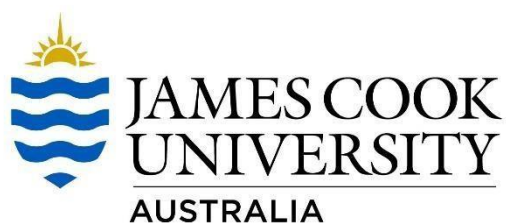


Mapping and Classifying New Roads in Insular Southeast Asia using Google Earth

Orientation Booklet

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Contents

| | |
|--|----|
| 1.0 Contact Info | 3 |
| 2.0 General Overview..... | 3 |
| 2.1 The Goal of this Exercise..... | 3 |
| 2.2 The Basics of your Task | 4 |
| 2.3 Terminology Used In this Booklet | 4 |
| 2.4 Google Earth and Your Digital Materials | 5 |
| 3.0 Detailed Overview..... | 6 |
| 3.1 Maximising Your Computer Resources..... | 6 |
| 3.2 Getting to Know Your Existing-Road Map | 7 |
| 3.2.1 Basic Contents of a Google Earth File (of Existing Roads)..... | 7 |
| 3.2.2 Changing the View of a Road Map | 11 |
| 3.2.3 Naming Convention for Map Files of Existing Roads | 12 |
| 3.3 Getting to Know Your Grid-Cell Map | 13 |
| 3.3.1 Changing the View of Your Grid-Cell Map | 13 |
| 3.3.2 Using your Grid-Cell Map to Efficiently Map New Roads | 16 |
| 3.4 Saving Your Altered Grid-Cell Map..... | 17 |
| 4.0 Mapping New Roads | 20 |
| 4.1 How to Map New Roads and Assign Them Attribute Data | 20 |
| 4.1.1 How to Search for New Roads Within Your Grid Cells..... | 20 |
| 4.1.2 Protocols for Mapping New Roads (Important) | 20 |
| 4.1.3 How to Map New Roads in Google Earth..... | 25 |
| 4.2 How to Save Your New-Road Map in Google Earth | 33 |
| 4.3 Mapping New Roads within Grid Cells | 33 |
| 4.4 Frequently Asked Questions | 34 |

1.0 Contact Info

If you have questions regarding your task as outlined in this booklet, contact the volunteer coordinators:

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2.0 General Overview

2.1 The Goal of this Exercise

The presence of roadways is one of the clearest and most significant indicators of human's occupation and perturbation of the natural environment. Road infrastructure is poised to expand greatly globally, particularly in the tropics, as populations, incomes and economic ambitions continue to expand. Knowing the extent and nature of current roadways will help decision makers prioritise where new roads should and should not be situated in order to balance economic development with ecological conservation.

The research project to which you will contribute as a citizen scientist seeks to define this balance. As a first step, the project will, with your assistance, develop a spatial database of existing roads across insular Southeast Asia, including those roads not officially mapped or recognised by national governments. In this way, researchers at James Cook University will be able to assess the current extent of roads amongst remaining ecologically-intact areas and indicate where proposed road infrastructure should and should not be situated.

2.2 The Basics of your Task

Using free Google Earth software to view satellite imagery of insular Southeast Asia (Indonesia, Malaysia, Papua New Guinea, Brunei), you are charged with two tasks:

- (i) Visually identifying and manually mapping 'new roads' not already mapped by existing-road maps, and
- (ii) Classifying these 'new roads' according to whether they are paved or unpaved as well as the date of observation.

The following pages will detail the step-by-step instructions necessary to achieve these goals. Rest assured, these are simple and straightforward. Due diligence and care are however of the utmost importance to ensuring an accurate and useful final map of roadways in the region.

Note: These instructions are intended for users of *Windows* computers. If you have an Apple/Mac computer, the commands will be subtly different from that of a windows computer. If you move easily between Macs and PC's, you likely won't have any issues.

2.3 Terminology Used In this Booklet

Existing Roads: Refers to those roads already mapped in a freely available dataset, either by a national government (official road data) or citizen scientists (Open Street Map) or other groups. Our ultimate goal is to add to these existing roads by looking for and mapping unmapped 'new roads' in Google Earth. Note. For the purposes of this study, Google roads are not considered existing roads, therefore you should turn off the Google roads layer in Google Earth, if it is visible.

New Roads: Refers to those roads you visually identify and manually map using Google Earth and which are not part of an existing road dataset. The roads are not 'new' in the sense that they have been recently constructed, though some may have been. Rather, they are 'new' in the sense that they are not part of the existing road dataset and so are instead newly discovered by us through visual analysis of Google Earth satellite imagery.

Attribute Data: Refers to the basic attributes or characteristics of the new roads we map. When we visually identify, interpret and map a new road we will also label the new road with its corresponding attributes, thus creating attribute data. The specific attributes of interest for us are as follows:

- road paved status (i.e., paved or unpaved), and
- observation date of the road (i.e., the acquisition date of the satellite imagery in Google Earth in which the new road is observed).

Google Earth File: Refers to computer files with a file extensions of “.kmz” or, sometimes, “.kml”. These files are map files that Google Earth uses, and which you can edit within Google Earth.

2.4 Google Earth and Your Digital Materials

Google Earth is a free software that allows users to view satellite imagery of any region of the Earth. We will use it to identify and map new roads alongside existing roads, which you will also view in Google Earth. You can freely download Google Earth and install it on your computer at this link:

<https://www.google.com/earth/download/ge/agree.html>

An internet connection is required to perform the tasks outlined in this booklet.

As detailed in later sections, you should already have the following Google Earth map files, which are required to get started mapping new roads. Contact Mr Engert if you do not have these.

- A few maps of existing roads, specific to your assigned region in insular Southeast Asia. These files have names based on the existing data source and the location, like ‘25k 123.kml’, ‘50k 456.kml’, osm_789.kml’, etc.
- One map of a ‘fishnet’ graticule with individually numbered grid cells of ~10x10 km, probably called Grid_SEA.kml, specific to your assigned region in insular Southeast Asia.

3.0 Detailed Overview

3.1 Maximising Your Computer Resources

The existing-road maps we will view in Google Earth can be taxing for your computer. To help your computer handle them, begin by instructing your computer to operate in 'high performance' mode, as seen in Figure 1.

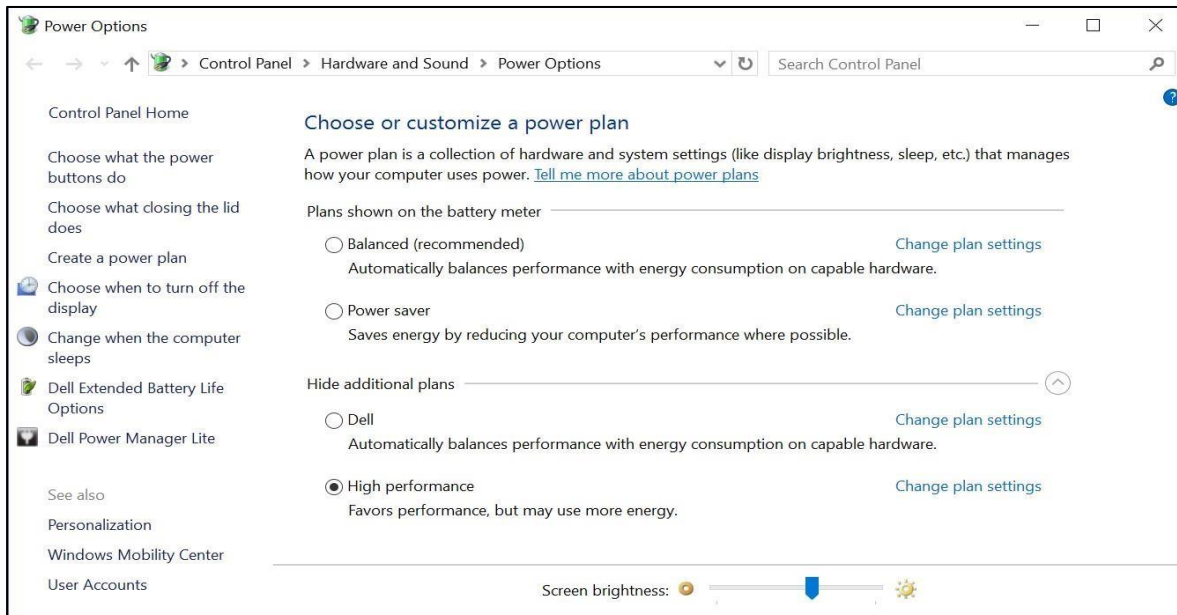


Figure 1: Power Options on your Computer

Find this option on your computer either by either (a) right clicking the battery symbol on the lower-right of your screen (Figure 2) or by (b) going into *Control Panel > Hardware and Sound > Power Options*.

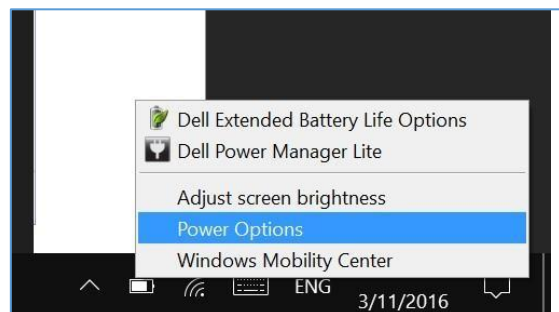


Figure 2: Power Options on Your Computer

Also, close any other programs your computer is running (e.g., Skype) so that it is not unnecessarily diverting resources to them.

3.2 Getting to Know Your Existing-Road Map

You will begin with various maps of existing roads for the region of insular Southeast Asia in which you'll be working. Your specific region will be clear to you at the outset of your work, as it will be delineated in Google Earth by your map of 'grid cells' (see Section 3.3 for details on your map of grid cell).

The existing-road maps with which you'll begin your mapping of new roads will capture most, but not all, of the roads visible in Google Earth. We have obtained the best available existing road maps for each region, however there will likely still be many new roads to map. Roads that are visible but unmapped are of interest to us – these are the 'new roads' we wish to map. These new roads will occur amongst the existing roads as well as in the peripheries of areas containing existing roads.

The existing-road maps you have will be Google Earth map files. In this booklet, the Google Earth map file of existing roads I will use as an example is called '**JALANLN_50K**' (*Jalan* means 'road' in Indonesian). Your existing-road maps will *not* have this name, however. Rather, your Google Earth map files of existing roads will have various names depending on the source of the data, and will appear something like those below.

- 25k 123.kmz
- 50k 456.kmz
- osm_789.kmz
- log_5253.kmz

In Section 3.2.3 I explain the reason behind this particular file name convention for your Google Earth map files of existing roads. You can still read through Section 3.2.1 and 3.2.2 without knowing this reason.

3.2.1 Basic Contents of a Google Earth File (of Existing Roads)

Let's look at an existing-road map in Google Earth to get orientated. Open Google Earth on your computer, then in Google Earth add to your display a single Google Earth map file of existing roads, e.g., '50k 123.kmz', or whatever your file happens to be called. Do so by going to File > Open and then selecting any single Google Earth map file of existing roads. Google Earth should automatically zoom to the extent of your existing-road map, as in Figure 3 below. Alternatively, you can open your map files by double clicking on the file icon in whatever location you have saved it.

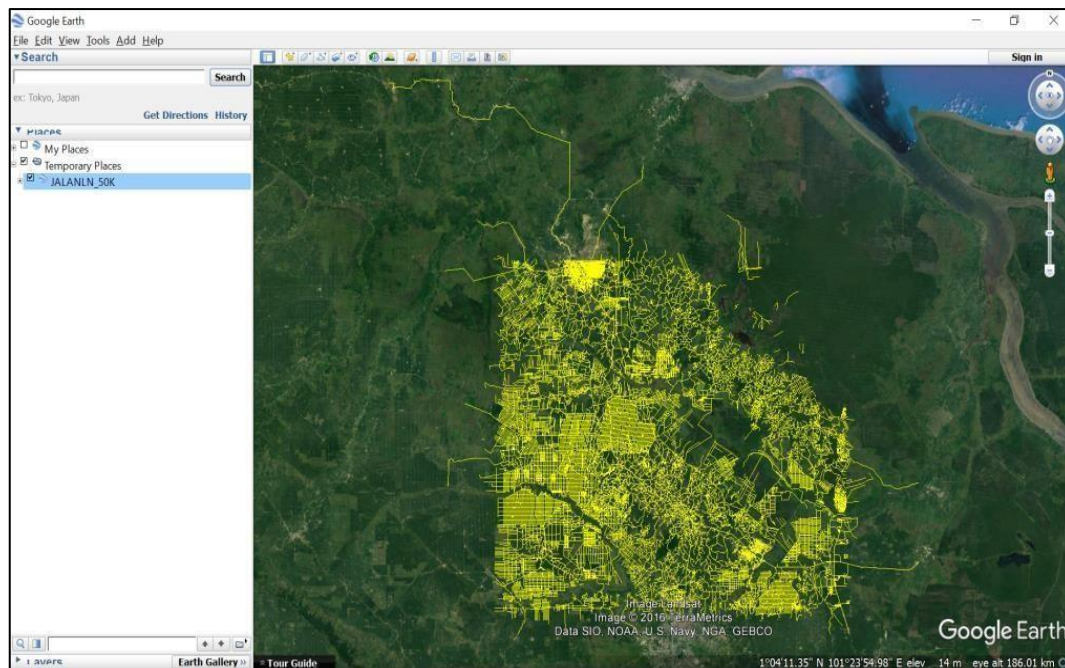


Figure 3: Initial View of Existing-road map in Google Earth

Hint: Later, if necessary, you can open more than one existing-road map at once. This will be necessary in two situations:

- (i) For a single location, you must simultaneously display two existing-road maps of different scales (recall Section 3.2.3, and consult Section 5.1.2).
- (ii) The local area (i.e., 'grid cell' as per Section 3.3) in which you are mapping new roads spans the edges of two adjacent existing-road maps.

It is recommended that you only add as many existing-road maps to your display as is necessary, because these files are taxing on your computer's resources and may slow down your navigation within Google Earth.

Your computer should now look like Figure 3 above. However, your existing-road map will have a different file name, be for a different location, and it will likely be a different colour to Figure 3. Note the following points of interest in Figure 3, which also apply to your display.

- The Google Earth map of existing roads, here called JALANLN_50K, is indicated by a globe symbol on the left-hand panel of Google Earth. In Figure 3 above it is highlighted in blue.
- In the left-hand panel in Google Earth, the file JALANLN_50K is visible under the heading 'Temporary Places'. All files listed under the heading Temporary Places are Google Earth files that you have saved in specific directories on your computer, e.g., C:\My Documents\My Existing Road Maps\JALANLN_50K.kmz. This is exactly how we want it. Never save any of your Google Earth files in your 'My Places' directory in Google Earth, which is also visible in the left-hand panel in Figure 3. Doing so would transfer your Google Earth map file to some hard-to-find directory on your computer.

In the left-hand panel, to the very left of your map of existing roads ('JALANLN_50K' here), you will see plus symbol, as below:



Click on the plus symbol to expand the map file of existing roads (JALANLN_50K). The plus symbol has now turned into a minus symbol ("-"), and you should now see a little folder or 'subdirectory' of the same name as your existing map of existing roads (JALANLN_50K here), as highlighted in Figure 4 below.

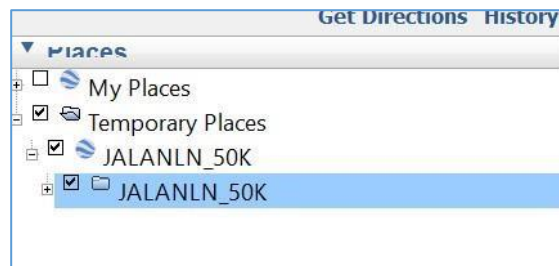


Figure 4: Expanded View of Existing-road map JALANLN_50K.

The sub-directory JALANLN_50K also has a plus symbol to its left, as in Figure 4. Click on this plus symbol to expand the sub-directory and see its contents. The plus symbol has again now turned into a minus symbol as your view becomes like in Figure 5.

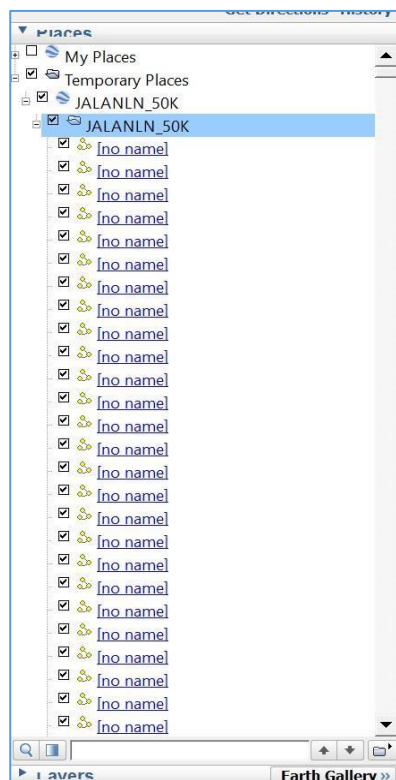
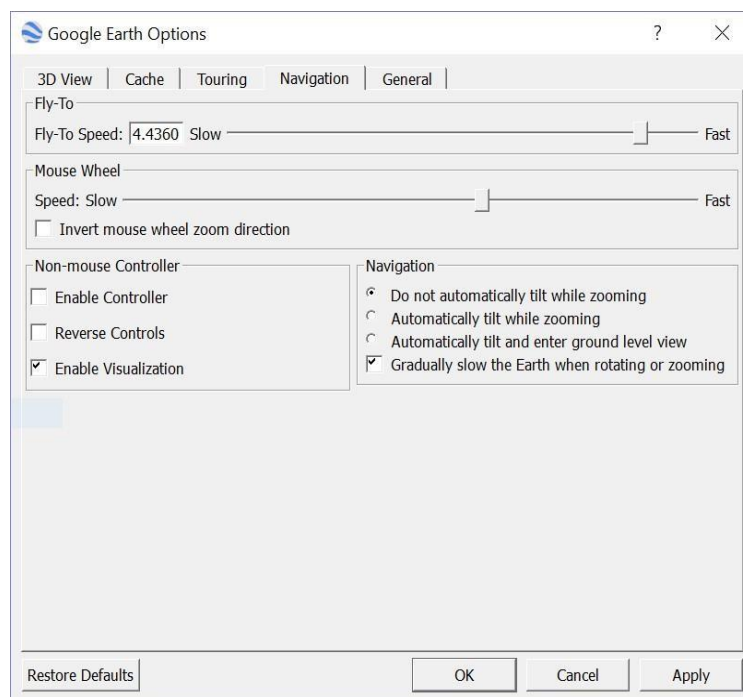


Figure 5: Fully Expanded View of the Google Earth File of an Existing-road map, JALANLN_50K.

Each of the little elements in Figure 5, here titled “[no_name}”, are individual roads in the Google Earth map file of existing roads, JALANLN_50K. In the language of Google Earth these elements are ‘ways’, i.e., individual linear features in the Google Earth file. On your computer, these elements might occasionally be labelled “NULL” or similar, but their particular name does not matter for us.

There are *lots* of ‘ways’ – often too many to scroll through. If you double-click on an individual ‘way’ in the left-hand panel of Google Earth you will automatically zoom to the corresponding individual road. Even after zooming to that road it may be hard to identify it amongst the many other roads surrounding it. It is some help to know that a given individual road in question will be situated in the centre of your screen and will be defined as a single length spanning the two nearest intersections of roads.

Technical Tip: If your computer takes a long time to zoom to the road you doubleclicked on and/or takes a long time to refresh the display after zooming, you might find it helpful to increase the speed with which Google Earth zooms and pans. Do this by going to menu Tools > Options. In the dialogue box that appears, click the ‘Navigation’ tab and increase the ‘Fly-To-Speed’ setting as in the picture below.



At this point, in the left-hand panel of Google Earth, click on the minus symbol next to the subdirectory (folder) JALANLN_50K to collapse it so that your view is like Figure 4 again. Similarly click the minus symbol next to the Google Earth file JALANLN_50K to collapse it so that your view is again like in Figure 3.

3.2.2 Changing the View of a Road Map

Before going too far, let's change the colour of your existing-road map to ensure that its roads are readily visible in Google Earth. The following steps are also applicable to the map of new roads that you will eventually create.

It is essential that your maps of existing roads display roads in different colours to the new roads you will eventually map. This will help you keep track of where you have already mapped new roads, so that you don't repeat your efforts. Note that changes to the colour of your road maps in Google Earth might be temporary, so you may have to repeat these steps each time you add a Google Earth map file of existing or new roads to your display in Google Earth.

With your view in Google Earth looking like Figure 3, right click on your map file of existing roads (JALANLN_50K here) in the left-hand panel. In the pop-up menu that appears, select 'Properties'. A dialogue box with various tabs should appear in Google Earth. In the dialogue box, click the tab "Style, Colour", as in Figure 6 below. In this box, you can adjust the colour, width, and opacity of the existing roads in your map file, JALANLN_50K. I recommend the settings show in in Figure 6.

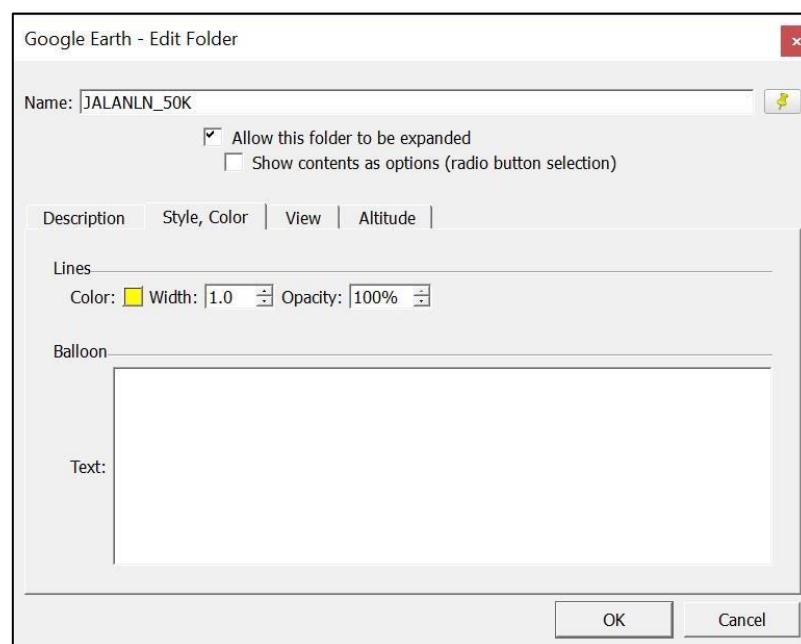


Figure 6: Style and Colour Tab in the Properties Dialogue Box for JALANLN_50K Existing-road map.

Before clicking 'ok' in the dialogue box, click on its 'Altitude' tab. Confirm that the option for altitude in this tab is set to 'clamped to ground', as shown in Figure 7 below. If this option is not as in Figure 7, change it so that it is. Now click 'ok' to close the Properties dialogue box.

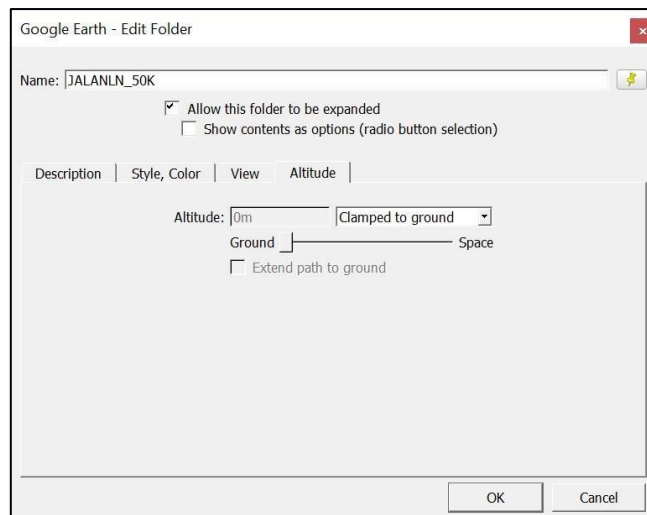


Figure 7: Altitude Tab in the Properties Dialogue Box for JALANLN_50K Existing-road map.

3.2.3 Naming Convention for Map Files of Existing Roads

As mentioned above, your Google Earth map files of existing roads will have names that appear much like those below.

- 25k 123.kmz
- 50k 456.kmz
- osm_789.kmz
- log_5253.kmz

Your map files of existing roads will begin with different prefixes depending on the source of the data. Official road maps from the Indonesian and PNG governments will begin with one of the three prefixes '25k', '50k' or '250k'. For those of you mapping new roads in Kalimantan (Indonesian Borneo), virtually all your official road-map files will have the pre-fix '50k'. Existing road maps in Malaysian Borneo (Sabah or Sarawak) will have prefixes "osm" for maps obtained from Open Street Map and "log" for maps obtained from the Borneo Logging Road project.

To avoid confusion, it is important that you understand the meaning of the file names of your Google Earth map files of existing roads. In short, the file name for any given Google Earth map file of official roads contains two bits of information about the official-road map in question:

1. The geographic scale of a given Google Earth map file of official roads for Indonesia or PNG is indicated by the *prefixes* of the file names (e.g., '25k', '50k' or '250k' in the examples above). In non-technical terms, the geographic scale of a map indicates the level of detail and spatial accuracy one can expect in that map. For our maps of official roads, the prefix '25k' indicates a fine scale of 1:25,000 (i.e., high level of detail), the prefix

'50k' indicates an intermediate scale of 1:50,000 (i.e., moderate level of details), and the prefix '250k' indicates a coarse scale of 1:250,000 (i.e., low level of detail).

2. The *location within insular Southeast Asia* of a given Google Earth map of existing roads is indicated by the *suffix* of the file name (e.g., '123', '456', '789' in the examples above). The actual numerical references do not concern us. Suffice to note here that, in simple terms, each number denotes a different location from the next. The suffixes in your actual Google Earth map files of existing roads will have anywhere from one to four numerical digits.

As there may be multiple road map files for your area of interest, it is important to open all Google Earth files for your package at the same time. It is important to recognise this so that you do not repeat your efforts by consulting the same location twice. Section 5.1.2 makes use of the preceding information when instructing you on the specifics of mapping new roads in Google Earth.

3.3 Getting to Know Your Grid-Cell Map

You have been assigned to search for new roads in a specific region of insular Southeast Asia. Your specific region is delineated by your single Google Earth map file of 'grid cells', which is called either **Grid_SEA.kml** (for those working in Sumatra) or **Grid_SEA_####.kml** (for those working elsewhere), where '####' is a unique numerical code that identifies the location of your region, e.g., 2589, 1234, etc. This location-identification code '####' can be disregarded – it is not important to you. For some regions this location-identification code will match the existing road location code, however for other regions it will not, so it is not worth paying too much attention to.

This map of grid cells displays a few hundred contiguous grid cells, which are 'squares' of approximately 10 km by 10 km each. The grid cells will help you keep track of where you have already mapped new roads within your region so you do not repeat your efforts. You are tasked with mapping new roads only within the grid cells of your map file, Grid_SEA.kml.

3.3.1 Changing the View of Your Grid-Cell Map

When you first open your grid-cell map in Google Earth (File > Open), it will look similar to Figure 8. However, your grid cells will also be of a different colour, and they will probably be opaque, not transparent (outlined). As already done for the existing-road maps (Section 3.2.2), you can change the colouring and shading of your grid cells to make them transparent and bright.

- Right-click the grid-cell file in the left-hand panel in Google Earth, select 'Properties' in the pop-up menu; select the 'Style, Colour' tab in the resulting dialogue box, and set the 'line' (i.e., grid cell outline colour) to a bright colour different to that of your existing roads; set

the drop-down menu for 'area' (i.e., fill) to 'outlined', as below, so that the cells are no longer opaque.

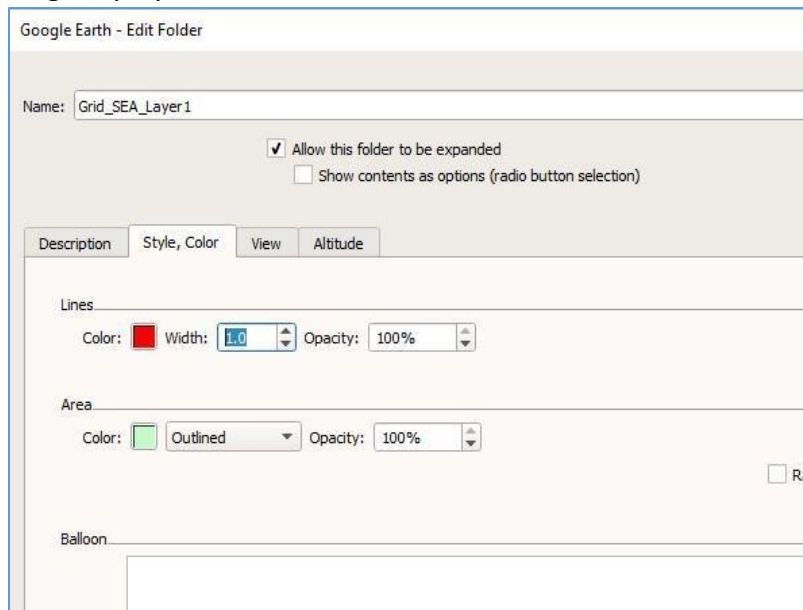


Figure 8 displays only the grid-cell map in the left-hand panel. In reality, while you are mapping new roads you will have both the grid-cell map and one or more existing-road map(s) loaded in Google Earth at once.

As done previously for our existing-road map, expand the grid-cell map 'Grid_SEA' in the lefthand panel in Google Earth to see its sub-directory, which is also called Grid_SEA. Then expand that sub-directory to see all the individual elements inside it, as per Figure 9.

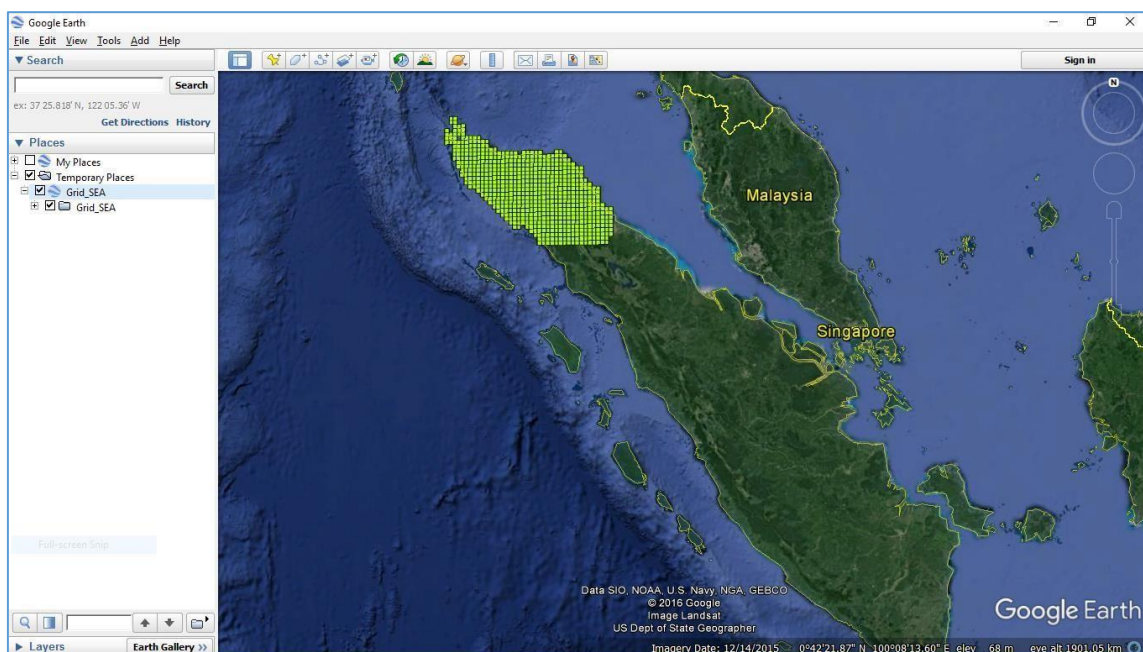


Figure 8: Grid-cell map for a Given Region within insular Southeast Asia

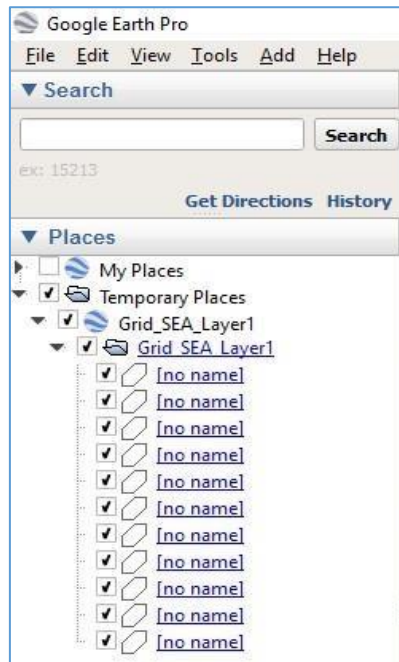


Figure 9: Expanded View of the Contents of the Grid-cell map

As with the individual roads of the existing-road map (Figure 4), each element of the grid-cell map (i.e., the listed 'no name' boxes in Figure 9) is an individual grid cell of approximately 10x10 km. Your region will likely have 10 – 30 grid cells.

With your view of the grid-cell map's contents expanded as per Figure 9, double click on any one of its elements (blue 'no name' cells) in the left-hand panel. Google Earth should immediately zoom to that cell. I double clicked the first cell and zoomed to it, as shown in Figure 10.

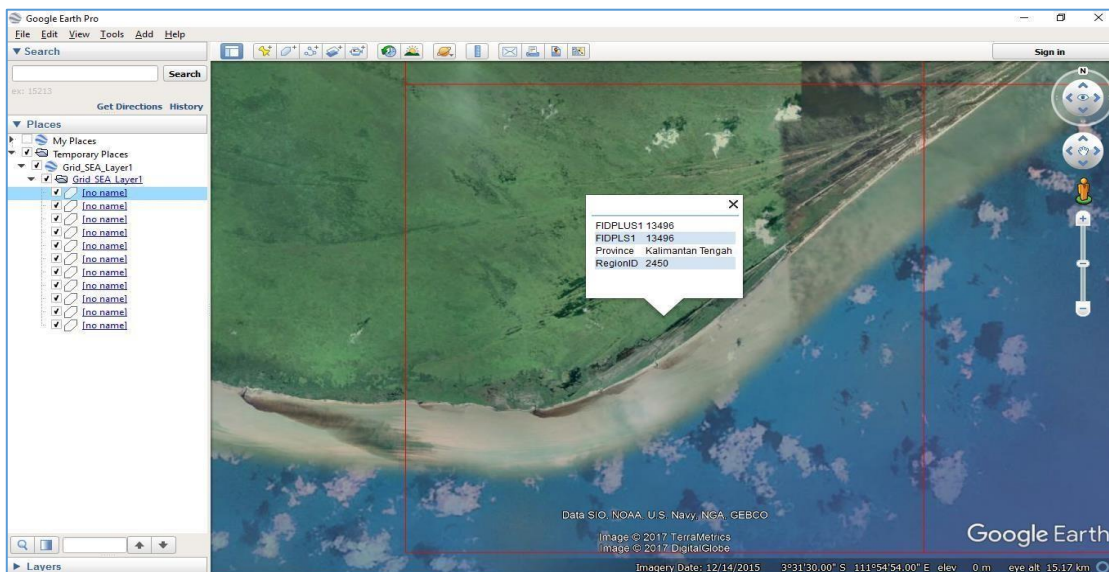


Figure 10: Initial View of a Single Grid Cell

Note that when you zoom to your cell, as in Figure 10, a pop-up bubble appears in the center of the grid cell. This shows you a unique identification number for the grid cell in question, labelled 'FIDPLUS1' and 'FIDPLS1' (they are the same number). You can disregard this and close the pop-up label.

3.3.2 Using your Grid-Cell Map to Efficiently Map New Roads

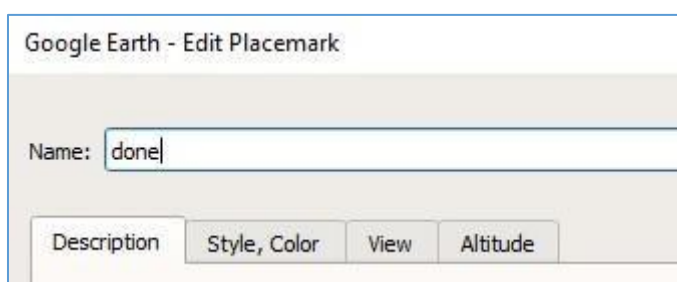
You are responsible for mapping new roads throughout all grid cells defined by your Google Earth map file of grid cells. When mapping new roads you'll want to inspect your grid cells one by one and individually 'tick off' each cell you inspect. This is very important, both for you to avoid revisiting cells later and for the larger JCU research project to keep track of which cells have been mapped. The method to tick off cells is outlined below.

Hypothetically, let us suppose that you are assigned only three grid cells: A, B and C. (Of course, in reality and as per Figure 10, these will all be identified as 'no name' in the lefthand panel of Google Earth). To begin your mapping, let's start with grid cell A. In the lefthand panel in Google Earth, double click on the element for cell A (or whichever is your first grid cell in your file) to zoom to that grid cell, as in Figure 10.

As in Figure 10, your 'cell A' should still be transparent and brightly outlined, after having followed the steps above. After inspecting grid cell A and mapping all its roads, we will change both the colour and the label of cell A to indicate that we have finished mapping all its roads.

To do so, in the left-hand panel of Google Earth, right click the element for grid cell A (or whichever is your first cell) and select 'Properties' in the resultant pop-up menu, then...

- ...In the 'Description' tab of this 'Properties' dialogue box, write "done", as shown below, and then...



- ...In the 'Style, Colour' tab of this same 'Properties' dialogue box, adjust the 'Area' colour parameter from 'Outlined' to 'Filled + Outlined', selecting whichever opaque 'fill colour' you wish, as in Figure 12. Now click 'ok', and your 'cell A' will look a lot like mine in Figure 12.

Now your 'grid cell A' should be completely opaque and have a new 'done' label in the lefthand panel (Figure 12), while your remaining cells are still transparent and labelled as 'no name'. This method of re-labelling and re-colouring must be strictly adhered because later stages of the JCU project depend on it.

At this point we can double click on the element for the next cell in the left-hand panel (being 'cell B' in this example), automatically zoom to its location, map new roads there, recolour and re-label that cell as described above, then move on to do the same in the next 'cell C', and so on.

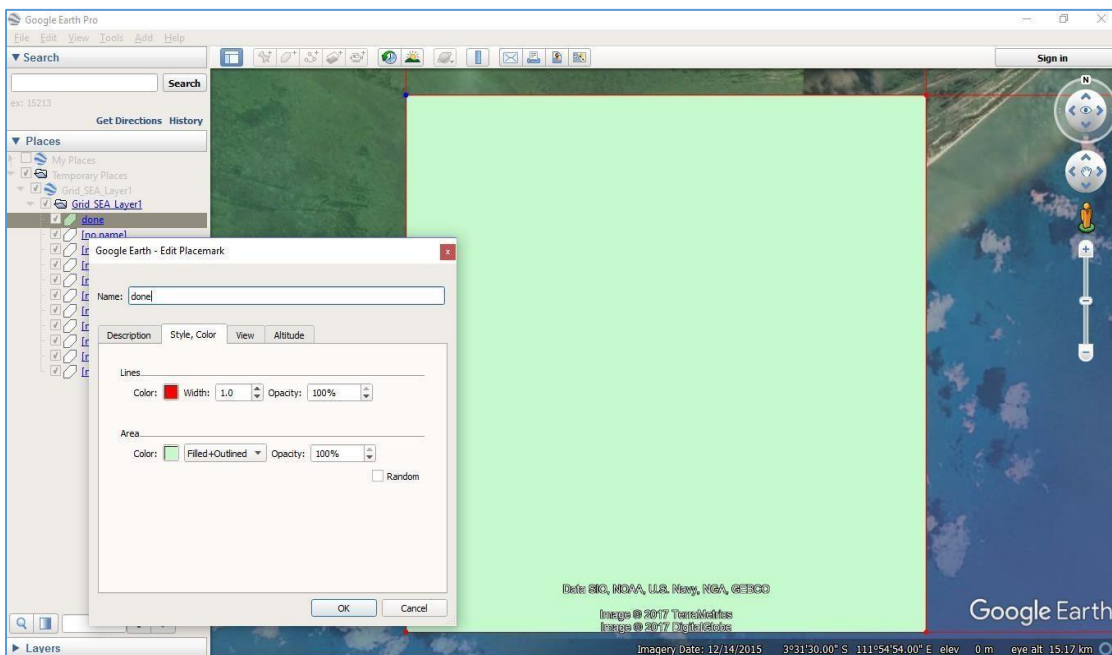


Figure 12: Grid Cell A is Now Denoted as 'Done'

3.4 Saving Your Altered Grid-Cell Map

This section concerns saving changes to your grid-cell map, Grid_SEA_####.kmz. **Saving changes to the Google Earth map file of new roads that you will create entails a slightly different protocol, described in Section 5.2.**

Within a given session of Google Earth, change you make to a Google Earth map file are temporary. These changes include: (a) adjustments to the colours/opacity of grid cells, (b) changes to the names of individual grid cells, and (c) the mapping of new roads (Section 5.1.3). To save such changes to your Google Earth map files you must save your map files before closing Google Earth. Strangely, in Google Earth the way to save changes to a Google Earth map file is to save a new version of the map file! In the case of our altered grid-cell map Grid_SEA_####, we do so as follows:

- In the left-hand panel of Google Earth, right click the Grid_SEA_#### Google Earth map file (not its sub-directory of the same name). In the pop-up menu that appears, select '**Save Places As**', as per Figure 13 below. DO NOT become confused and select the option 'Save to My Places'.
- Specify the new file name and a directory location for the altered version of the gridcell map Grid_SEA_#### you are saving.
 - **Helpful Hint:** I recommend saving the altered file with the same name as the original plus the date on which you save the file, e.g., Grid_SEA_####_Nov28.kmz, presuming you altered the file on November 28. This way, after many sessions in Google Earth in which you create many versions of a given map file, you will still easily know which version of your map file is the most recent. Keep older version alongside newer versions in a single directory (e.g., 'C:\My Documents\My Grid Maps\'). This way, should you discover that your current version of a map file is rubbish, you are still able to re-commence work from an earlier version of the file.

In your subsequent mapping sessions in Google Earth, you can continue your work by opening the most recent version of your Google Earth map file of grid cells (e.g., Grid_SEA_####_Nov28.kmz) and new roads (discussed in later sections).

It's also a very good idea to continually save your work as above during a Google Earth session, especially if your computer is prone to freezing or crashing. You will lose all your unsaved work if (or rather, when) Google Earth crashes!!!

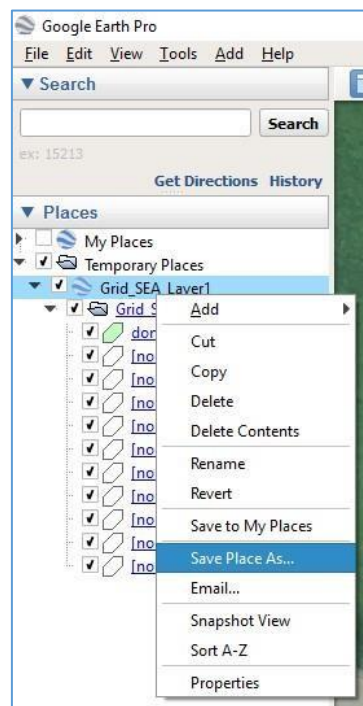


Figure 13: Saving an Altered Google Earth File to a New File

When you close Google Earth, you'll see the dialogue box below. If all your changes to your Google Earth files are already saved to a new version of the file (e.g., Grid_SEA_####_Nov28.kmz), click 'Discard'. If not, click 'Cancel' and save new versions of the files. **Never click 'Save' in the dialogue box below.** (If you do, your files will be saved, but they'll be transferred to your 'My Places' directory deep in your C drive controlled by Google Earth, making them harder to find and update later).



4.0 Mapping New Roads

4.1 How to Map New Roads and Assign Them Attribute Data

In Google Earth, your display should now have both a transparent grid-cell map (Section 3.3.1) and at least one existing-road map. This section discusses how to use these files to search for new roads, how to map the new roads in Google Earth, and how to assign attribute data to these new roads.

4.1.1 How to Search for New Roads Within Your Grid Cells

Using your map(s) of existing roads as a reference of where roads already exist, visually search for new roads in Google Earth on a cell-by-cell basis. Zoom to an individual grid cell and visually scan its area for new roads in a systematic manner. For example, scan from left to right and from top to bottom. This way you are most likely to visually identify all new roads in your grid cell with the least investment of time and without overlooking areas within your grid cell. Once you have fully scanned the grid cell and mapped any new roads it contains, do not forget to make that grid cell opaque to remind yourself that you have finished working within it (Section 3.3.2).

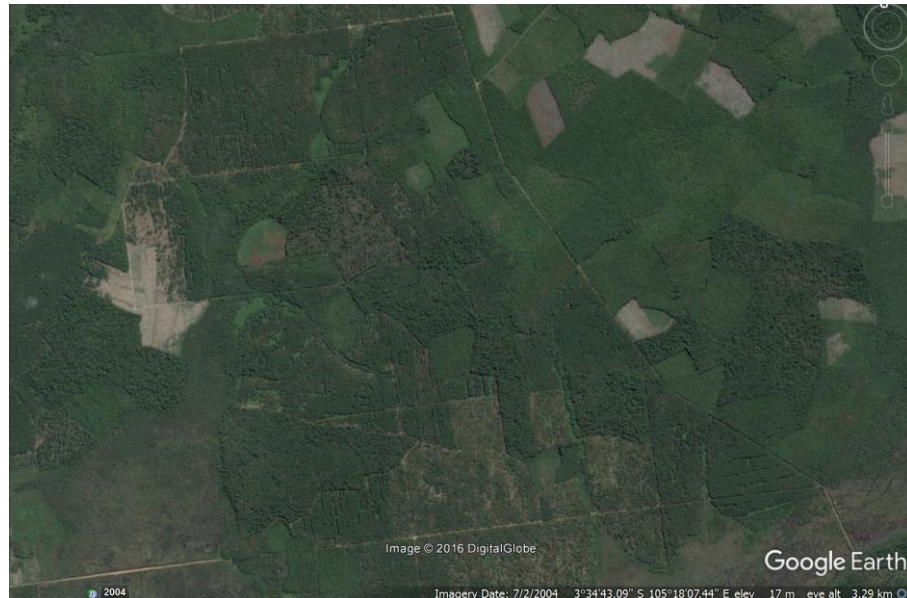
4.1.2 Protocols for Mapping New Roads (Important)

There are a few basic protocols applicable to the search for and mapping of new roads, listed below. These are essential to ensuring a minimum standard of scientific reliability, and so must be adhered to at all times.

- You must not attempt to visually identify (and certainly not map!) roads while viewing the Earth at altitudes greater than **5 km**. In non-technical terms, the altitude of observation is your 'zoom level' in Google Earth. While visually scanning your grid cell, you are encouraged to 'zoom in' using Google Earth as close as necessary in order to identify and map the new roads (Section 5.1.3). In Figure 14, you can see where Google Earth reports your 'visual altitude' above the Earth (4.88 km in the figure) as well as the buttons by which you can increase or decrease your altitude / zoom. In practice you will generally view the Earth at altitudes ranging from 1-4 km.
- Do not search for and map new roads in towns, urban areas, cities, and other areas characterised by concentrations of houses, buildings, etc. ('settlements' hereafter). Rather, concentrate your efforts in all other areas. Clearly, the exact boundary between 'settlements' and 'all other areas' is a bit of a grey area, so you are required to use your best judgement as to what constitutes a settlement.

- The images below provide some indication of what the term 'settlement' refers to for our purposes. Note how 'Not Settled' areas may still be characterised by concentrations of infrastructure, typically that associated with oil-palm plantations or other agriculture. Such areas are not primarily residential, although sparsely distributed residences may occur within them. Areas characterised by concentrations of residences and associated shops etc. are considered 'Settlements'.

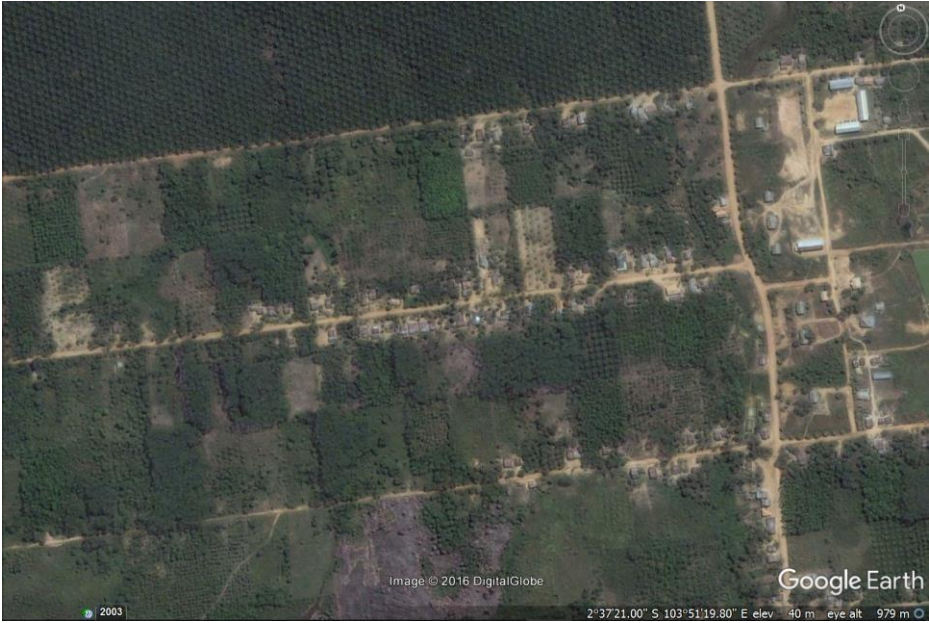
Not
Settled



Not
Settled



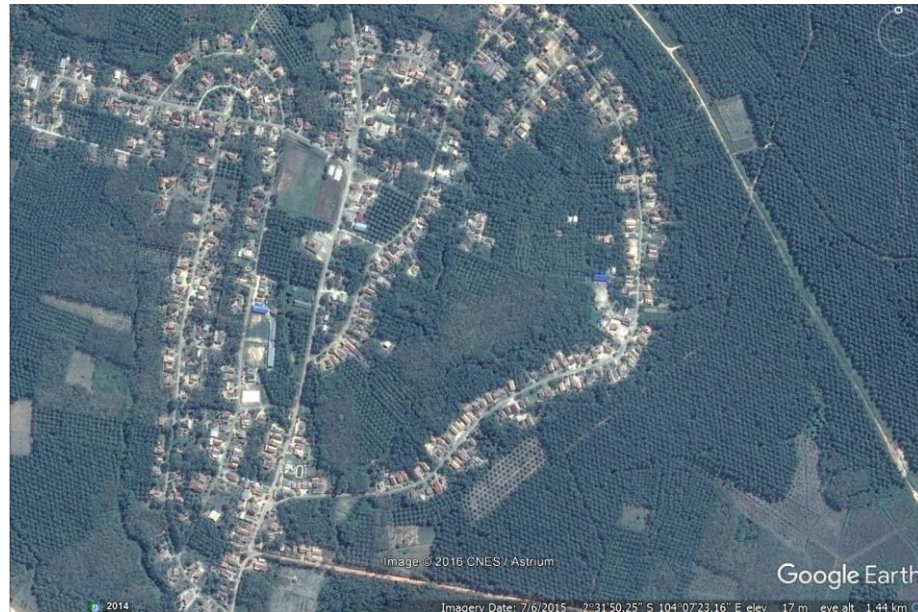
Not
Settled



Not
Settled



Settled



- If in doubt about what constitutes a settlement, consider the following questions:
 - Are the new roads you are observing for conveying people *around their settlement*? Or rather are they for *conveying people between settlements, across rural areas, within plantations, etc.*?
 - Are the new roads you are observing lined by houses or buildings? Or rather are they situated in rural, agricultural, and/or forested contexts characterised by only occasional buildings?
- If in doubt about whether a given feature visible in Google Earth is actually a road or some other linear feature, such as a gully, dry river bed, etc., do not map the feature as a new road. Similarly, if you suspect that a linear feature might be a road but cannot be certain because it is overgrown with vegetation, do not map it as a new road.

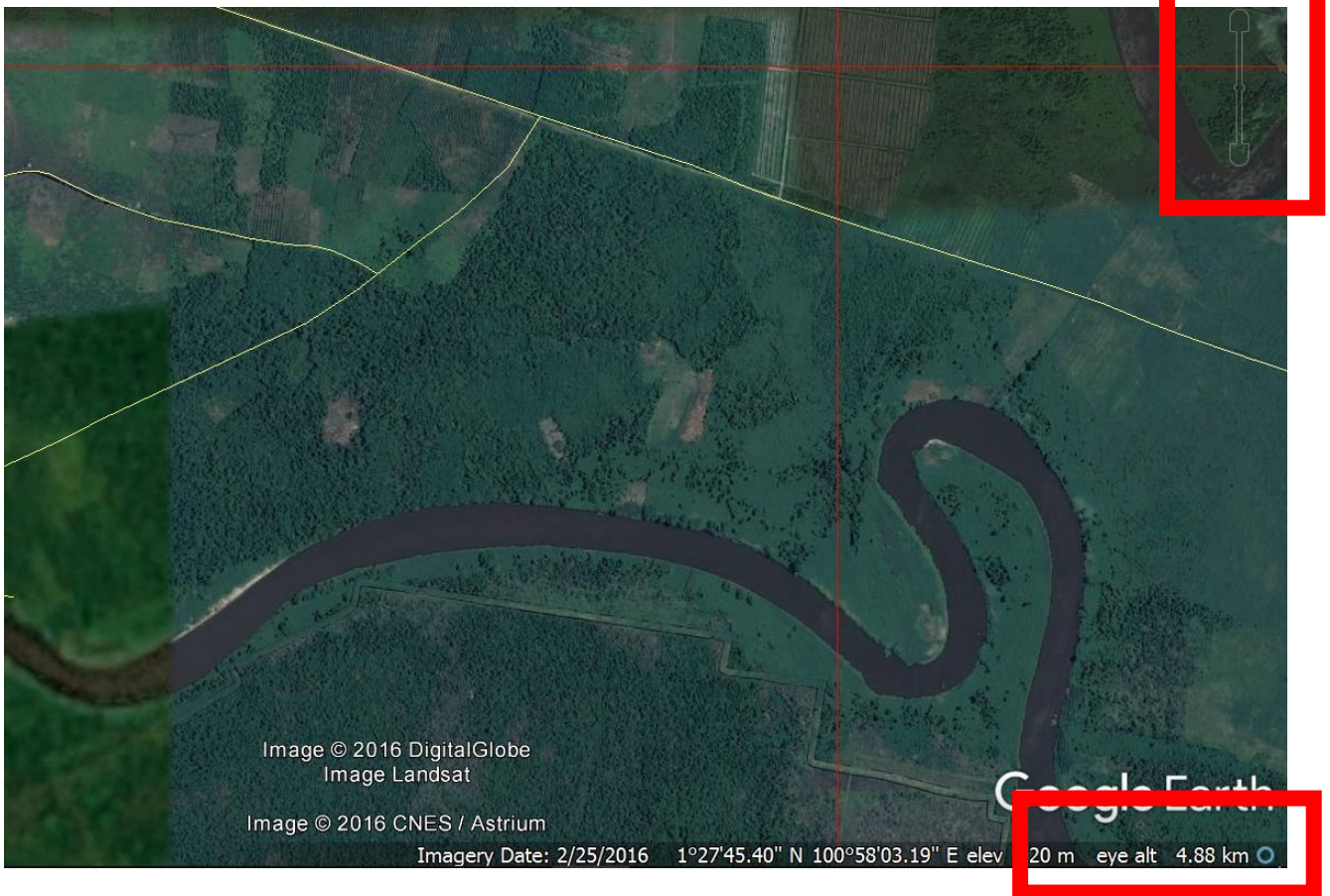


Figure 14: View of Altitude and Zoom Button in Google Earth

- **If you are mapping new roads in Sumatra (skip to next section if otherwise):** Recalling the meaning of the 'prefixes' (i.e., scales) and 'suffixes' (i.e., locations) of the names of your Google Earth map files of official roads (Section 3.2.3), where two map files of official road exist at different scales but for the same location you should display *both* map files simultaneously in Google Earth while searching for new roads. For example, if I have the official-road maps '250k 612.kmz' and '50k 612.kmz', these are clearly both for the same location, denoted by the suffice '612', so I should display both these officialroad maps simultaneously in Google Earth while scanning for new roads in the location covered by these two maps. The simultaneous observation of both maps of official roads is important because the official-road maps of different scales are generally incomplete in different ways, so that only together do they present a complete picture of the extent official roads.
 - When simultaneously displaying two maps of official road with different scales for the same locations, it is a good idea to colour the coarser-scale map with a thicker, darker lines than the finer-scale map (see Section 3.2.2 for map colouring). When viewing both maps of official roads at once for a given location, you'll note that they do not align perfectly with each other. This is due to their difference in scale.

Generally, the coarser-scale map will be less accurate than the finer-scale map. That is ok.

- Maps of official road of different scales for the same locations occur only in a few areas of insular Southeast Asia:
 - **Sumatra** – maps of official roads at the scale of ‘250k’ coincide with maps of the scale ‘50k’ across the entire island of Sumatra. (Google ‘Sumatra’ if you do not know where it is). So, for those of you mapping new roads anywhere in Sumatra, ensure that you are displaying both your official road maps at 250k and 50k scales for any given location.

4.1.3 How to Map New Roads in Google Earth

Visually identifying a new road in Google Earth is relatively straightforward, and so is not discussed at length here. Basically, you know a road when you see it. This section instead discusses the following points:

- Road mis-interpretation
- Properly interpreting road attributes
- Mapping new roads as a Google Earth map file, and assigning new roads their corresponding attribute data

4.1.3.1 Potential Mis-Interpretation

The main source of road mis-interpretation arises from the occurrence of drainage canals in peatlands. Peatlands are swampy areas roughly distributed throughout insular Southeast Asia as per the brown areas in Figure 15. Figure 16 shows some drainage canals in peatlands, which apparently define the extent of a plantation. The canals are distinguished from roads by the fact that canals are filled with water and so are far darker than dirt roads, some of which also visible in Figure 16 running alongside canals.

A similar but far rarer potential sources of mis-interpretation may arise from corridors of electrical transmission wires running between pylons (large electrical towers). These corridors often cut long linear swaths through vegetation, and so may appear as roads. These corridors may, in fact, occasionally be accompanied by parallel service roads running along their lengths (as for the electrical company), which in turn may be used by the public. In such cases, you could then map the service road as a ‘new road’, provided that it is not already captured by your existing-road maps, of course.



Figure 15: Peatlands in Insular Southeast Asia (Indonesia, Malaysia but excluding Papua New Guinea).

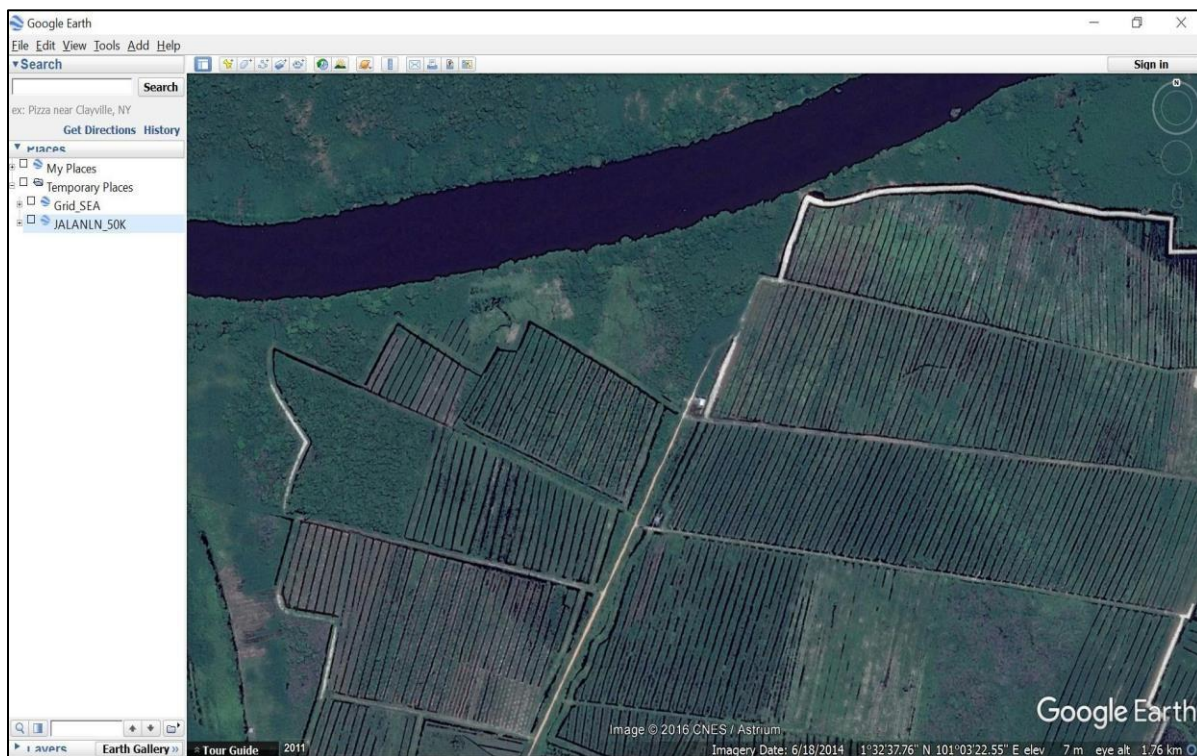


Figure 16: Canals in Peatlands

4.1.3.2 Interpreting Road Attributes

As stated in Section 2.2, you are tasked with interpreting and recording two attributes of the new roads you map:

- Road paved status (i.e., paved or unpaved), and
- Observation date of the road (i.e., the date of the satellite imagery in Google Earth in which the new road was observed).

Observation date is the easiest attribute to identify. This attribute is simply the acquisition date of the satellite imagery shown in Google Earth for the area in which you visually identify a new road. In Google Earth, this date is visible at the bottom of the screen. In Figure 14, for example, the “imagery date” is reported as “2/25/2016”, reflecting a “M DD YYYY” format for recording the date (M = month, D = day, Y = year). We will use a slightly **DIFFERENT** date format when recording the reported date as attribute data for our new roads, namely **MM_DD_YYYY**, as detailed in Section 5.1.3.3.

Interpreting road paved status is also straightforward. Most new roads will be unpaved. Compared to paved roads, unpaved roads are characterised by the relatively bright colours of bare tropical soil and/or gravel, often with shades of orange, brown, white and grey. Figure 16 shows an unpaved road.

Figure 17 shows both paved roads (north-south orientation) and unpaved roads (east-west orientation). As this figure illustrates, often the best means of identifying a given road’s paved status is to compare it to nearby features, including other roads, bare patches of earth, etc.. This is particularly the case for roads that appear to be paved, as confirming that a road is paved is often tricky.

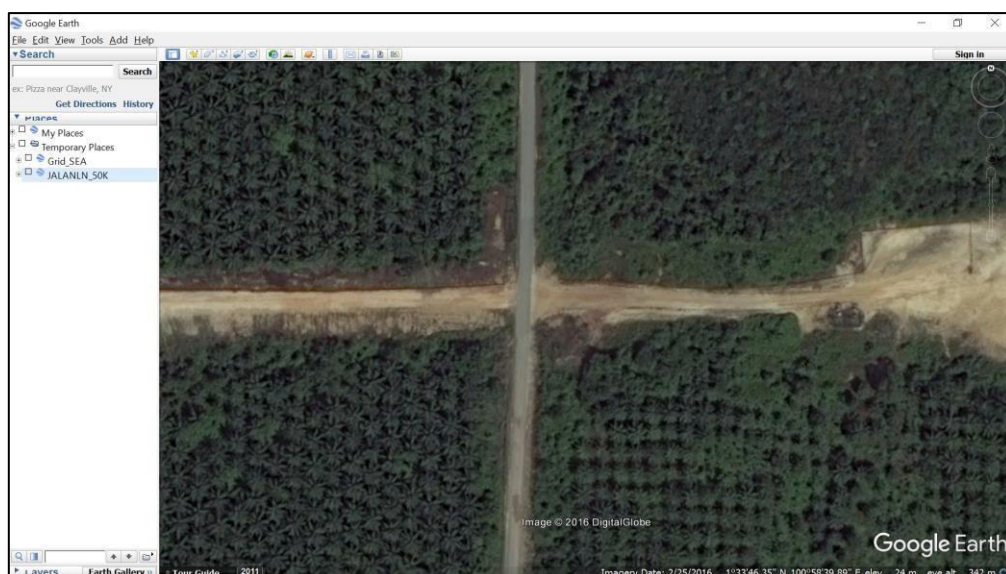


Figure 17: Paved (North-South) and Unpaved (East-West) Roads in an Oil-Palm Plantation.

Other tricks for properly interpreting a road's paved status are listed below:

- As shown in Figure 18, paved roads will often have unpaved edges or gullies. These stand out as bright edges against the darker bitumen of the paved road. This 'contextual interpretation' helps identify a road as paved.
- As shown in Figure 19, unpaved roads may occasionally display tyre tracks. Care must be taken in differentiating parallel tyre tracks from the parallel unpaved edges of paved roads in Figure 18. Knowing your local context (e.g., plantation, intersettlement road) and visual altitude above the Earth (193 m in Figure 19) will aid you in this respect.

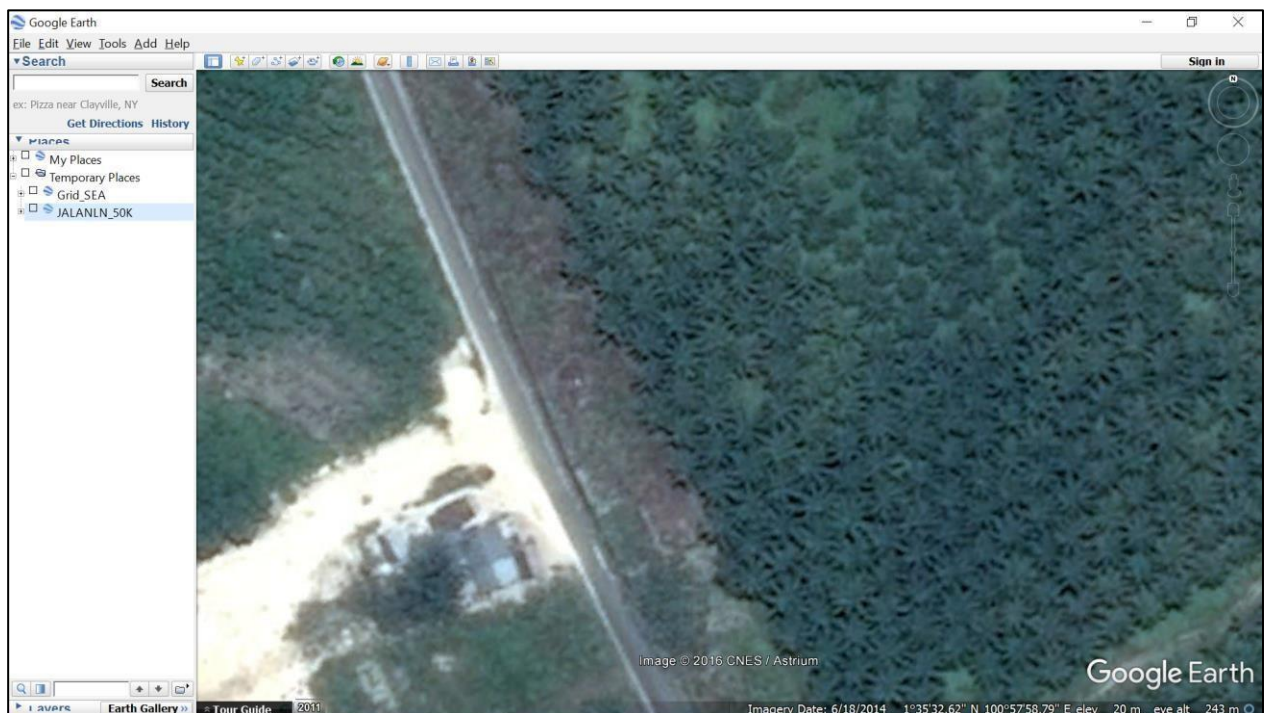


Figure 18: Paved Road (Northwest-Southeast Orientation) with Bare Dirt Edges.

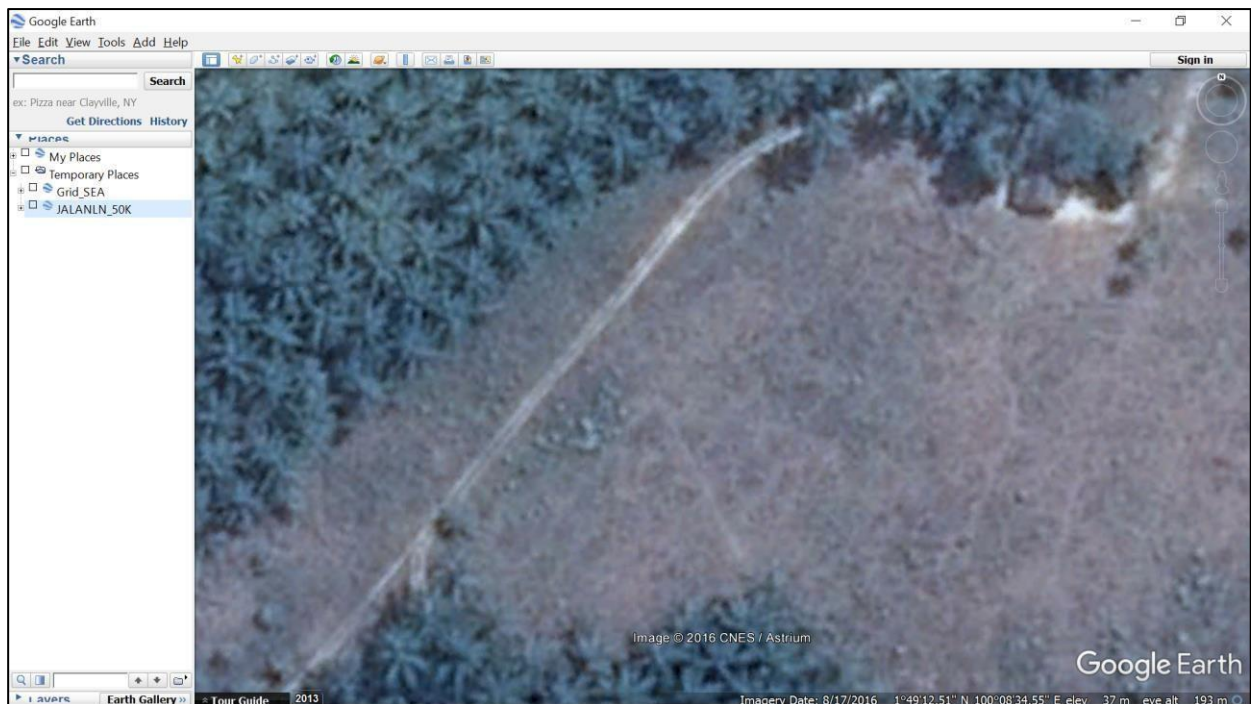


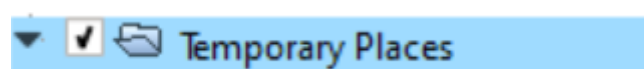
Figure 19: Unpaved Road with Tyre Tracks in an Oil Palm Plantation

4.1.3.3 Digitising New Roads and Assigning Them Attribute Data

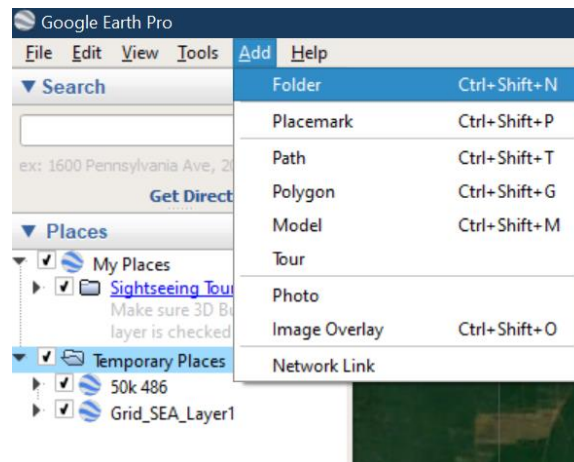
Mapping or 'digitising' new roads simply entails using your mouse to trace a road visible in Google Earth on your computer screen. In doing so, you map a new road or 'way' that is part of a larger Google Earth map file. Recall that we are interested in mapping only those 'new roads' not already captured by the existing-road maps. The following text explains how to map new roads and assign them their corresponding attribute data.

In preparing to map new roads during your first session of Google Earth, it is essential that we first create a new sub-directory in whichever Google Earth map file of *existing* roads that you happen to be viewing. Any Google Earth map file of existing roads will suffice. The new sub-directory you create will exclusively contain the *new* roads we map through our first session of Google Earth. Before the end of our first session we will convert this new subdirectory of new roads into a stand-alone Google Earth map file of new roads, which we can then build upon during later mapping sessions.

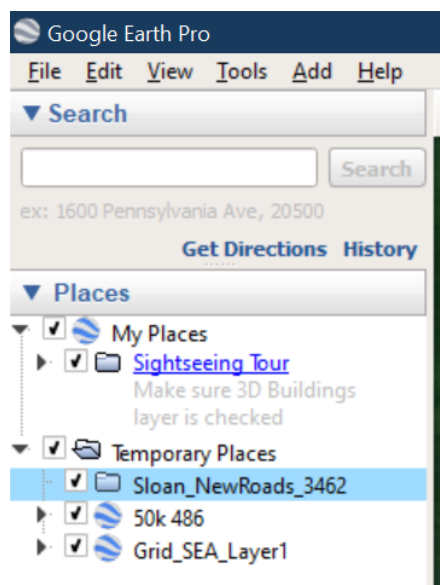
- In Google Earth, in the left-hand panel, highlight (i.e., click on) the folder labelled 'Temporary Places'.



- In Google Earth, at the top of the screen, click the 'Add' menu and select 'New Folder', as below. Alternatively you may right click on the 'Temporary Places' folder.



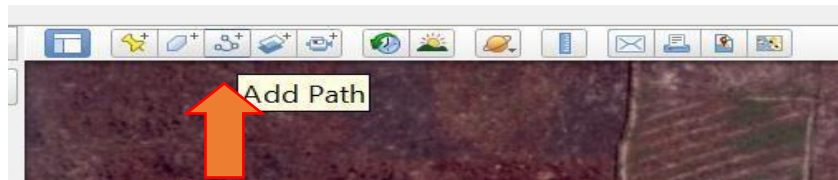
- Label your new folder (i.e., sub-directory) thusly: "YOUR LAST NAME_NewRoads_THE PACKAGE NAME". In my example, my new folder's name is "Sloan_NewRoads_3462". Move your folder into the 'Temporary Places' directory by clicking and dragging it. Your left-hand panel should now look like mine below.



Before digitising your first new road, ensure that your new sub-directory (i.e., Sloan_NewRoads_3462) is still highlighted in the left-hand panel, as shown immediately above. Highlighting this sub-directory before digitising a new road tells Google Earth that we want the new road 'way' to be saved into this particular sub-directory and not elsewhere. This is important.

Now that we are set up to map new roads, we can do so according to these steps:

In the row of buttons at the top of the screen in Google Earth, click the one labelled 'Add Path', which is the third to the right of the yellow push-pin button. 'Path' is just another word for 'way' or 'road', i.e. a linear feature.



- A dialogue box appears in which you specify the name of your new road. The name of your new road will contain all the attribute data for the road, so it is important that you understand this step well. The name of your new road will be a composite of the following bits of information, in order, with each bit separated by a “_” character:
 - Your last name
 - The term 'NewRoad', without spaces and with both 'N' and the 'R' capitalised
 - '1' if the road is paved, or a '2' if the road is unpaved
 - The observation date, in the format MM_DD_YYYY.

So, in the case of an *unpaved* new road I identify in Google Earth in a satellite image with an observation date reported as “2/25/2016”, I would label this new road as “Sloan_NewRoad_2_02_25_2016”.

Similarly, in the case of a *paved* new road I identify in a satellite image having the same observation date, I would label it as “Sloan_NewRoad_1_02_25_2016”.

Finally, for a paved road with a reported observation date of 12/9/2015, I would label this new road as “Sloan_NewRoad_1_12_09_2015”.

Tip: In the first example immediately above, note how the month of observation reported by Google Earth is '2' (as in February) but it is then 'padded' with a leading 0 in our attribute data so that it becomes '02'. This is essential to ensuring that each and every month is denoted by two numerical digits, from '01' (January) through to '12' (December). The same principle applies to days of the month. Thus, the first day of the month is denoted '01', not '1', while the 10th day is simply denoted as '10'.

Before clicking 'ok' in the dialogue box for your new road, you must still digitise the road itself. You'll now notice that when you hover your mouse over Google Earth it looks like a 'cross hair' symbol. As you click your mouse along the road visible in Google Earth you can record little points or 'nodes' connected to each other by lines, all of which are now visible on your screen. Continue to do this along the entire length of the new road you are mapping. While you are in this digitising mode you can still adjust your 'zoom' (altitude) as usual. You can also pan your view up/down and left/right in Google Earth using the four arrow keys on your keyboard. To finish digitising your new road, double click at the end of the road to define its 'terminal node' or click 'Ok'. Your new road will now be digitised, and you can click 'ok' in the dialogue box to finally record the new road within your sub-directory.

- Once your new road is thus labelled and digitised, it should appear as in Figure 20. (Your road will of course have a different shape and colour).
- If you make a mistake and wish to delete a given new road 'way', simply right click it in the left-hand panel and select 'delete' in the pop-up menu. (Use the same method to remove whole map files from your display in Google Earth. Choosing to 'delete' a map file from your display will not delete the actual file from your computer).

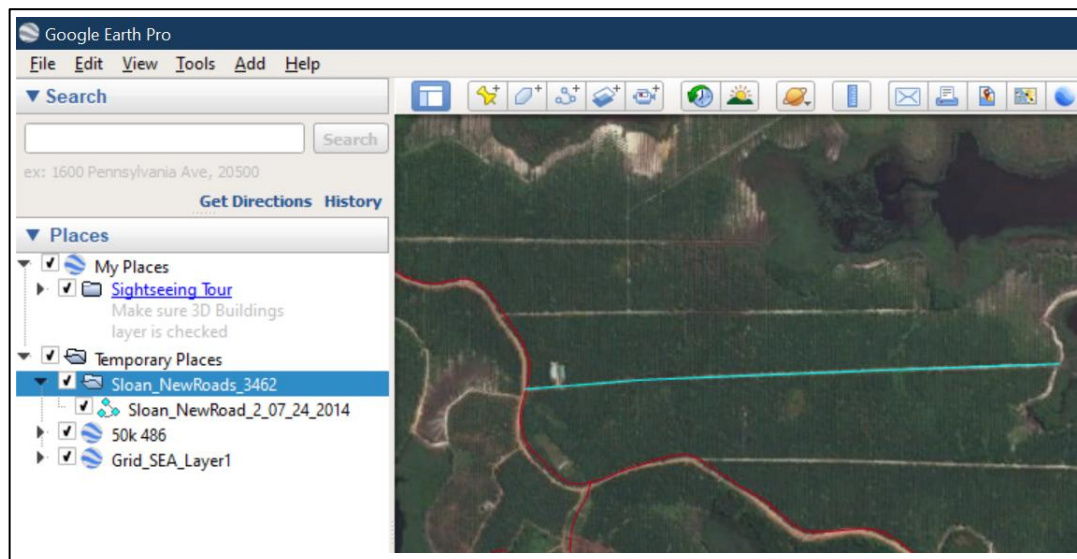


Figure 20: A Digitised New Road (in Teal Blue)

4.2 How to Save Your New-Road Map in Google Earth

Upon mapping a few new roads during your first session of Google Earth you are now ready to save your sub-directory of new roads (“Sloan_NewRoads_3462” in Figure 20) as a stand-alone Google Earth map file. Once saved as a new Google Earth file, can you continue to add new roads to this map file in later sessions of Google Earth.

Saving Google Earth map files was discussed in Section 3.4. *However*, the process for saving a map of new roads is slightly different, so pay careful attention here.

Like in Section 3.4, to save your new roads right click on the *sub-directory of new roads* (‘Sloan_NewRoads_3462’ in Figure 20) in the left-hand panel and select ‘Save Places As...’ in the pop-up menu. You can now specify where on your computer you wish to save your new roads as a stand-alone Google Earth map file. The default name of your new Google Earth map file of new roads will be the same as your sub-directory of new roads (Sloan_NewRoads_3462.kmz). To help keep track of your mapping efforts, you should make the name of your new road file a composite of the following bits of information, in order, with each bit separated by a “_” character:

- Your last name
- The term ‘NewRoads’, without spaces and with both the ‘N’ and the ‘R’ capitalised
- The XXXX location-identification code from the Grid cell being mapped
- The mapping date, in format MM_DD_YY, so you know which file is the most recent
- As you should be saving your file regularly to avoid losing progress if Google Earth crashes, it is useful to add an extra number at the end of the file name to note which is the most recent file.

Therefore, your new road file, with all new roads mapped in XXXX grid will have a name something like Sloan_NewRoads_3462_08_22_19_1.kmz.

This name might seem a bit long, but including this information will ensure you can keep track of your new road files and not lose time by re-doing work that you have already done.

4.3 Mapping New Roads within Grid Cells

Many new roads you observe will of course cross the boundaries of a given grid cell. In this situation, there are two courses of action you may take, depending on where the road lays:

- Where a road crosses from one grid cell into an adjacent cell in Grid_SEA_####.kml, simply map the road seamlessly as it crosses from one cell to the other.

- Where a road crosses from one grid cell into adjacent space that is not within any of your grid cells in Grid_SEA_####.kml, simply map the road in question as far as the edge of your grid cell. In other words, cease mapping the road once you reach the edge of your grid cell.

4.4 Frequently Asked Questions

1. What if my existing-road maps are ‘inaccurate’?

You will notice that many roads mapped by a Google Earth file of existing roads are slightly offset (typically by ~10-50 meters) from the roads visible in Google Earth. The degree of offset will be greatest for maps of ‘250k’ scale and least for maps of ‘25k’ scale. Such offsets should NOT be interpreted as meaning that a given road visible in Google Earth has not been captured by an existing-road dataset. Consider such roads to have been fully captured by an existing road dataset, regardless of any such offsets.

Occasionally you may also notice that your Google Earth map files of existing roads display a road occurring where Google Earth indicates no such road exists. For example, the existing road map may display a road through a forest that Google Earth indicates is still intact. Overlook any such discrepancies.

2. When digitising a new road that actually intersects an existing road according to the satellite imagery of Google Earth, should I *extend* the digitisation of the new road so that it intersects the existing road if that existing-road map is offset from the satellite imagery of Google Earth?

No. Just digitise (trace) the new road over where you see it occurring as per the underlying satellite imagery of Google Earth. Do not ‘extend’ the new road beyond where the satellite imagery shows it to occur.

See also Question 1 above. In general, the degree of offset of an existing-road map relative to the roads visible in the Google Earth satellite imagery will be about 10-50 meters.

3. What if I am unsure whether I am observing a road in Google Earth?

If in doubt about whether a given feature visible in Google Earth is actually a road or some other linear feature, such as a gully, dry river bed, etc., do not map the feature as a new

road. Similarly, if you cannot be certain that a linear feature is a road because it is overgrown with vegetation, do not map it as a new road.

4. What if a new road I observe is both paved and unpaved along its length?

Map (digitise) the paved length separately from the unpaved length, since each length will require different attribute data.

5. What I observe a new road that disappears and reappears over its length? When digitising this new road, should I interpolate its invisible lengths on the basis of those lengths that I can clearly see?

No, just digitise road lengths that you can clearly see and interpret as roads. Do not interpolate or 'guess at' lengths of new roads that you cannot clearly see as such. Where a given new road disappears and reappears, as may occur be the case for disused seasonal roads under a forest canopy, define the road as multiple 'ways' in Google Earth, which each 'way' being a visible segment of the road.

6. What if there is no imagery date in Google Earth for the location I am mapping?

There are three potential solutions to this problem.

1. Wait a few seconds. The image date 'loads' from the internet after your image loads in Google Earth. If your internet is slow, the image date might not appear for 5-10 seconds after you pan to a new area.
2. Zoom in very close (e.g., <1 or 2 km altitude) and/or zoom in and then moderately zoom out, say to 4-5 km altitude. This seems to make the image date appear where previously done was displayed.
3. Failing option one and two, click the 'clock' button in the toolbar in Google Earth, shown below...



...this button shows the archive of all Google Earth images available for a given location over time, from earliest to latest. In the example shown below, you can see images are available between 1984 and 2016. You can click through the images. Each is dated by month and

year of the image in the archive in the upper left, e.g., 12/2014 for Dec. 2014 in the example below. The white text at the bottom of the screen confirms this date to be 12/05/2014 in the example below. If this white text is for some reason not visible to you, just assume that the day is '01' and record the date (in this case) 12/01/2014 when naming any new roads in the area using the information at hand, following the standard MM_DD_YYYY date format. Clearly, you'll want to date your new road according to the latest image that shows that road! Click the clock button once more to return to the normal mode in Google Earth.

