GeoCue Support
5/29/2025

Flight Planning

For LIDAR

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Summary

This document provides instructions for planning a flight to be used for LIDAR collection with a small, unmanned aircraft. The first section will provide guidelines for flight planning. Followed by specific instructions for flight planning applications. The first, DJI GS Pro should be used when terrain following is not needed (flat terrain). The second are instructions for using Litchi or a combination of Mission Planner and Litchi when terrain following is needed. The third, Q Ground Control, is used for non-DJI platforms.

General Flight Planning Considerations

Line Spacing

Line spacing should be planned carefully to avoid gaps between flight lines and to ensure the desired coverage is achieved. Line spacing can be quickly calculated using our **TrueView Mission Planning** spreadsheet. Download the spreadsheet from the Downloads -> Notices section in your Reckon account, then use the Line Spacing Spreadsheet section of this document. The three factors that will influence line spacing are flying height, scan angle, and side overlap. These factors are discussed below.

Flying Height

Flying height is aircrafts elevation above the surface being mapped. When planning a LIDAR mission, the flying height should be carefully considered. If the maximum range of the LIDAR is exceeded, then dropouts (no point return recorded) will occur and voids will be present in the point cloud. If scan angle is constant, then the width of the swath (Figure 1) will increase as flying height above the surface increases. Note that surfaces with low reflectivity (wet surfaces, coal, fresh asphalt, etc.) will suffer from dropouts even at lower flying heights. The recommended flying height for the TrueView 410 is 60 meters.

Scan Angle

Scan angle (Figure 1) refers to the angle, off nadir, at which the LIDAR data will be clipped to. The angle is usually expressed as the half angle. So, a scan angle of +40° and -40° produces a total scan angle of 80°. A larger scan angle produces a wider swath width but creates unfavorable incident angles at the edge of the swath. The recommended scan angle is +/-40°.

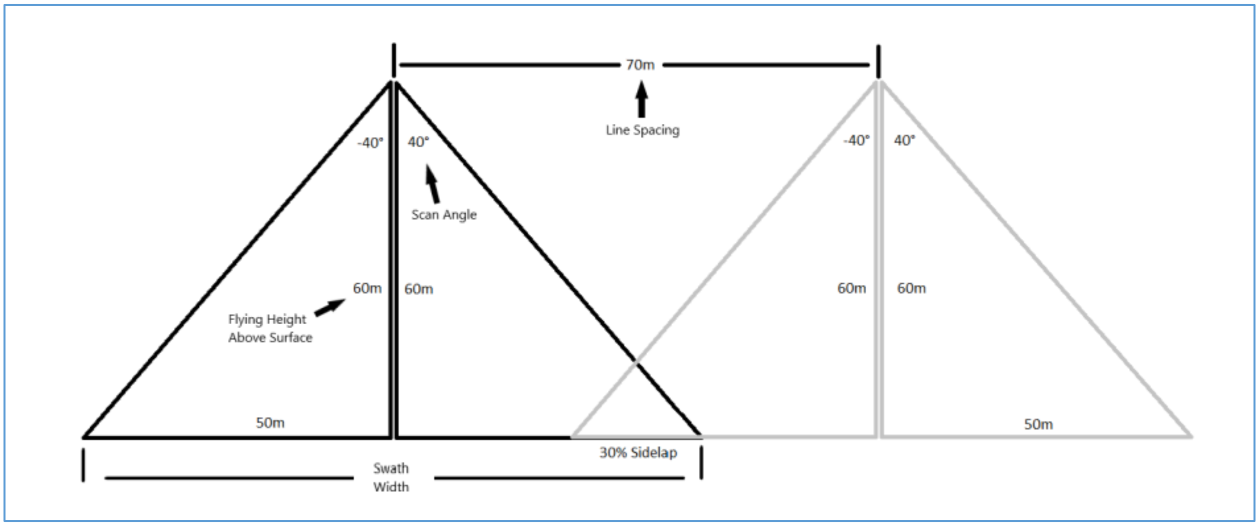

Figure 1 – Flight Planning Parameters Explained

Side Overlap

Side overlap refers to the area between two flight lines where the two swaths overlap. It is important to calculate side overlap into your flight plan for the two reasons listed below:

1. Flight line alignment analysis – The space in between two flight lines represents the same surface in the real world, but the point cloud is mapped from two different locations. If the LIDAR points are plotted correctly, the points in these areas should be at the same elevation. These areas provide a good place to analyze your LIDAR data.
2. Terrain elevation variability – The distance between the LIDAR scanner and the surface will change across the site due to the varying terrain, even when using terrain following. If you recall from the previous sections (Flying Height and Scan Angle) you know that the swath width is a function of the flying height and scan angle. If the terrain beneath the scanner rises closer to the scanner, the swath width becomes narrower, and you risk creating gaps in the LIDAR data between flight lines. Planning side overlap into your flight plan allows for terrain variability to occur without creating gaps in the point cloud.

Side overlap can also be used as a means of increasing point density, which is useful in areas of dense vegetation. The recommended amount of side overlap is 30%, but increasing this to 50% means that the area between flight lines is captured twice and captured from different angles. This allows for a greater opportunity to capture more points beneath heavy vegetation.

Line Spacing Spreadsheet

The TrueView line spacing spreadsheet (available from the Downloads -> Notices section in your Reckon account) is a useful tool to quickly calculate line spacing base on the desired flying height, scan angle, and side overlap. The Line Spacing tab of the spreadsheet is divided into two sections: Swath Width (top section) and Line Spacing based on user defined side overlap (bottom section).

The top table of the spreadsheet (Figure 2) shows the swath width by identifying the half scan angle on the left (vertical) column and the flying height across the top (horizontal) row. The number in the cell where these two intersect is the swath width. The highlighted cells in Figure 2 show a half angle of 40° and a flying height of 60 meters produces a swath width of 100.7 meters. Note that the scan angle is the half angle, but the swath is doubled to reflect the entire swath width when processed at +40° and -40° (total of 80°).

Scan Angle (Half-Angle) (Degrees)	Swath Width for Given Altitude & Scan Angle												
	20	25	30	35	40	45	50	55	60	65	70	75	<= Altitude (Meters)
5	3.5	4.4	5.2	6.1	7.0	7.9	8.7	9.6	10.5	11.4	12.2	13.1	
10	7.1	8.8	10.6	12.3	14.1	15.9	17.6	19.4	21.2	22.9	24.7	26.4	
15	10.7	13.4	16.1	18.8	21.4	24.1	26.8	29.5	32.2	34.8	37.5	40.2	
20	14.6	18.2	21.8	25.5	29.1	32.8	36.4	40.0	43.7	47.3	51.0	54.6	
25	18.7	23.3	28.0	32.6	37.3	42.0	46.6	51.3	56.0	60.6	65.3	69.9	
30	23.1	28.9	34.6	40.4	46.2	52.0	57.7	63.5	69.3	75.1	80.8	86.6	
35	28.0	35.0	42.0	49.0	56.0	63.0	70.0	77.0	84.0	91.0	98.0	105.0	
40	33.6	42.0	50.3	58.7	67.1	75.5	83.9	92.3	100.7	109.1	117.5	125.9	
45	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	
50	47.7	59.6	71.5	83.4	95.3	107.3	119.2	131.1	143.0	154.9	166.8	178.8	
55	57.1	71.4	85.7	100.0	114.3	128.5	142.8	157.1	171.4	185.7	199.9	214.2	
60	69.3	86.6	103.9	121.2	138.6	155.9	173.2	190.5	207.8	225.2	242.5	259.8	

Figure 2 – Swath Width Planning Table

The bottom portion of the spreadsheet (Figure 3) allows the user to enter the desired side overlap as a percentage, press enter, and the line spacing is updated in the spreadsheet. The highlighted cells in Figure 3 show a half scan angle of 40°, flying height of 60 meters, and a percentage side overlap of 30%. This produces a line spacing of 70.5 meters. This is the number we will use when planning our flight. For practical purposes, the exact number does not have to be used so we will round down to 70 meters.

Scan Angle (Half-Angle) (Degrees)	Line-to-Line Spacing for %Overlap for Above Swath Width												30.0%
	20	25	30	35	40	45	50	55	60	65	70	75	<= Altitude (Meters)
5	2.4	3.1	3.7	4.3	4.9	5.5	6.1	6.7	7.3	8.0	8.6	9.2	
10	4.9	6.2	7.4	8.6	9.9	11.1	12.3	13.6	14.8	16.0	17.3	18.5	
15	7.5	9.4	11.3	13.1	15.0	16.9	18.8	20.6	22.5	24.4	26.3	28.1	
20	10.2	12.7	15.3	17.8	20.4	22.9	25.5	28.0	30.6	33.1	35.7	38.2	
25	13.1	16.3	19.6	22.8	26.1	29.4	32.6	35.9	39.2	42.4	45.7	49.0	
30	16.2	20.2	24.2	28.3	32.3	36.4	40.4	44.5	48.5	52.5	56.6	60.6	Enter Side Overlap percentage here
35	19.6	24.5	29.4	34.3	39.2	44.1	49.0	53.9	58.8	63.7	68.6	73.5	
40	23.5	29.4	35.2	41.1	47.0	52.9	58.7	64.6	70.5	76.4	82.2	88.1	
45	28.0	35.0	42.0	49.0	56.0	63.0	70.0	77.0	84.0	91.0	98.0	105.0	
50	33.4	41.7	50.1	58.4	66.7	75.1	83.4	91.8	100.1	108.4	116.8	125.1	
55	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	
60	48.5	60.6	72.7	84.9	97.0	109.1	121.2	133.4	145.5	157.6	169.7	181.9	

Figure 3 - Sidelap

Optimizing IMU Data

The heading alignment maneuver is important for getting accurate orientation values from your sensor, and this maneuver is covered in detail in the applicable TrueView Hardware User Guide for your 3DIS model. In addition to the heading alignment maneuver, it is important to create a mission plan that optimizes the IMU output for improved LIDAR accuracy.

Box Turns

At the end of each flight line, the drone will change headings and transition to the next flight line. To optimize accuracy, perform box-turns at the ends of flight lines. These are highly efficient turns that also keep the heading aligned. Some flight planning applications attempt to create rounded turns to avoid stopping and save time, but box-turns are better for IMU output. A box turn (Figure 4) can be described as follows:

- At the end of a flight line quickly coming to a hover
- Rotate about the Down axis by +/-90 deg
- Accelerate to the start of the next line and come to a hover
- Rotate about the Down axis by +/- 90
- Accelerate and fly the next line

Figure 4

Short Flight lines

Heading drift occurs when the IMU does not experience acceleration/deceleration or heading changes. When an aircraft is flying along a flight line, it is flying at a constant speed and heading so it is susceptible to heading drift which results in inaccurate LIDAR data. To avoid this, plan your mission so the flight lines do not exceed 500 meters in length. This may require multiple overlapping flight plans to cover the project.

Optional Heading Alignment Maneuver in Flight Line

Short flight lines may not always be a solution for some projects, corridor missions being one example. For these types of projects, the heading alignment maneuver can be planned into the flight line. The following information reviews how to perform this, but this is strictly optional and does not need to be performed in most cases. This can be performed if it is observed that much higher than normal dynamic trajectory issues that are not fully correctable by point cloud registration (Strip Adjustment or Strip Alignment) are present in the dataset or if higher quality data in this regard is required. This is ordinarily not the case and point cloud registration resolves any dynamic trajectory issues seen in the data. If it has been determined that this operation is required: Figure 5 shows how this mid-flight line heading alignment maneuver may look. In this example, the aircraft is traveling north to point 2, then turns 90° and accelerates to point 3. From point 3 it will travel back down line to point 4, where it will continue along the planned flight line.

Figure 5

Note: It is recommended to include control/cross strips in every LIDAR flight for QAQC purposes. This is reviewed in Figure 11 later in this document.

Boresite Calibration

If you wish to fly a boresite calibration flight to verify the sensor calibration or when deemed necessary for the recalibration of a system, we recommend a flight similar to those shown in Figure 6, Figure 7, and Figure 8. We fly these at 60m AGL. Please arrange the flight, so the flight lines (especially the crossing lines) are placed over areas of buildings with sloped roofs or ground. Notice in the example below, the crossing flight lines are setup over a building with a pitched roof. A 30-55° slope is preferable. It is not important that the flight be oriented north/south, it just happens to be that way for our shop building. The flight lines should be parallel or perpendicular to the centerline of the building roof top, or other such sloped features, where you are flying. Send us a copy of your proposed flight plan and we can verify its suitability for you.

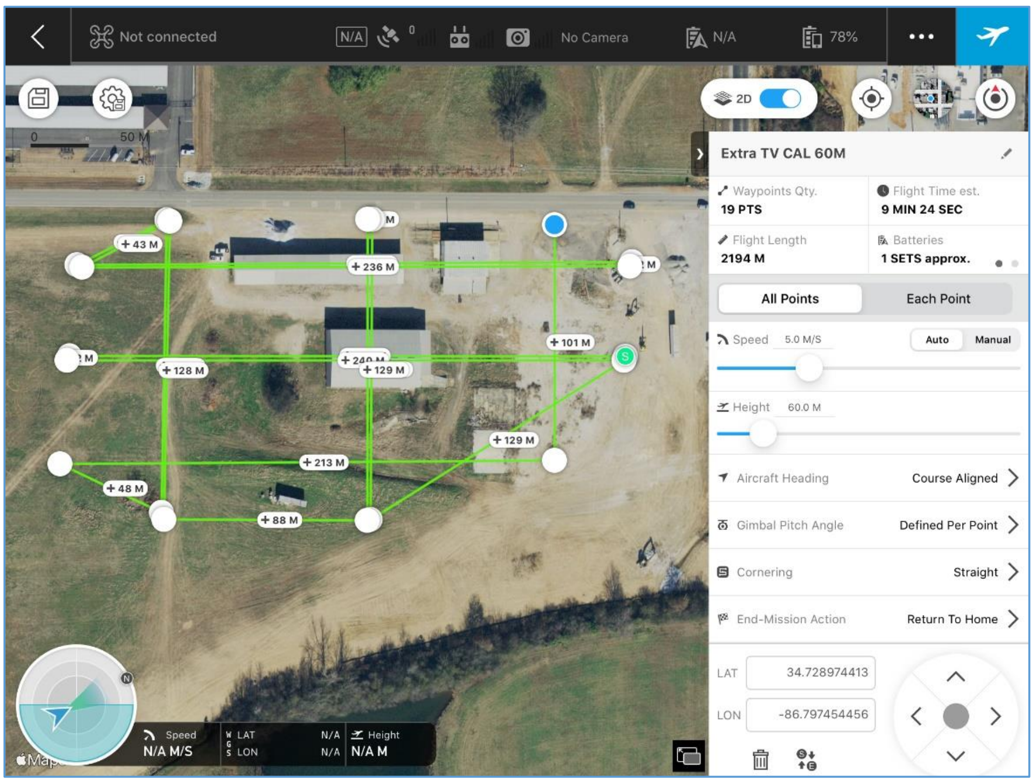

Figure 6 - Calibration Flight Plan

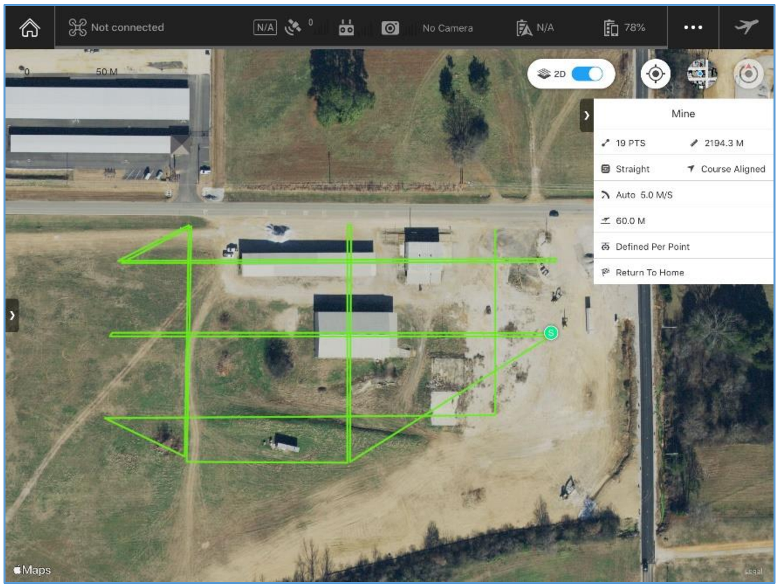

Figure 7 - Calibration Flight Plan Parameters

Below is a screenshot of the typical calibration flight we perform for every sensor. The starting point is labeled with a green "S" which I have labeled point 1 in the screenshot. The drone flies West along the centerline of the building rooftop to point 2. The drone heading then rotates 180° and flies east back along the centerline of the building rooftop to point 3. Then travel south west to point 4, turn north, and fly to point 5. Rotate the heading 180° and then fly back south to point 6. Then to point 7 and so on until the flight is complete, ending at point 16.

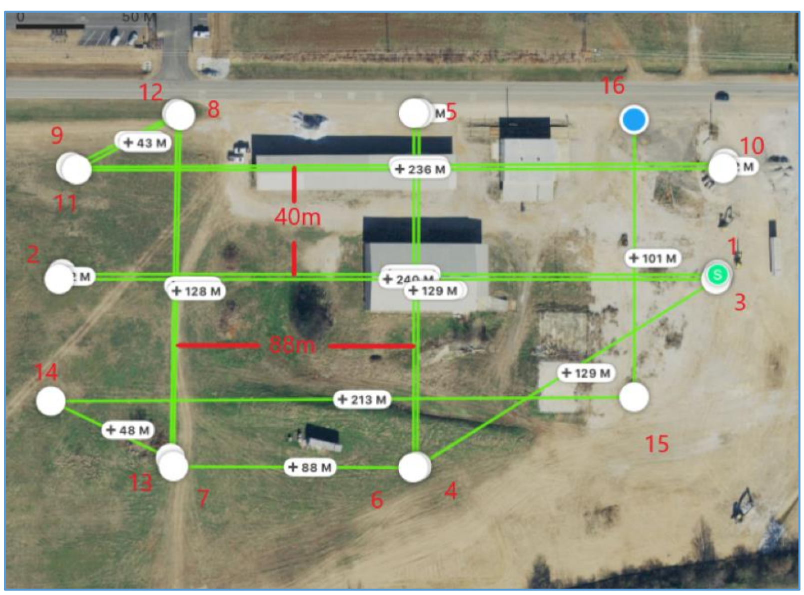

Figure 8 - Calibration Flight Plan

Flight Planning Applications

DJI GS Pro

DJI GS Pro is a flight planning tool that allows the user to layout the desired path of the flight. This application does not have the ability to maintain a constant elevation above the terrain, so this application should only be used on flat terrain. Using this application, the aircraft will maintain a constant elevation above takeoff for the entire mission.

Now that we have calculated our line spacing, we can open GS Pro and plan a mission.

1. Open DJI GS Pro and tap the plus sign to create a new mission.
    a. Note: “My Missions” may need to be tapped first depending on which menu is available.
2. Select “Waypoint Route” as the mission type and navigate to the flight area on the map.
3. Tap on the screen where you want the first flight line to begin (Waypoint 1).
4. Tap a second time where you want the first flight line to end (Waypoint 2).
5. Tap a third time to start the beginning of the second flight line (Waypoint 3). This point should be perpendicular to the first flight line. The distance between the two points should be displayed. Drag the third point until the distance between the second and third point matches our desired line spacing.
6. Place a fourth point to form the second flight line. This flight line should be parallel to the first flight line.
7. Continue with this pattern until the entire mission area is covered.
8. Set the heading to following the flight path.
9. Set the altitude to the desired flying altitude.
10. Set the flying speed to 5 m/s.
11. Set the “End Mission Action” to Return-to-Home (RTH) and set the RTH altitude.
12. Save the mission.

Litchi

Litchi is a flight planning application that allows the user to fly the drone from one planned waypoint to the next. Litchi has a built-in elevation database that will help the aircraft maintain a constant elevation above the terrain. Litchi does not have the ability to create a grid mapping mission, so users will have to place each waypoint like the method in GS Pro, or a grid mission can be created in mission planner and imported into Litchi. This section will describe how to manually create a flight plan in litchi. See the Mission Planner + Litchi section of this document to create a grid flight plan that can be imported into Litchi.

Litchi’s functionality can be divided into two parts: Mission Hub and the mobile application. Mission hub is an online mission planning tool that makes adjusting our flight plan easier. The flight plan is then synced with our account, which can be imported to the mobile app when ready to execute the mission.

Creating a mission in Mission Hub

1. Open Mission Hub and log in to your account.
2. Click settings and set the settings shown in Figure 9. Close when finished.

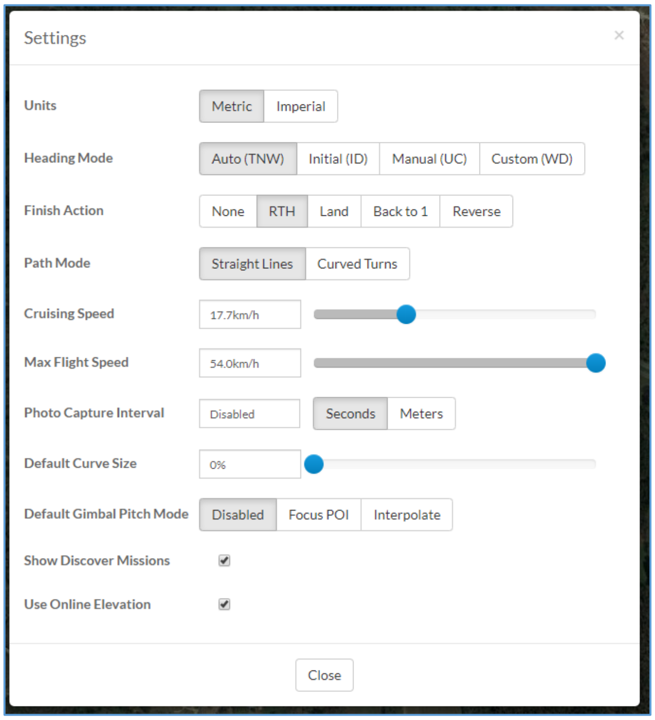

Figure 9 – Example Mission Hub Settings

3. Navigate to your flight area on the map.
4. Click on the map where you plan to launch the aircraft from. This will create waypoint 1.
5. Click the map where the first flight line will begin to create waypoint 2 (Figure 10). Waypoints can be selected by clicking on it until it turns green, then drag it to refine its positions on the map.
6. Click on the map where the first flight line will end to create waypoint 3 (Figure 10). This will form the first flight line.
7. Click on the map where the second flight line will start to create waypoint 4 (Figure 10). The line between point 3 and 4 should be perpendicular to the first flight line and should be the same distance as our desired line spacing (70 meters for this example). Click the waypoint 4 to select it, then drag and drop it to refine its position and distance from waypoint 3.
8. Click on the map where the second flight line will end to create waypoint 5 (Figure 10). Flight line 2 should be parallel to flight line 1, so click on waypoint 5 and drag it on the map until they are parallel.

Figure 10 – Line Spacing in Mission Hub

9. Repeat these steps until the entire mission area is covered by the flight plan. Be sure the flight plan extends beyond the survey area so that data voids are not created in the survey area.
10. Plan one cross strip that intersects all flights lines at a perpendicular angle (Figure 11). Ideally, this line would cross over a building roof top.
11. Click and place the last waypoint at the takeoff location so the drone will fly back to the takeoff location when the mission is complete. This last point is illustrated as waypoint 15 in Figure 11

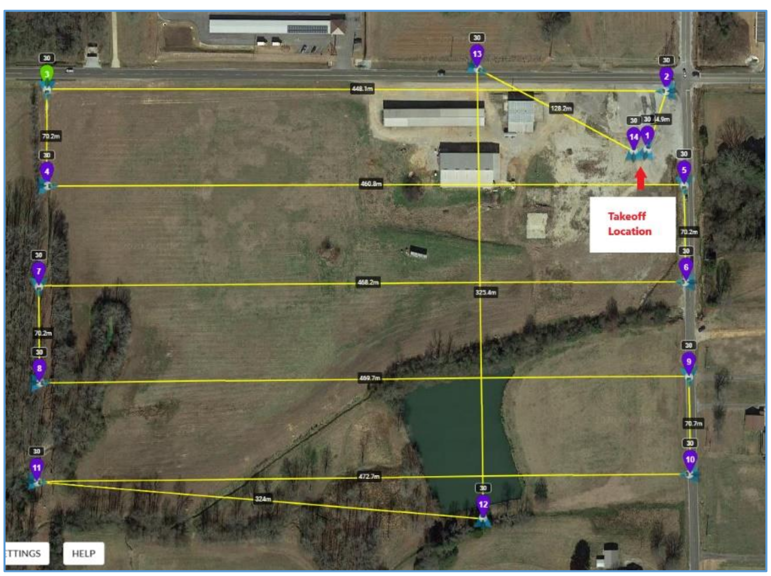

Figure 11 – Set the final waypoint to the takeoff location. Flight plan illustrates North/South control/cross strip included.

12. The next step is to add waypoints in areas where elevation change occurs. The aircraft will only ascend or descend from one waypoint elevation to the next, so it is important to add waypoints along the flight line where elevation changes occur.

a. Example: The elevation of waypoint 2 is higher than waypoint 3, so the aircraft will gradually descend along the flight line from waypoint 2 to the elevation of waypoint 3 (Figure 12). For the sake of this explanation, pretend that the terrain is relatively flat from waypoint 2 along the gravel area but rapidly drops in elevation over the grass along the flight line (Figure 13). A waypoint should be added in this area so the drone will fly relatively flat until it reaches the grass, then begins descending to the end of the flight line. This will allow the drone to maintain a constant elevation above the terrain. Figure 14 shows the dangers of not placing enough waypoints at the points of elevation change. In Figure 14, the drone would fly directly from waypoint 1 to waypoint 2 and crash into the ground if it is not told to climb or descend at the correct location. Step 11 begins the process of adding points along flight lines.

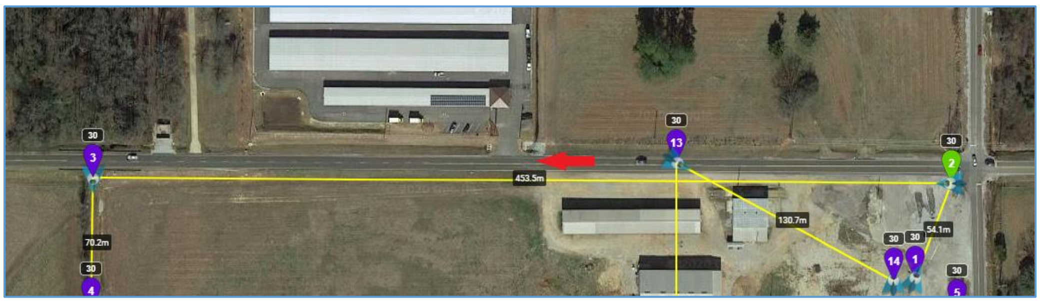

Figure 12 – Linear descent between waypoints

Figure 13 – Insert waypoint to control area of elevation change

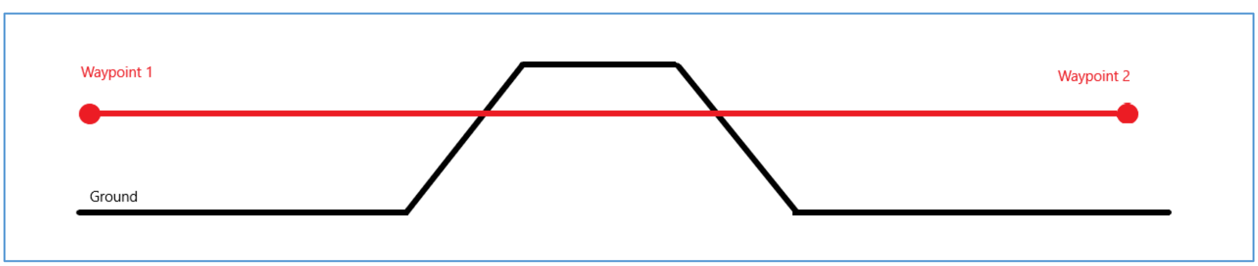

Figure 14 – Illustrating dangers of insufficient waypoints along elevation change

13. Click on waypoint 2 to select it. It should turn green when it is selected and the waypoint setting dialog should appear (Figure 15) if it is not already visible.

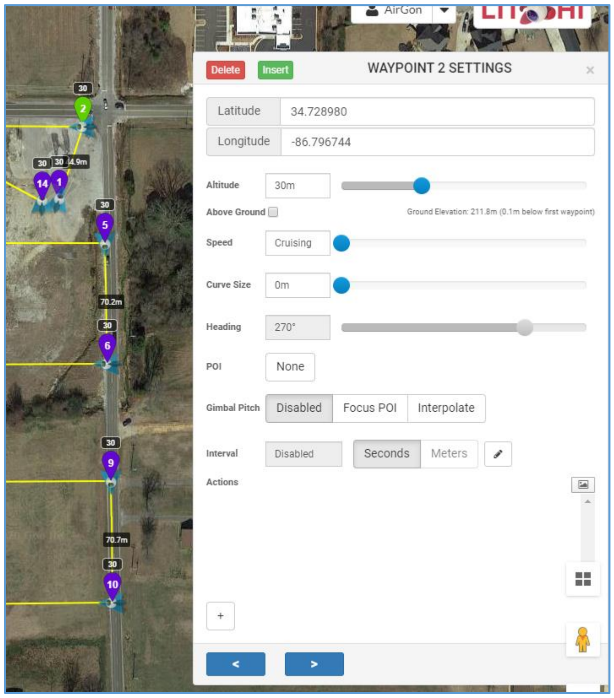

Figure 15 – Waypoint Setting Dialog

14. Click *Insert* and a waypoint will be added halfway between waypoint 2 and waypoint 3. The waypoints will be renumbered so the new waypoint becomes waypoint 3, and the end of the flight line becomes waypoint 4 (Figure 16). The new waypoint can be selected and dragged to the correct location where elevation change occurs. Be sure to keep the new waypoints in a straight line so the correct line spacing is maintained. Multiple waypoints may need to be added along a flight line to correctly model the elevation profile along the flight line.

Figure 16

15. Continue this process for the entire mission, placing new waypoints along the areas where elevation change occurs.
16. When all waypoints have been added, the next step is to adjust the waypoint elevations to Litchi's built-in elevation database.

17. Click on any waypoint in the mission to select it. The waypoint will turn green when selected.
18. Hold CTRL, then select a second waypoint. The waypoint settings dialog becomes the batch settings dialog (Figure 17), allowing the user to change the settings of multiple points.
19. Click *Select All* (Figure 17, step 19) at the bottom of the batch settings dialog to select all points in the mission. All waypoints should be green.
20. Enter the flying height in the altitude box (Figure 17, step 20).
21. Check the box next to "Above Ground" (Figure 17, step 21).
22. Click apply when finished.

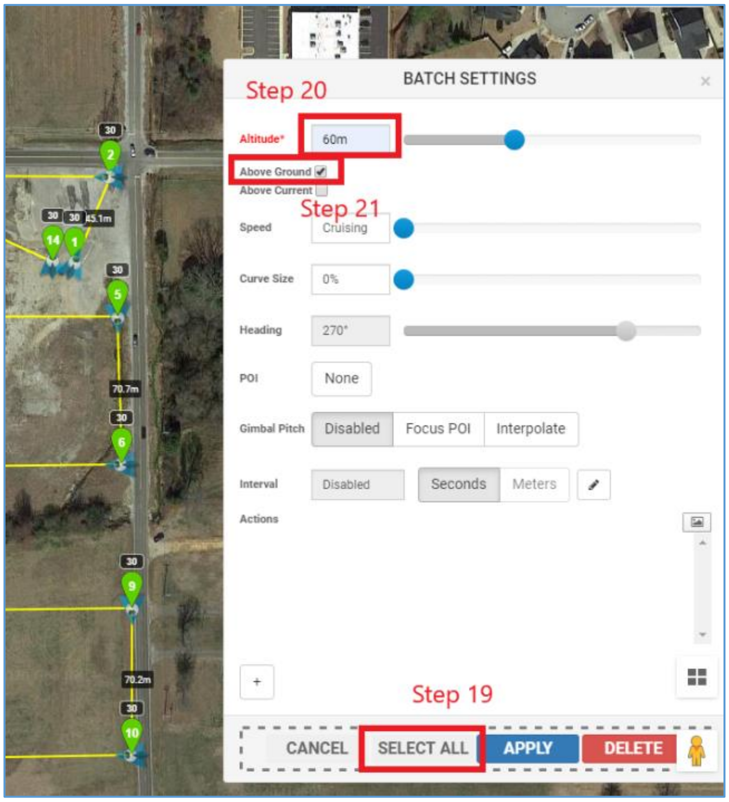

Figure 17 – Adjust Waypoint Elevations

23. All point elevations should now be adjusted. Each waypoint should now have two elevations associated with it. The elevation highlighted in yellow represents the elevation above the ground elevation. The elevation in parentheses (white) represents the elevation above the takeoff elevation.
    a. Zoom in to waypoint 1 to see the new elevations displayed on the map (Figure 18). Both elevations should be the same here because the takeoff elevation and the above terrain elevation are the same (60 meters).
    b. Zoom in to a different waypoint in the flight plan. For our example, we have zoomed in to waypoint 11 (Figure 19). The above ground elevation is 60 meters, which we set for each waypoint in step 20. The elevation above takeoff is 54.2 meters. This means the surface elevation at waypoint 11 is 5.8 meters lower than waypoint 1 (takeoff elevation).

Figure 18

Figure 19

24. Examine each waypoint for elevation errors and adjust if necessary.
25. Once you are satisfied with the mission plan, click *Missions*, then *Save*, then give the mission a name.
26. Once the mission is saved, it can be loaded to the mobile app by logging in to your account on the mobile app.

Loading the Mission on the Mobile App

27. Open Litchi on your iPad or mobile device.
28. Login into your Litchi account in the mobile app. (An internet connection is required).
29. Click the folder icon and scroll to the mission you wish to fly.
30. Tap *load.*
31. The mission should be plotted on the screen. Press the play button when the mission is ready to be uploaded to the aircraft.
32. You will be prompted to enter the waypoint number you wish to start from. If you are starting the mission from the beginning, enter waypoint 1. If you are trying to resume from a previous waypoint, enter the waypoint number you wish to start from.

Mission Planner + Litchi

Mission planner is a flight planning app that creates a grid flight plan based on the user's settings and polygon outline. We use mission planner to create the horizontal flight grid but since it does not have terrain following, we will create a waypoint file that can be imported into Litchi.

Mission Planner

Initial Setup

The initial setup requires setting up a fake camera model that Mission Planner will use to calculate our line spacing. If the camera model has been previously configured, skip to Planning a Mission.

1. Download and install mission planner from this link: http://firmware.ardupilot.org/Tools/MissionPlanner/
2. Open Mission Planner and click the "Flight Plan" icon at the top of the screen.
3. Zoom in to anywhere on the map. The location is not important at this point because we are only setting up a camera model which will be saved for later use.
4. Right click on the map a select "Draw Polygon" then "Add Polygon Point".
5. Continue to left-click until a polygon is formed.
6. Right click inside the polygon and select Auto Waypoint> Survey Grid. The Survey (Grid) window should open with yellow flight lines visible inside of your polygon.
7. In the upper right corner of this window, you should see three tabs: Simple, Grid Options, and Camera Config.
   a. If Grid options and Camera config are not visible, check the Advanced Options box.
8. On the simple tab, set the altitude of the flight. For our example, we will use 60m.
9. On the "Grid Options" tab, set the sidelap to 30.
   a. Notice the "Distance between lines" at the top of this tab. This distance cannot be set directly, but we can adjust it with other settings.
10. On the camera config tab, set the values as shown in Figure 20.

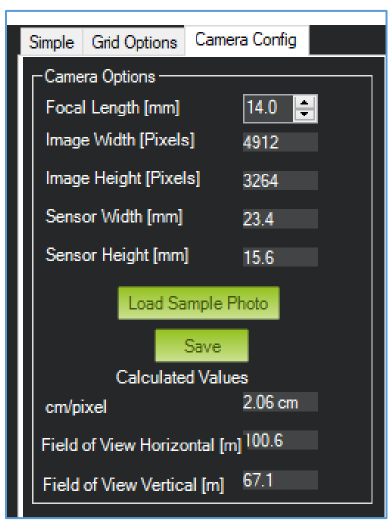

Figure 20 – Mission Planner Camera Config tab

11. Check the distance between flight lines on the Grid options tab and make sure it matches our desired line spacing. If not, adjust the focal length on the Camera config tab until the desire flight spacing is achieved. The values in Figure 20 will allow us to adjust the flight altitude while maintaining 30% side overlap.
12. Save the camera model and name it “LIDAR Scanner”. Mission Planner can now be closed.

Note: If planning for camera, a sample photo can be loaded (Figure 20**) to create a grid mission based on the camera properties.**

Planning A Mission

13. Open Mission Planner and click the “Flight Plan” icon at the top of the screen.
14. Zoom in to the area where the mission will be performed.
15. Right-click on one corner of the mission area and click Draw Polygon -> Add Polygon Point.
16. Click at each corner of the project area the create a polygon around the flight area.
17. Right-click inside the polygon and select Auto WP -> Survey (Grid).
18. The Survey (Grid) window should open with yellow flight lines visible inside of your polygon.
19. On the simple tab, select the camera model for “LIDAR – 30%” and enter the flying altitude. Adjust the angle if needed.
20. Now check the distance between lines on the Grid options tab to verify the correct spacing.
21. Once the mission settings are correct and you are happy with the flight plan, click “Accept” at the bottom of the simple tab.
22. Click “View KML” (Figure 21) on the right side of the screen to download the KML file.
23. After the KML file has downloaded, move it to a planning folder associated with this project.

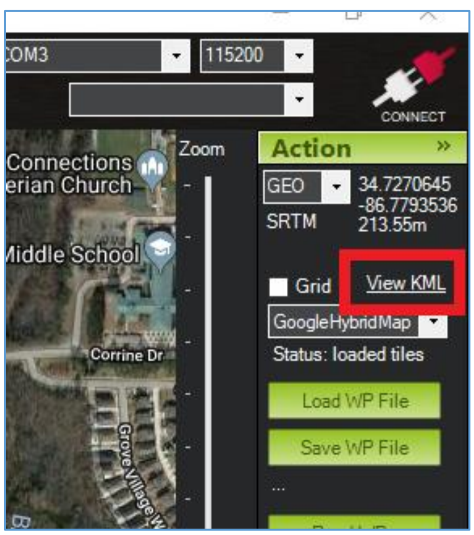

Figure 21 – Mission Planner - View KML

24. Right-click on the kml file and open with notepad++.
25. Double-click the link at the bottom with WPS in the name (Figure 22).

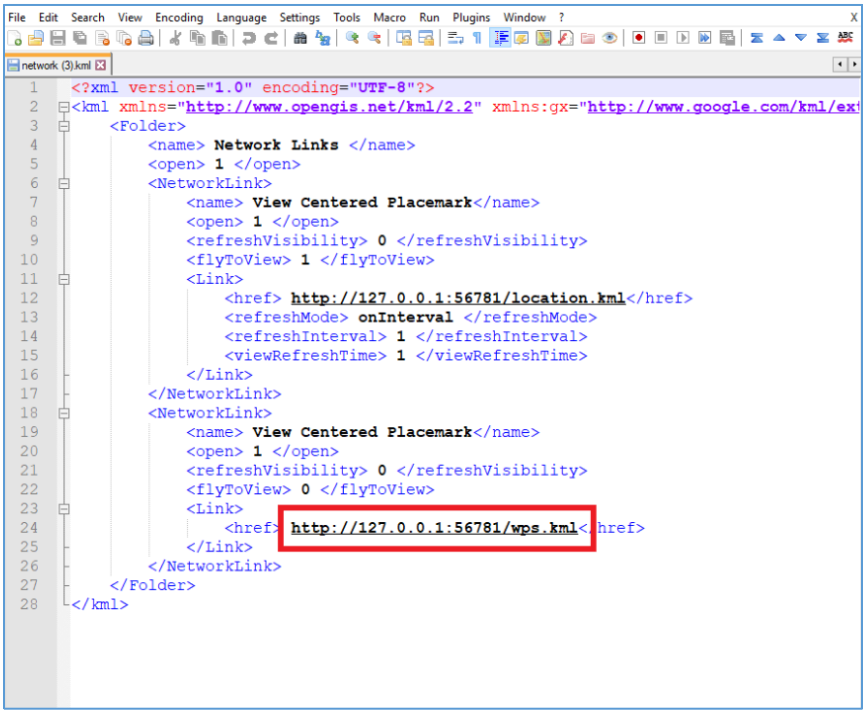

Figure 22 – Link in KML file

26. A file named wps.kml should be downloaded. Move this file into your project planning folder. This file will be imported into Litchi.

Litchi

Litchi is a flight planning app that allows the user to fly the drone from one planned waypoint to the next. Litchi has a built-in elevation database that will help the aircraft maintain a constant elevation above the terrain. Litchi was primarily developed for photographers and videographers, so it does not have the ability to create evenly spaced flight lines. For this reason, we have created the wps file from mission planner that contains the waypoints of our grid flight plan.

Litchi's functionality can be divided into two parts: Mission Hub and the mobile application. Mission hub is an online mission planning tool that makes adjusting our flight plan easier. The flight plan is then synced with our account, which can be accessed by the mobile app when ready to execute the mission.

Initial Setup

27. Download Litchi to the mobile device that will be used when flying the mission.
28. Create an account and login to Mission Hub.
29. Click "Settings" to set our default settings. Use the settings as shown in Figure 23 then close.

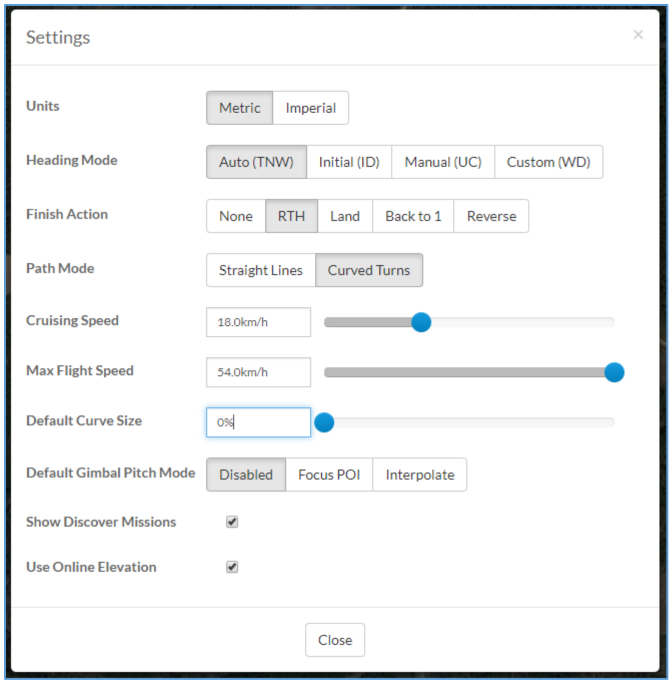

Figure 23 - Settings

Planning a Mission

Now we will import the wps.kml file we created earlier in Mission planner.

30. Click Mission -> Import.
31. Choose the wps file created in mission planner and click “Import to New mission”.
    a. The flight plan should now be visible.
32. Notice the waypoint numbers are more than the number of planned waypoints. This is because three sets of points are created in the WPS file. We need to delete the two extra sets before we begin editing the mission.
33. Click on one of the waypoints to select it. Click the right arrow (Figure 24) to move to the next highest waypoint. Continue until you have reached the highest numbered waypoint. The selected waypoint is shown at the top of the waypoint setting dialog.

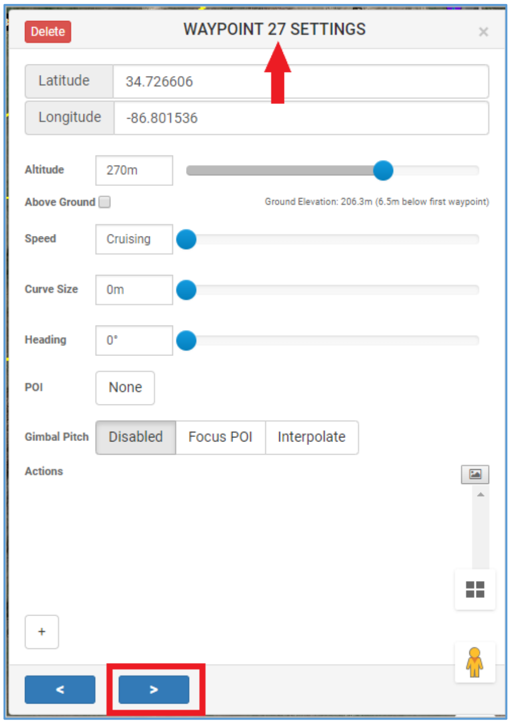

Figure 24 – Waypoint Settings

34. Click delete until two sets of waypoints have been deleted, leaving only one set.
35. While one waypoint is selected, press and hold CTRL while selecting a second point. Once the second point is selected, click select all at the bottom of the waypoints settings dialog.
36. Set the altitude of the mission, then check the box next to "Above Ground". This will adjust the waypoint elevation so that it is the specified altitude above the ground at its location.
37. Click Apply all.
38. Click Waypoint 2 and then click the left arrow to select waypoint 1.
39. The speed selected for waypoint 1 is the speed the drone will use to fly to waypoint 2. For waypoint 1, set the speed to max (54 km/h). The drone will fly from waypoint 1 to waypoint 2 at 54 km/h. Check to be sure the correct flying height is set and "Above ground" is checked.
40. Click the right arrow to move to waypoint 2.
41. Waypoint 2 is the beginning of our first flight line. We want the aircraft traveling at 5 m/s along the flight path for optimal point density. Because of this, we will check to be sure the speed of waypoint 2 is set to 5 m/s (18km/h). Also check the altitude above ground. The aircraft will fly from point 2 to point 3 at 5 m/s (18km/h). Point 3 will start the transition from line 1 to line 2. This data will not be used when processing, so the speed of the transition can be set to 54 km/h.
42. Repeat this process so that each flight line is flown at 18km/h and the transition lines are flown at 54 km/h. The return path home can also be set to 54km/h.
43. Save the mission and give it a unique name. This mission will save to the account and will be selected in the field from the mobile app.

Q Ground Control – Waypoint Flight Planning

Planning a mission in Q Ground Control can go one of two routes – Waypoint Mission and Survey Mission. Planning a Waypoint mission gives you total control over every waypoint including speed, height, waypoint action, etc. It also makes it possible to add the cross-flight line for TrueView flight line alignment analysis. This section shows how to create a Waypoint mission.

1. Open Q Ground Control and navigate the map to your flight area.
2. Click the “Plan” button on the left side of the window to bring up your planning options (Figure 25).

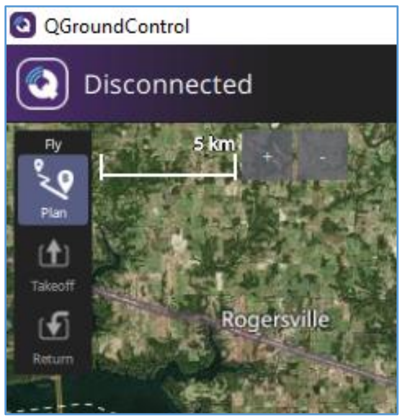

Figure 25: Q Ground Control Startup Options

3. Select “Blank” as we will be manually setting each waypoint for maximum control.
4. There will be a “Mission Start” menu on the right side of the page. This is basically your mission settings that will be applied to all waypoints. Set the initial waypoint altitude to your planned mission flying height. Set the Flight Speed to 5 m/s (11.2 mph). The camera and Vehicle Info settings are irrelevant. Launch position should be automatically set to the ground level.

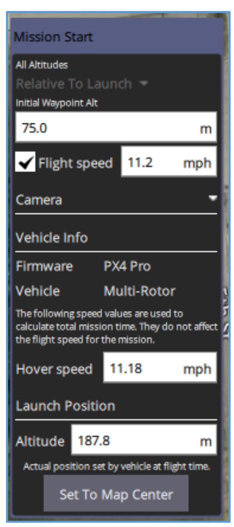

Figure 26: Mission Start Options

5. Q Ground Control likes to establish a takeoff point. To do so, select “Takeoff” on the left menu and place it in the area you plan on taking off from. This does not have to be exact. Once the takeoff waypoint is placed, you will see a Takeoff waypoint setting on the right side. Verify the altitude is your planned flying height.

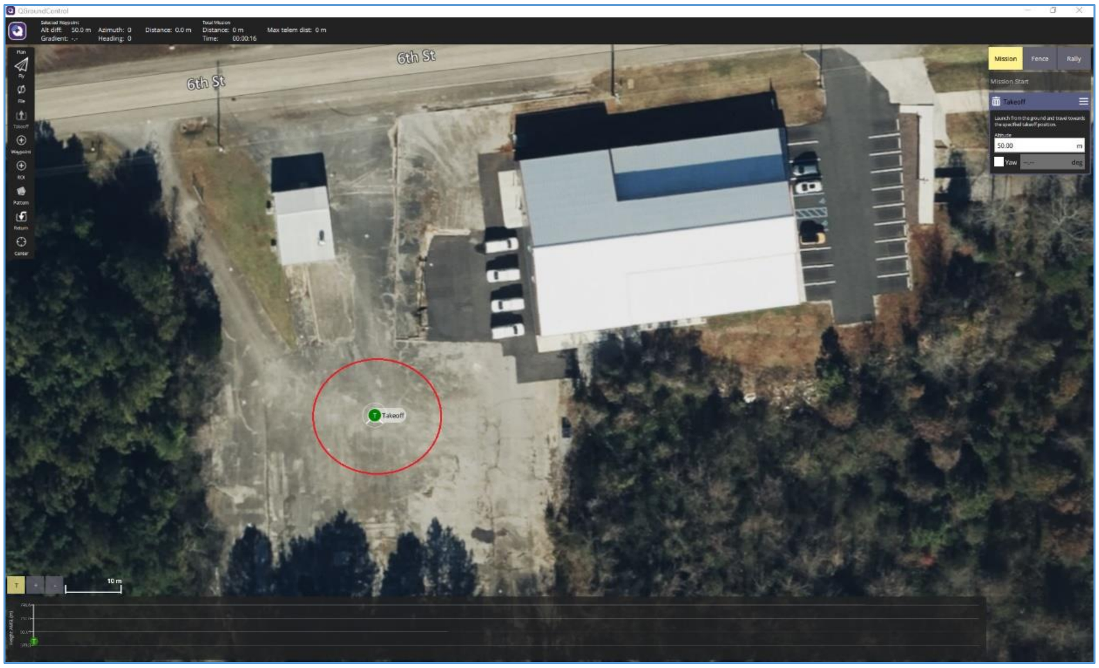

Figure 27: Takeoff Location

6. Click “Waypoint” on the left menu.
7. To place the waypoints, simply left click on the positions you would like them to be. The distance each selected waypoint is from the previous is in the upper left corner of the window. This is used to measure the line spacing distance.

Figure 28: Distance from Waypoint 3 to Waypoint 4 is shown at the top left of the window.

8. To ensure the line is perpendicular, we recommend measuring the distance from the ending waypoint of the flight line to the previous flight line. In this situation, we are making sure the distance between waypoints 5 and 6 match the distance between 3 and 4 (circled – figure 29). Once measured, waypoint 6 can be moved to start the next flight line.

Figure 29: perpendicular flight lines

9. Repeat these steps until the entire mission area is covered by the flight plan. Be sure the flight plan extends beyond the survey area so that data voids are not created in the survey area.
10. Plan one cross strip that intersects all flights lines at a perpendicular angle. Ideally, this line would cross over a building roof top, vertical feature, etc.

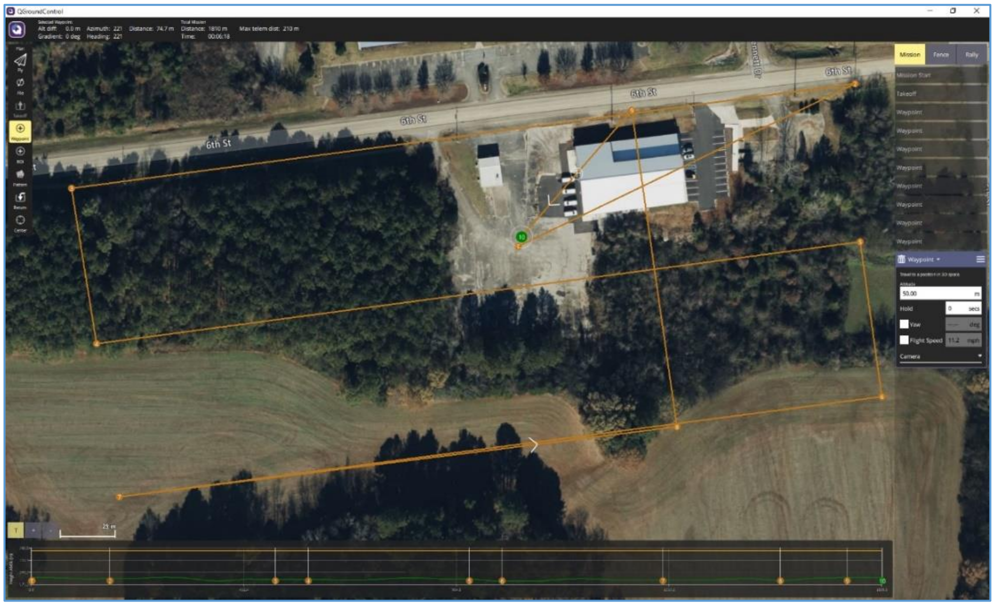

Figure 30: The completed mission

11. Click and place the last waypoint at the takeoff location so the drone will fly back to the takeoff location when the mission is complete.
12. All the waypoints should be listed on the right-hand side of the window, you can select each one to change the altitude, delete, etc.
13. Once satisfied with your mission, click “File” on the left side. Under Storage, select “Save As…” and save it to your desired location with a descriptive name. You can also select “Save Mission Waypoints As KML…” to save as a .kml to view the mission in Google Earth.

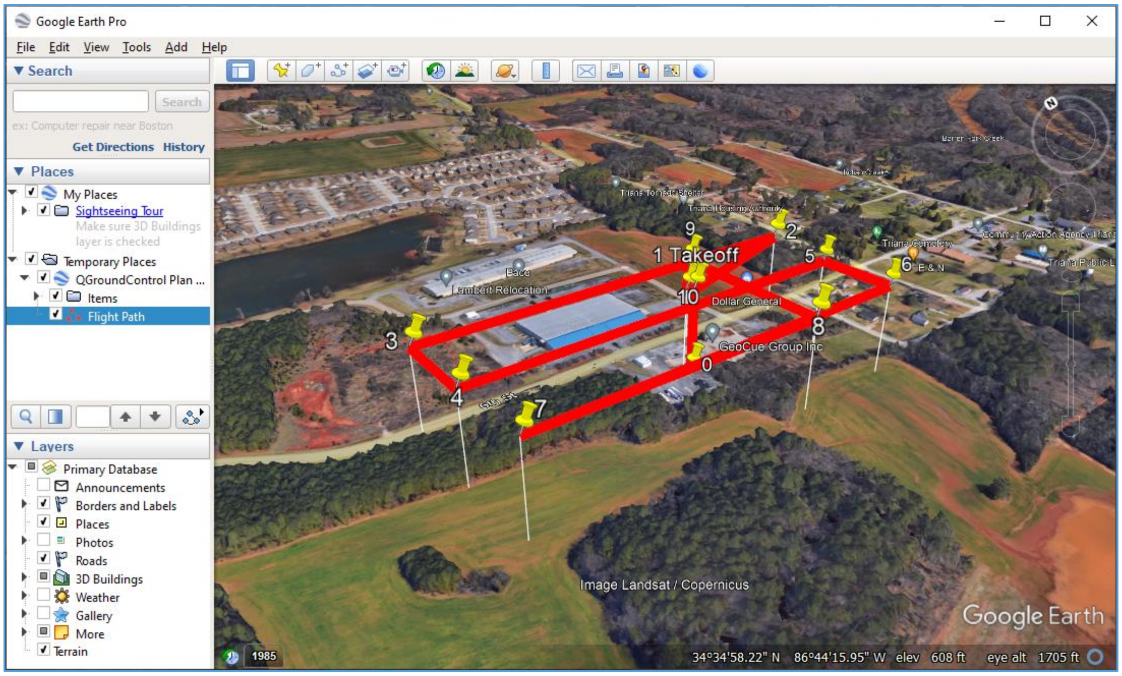

Figure 31: Mission .kml in Google Earth

Q Ground Control – Survey Flight Planning

The second method for flight planning is the Survey method. This includes making a grid using a boundary set by the user that automatically creates the flight lines. While this option doesn't include the customizability of the waypoint method, planning a Survey flight gives you the ability to use Q Ground Control's terrain following feature.

1. Open Q Ground Control and navigate the map to your flight area.
2. Click the "Plan" button on the left side of the window to bring up your planning options (Figure 32).

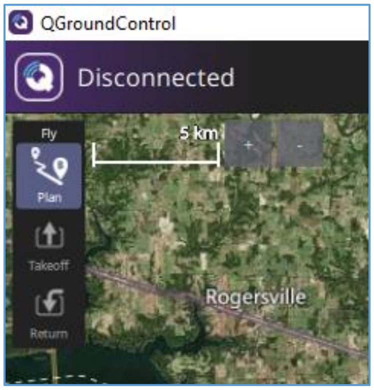

Figure 32: Q Ground Control Startup Options

3. Select "Survey" (Figure 33).

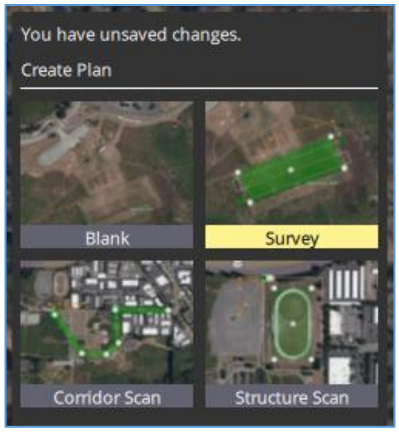

Figure 33: Flight Planning Options

4. There will be a "Mission Start" menu on the right side of the page (Figure 34). This is basically your mission settings that will be applied to all waypoints. Set the initial waypoint altitude to your planned mission flying height. Set the Flight Speed to 5 m/s (11.2 mph). The camera and Vehicle Info settings are irrelevant. Launch position should be automatically set to the ground level.

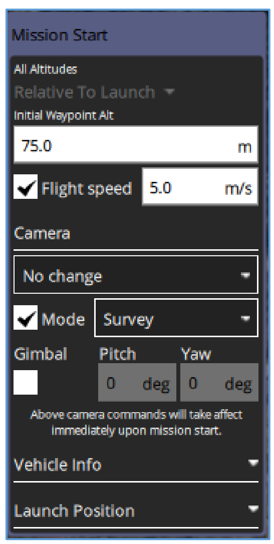

Figure 25: Mission Start Menu

5. Q Ground Control likes to establish a takeoff point. To do so, select "Takeoff" on the left menu (Figure 35) and drag the takeoff icon in your map view to the area you plan on taking off from. This does not have to be exact. Once the takeoff waypoint is placed, select "Done".

Figure 26: Takeoff Menu

6. Now select the “Survey” option on the right, followed by the polygon option at the top of your window (Figure 36). You can load a .kml or .shp into your project or draw one. If you are drawing one, select “Basic”. A polygon will automatically appear in the map view. Drag the vertices at the corners to shape. To add new vertices, click the “+” symbols at the edges of the polygon, between the existing vertices.

Figure 27: Survey Flight Planning Grid

7. Once you are happy with the shape of your flight boundary you can modify the settings further on the right under the “Survey” menu (Figure 37). On the first page of the menu set the altitude,

line spacing, angle, and turnaround distance. The trigger distance does not matter here. The next tab is a page for camera settings, ignore that tab.

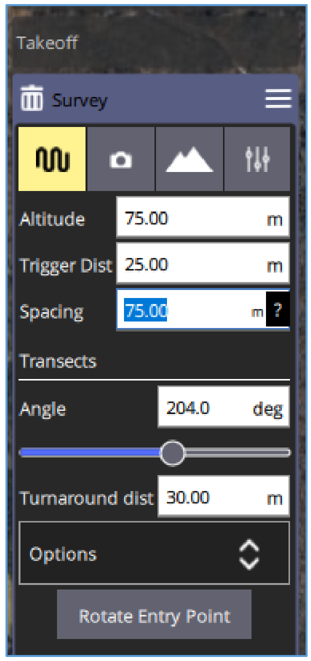

Figure 28: Survey Flight Planning Options

8. The next tab is for terrain following (Figure 38). To enable terrain following, change the setting from “Relative to Launch” to “Calculated above Terrain”. Have your tolerance set to 10m, and your Max Climb/Descent Rate at 5 m/s. Note: There is also a diagram at the bottom of the window showing the height of the drone (orange line) compared to the height of the terrain (green line).

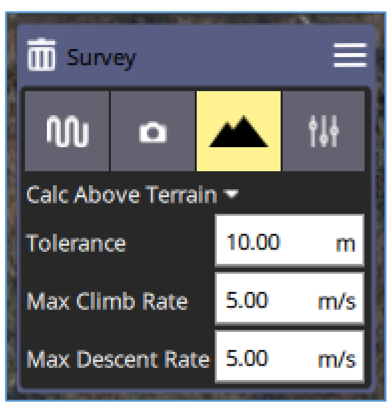

Figure 29: Terrain Following Options

9. Once that is complete there should be a menu for after the flight is complete labeled “Return to Launch”. This is where you can tell the drone what to do once the flight is complete, we recommend having it set to “Return to Launch”.

10. Once satisfied with your mission, click “File” on the left side. Under Storage, select “Save As…” and save it to your desired location with a descriptive name. You can also select “Save Mission Waypoints As KML…” to save as a .kml to view the mission in Google Earth (Figure 39).

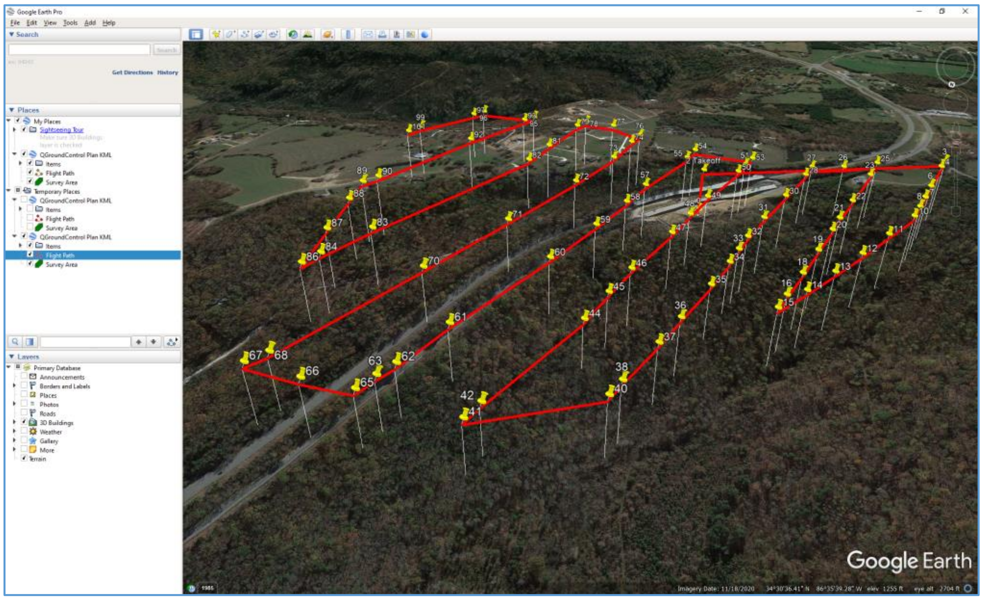

Figure 30: Completed Flight Plan .kml in Google Earth

DJI Pilot 2 – Area Route

DJI Pilot 2 is the flight app that comes preinstalled on DJI remote controllers and used by default with the M350, M300, M30 and Mavic 3 Enterprise drones. With the DJI Flighthub 2 cloud integration one can also flight plan from any web browser on a separate device and live view a mission that is in progress remotely. In the past, setting each waypoint was the only way to mission plan using Pilot 2 for TrueView flights. Now with the Custom Camera it is possible to use the Area Route option when starting a mission plan. The advantage of this is being able to adjust your flight plan settings or area and have your flight line spacing remain correct during adjustments. If desired overlap on the entire flight needs to be increased this can also be done easily in a few seconds.

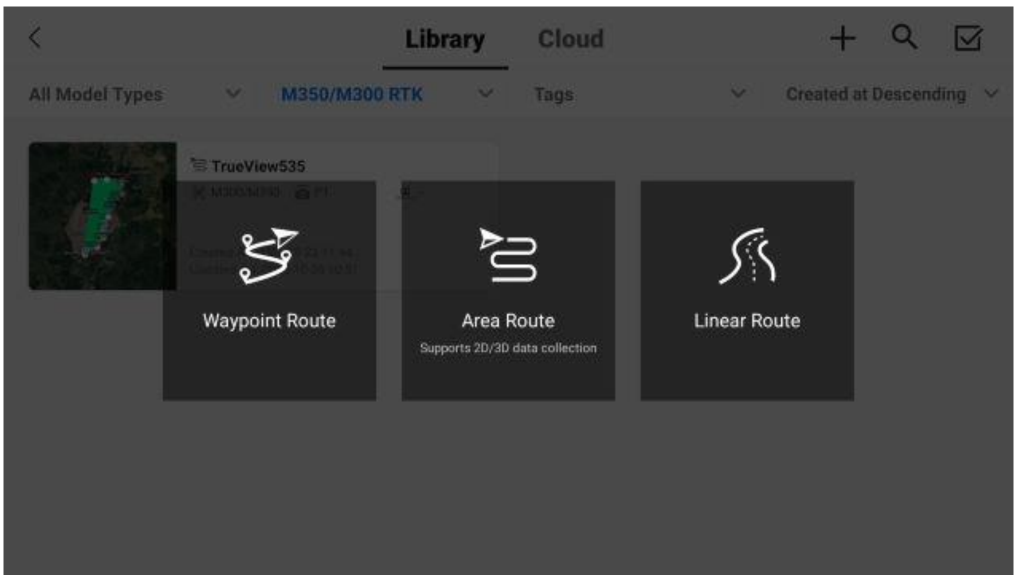

Figure 31: Mission planning options in Pilot 2

1. Choose Flight Route on the home screen and then tap the + Icon on the top right (Figure 31)
2. Select the Area Route option.
3. Input your polygon in which your mission will be flown, then choose the M350/M300 RTK option as the Aircraft Model. (Figure 32)
4. For Camera Model pick Custom Camera.

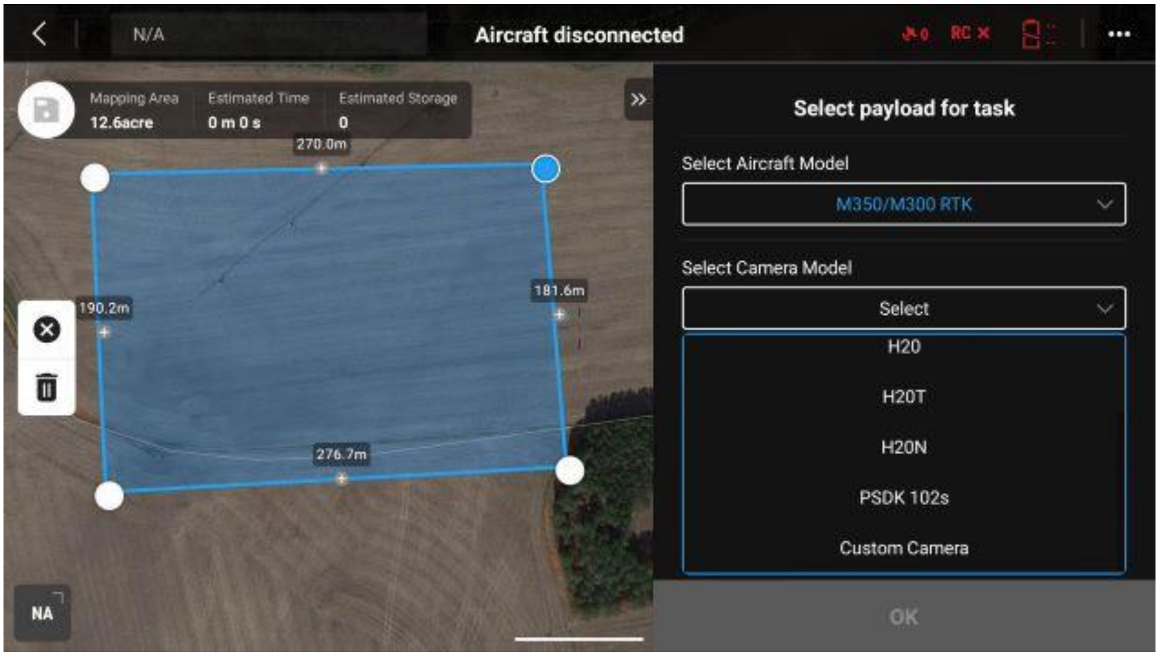

Figure 32: Pilot 2 payload task

5. Add the camera value shown (Figure 33) in as the camera parameters.

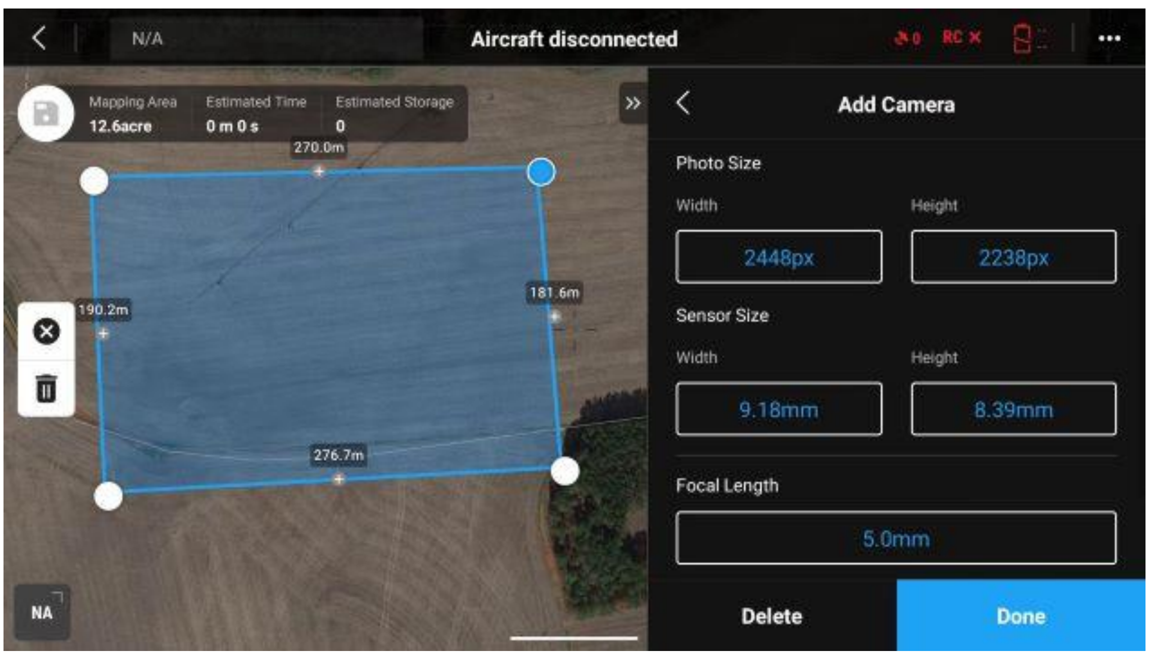

Figure 33: Adding camera values

6. Once saved it is then possible to have properly spaced flight lines to be auto created by simply moving your survey polygon boundary points around the map (Figure 34). These flight lines will also be auto adjusted by the altitude of your mission. The desired overlap can also be increased depending on what is needed.

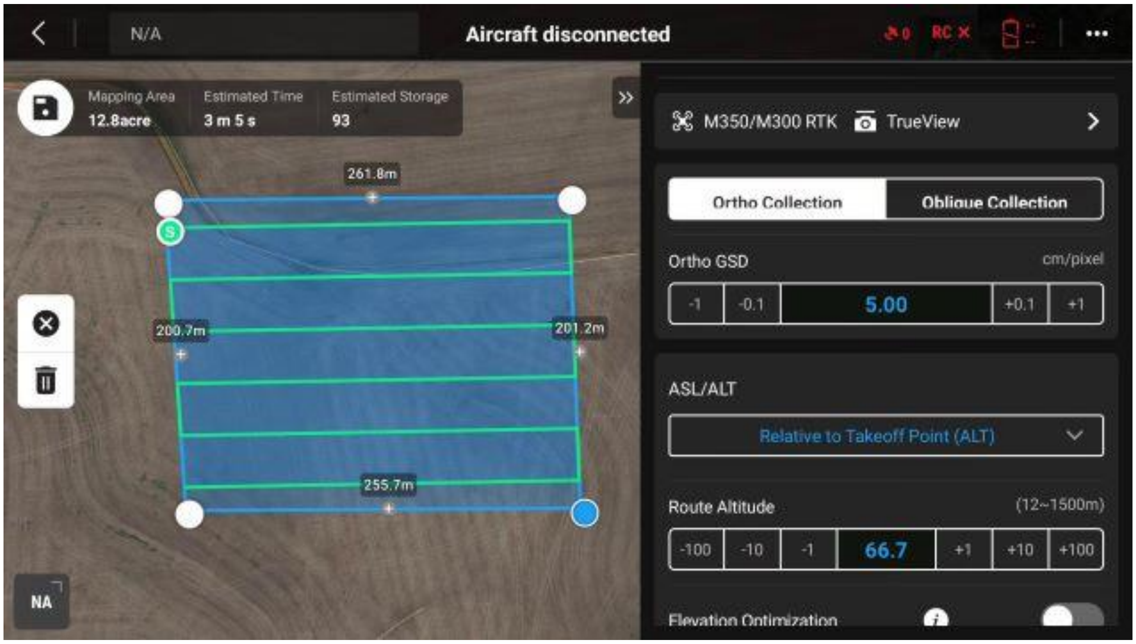

Figure 34: Pilot 2 auto flight lines

	Photo Size		Sensor Size			
FOV (degrees)	**Width**	**Height**	**Width**	**Height**	**Focal Length**	**Min. Interval**
60	1540px	1540px	5.78mm	5.78mm	5.0mm	2secs
75 (TV540 & TV1 26MP)	2047px	2047px	7.68mm	7.68mm	5.0mm	2secs
80 (TV1 45 & 61MP)	2238px	2238px	8.39mm	8.39mm	5.0mm	2secs
100	3178px	3178px	11.92mm	11.92mm	5.0mm	2secs

Figure 35: Camera parameters with different FOVs

It is recommended to work with 80deg FOV for all the sensors, except the TV1 Lite and TV540.

Support

Our searchable support knowledge base contains information on workflows, tips, hints, and probable resolutions to error messages or commonly encountered situations.

https://support.geocue.com/

Normal support business hours are **Monday - Friday, 8 AM — 5 PM** USA Central Time.

Our GeoCue Support website contains general workflow information, in addition to specific issue and error messages that you may encounter. Click on the link and search for information contained in the knowledge base.

If a support request is sent during business hours a representative will typically get back to you within 4 hours. If received after hours, a response will be sent the following day. To speed response time please include the following information in your request:

- Contact information - please include e-mail address and phone number
- Company name
- Product name and version number
- TrueView Model and Serial Number

If your request includes problems pertaining to a specific error message, please include a screen shot of the error message.

For hardware and software support contact: support@geocue.com