LiDAR for Dummy Archaeologists

GREG JACKSON, December, 2024

LiDAR is an acronym for **Li**ght **D**etection **A**nd **R**anging. It is a remote sensing technology that uses laser beams to measure precise distances in the environment. It has many uses in geology and agriculture. Until recently LiDAR data was collected by planes or helicopters, but increasingly unmanned drones are used to collect the data. In archaeology LiDAR technology can be used to remove the vegetation from an aerial image to give a 'bare earth' image showing what is under the trees, bushes and grass. It can also be used to create a contour map which may be useful.

LiDAR is available free from the internet for almost all of Australia.

Some useful acronyms

ELVIS = **EL**e**V**ation **I**nformation **S**ystem (free from Geoscience Australia)

GIS = **G**raphical **I**nformation **S**ystems (free from https://qgis.org/download/)

How to use ELVIS LiDAR data and QGIS to create a vegetation free map or a contour map.

STEP 1: Getting the data from ELVIS

Enter 'Elvis Lidar' in Google and select 'Elvis' (the first thing that comes up)

In Elvis select 'Location Search' e.g. Audley NSW

select the Location from the list

select 'Order Data'

select 'Polygon'

select 'Draw' and encircle area of interest (Do not select a large area of interest as this will result in very big files).

select 'Search'

select a 'Digital elevation models' and 'Point clouds' from the data offered. Go for the '1m' data, ignore the rest of the data offered.

scroll down to bottom and fill out 'industry' (I use 'other'), put in email address for your data delivery and tick '*I am not a robot*'. Sometimes you have to identify bikes or other things.

select 'Order Datasets'. The data will be emailed as a zip file, might take a while.

Create a project directory with a suitable name (e.g. Audley) and move the '.zip' file to this directory. Create a 'TIF' directory in this project directory.

Download zipped data from your email using the link provided. This may also take a little while. A temp file '.crdownload' will be created before the '.zip' file arrives, just ignore it and wait till the .zip arrives.

Move the zip file to your directory

Right click on zip file and 'Extract all' the data supplied to the default directory then find all the .TIF files and move them to the TIF directory. Ignore the rest of the files. This can also take a while.

STEP 2: We are now ready to run QGIS which is available free from https://qgis.org/download/ download the long-term version.

Install QGIS and a convenient shortcut. Note: The instructions below are for QGIS 3.34 (in Oct. 24, later versions may have slightly different instructions)

In QGIS select 'Project' >> 'New'

Select 'Raster' >> 'Miscellaneous' >> 'Merge' then select the small box on top line RH side, at the end of the 'Input Layers' line.

Select 'Directory' and then click on the directory containing your 'TIF' files >> 'select files' >> 'OK'
from the bottom >> 'Run'. This will produce a fuzzy point cloud of your target area visible on the screen. White is high ground and black is low but no real detail is yet visible.

Select 'Project' >> 'Save As' and type in appropriate name to save in the directory for this project.

We can now use QGIS to either strip away all the vegetation **OR** create a ground contour map. Open a Google Earth (or SIX aerial view in NSW) of the site so you can see what features are modern and what is not visible in an aerial photograph because it is hidden under the vegetation.

To Create a vegetation free image
We use a process called Hillshade analysis. Hillshade analysis works by simulating a raking light source falling across your terrain model, which produces shadows that may potentially be archaeological features. The angle and azimuth of this virtual raking light is variable, and the vertical dimension of features can be adjusted.

In QGIS select 'Raster' >> Analysis >> 'Hillshade' initially accept all the default parameters and hit 'Run'

Use the 'Adjust Parameters' and re-'Run' to improve your image. You may need to do this many times to optimise the results. Adjust the parameters one at a time using trial and error.

You can zoom in and out by adjusting the 'Scale' and 'Magnifier' at the bottom of the screen.

The GPS cursor position is shown in the 'Coordinate' at the bottom of screen as grid coordinates, eastings and northings (datum WGS84).

When happy with the result use Windows 'Snip' tool (or 'Print Screen') to capture the area of interest and load it into Windows Paint to add labelling **or** 'Project'>> Import/Export will save your vegetation free map as a PDF.

When you have the image you want Select 'Project' >> 'Save'.
The final image will look like the example in Image 1 of the Fosters Flat sawmill site in the Royal National Park, Sydney.

Limitations: The resolution is not great with only large objects visible. The '1 meter' LiDAR that is available free will not detect small object. It is good at locating old roads and tracks and objects the size of a bus or a sawmill boiler. The footings for houses and buildings are usually also visible. LiDAR will not usually detect objects the size of outside toilets or a small car.

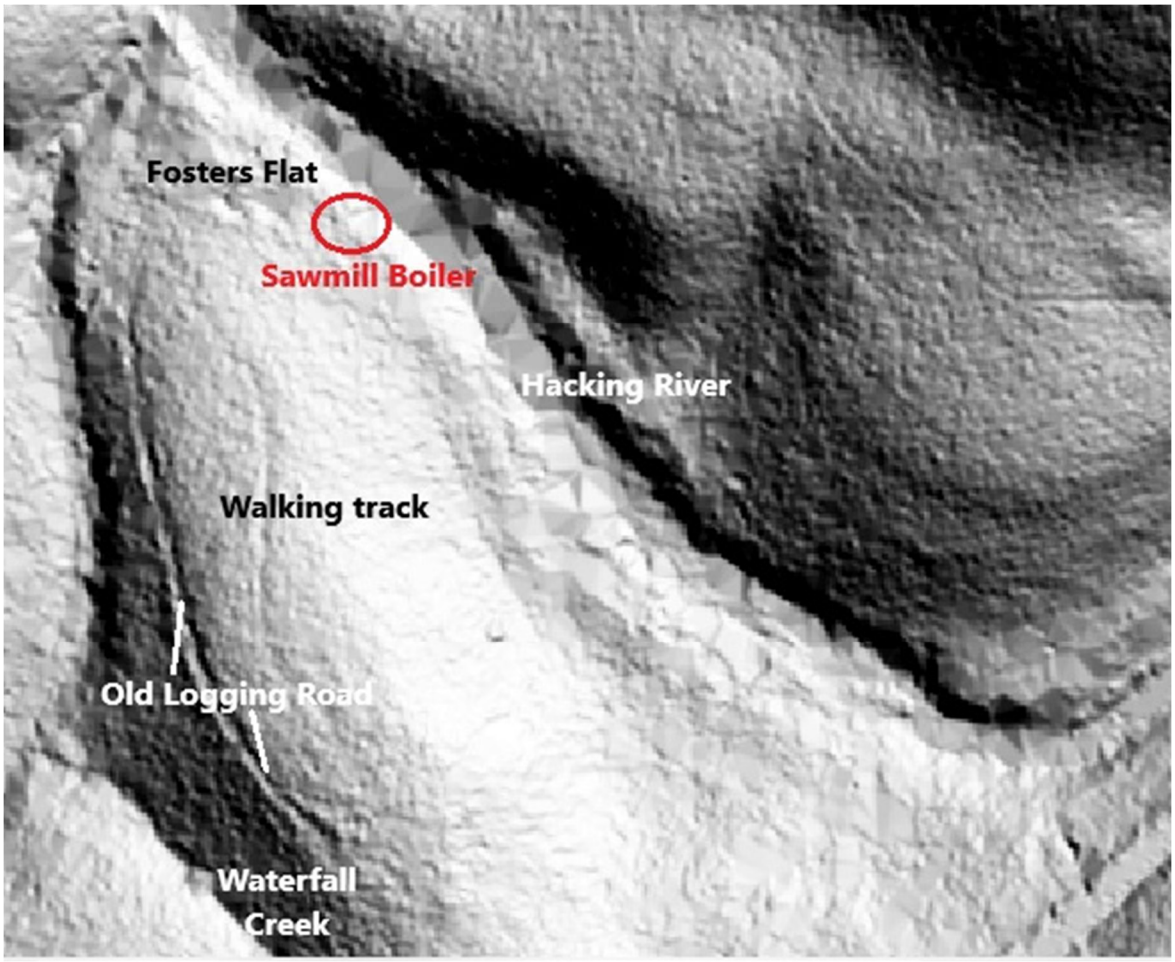

Image 1: LiDAR snapshot of Fosters Flat, an old sawmill site, in the Royal National Park, Sydney with vegetation removed. The sawmill boiler is only just visible.

To Create a Ground Contour Map

Once you have the point cloud of your target area select 'Raster' >>'Extraction' >> 'contour' and adjust contours in 'Interval between contour lines' to what you want. e.g. 1.0m. The default is 10m.

Select 'Run' this will produce the contour map

The map scale can be adjusted using the 'Scale' and 'Magnifier' at the bottom of the screen

Use the 'Adjust Parameters' and re-run to improve image.

GPS cursor position is shown in the 'Coordinate' at bottom of screen as eastings and northings (WGS84).

When happy with the result use Windows 'Snip' tool or 'Print Screen' to capture the area of interest and load it into Windows Paint to add labelling **or** 'Project'>> Import/Export will save your contour map as a PDF

When you have the image you want Select ‘Project’ >> ‘Save’.
The final image will look like the example in Image 2, the same site as Image 1.

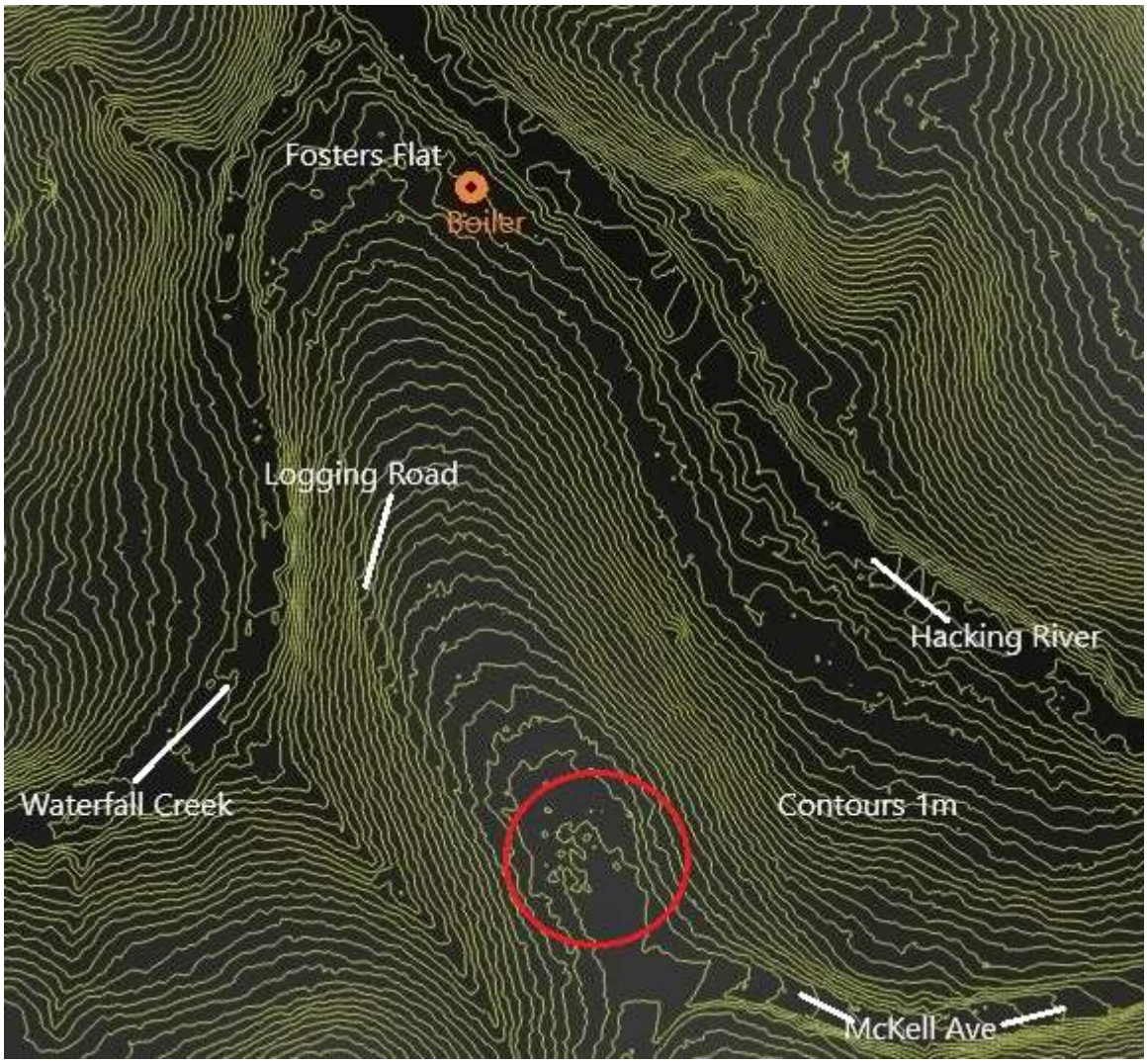

Image 2: A one-meter contour map of Fosters Flat in the RNP. Same site as Image 1. The logging road is visible but not the walking track or the boiler. The red circled area is ground disturbance caused by a successful police search for a buried body.

Measurements: To make a physical measurement in QGIS, you can use the Measure tool to measure length, area, or angle:

e.g. Making a distance measurement in QGIS 3.34:

1. Click ‘View’ >> ‘Measure’ >> ‘Measure Line’
2. Choose what you want to measure
3. Click on where you want to start the measurement
4. click to mark the end point
5. Read the distance in the Measure window

Warning: While the measurement tool works fine it seems impossible to turn off. You have to return to Step 1 and reload your image. I also have trouble reloading saved projects into QGIS.

Conclusion: Creating a free LiDAR image is a leisurely process and require patience and perseverance but it can be very rewarding giving us insights into some previously intractable historic problems. The most difficult part is selecting a suitable historic target area and then interpreting the results.