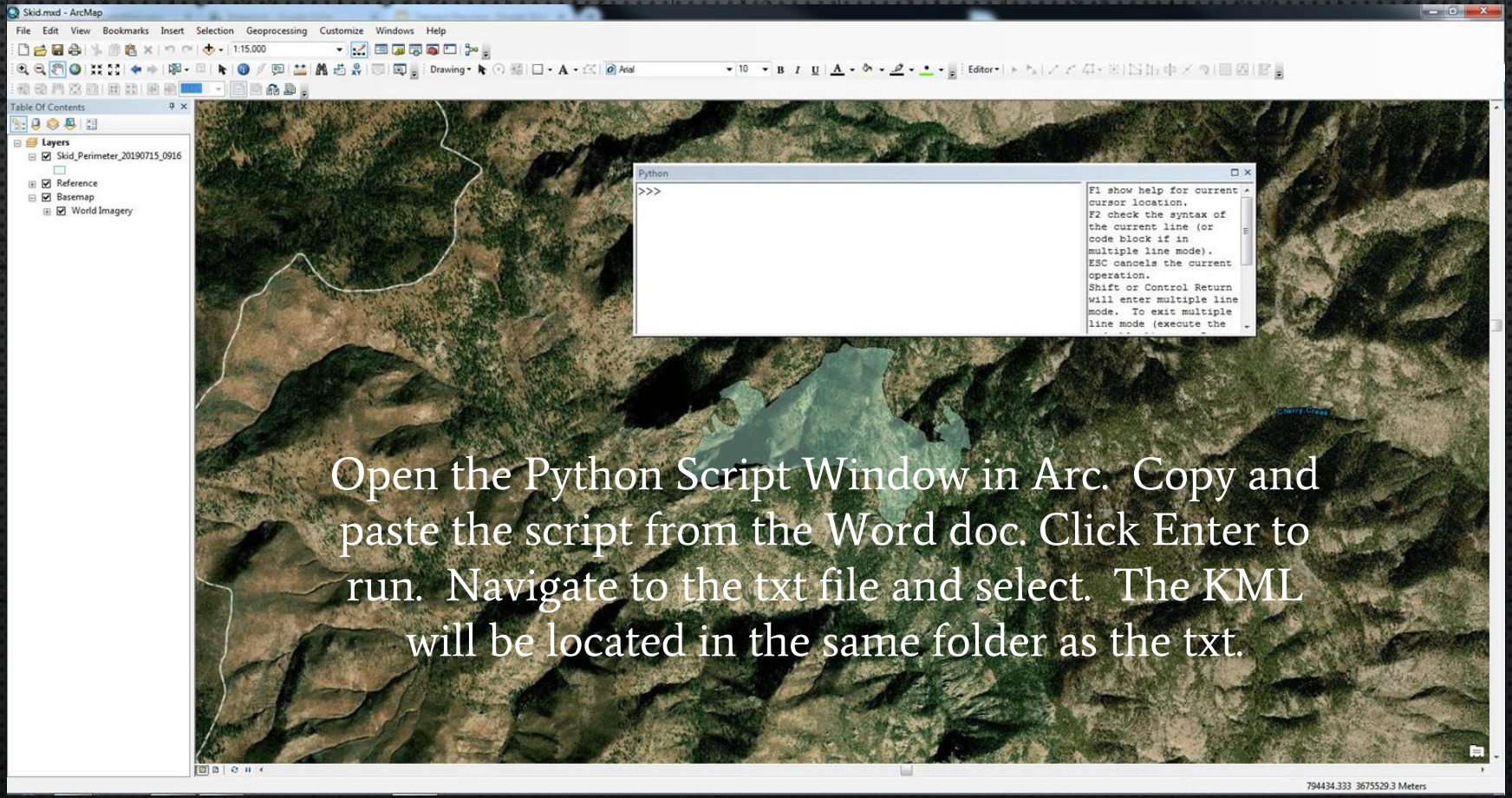
Rename and change the file extension to txt

Name	Date modified	Type	Size
class.txt	11/18/2019 11:51 ...	Text Document	4 KB

SLYDER SCRIPT

Open Arc and locate the Slyder Script for the next steps

SLYDER SCRIPT



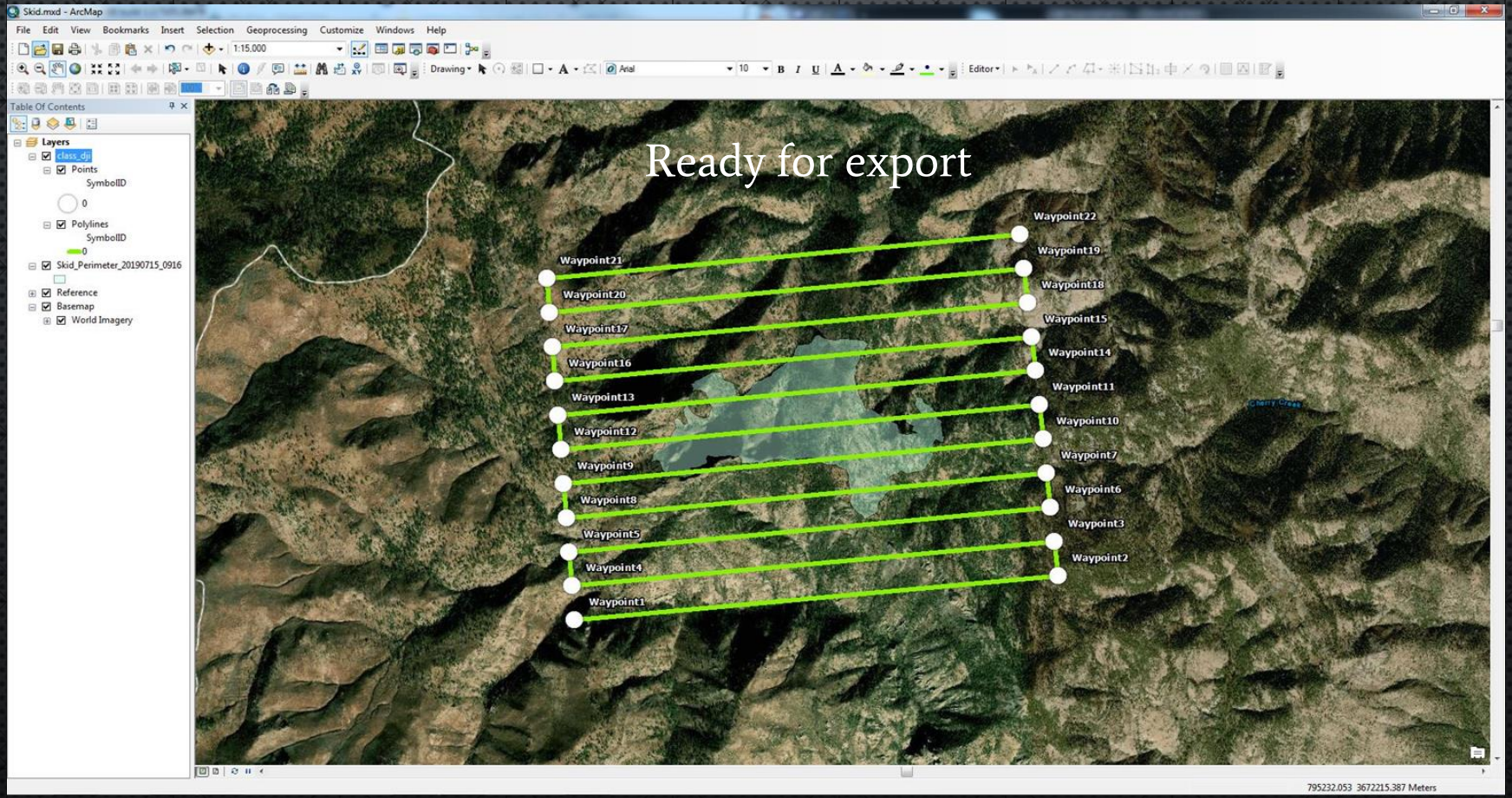
Open the Python Script Window in Arc. Copy and paste the script from the Word doc. Click Enter to run. Navigate to the txt file and select. The KML will be located in the same folder as the txt.

SLYDER SCRIPT

_dji.kml needs converted in Arc using the toolbox

Name	Date modified	Type	Size
class.txt	11/18/2019 11:51 ...	Text Document	4 KB
class_dji.kml	11/18/2019 12:20 ...	KML	15 KB

ArcGIS


Skid.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
class_dji
Points
SymbolID
0
Polylines
SymbolID
0
Skid_Perimeter_20190715_0916
Reference
Basemap
World Imagery
Ready for export
Waypoint22
Waypoint19
Waypoint18
Waypoint15
Waypoint14
Waypoint11
Waypoint10
Waypoint7
Waypoint6
Waypoint3
Waypoint2
Waypoint21
Waypoint20
Waypoint17
Waypoint16
Waypoint13
Waypoint12
Waypoint9
Waypoint8
Waypoint5
Waypoint4
Waypoint1
795232.053 3672215.387 Meters

ArcGIS

From here generate a base map for the GCS so the flight crew has the ability to fly the lines and collect a data set.

TRANSECT PLANNING

- Student can use the Object Distance Spreadsheet
- Student can build a flight plan in Mission Planner
- Student can process the plan to become flight lines in the GCS

TRANSECT PLANNING

- Can these principles be used in other or modified ways?
  - Single Pass
  - Double Pass
  - Small sections of line(Division)

IGNIS APP

Has flight planning capability including mapping

- Has terrain following capability
- Use the ODS to work out parameters
- Input information with the UASP to Ignis app

Questions