

Google Earth Handbook



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1. **Overview**

In order to minimize time and costs for international prospecting of project sites for its G168 VAWTs, WHI encourages the use of Google Earth along with a combination of other tools that provide wind speeds and property boundary information that is available with a public license and usable on Google Earth (GE).

This handbook is a guide to show how to use the GE tools, present the resulting information, and create annotations, with an emphasis on knowing how to represent VAWT arrays. In order make it easy for people to find sites that would work with shorter VAWT arrays, Wind Harvest International is making this handbook and other wind site “prospecting” tools and information available in the library section of its website (windharvest.com) with a Creative Commons copyright (BY-SA) that allows you to share and adapt this. Please send your suggested improvements back to us at info@windharvest.com so we can include those improvements in later version.

1.1. **What is Google Earth?**

The advent of satellites, initially designed for spying across seas, now brings the global economy together. Using the high definition imagery from satellites this makes global surveying possible without travel. Today, you can charter a satellite to take even more detailed images and readings at any time almost anywhere in the world (for the right price)[3]. Google simply collects these images when possible on their servers, and the tools they provide allow users to probe their data.

“In 2004, Google acquired Keyhole Corporation, a digital mapping company whose Keyhole Viewer maps program united traditional satellite imagery [...] Shortly after, in 2005, Google repackaged the software as Google Earth [...] Today, [it] exists in several different formats: a free, non-commercial version, Google Earth Plus, which adds support for GPS devices, data importing, and better printing; and Google Earth Pro, which includes, among other enhancements, faster performance, better measurement tools, and a module to create fly-in movies.” [2]

1.2. **General Info**

Google Earth's free, expansive software is comprehensive, simple, and constantly being updated. It is a tool that all but, replaces traditional maps by creating a system where everything is based on longitude and latitude. The tools and large data sets make preliminary surveying as simple as point and click.



“Google Earth is built from information that is available from a broad range of sources, including commercial and public sources. For example, this same information is available to anyone who flies over or drives by a piece of property. Please note that as we acquire our data from third-party sources and aggregate the original images, we're unable to delete any aerial or satellite imagery on request.” [1]

The base elevation data is at about a 15m-30m resolution from a mission by the United States Geological Surveyors. [4] This means that any distances relative to 15m involves interpolating a small amount of data, and so it is possible that the slope may vary slightly. This is being replaced with an updated database; with a resolution of 2.5 to 10m as surveying techniques continue to improve. However, considering the turbine size, the accuracy is likely high enough for initial surveying techniques.

1.3. Content Panels and Navigation

At the start of the Google Earth App the initial image is of the earth centered on the screen, the screen is known as the viewing window. There is also a sidebar on the left with three collapsible sections; a) search b) places c) layers, and a toolbar across the top of the viewing window. If the panel on the left is missing press (ALT+Command+b), if the toolbar is missing press (ALT+Command+t) or on the very top, under the tab **View** you will see both the toolbar and sidebar (make sure they are check marked in order to see them on the viewing window. Additionally, there is a transparent bar at the bottom of the viewing window.

The section below discusses the Content Panels, and how to use them.

*The size of the side bar can be changed, by using your mouse at the right edge, as well as the panel sizes for search, my places and layers.

a) Search

Most people are familiar with Google as a search engine, the top panel is a traditional search bar. The following are search types which it is designed to follow:

- i Exact Address, City, Town, District, State, etc.
- ii Geographical or man made location (i.e. Mountains, Buildings, bodies of water)
- iii GPS Coordinates (Lat/Long or UTM)

*Tips: For the Latitude and Longitude coordinates, if the given coordinates are not

showing the area you are pursuing; add a negative sign in front of the Longitude coordinates or determine the directions N, E, W, S that should be placed after the Latitude and after the Longitude.

Here are some examples:

19°52'11.73", 155° 9'36.15" (incorrect; this will lead you to some other area)

19°52'11.73"N, 155° 9'36.15"W (correct)

19°52'11.73", -155° 9'36.15" (correct)

b) My Places

The middle section of the sidebar is where all the user's created annotations are stored, they can be turned on and off (by checkmarks), edited, or accessed. Each of the items in the section can be classified as one of the following (they will be defined in future sections):

i Place Marks

ii Paths

iii Polygons

iv Tours

c) Layers

In bottom section of the left panel there are also large data sets that Google accesses to supplement the map. These different sets are placed over the top of the map, and can be turned on and off in the layers window. The most useful layers include:

i Borders and Labels

ii Places

iii Photos

iv Roads

d) Toolbar

The top panel is the toolbar, where a user can quickly create notations, change some settings, export imagery and investigate distances. The description of each icon can be determined by letting the mouse float over them. From left to right, the icon groups are



as follows:

- i Hide Sidebars
- ii Annotation Tools
- iii Imagery Adjustments (Time or Lighting)
- iv Planet Selection
- v Ruler
- vi Exporting Data

TUTORIAL VIDEO [A]

<https://www.youtube.com/playlist?list=PLFD708B289C411B43GEHanbook.doc>

e) Status Bar

The bottom, right of the viewing window has a description of the current conditions, including the GPS coordinates and elevation of the mouse, current viewing altitude, and the capture date of the imagery. In the cases where multiple image dates are laced together, the date will not be shown, but can normally be determined by zooming in closer.

1.4. Navigation

There are four types of movement that are possible with Google Earth navigation, pan, zoom, rotate and tilt. Each type of navigation can be executed with either a mouse click on the navigation key in the top right of the viewing window, or with a keyboard shortcut. [1]

TUTORIAL VIDEO - <https://youtu.be/mGZp9Eid8rU>

[EXTREMELY USEFUL] There are 3 quick adjustment shortcuts if you want to straighten the viewing window. The shortcuts are:

- i N – Rotates viewing window so 'N'orth is towards the top of the screen.
- ii U – Tilts viewing window to be directly 'U'p and down (straight down).
- iii R - 'R'esets the viewing window (same as N and U)

2. **Tools**

Tools are any commands that can be used to annotate, or present annotations on Google Earth.

Each tool has an associated setting, which can be accessed by secondary clicking on the tool, and

selecting 'Get Info.' One of these settings, is an associated view, which will be used when the tool is selected, it can be set by selecting the 'Snapshot View' option either from the secondary click menu, or each aspect of the view can be manually changed in the settings.

2.1. Place mark

The place mark is one of the most versatile tools, due to its simplicity. It is possible to use the place mark as a label, an icon, both or neither. It is possible to change the icon symbol and size in the settings, by clicking on the button to the right of the title. Finally, it is possible to include notes such as information, images, links and references that appear when the mark is clicked on.

TUTORIAL VIDEO - <https://youtu.be/xSVFB-kjST0>

2.2. Polygon

Visual: 

The polygon allows the user to outline a region with multiple points, along with the same note capability as the place mark. The width of the outline, and the color and opacity of both the outline and fill can be changed in the settings. This tool has less obvious applications for WHI surveying, like highlighting potentially problematic geography or locations.

TUTORIAL VIDEO - <https://youtu.be/40Ybn-BXWFA>

2.3. Paths / Tours

The path is likely the most useful tool. It allows the user to create a line that connects between multiple points. The line color and width can be varied in the settings.

Once the path is set, it is possible to create a tour based on that line, using settings in the main Google Earth Preferences. These tours are very effective for presenting regions at a far and close altitude.

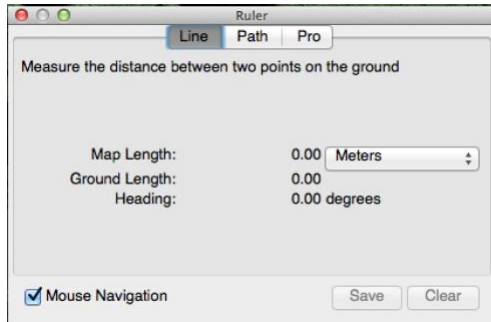
TUTORIAL VIDEO - <https://youtu.be/ts9w1yMUbK4>

2.4. Ruler

Visual: 

The Ruler app allows the measurements of distances and elevation as well as the creation of lines and paths. The following are the steps to a basic line creation with the ruler app:

Step 1: Click on Ruler App and a pop-up window will appear



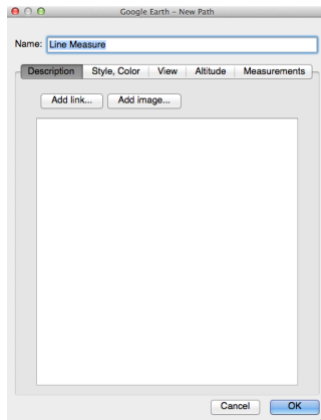
Step 2: Determine the Map Length.

Step 3: Click on the area you want to begin the line, line will start to form when the targeting symbol appears.

Step 4: Drag the line and click once to finish the line.

*Tip: You may edit the length of the line by dragging the endpoints of the line.

Step 5: After you save the line, another pop-up window will appear.



You can edit the line color and thickness under the **Style, Color** tab. Also rename the line.

2.5. Folders and Exporting

When creating a large number of objects, at times it may be desirable to hide them as a group. In that case, the filing system allows the user to collect files in a collapsible folder and turn them on or off, using the checkbox next to it. There can be an infinite amount of folders within one another, with any variety of tools within.

Exporting files is done by simply secondary clicking on the file to export, and selecting 'Save Place As...' The default file type is a .kmz file, and this is exchangeable between any users

who also have Google Earth.

a) TUTORIAL VIDEO - https://youtu.be/9Sg88z_DYRg

2.6. Saving Images/Maps

When saving an image click on file/save/save image. In this view you can edit the title/description of your map as well as edit the legend by either making changes to the “places” in the view screen or manually changing the legend by clicking on it and editing each section. Once you have the legend and title desired click on “save image” on the top bar. You can also change the “map options” at the top bar and delete the title and description or legend from the image if you require an image with no description.

3. Techniques for Representing a VAWT Array

WHI uses several techniques to represent VAWT array depending on the accuracy and visual impact of image desired. One technique is to use lines of varying widths to represent arrays of VAWTs from different heights, another is to use circles to represent each individual VAWT.

3.1. Using Lines to Represent VAWTs

WHI uses several conditions to determine where to locate a VAWT array, but once the location has been selected it is almost always the case that the desired width of the line be ~12m. However, when setting a line width, Google Earth will only set the pixel width of the line, this means that repositioning the viewing window will result in a line with a varying absolute width. Also, depending on the size and density of the installation, it may be necessary to use different views in order to be able to visualize at both a macro and micro scale.

The following is a set of instructions for the most effective way to create a line of a desired width, as well as how to prepare an image for presentation purposes.

a) *Accurate Line Width and Arranging Layout*

- i The best method for setting up images with a desired width is to create the lines. I begin with a view which is far too close for presentation purposes, and then to later copy that folder and change its settings. To do this, follow this next set of steps:

- Step 1: Choose an elevation, at an altitude which is easy to navigate
- Step 2: Set the width of a line somewhere around 5
- Step 3: Measure the line width with the ruler (as close to perpendicular as

possible)

- Step 4: Adjust the line width (up if too thin, down if too thick)
 - Step 5: Repeat Step 3 and 4 points until satisfied, small variations to the view altitude can fine tune the line width as close to 12 as desired.
- ii Then, create a folder for the layout, and make sure to snapshot the current view to both the file, and the first path within it. Now finalize the path location and length, by keeping an eye on the measurement while adjusting the end points.
[Recommendation: Describe the type of VAWT array in the notes section of the path, it makes length verification much easier.]
- iii It is best to copy the first path, and edit it's end points to create the next arrays, this is because the copied line will share the characteristics which were just chosen to ensure a line width of 12m.
- iv Depending on the presentation requirements, you may want to create sections by outlining different groups with a no-fill polygon, or introduce labels. Labels can be created by making a place mark with an icon size of 0.

b) Preparing Multiple Images

- i Once the paths have the correct end points, and associated annotation, images with different scales will likely be necessary for presentation purposes. The first step is to reduce the pixel width to maintain the 12m path thickness:
- Step 1: Copy the folder containing the first build (don't want to ruin the close-up scaling).
 - Step 2: Choose the new desired altitude
 - Step 3: Adjust the line width of all the paths in the folder simultaneously, by going into the settings of the folder and selecting 'Share Style' option.
 - Step 4: Measure the new line width with the ruler.
 - Step 5: Repeat steps 3 and 4 until satisfied.
- ii Now that the view is prepared, ensure that any extra tools which would be visible in the viewing window are turned off. Setting the navigation tools to 'Compass Only'

under the 'View' tab, in 'Show Navigation' makes the image visually less cluttered. Additionally, for a top down view it is useful to include a legend for comparison, which is under the 'View' option.

- iii Tilting the viewing window at an angle captures the local geography better than top down, so they may also be included. However, due to the way that Google draws paths, when the viewing window is at an angle paths that are further have a larger absolute width than the closer ones. Also, the scale legend is not applicable for an angled view, so make sure that it is turned off.
- iv Note that if multiple views are desired for one folder, it is possible to create a place mark with an icon and label size of 0, and simply use it to snapshot a view.

3.2. Using a circle Placemark to represent a VAWT

In order to create a placemark that represents a single VAWT, first choose an appropriate eye altitude (eg 500m or 1km).

- a) First create lines to represent VAWT arrays with the correct size of array and gaps between arrays.
- b) Click on the placemark icon and choose the “donut” icon (<http://maps.google.com/mapfiles/kml/shapes/donut.png>)
- c) Change the “Style/Color” of the icon so that the label has 0% opacity so that it is not visible and change the scale of the icon to be approx. 12m across when placed at the eye altitude that you have chosen. If the placed icon is larger or smaller than the 12m when placed (use the ruler to determine the size) edit the icon and change the scale.
- d) Place the icon at the beginning of one of the lines representing an array.
- e) Once created at the correct size when you place additional icons they will be the same size and shape of the first one created. Place as many icons as needed within the created lines of the arrays needed.
 - i If an array is needed of 4 VAWTs of 52 m long, 4 circles of 12m diameter should connect up to fill the space. Once done you can delete the line created for the array.
- f) Save the image that you need once created. If you change the eye altitude while using placemarks, the scale of the placemark changes, this view is only useful for an image, not

for viewing in google earth.

3.3. Alternative circle representation

- a) Zoom in your designated location. The visual should be an aerial view (not tilted).

*Escape ground view if in ground view. All dynamics of visual composition can be readjusted on the upper right corner with the compass setting and the other settings below the compass.

- i Here is an example:



Visual is tilted

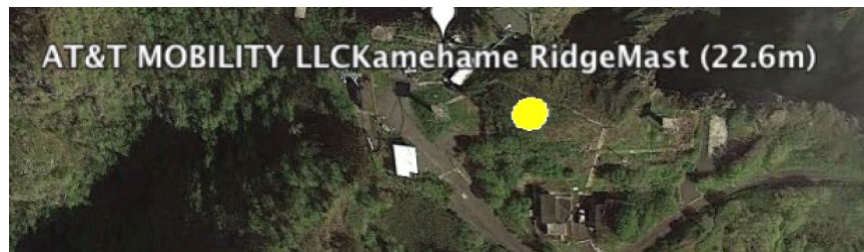


Visual is directly above in Aerial view

- b) Click on the ruler app, and measure out the diameter of your circle on your designated location and save. Do another measurement and place it in the center and perpendicular to the previous diameter and save.
- c) Click on the Polygon app, and click on one end point of the diameter, then one by one click in a circular pattern making sure the point lands on all four ends of the cross measurements you made. *Tips: You can readjust the points after placing them on. Also if you made a mistake, click on a point (once) and press the delete or back space tab on your keyboard.

- i Save the polygon and delete the ruler measurements. Here is an example:





4. **Representing Existing HAWTS**

If you desire to mark where there are existing HAWTS are alongside a representation of VAWTs so that they can be viewed from different eye altitudes this is done by creating a small place mark.

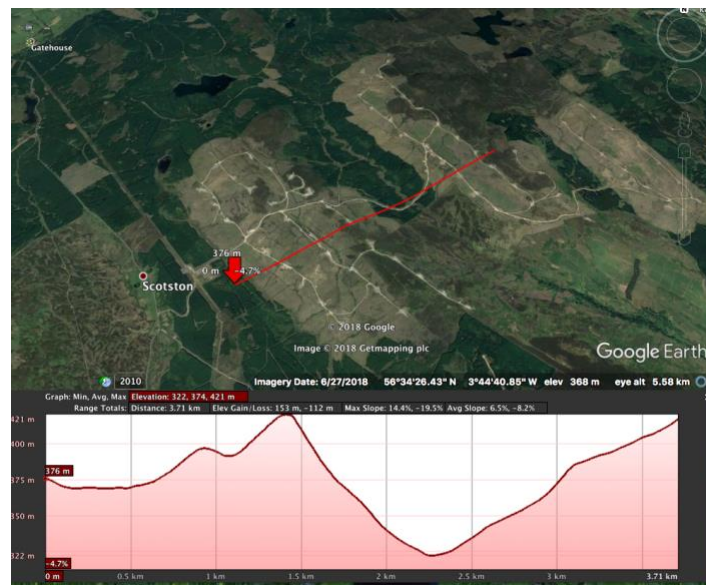
- a) Click on the place mark icon and to the right of the name of the icon click on the yellow pin. This will allow you to change the visual of the icon. For HAWT representation, use the icon image of the sun.
- b) Click on style and color for the icon. Change the Opacity of the “Label” Section to 0% and the scale of the “Icon” Section to .4.

These changes to the standard placemark pin will create a visual that is reminiscent of a HAWT turbine and will help visualize the area from further away.

5. **Elevation Profiles**

It is possible to view a profile of the elevation along any path that may be of interest to the user. Often an elevation profile is the best way to visualize the geography, and it can be used in conjunction with a tilted view to get the best feel for the environment.

The top down view is the best way to use an elevation profile, and it is best to align the edges of the path with the edges of the profile.



6. **Recommended Settings and User Interface**

When moving through unfamiliar territory it is easy to get disoriented, misunderstand elevation profiles, or miss key geological features. There are some settings which can make surveying consistent and timely:

- 6.1. Use a Mouse: If you are using a laptop, it is highly advised to use a mouse. The number of functions can become tedious using a trackpad. Also, when moving locally, it is important to be able to keep the mouse still when letting go, and the rolling action of a finger lifting a trackpad may be problematic. This is because if the terrain isn't held perfectly still at the instant of release, the map will continue to scroll. The terminology in the manual will refer to primary- and secondary-click and scrolling, which can be different for each computer.
- 6.2. Customize the Sensitivity: While it is entertaining to view the world move by as you move from location to location, it is more time effective to move quickly. However, too fast and it is possible to lose track of relative locations. The speed can be tampered with under 'Google Earth' >> 'Preferences' >> 'Navigation' and change the 'Fly-to Speed'. The sensitivity of the zoom feature is adjusted just below. While in this setting, ensure that the button for 'Automatically Tilt while zooming' is off.
- 6.3. Exaggerate Elevation: During preliminary assessment of a location for suitable low wind resources, it is important to get a feel for any large features in the immediate area, and then elevation profile tools can be used to give precise answers for areas of interest. Conversely, in some cases it is preferable to suppress the 3D effects to simply view flattened out imagery. This setting is found under 'Google Earth' >> 'Preferences' >> '3D View', where a number

less than 1 factor down the visible topography, and over one will exaggerate hills and valleys.

- 6.4. Versatile Search Bar: The search bar in the top left corner [Figure 3 - 1] uses the same database as Google Maps to find regions, streets and establishments. It also will search for Latitude-Longitude, or Universal Transverse Mercator (UTM) depending on the setting under 'Google Earth' >> 'Preferences' >> '3D View'.

7. Rules of Thumb for Locating an Array on Landscape

In many jurisdictions, permits require that the location of an array is 1.5 times the height of the array away from a road or property line.

When adding in an array, an access road should be included. The road should be 3 meters wide.

When adding in the access road, try and have it cross as few property lines as possible.

8. KMZ Files and Box.com

WHI uses an online file sharing service called Box.com to facilitate the exchanging of computer files among employees and consultants.

9. References

9.1. Bibliography

- a) [1] Google. "Google Earth Imagery Sources." Google Earth Help. Google Earth, n.d. Web. 20 Aug. 2013. <<https://support.google.com/earth/answer/21413?hl=en>>.
- b) [2] Satellite Imaging Corporation. "Google Earth to Plan High-Resolution Satellite Image Data." Google Earth: Identifying High-Resolution Satellite Target Locations. GeoEye/Astrium/RapidEye, n.d. Web. 18 Aug. 2013. <http://www.satimagingcorp.com/google_earth.html>.
- c) [3] Satellite Imaging Corporation. "Satellite Images and Geospatial Data for GIS & Mapping Applications." Satellite Images and Geospatial Data for GIS & Mapping Applications. GeoEye/Astrium/RapidEye, n.d. Web. 18 Aug. 2013. <<http://www.satimagingcorp.com/>>.
- d) [4] "SRTM Topography." National Imagery and Mapping Agency, n.d. Web. 20 Aug. 2013. <http://dds.cr.usgs.gov/srtm/version2_1/Documentation/SRTM_Topo.pdf>.
- [5] Vortex. "Vortex Online Wind Modeling for Professionals. By Professionals." Vortex, n.d. Web. 20 Aug. 2013. <<http://vortex.es/>>.

9.2. Links to Online Video Tutorial (by Jm Williams)

- a) <https://www.youtube.com/playlist?list=PLFD708B289C411B43>
- b) [A] Panels/Layers –
<https://www.youtube.com/watch?v=BzLtlFUjPbE&list=PLFD708B289C411B43&index=2>
- c) [B] Navigation –
<https://www.youtube.com/watch?v=mGZp9Eid8rU&list=PLFD708B289C411B43&index=3>
- d) [C] Place marks – <https://www.youtube.com/watch?v=xSVFB-kjST0&list=PLFD708B289C411B43&index=4>
- e) [D] Polygons – <https://www.youtube.com/watch?v=40Ybn-BXWFA&list=PLFD708B289C411B43&index=5>
- f) [E] Paths/Tours –
<https://www.youtube.com/watch?v=ts9w1yMUbK4&list=PLFD708B289C411B43&index=6>
- g) [F] Folders –
https://www.youtube.com/watch?v=9Sg88z_DYRg&list=PLFD708B289C411B43&index=7

