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## **Geographical Information Systems Technologies for Water and Wastewater Systems**

Washington State Department of Health

# Your Presenter Today

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Rural Development Specialist

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# Rural Community Assistance Partnership

**RCAP National Office**  
1701 K St. NW, Suite 700  
Washington, D.C. 20006  
[www.rcap.org](http://www.rcap.org)

**Western RCAP**  
Rural Community Assistance  
Corporation  
[www.rcac.org](http://www.rcac.org)

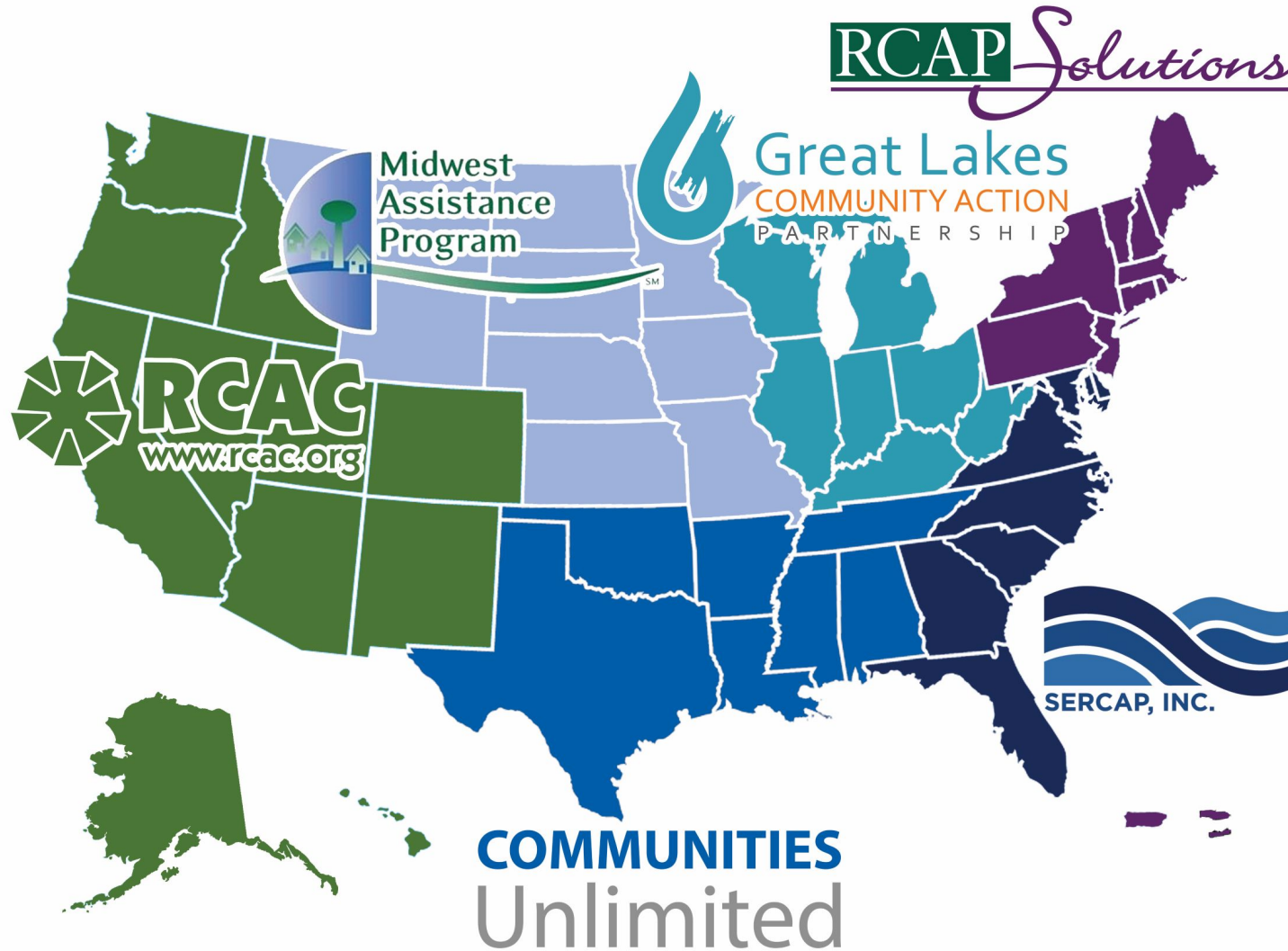
**Midwestern RCAP**  
Midwest Assistance Program  
[www.map-inc.org](http://www.map-inc.org)

**Southern RCAP**  
Communities Unlimited  
[www.communitiesu.org](http://www.communitiesu.org)

**Great Lakes RCAP**  
Great Lakes Community  
Action Partnership  
[www.glcap.org](http://www.glcap.org)

**Southeastern RCAP**  
Southeast Rural Community  
Assistance Project  
[www.sercap.org](http://www.sercap.org)

**Northeastern RCAP**  
RCAP Solutions  
[www.rcapsolutions.org](http://www.rcapsolutions.org)



# RCAC Programs

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Affordable housing



Community facilities



Water and wastewater infrastructure financing (Loan Fund)



Classroom and online training



On-site technical assistance



Median Household Income (MHI) surveys

# WELCOME!

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This material is based upon work supported by the Washington State Department of Health (DOH) and the US EPA.

Any opinions, findings, conclusions or recommendations expressed in this material are solely the responsibility of the authors and do not necessarily represent the official views of DOH or US EPA.

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# Today's Agenda

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- Overview of GIS Technologies and Benefits

- Mapping in Google Earth Pro



- Mapping in ArcGIS Online



# Poll

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What type of system map does your utility currently use?

- As built engineered plans
- Google Earth or ArcGIS maps
- Hand drawn maps
- Assorted maps, sketches, and diagrams

# GIS Technologies – Software Programs Overview

## Google Earth Pro

Free download

Easy to use

Mobile map viewer

Limited options for comparing asset information

## ESRI - ArcGIS Online

Annual Subscription Fee – Approx.. \$1000

Requires a training in GIS to setup maps  
Easy to operate and use once setup

User-friendly mobile app  
Can be used offline

In-depth data analysis and asset management



# Google Earth Pro

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## **GE Pro free download**

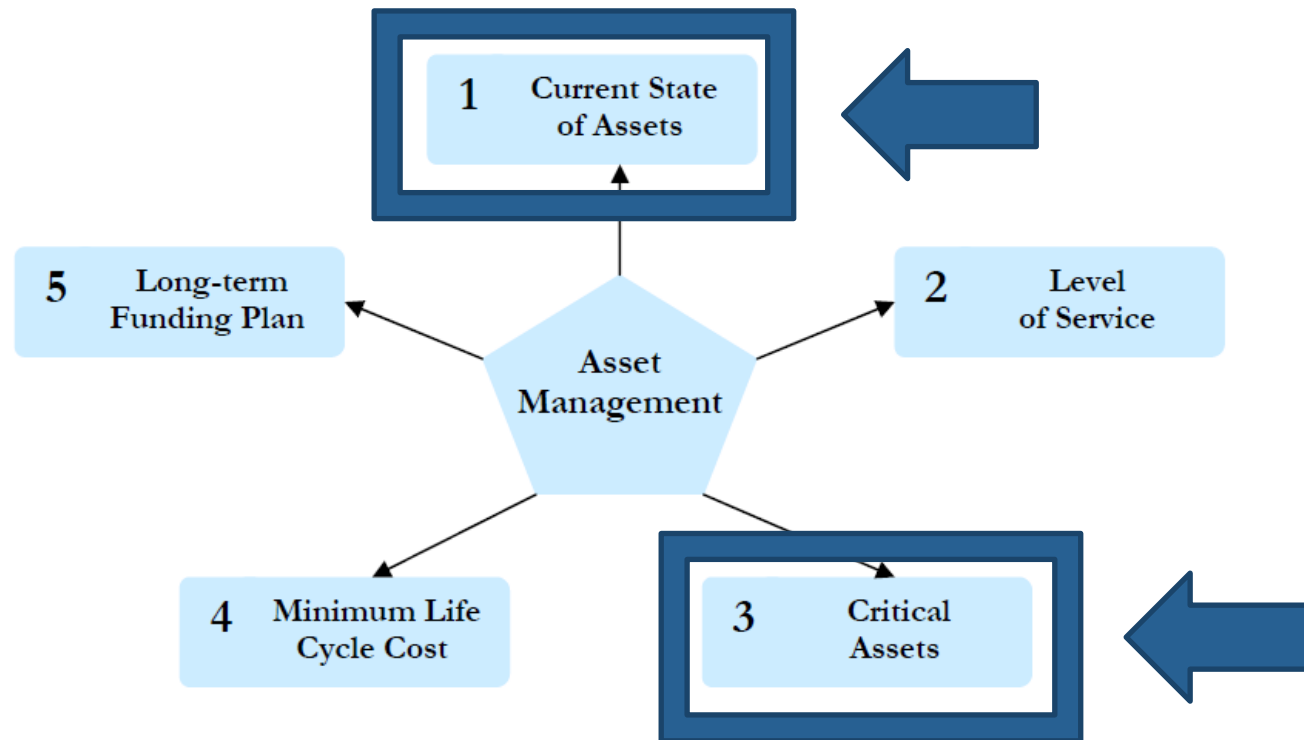
Using a desktop computer, download the free software:

<https://www.google.com/earth/versions/#earth-pro>

**Administrative permission may be required for installation!**

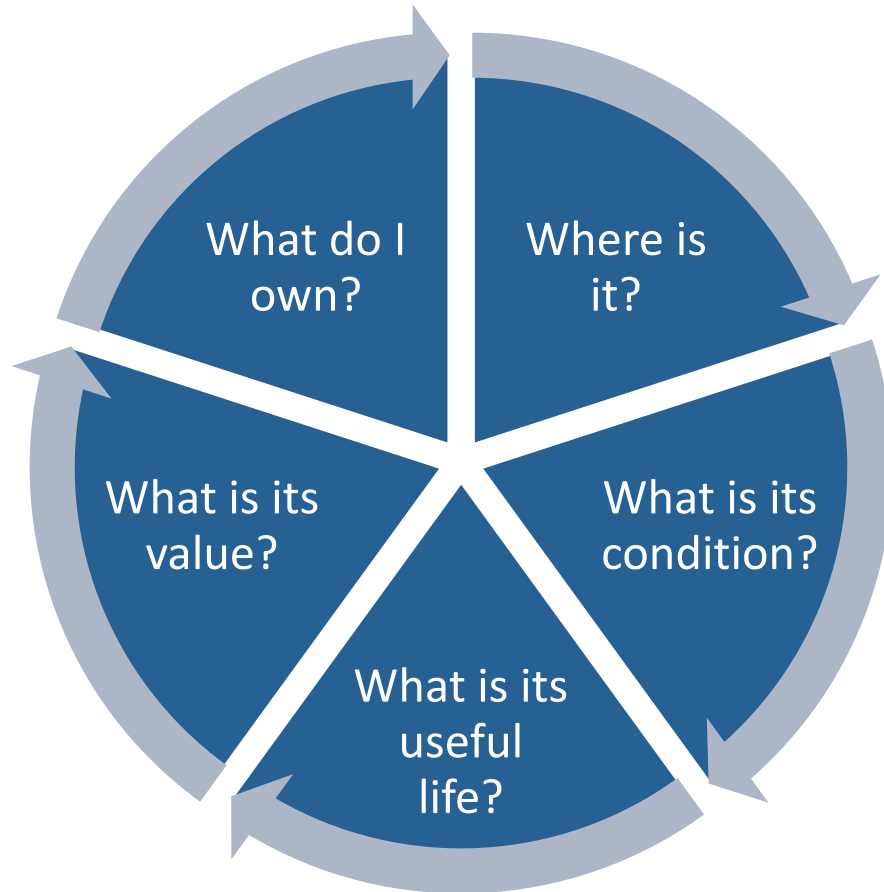
# What is Asset Management

Flow Chart: The Five Core Questions of Asset Management Framework



# Step 1 Current State of Assets

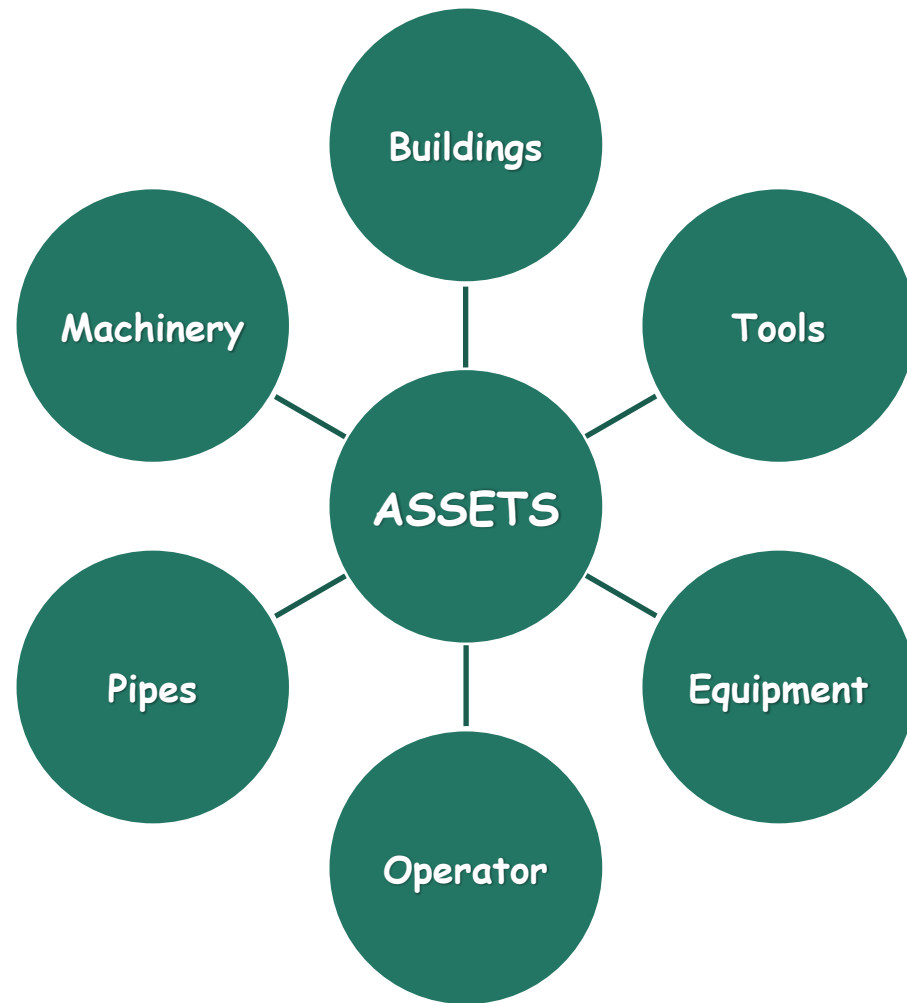
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- Identify number/feet/type
- Coordinates
- Year Installed
- Condition (1-10)
- Manufacture recommendation (flexible)
- Replacement Cost (updated annually)

# What should you map?

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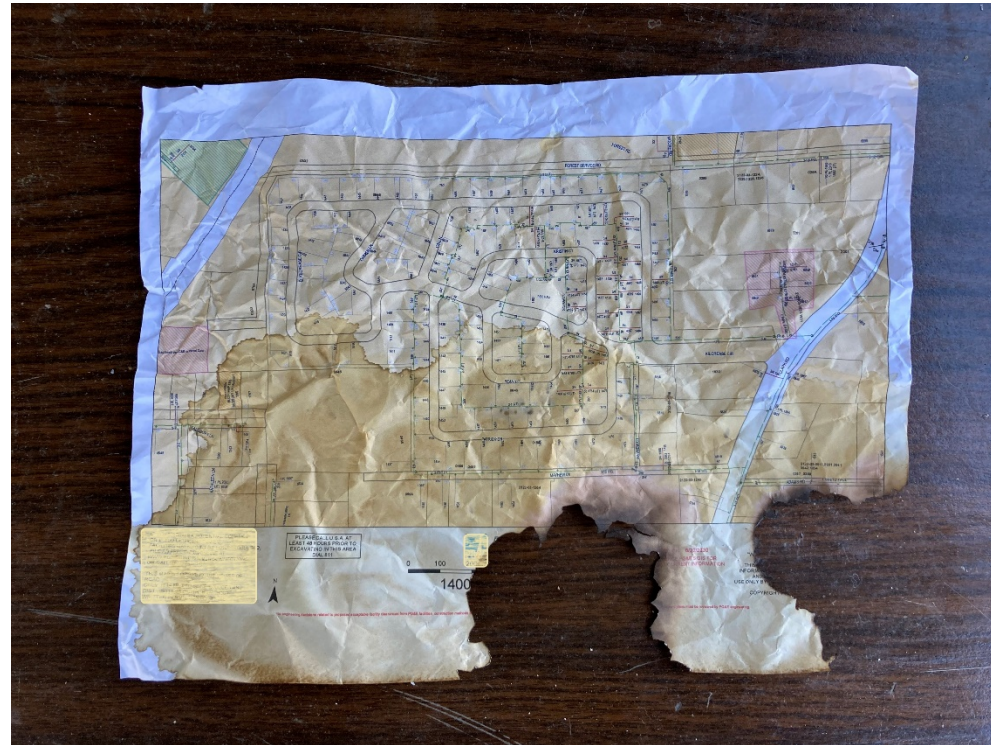
Anything you find important!

- Hydrants
- Valves
- Meters
- Pipes
- Security fence
- Source water protection
- Locations of regular breaks..

# Gathering Existing information

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- Old system maps or As-builts
  - Can digitize or use old maps as reference
- Import and Georeferenced CAD files
- Existing GIS or GEP data



# Reference vs. GPS

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- Accuracy is important but..
- Reference
  - Quality satellite or aerial imagery
  - Using older existing information (As-built)
  - Legacy knowledge
- GPS
  - Mapping grade – 3-5 feet accuracy
  - Survey grade – 1cm accuracy
- A Combination

# Asset Inventory – Recommended with GEP

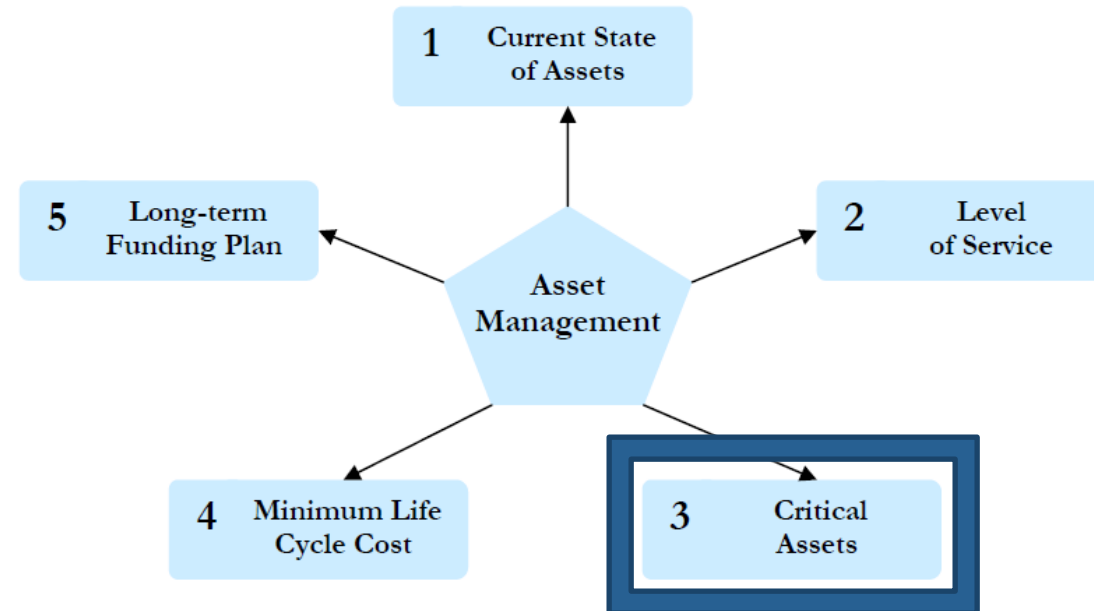
## Risk Analysis Worksheet

System Name:

Required Fields									
Asset ID (Unique)	Existing Assets (From Reserves Sheet)	Install Date (From Reserves Sheet)	Asset Condition (See Table)	Probability of Failure (PoF) [See Table]	Consequence of Failure (CoF) [See Table]	Redundancy Multiplier [See Table]	Criticality (PoF)x(CoF)x(Redundancy)	Estimated Remaining Useful Life	Priority
	<b>Treatment Plant</b>						0		
Primary Tank #1	Xerex Tank / Fiberglass Storage Tank 30,000 Gal	2017	Excellent	1	5	0.5	2.5	26	1
Primary Tank #2	Xerex Tank / Fiberglass Storage Tank 30,000 Gal	2017	Excellent	1	5	0.5	2.5	26	1
Equalization Tank	Xerex Tank / Fiberglass Storage Tank 30,000 Gal	2017	Excellent	1	5	0.5	2.5	26	1
Blend Tank	Xerex Tank / Fiberglass Storage Tank 40,000 Gal	2017	Excellent	1	5	0.5	2.5	26	1
Equalization Tank	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Equalization Tank	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Blend Tank #1	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Blend Tank #2	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Blend Tank #3	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	3	0.1	0.6	11	7
Blend Tank #4	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Max Unit #3	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.1	0.4	11	8
Max Unit #3	Orenco / Effluent Pump 1HP, 75gpm, 230V, 60Hz	2017	Good	2	2	0.5	2	11	5
Max Unit #3	Orenco / Effluent Pump 2HP, 145gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 2HP, 145gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 2HP, 145gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 2HP, 145gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 1.5HP, 75gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 1.5HP, 75gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Max Unit #3	Orenco / Effluent Pump 1.5HP, 75gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Backflow Basin	Orenco / Sewage Pump 1.5HP, 65gpm, 230V, 60Hz, 1Pz	2017	Good	2	2		0	11	
Influent	Siemens Sitrans / 4" Mag Meter w/ MAG5000 Transmitter	2017	Good	1	1	1	1	11	6
Effluent	Siemens Sitrans / 3" Mag Meter w/ MAG5000 Transmitter	2017	Good	1	1		0	11	
Max Unit #1	Advan Tex Max Tanks / Packed Bed Filters 300sq ft., 42' long	2017	Good	1	2		0	6	

# Step 3 Critical Assets

Flow Chart: The Five Core Questions of Asset Management Framework





# Step 3 Critical Assets

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## How *important* is this asset?

- Does it have redundancy?

## What's the *probability* of failure?

- Past history
- Age and condition
- **Trends**

## Risk based planning process

- Risk = f (Criticality x Condition)

# GIS Mapping Basics in Google Earth Pro

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Basic steps to creating a GIS map in GEP and ArcGIS Online

# Google Earth Pro – What We Will Learn

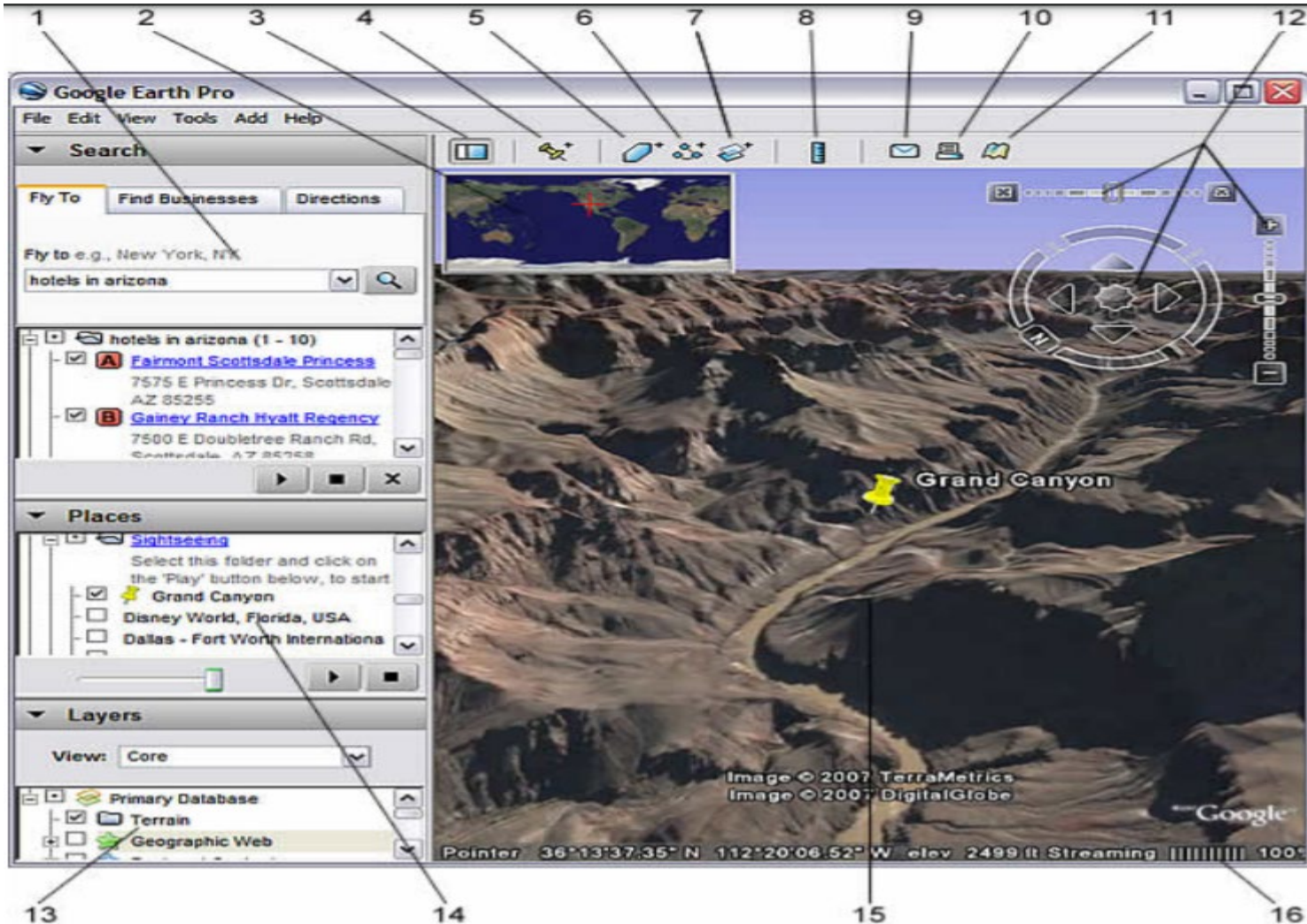
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Models/Maps made with Google Earth Pro for Desktop

Mapping tools:

- Placemark (points) – tanks, wells, buildings
- Path/Polygon – pipes, boundaries
- Overlay – photos, maps
- Import - photos, shapefiles, GPS coordinates

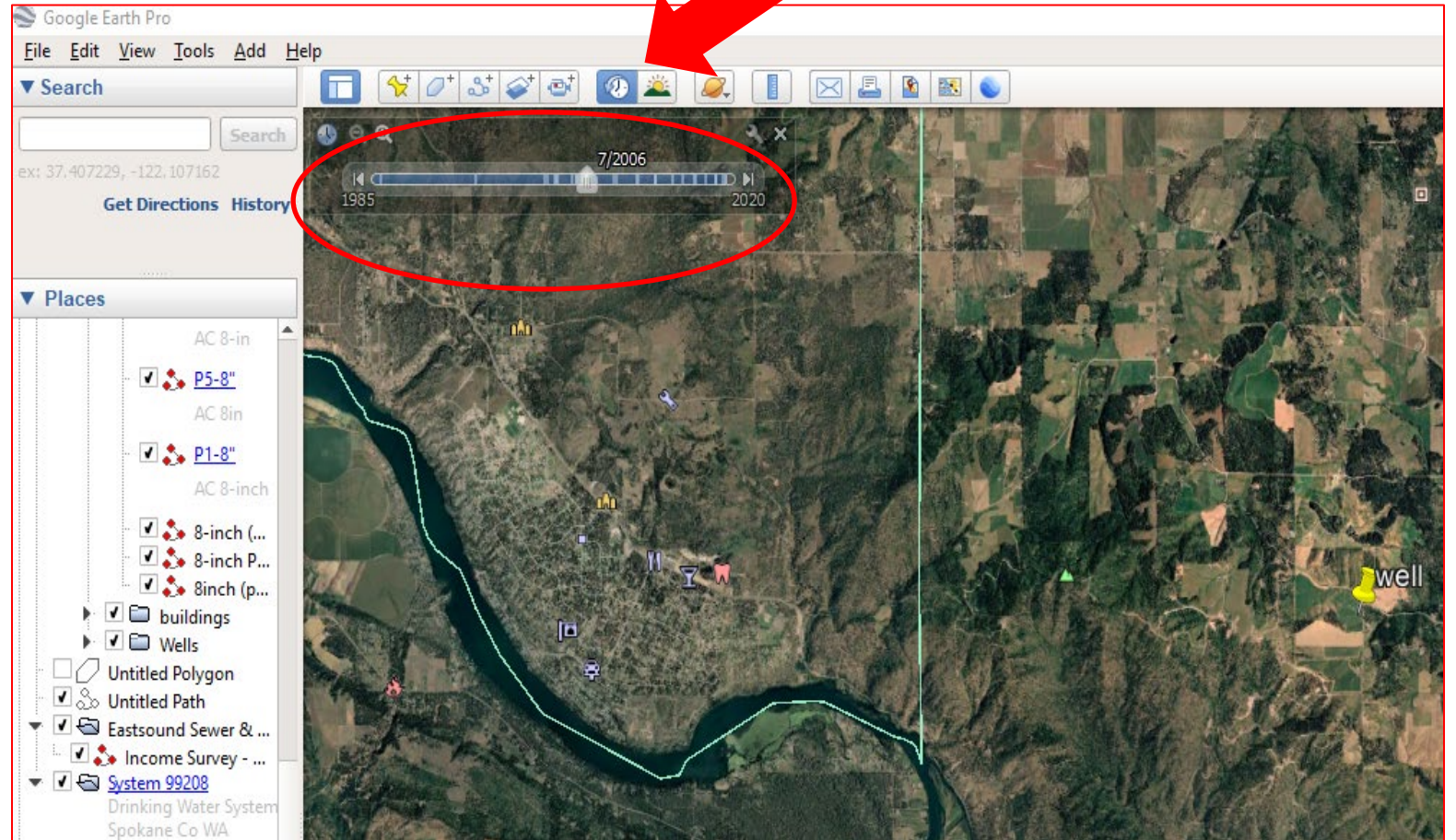
# Getting to Know GEP – Some Features of Main Window



1. **Search panel** - Use this to [find places and directions](#) and [manage search results](#). [Google Earth EC](#) may display additional tabs here.
2. **Overview map** - Use this for an [additional perspective](#) of the Earth.
3. **Hide/Show sidebar** - Click this to conceal or the display the side bar (Search, Places and Layers panels).
4. **Placemark** - Click this to add a [placemark for a location](#).
5. **Polygon** - Click this to [add a polygon](#).
6. **Path** - Click this to [add a path \(line or lines\)](#).
7. **Image Overlay** - Click this to add an [image overlay on the Earth](#).
8. **Measure** - Click this to [measure a distance or area size](#).
9. **Email** - Click this to email a [view](#) or [image](#).
10. **Print** - Click this to print the current view of the Earth.
11. **Show in Google Maps** - Click this to show the current view in Google Maps in your web browser
12. **Navigation controls** - Use these to tilt, zoom and move around your viewpoint ([see below](#)).
13. **Layers panel** - [Use this to display points of interest](#).
14. **Places panel** - Use this to [locate, save, organize and revisit placemarks](#).

# Historical Imagery

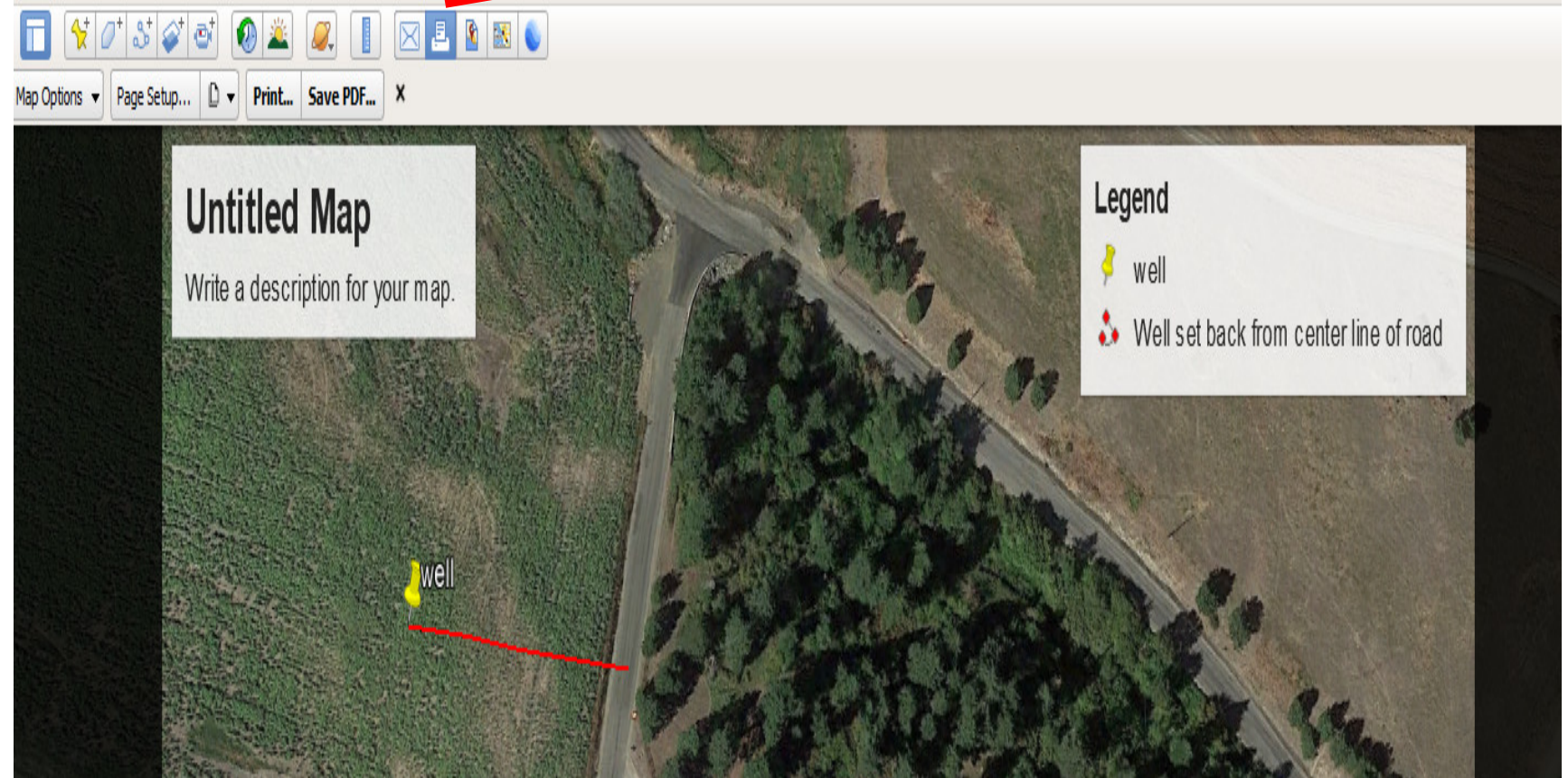
- Was it built in 1985?
- 1995?
- 2020?
- You might be able to tell from GEP historical imagery.



# Print or Save Image

Both allow you to add:

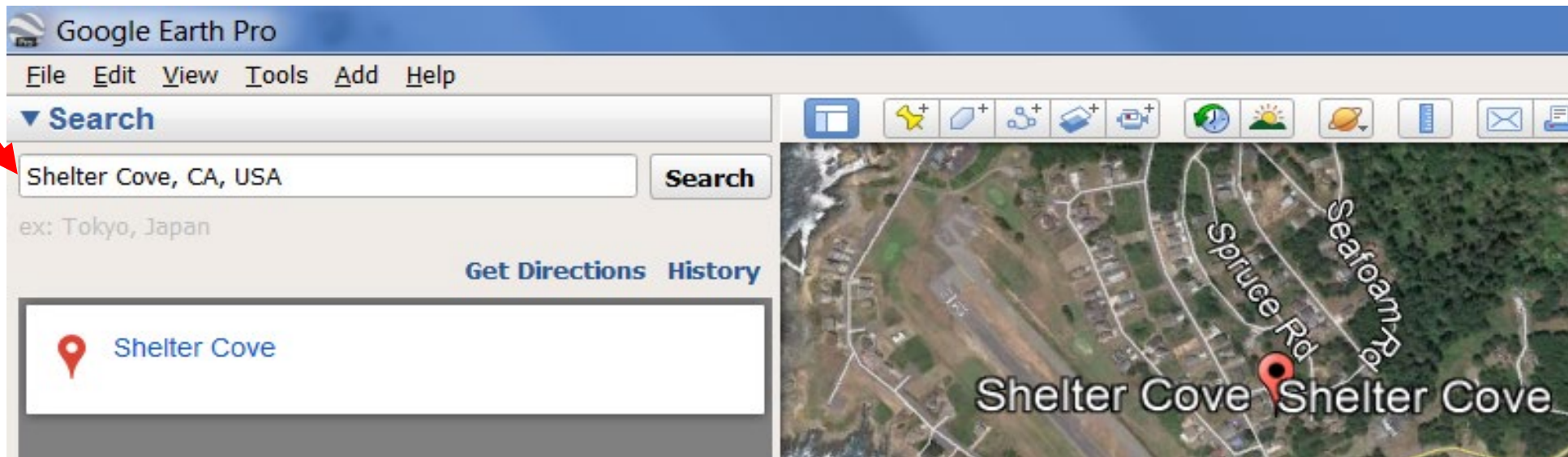
- Map title
- Map description
- Legend



# Let's Start Mapping

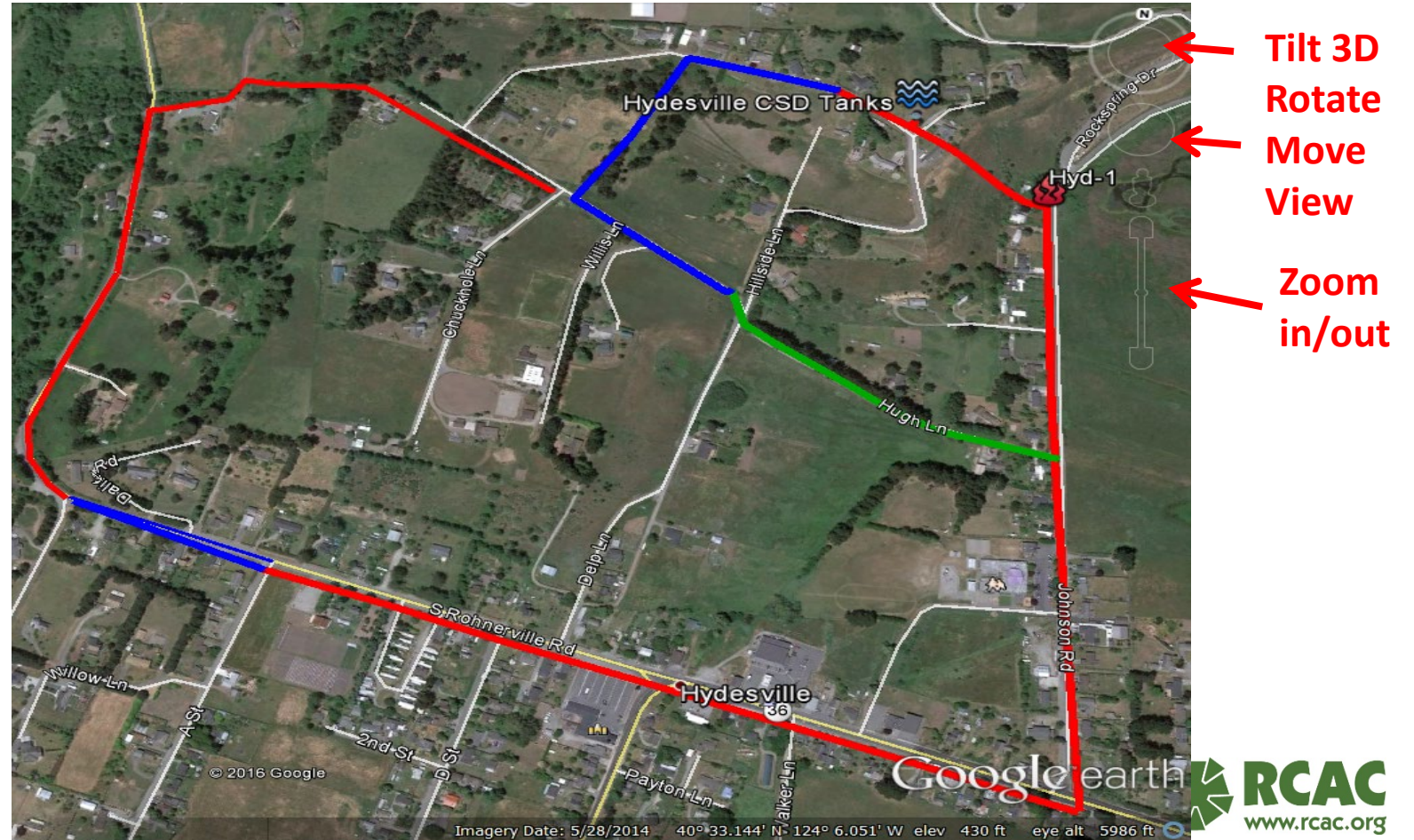
---

1. Open Google Earth Pro
2. Enter a zip code, city, address or GPS coordinates in the search window, in the top left corner



# Image Controls

Use the zoom and pan tools to position the satellite image to the system area.



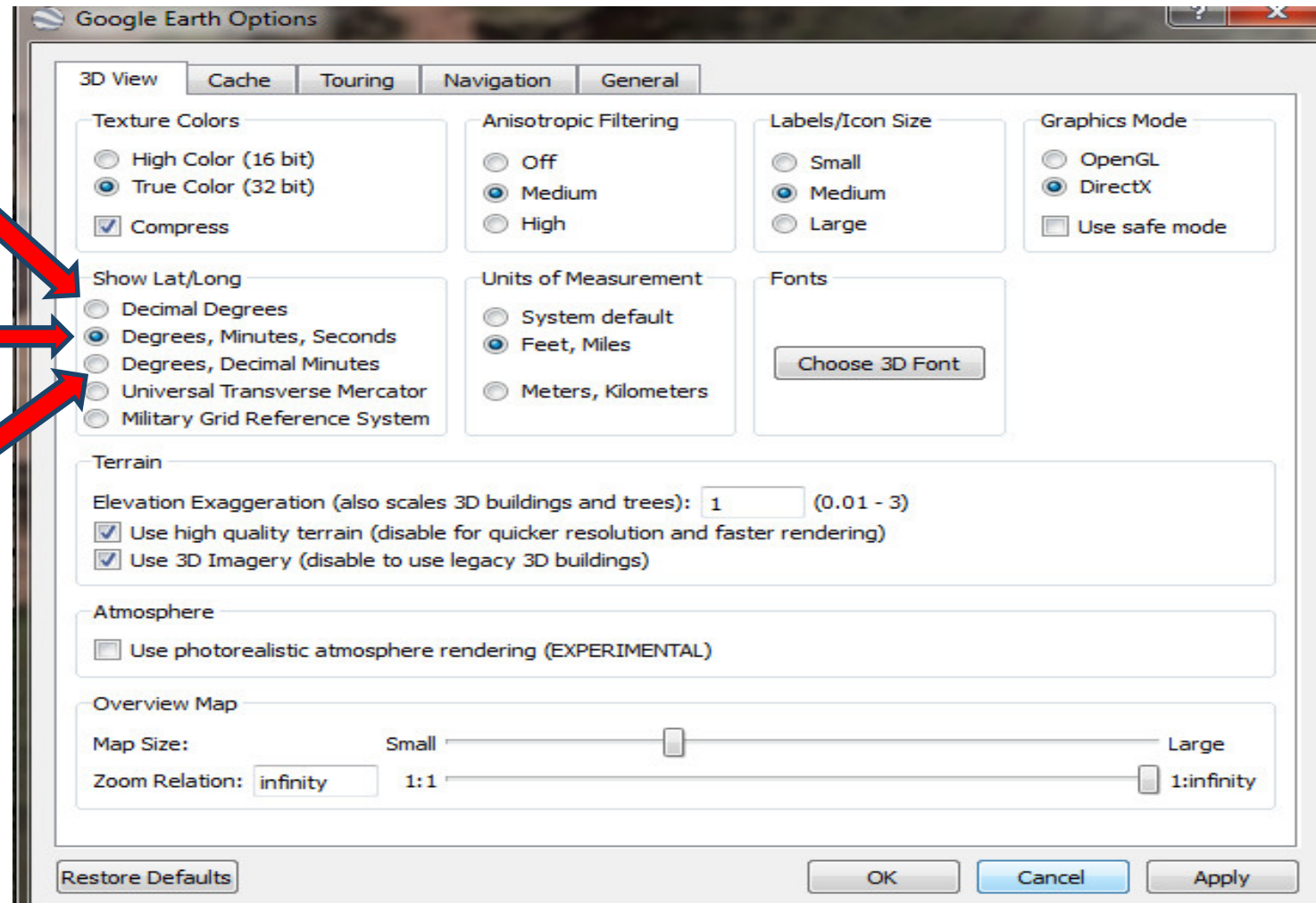


# Tools – Options: Lat/Long Format Options

Lat: 47.692530°  
Long: -117.077601°

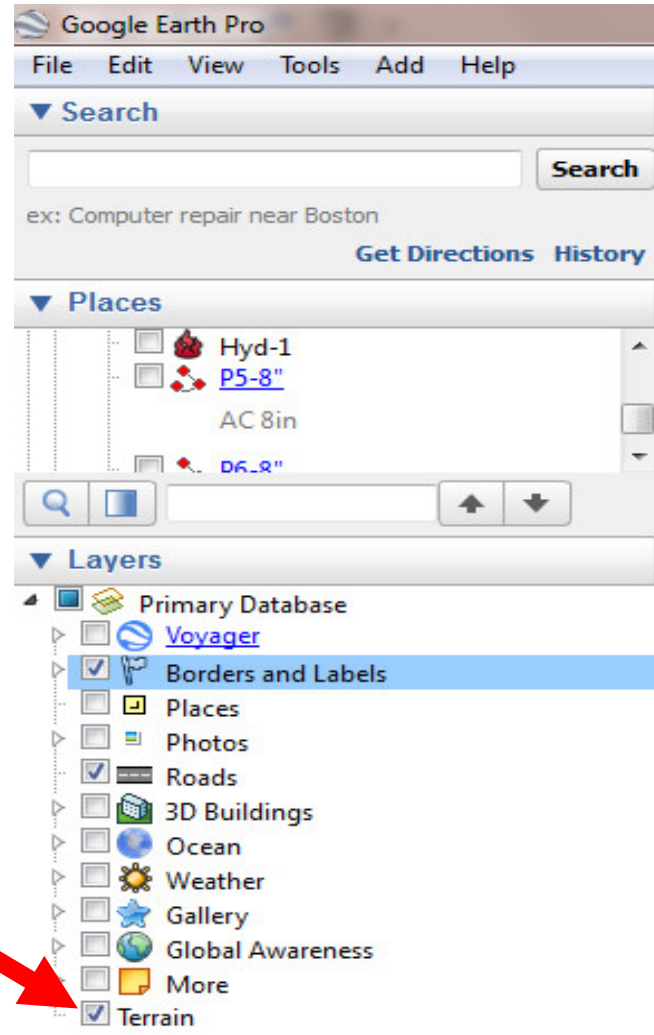
Lat: 47°41'33.12"N  
Long: 117° 4'39.39"W

Lat: 47° 41.552'N  
Long: 117° 4.656'W



# Layers

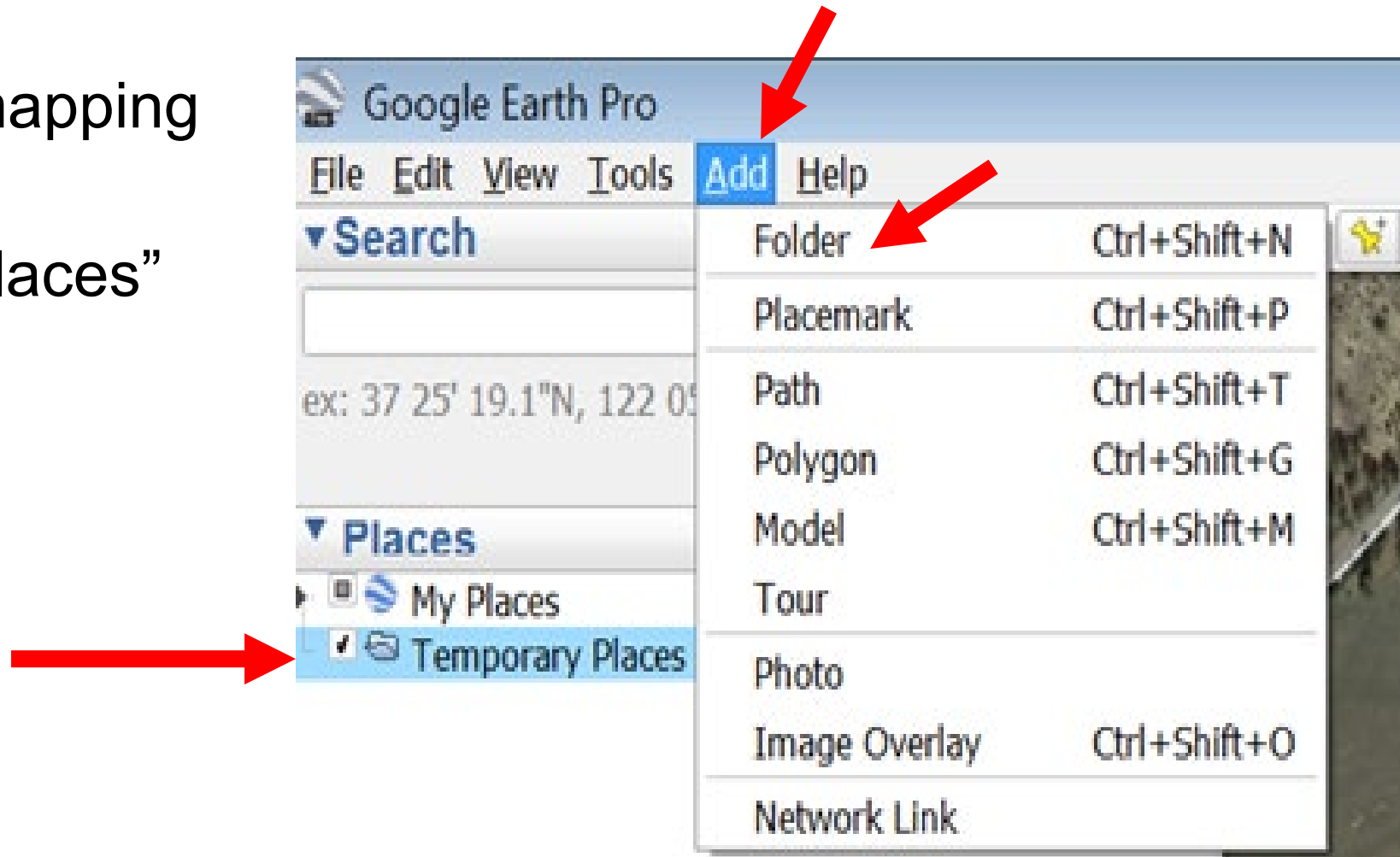
To show ground elevation at pointer



# Add Folder

Start any new mapping project with:

- “Temporary Places”
- “Add”
- “Folder”



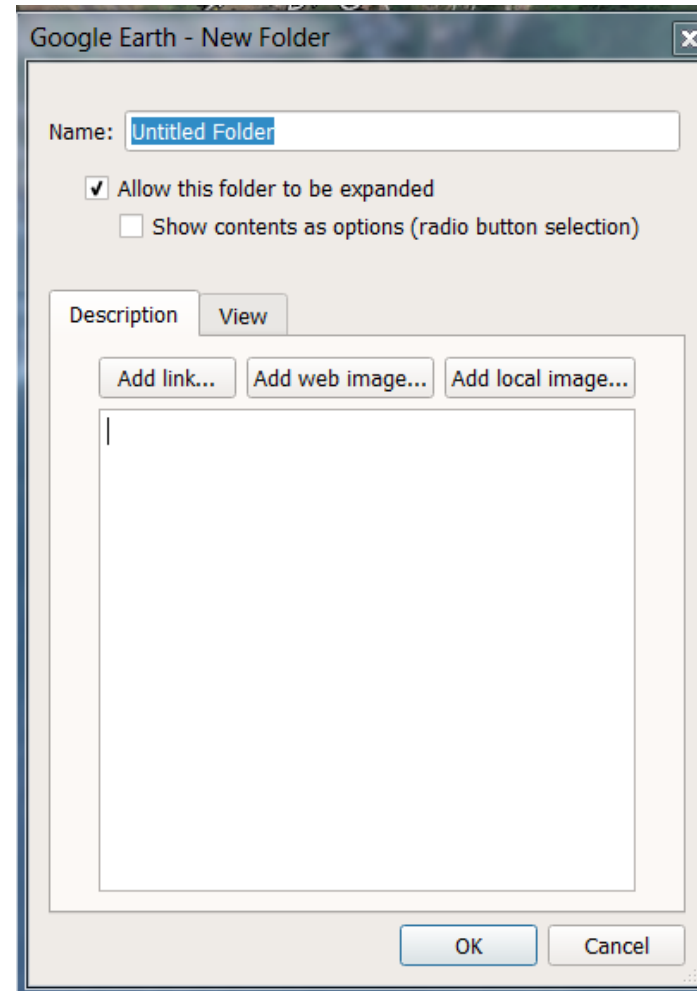
# Create a Folder Name and Save

Name your folder

Add a description

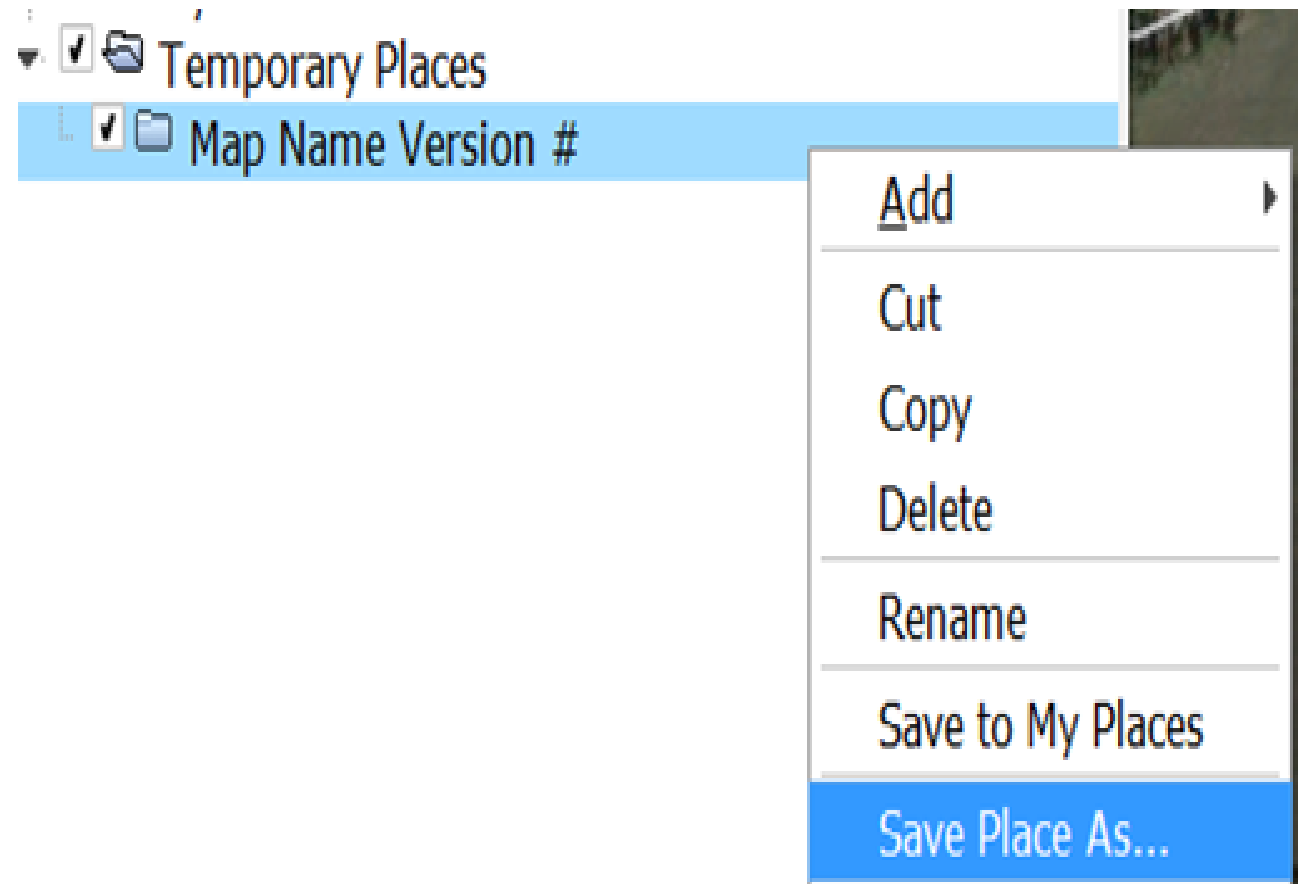
Save your folder by clicking OK.

- **OK = Save in the properties box.**
- This folder can now hold all the new mapping Placemarks, Paths and Overlays you create.



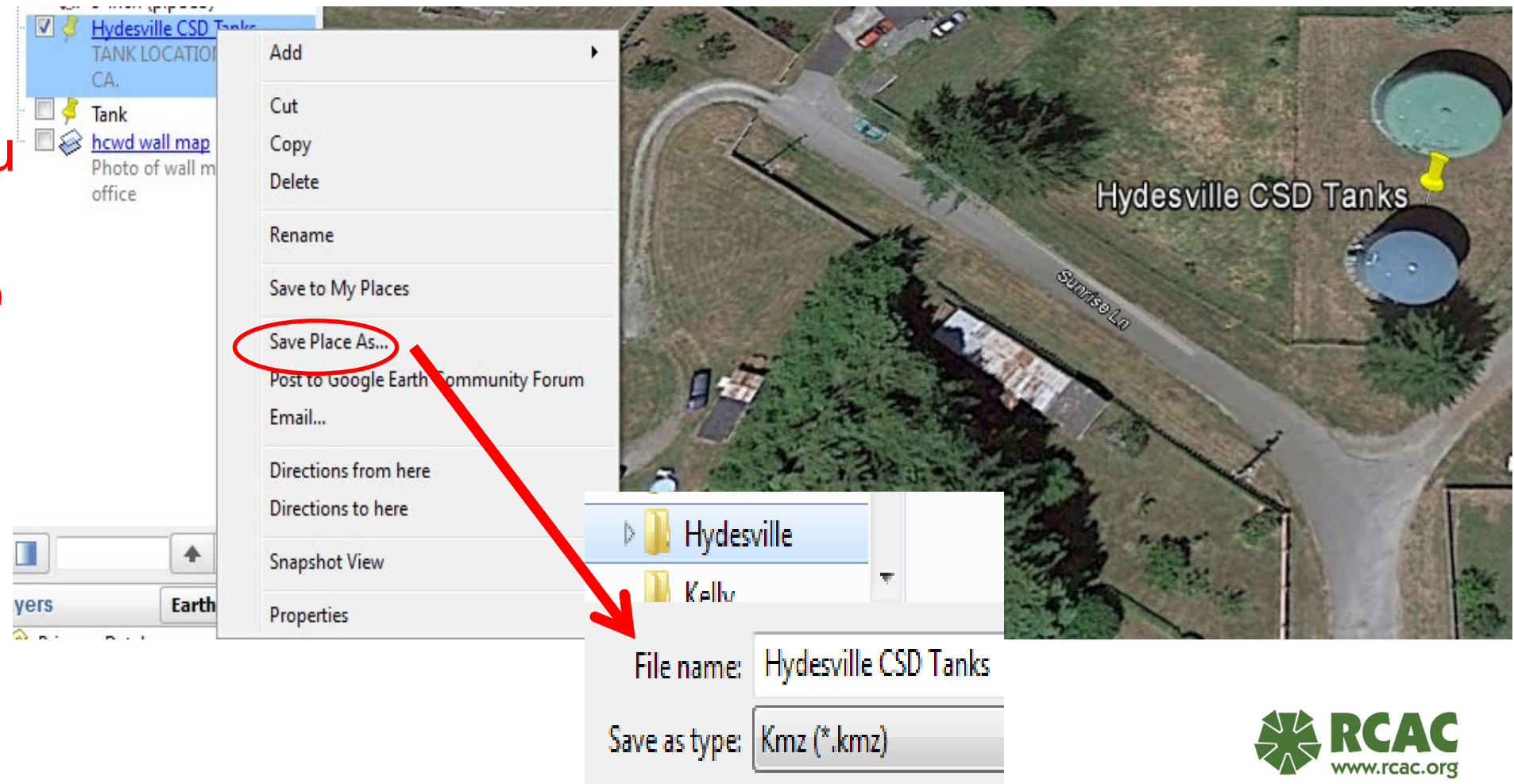
# “Save Place As”

- Save the folder using “Save Place As”
- This allows you to select the location on your computer to save the map file.

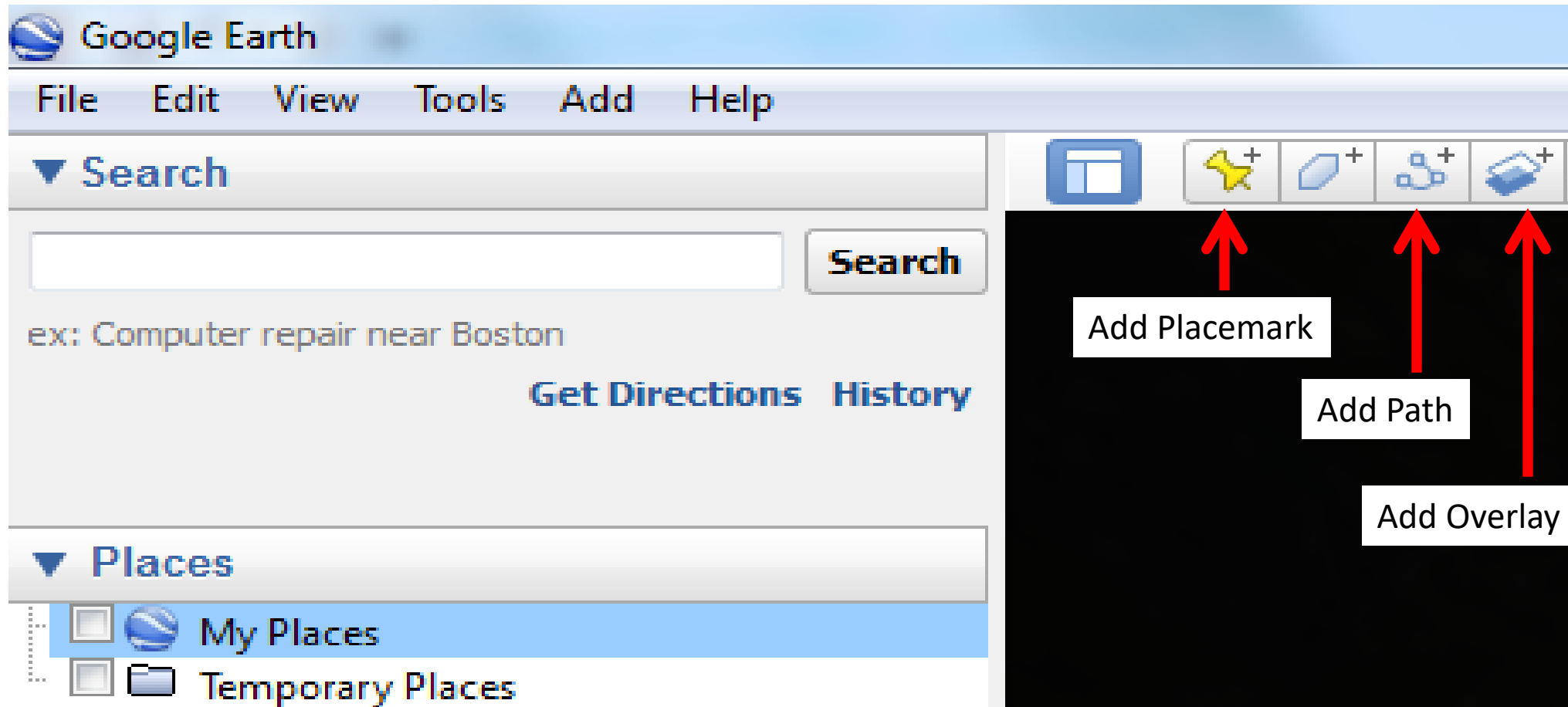


# “Save Place As”

“Save Place As” allows you to select the location to save the folder.

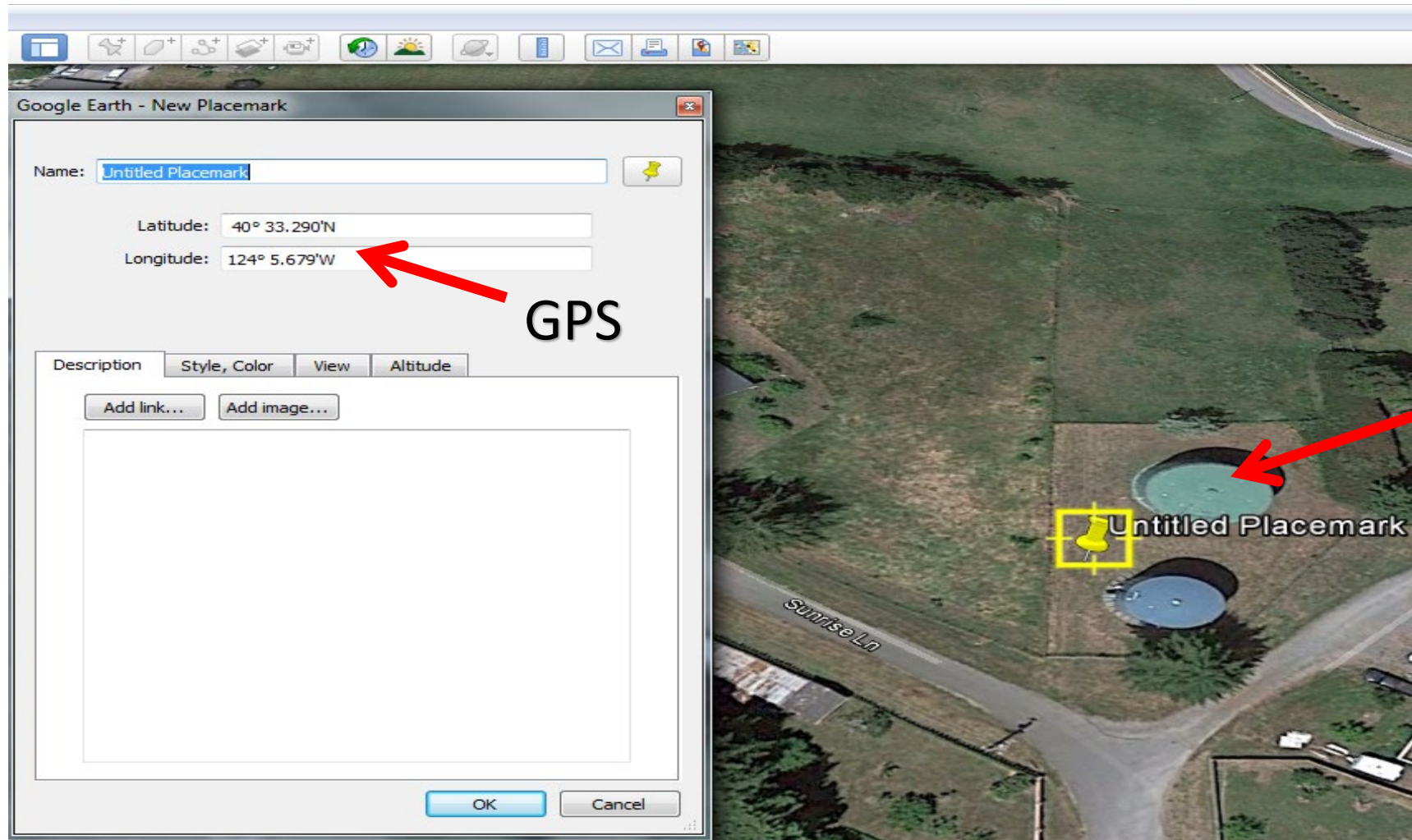


# Basic Mapping Tools



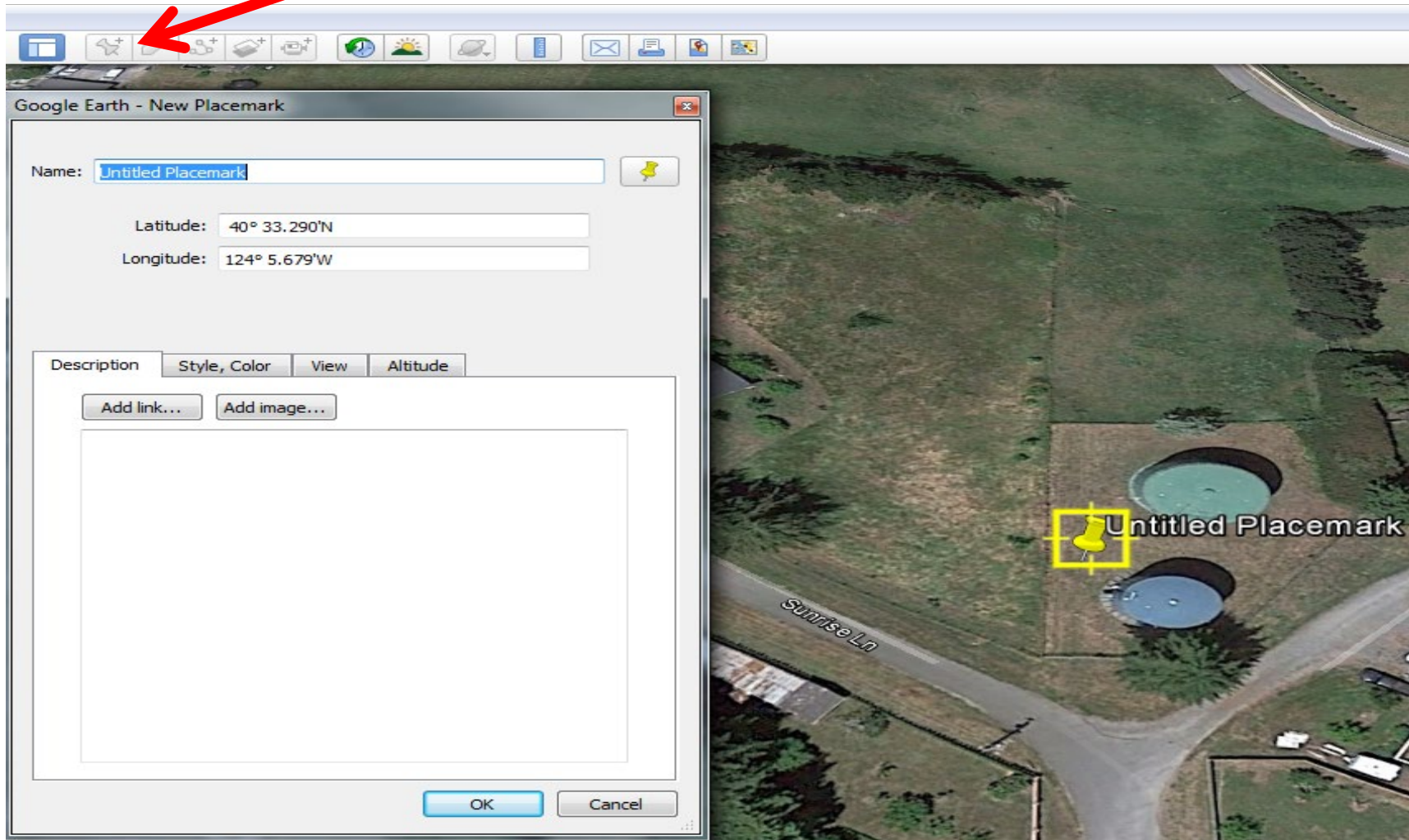
The image shows the Google Earth desktop application interface. At the top is the title bar "Google Earth" and a menu bar with "File", "Edit", "View", "Tools", "Add", and "Help". Below the menu bar is a "Search" section with a search box containing the text "ex: Computer repair near Boston" and a "Search" button. Below the search box are links for "Get Directions" and "History". At the bottom left is a "Places" panel with a tree view showing "My Places" and "Temporary Places". On the right side, a toolbar contains several icons. Three red arrows point from callout boxes to specific icons: "Add Placemark" points to the yellow pushpin icon, "Add Path" points to the blue path icon, and "Add Overlay" points to the blue rectangle icon.

# Adding Features: Reference vs. GPS





# Add Placemark



# Edit Placemark

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1. Reopen the properties box by right clicking on the new marker and selecting “properties”.
2. This will open edit mode and allow you to move the marker and edit the label text.
3. The marker will be surrounded by a flashing yellow box when in edit mode and the properties box will be on the screen.
4. Save your edits by clicking OK in the properties box before closing  
**OR**
5. **OR** Select “Cancel” to remove placemark.

# Edit Placemark

**Google Earth - Edit Placemark**

Name:

Latitude:

Longitude:

Description | Style, Color | View | Altitude

TANK LOCATION Hydesville CA.  
ERECTION CONTRACTOR: Trusco Tank Inc.  
DATE OF ERECTION: 1996  
CAPACITY: .4 MG  
DIAMETER: 31.5'  
HEIGHT: 34.11'  
Elev (GE) 499'  
Last inspection Report: 7-20-15 DB Gaya Consulting

**Save Your Edits**

Places

- My Places
- Temporary Places
- HydesvilleCSD.kmz
  - HydesvilleCSD
    - pipe 26 4-inch
    - 8-inch Pipe 34
    - 8inch (pipe 34)
    - 8-inch (pipe 33)
    - Hydesville CSD Tanks**
    - TANK LOCATION Hydesville CA.
    - Tank
    - hcwd wall map
    - Photo of wall map in HCWD office

Hydesville CSD Tanks

© 2016 Google

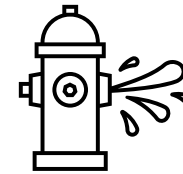
Imagery Date: 5/28/2014 40° 33.285' N 124° 5.669' W elev 499 ft eye alt 933 ft

# How to Change Placemark Icons

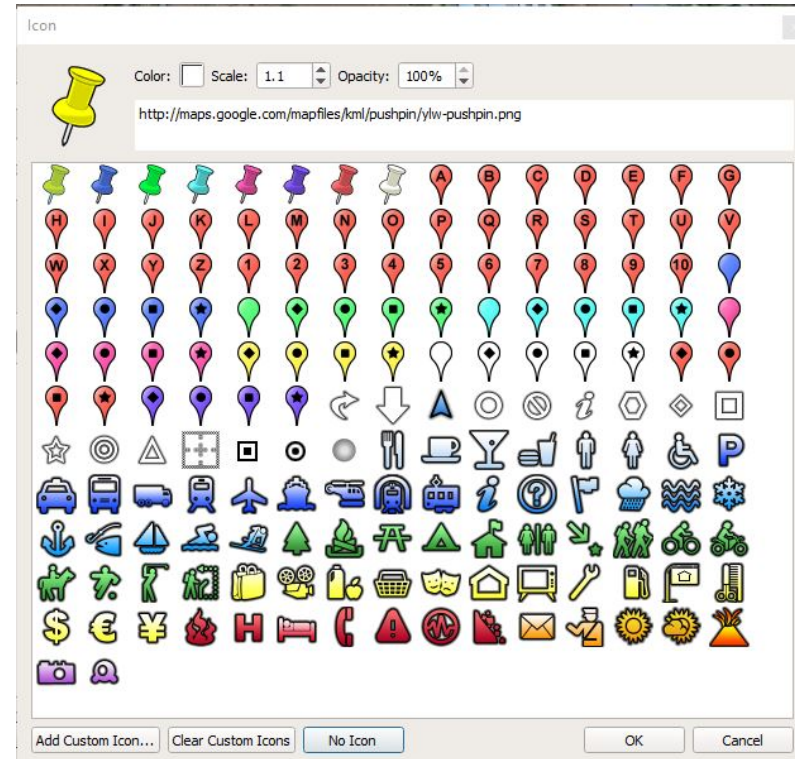
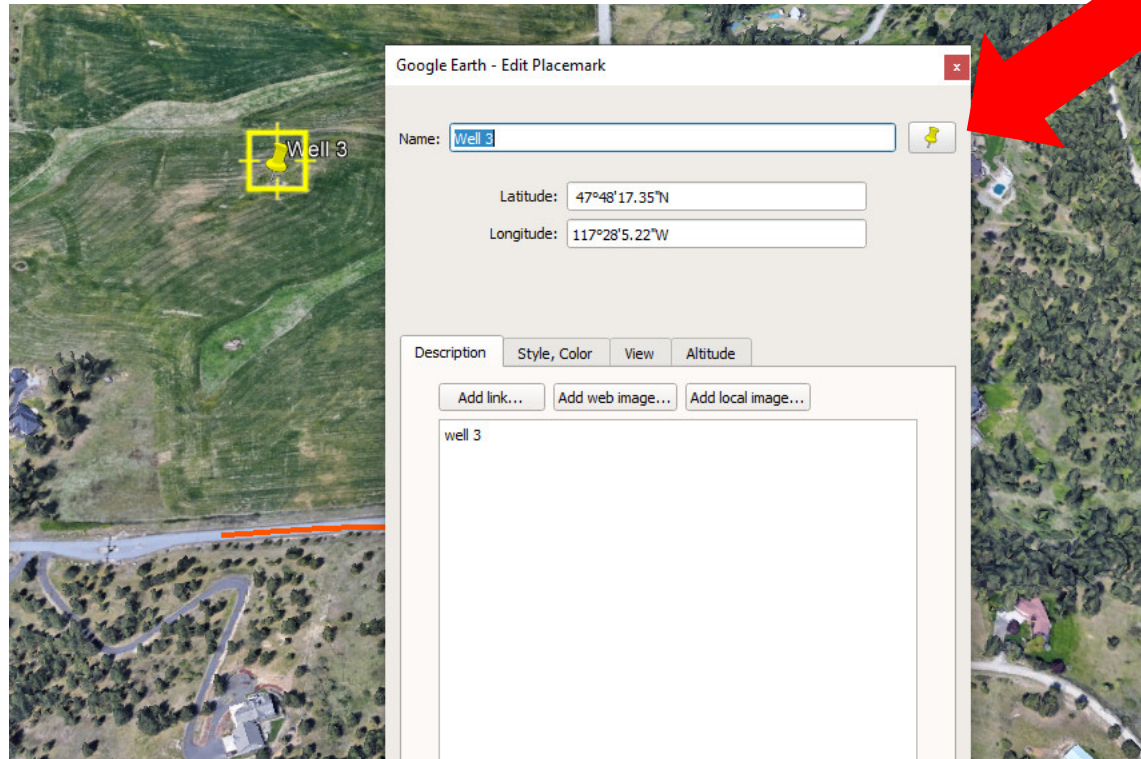
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From the GEP standard icon to a fire hydrant:

1. Select picture or icon of fire hydrant
2. Save image in your pictures folder
3. Select “Edit Placemark”
4. Next to “Name” click on the Placemark icon
5. “Add Custom Icon” and open your saved picture. Save your work by clicking OK



# How to Change Placemark Icon

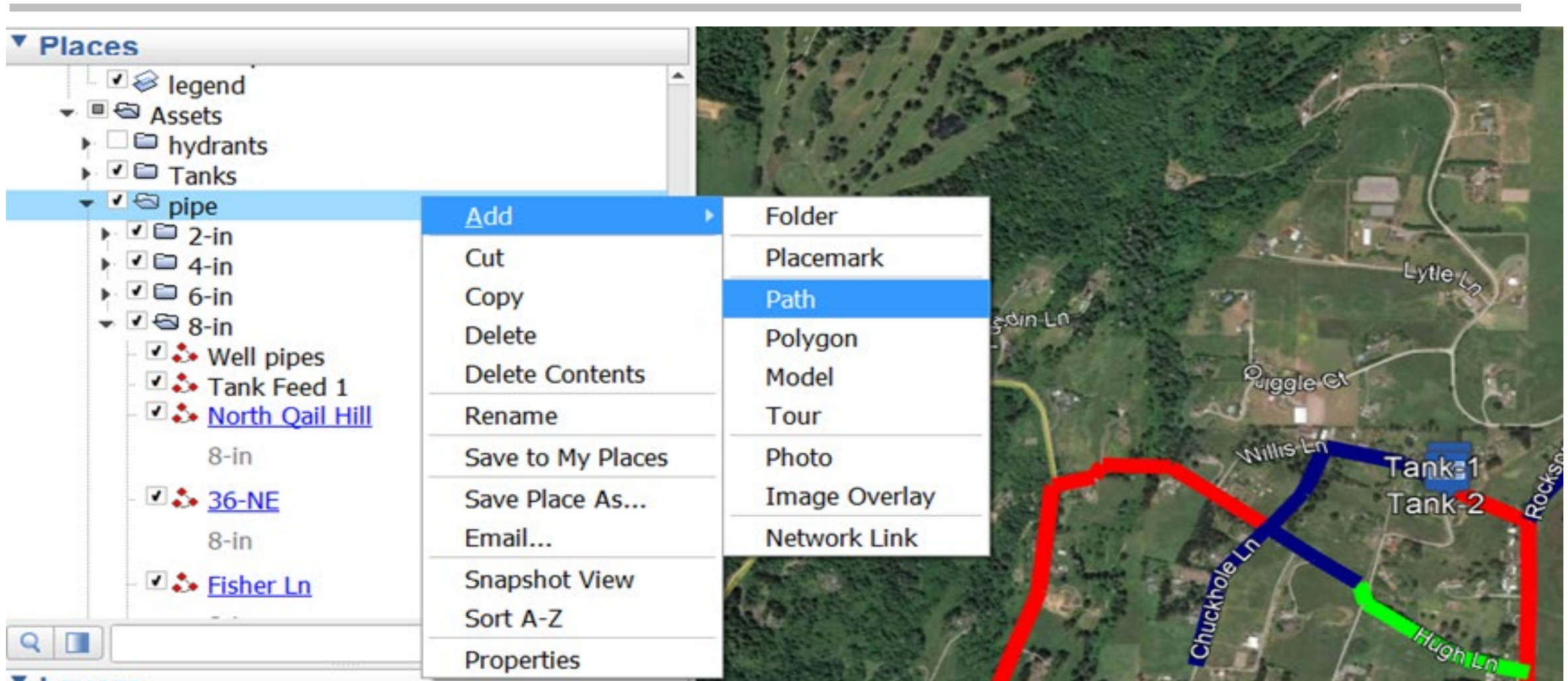


# Add Path = Add Pipe

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1. Select Path tool
2. Name your Path
3. Add a description
4. Start drawing the pipe by left clicking once on the starting point of the pipe
5. Then click again at each change of direction
6. Do not hold down on the left mouse, as this will rapidly create multiple points “vertices” that must be undone
7. OK to save or right click to undo

# Add Path = Add Pipe



# Edit Path = Edit Pipe

---

1. Change the pipe color using the “Style, Color Tab”
2. Record detailed information in the description box (diameter, type and age)
3. Click OK when finished to save your edits

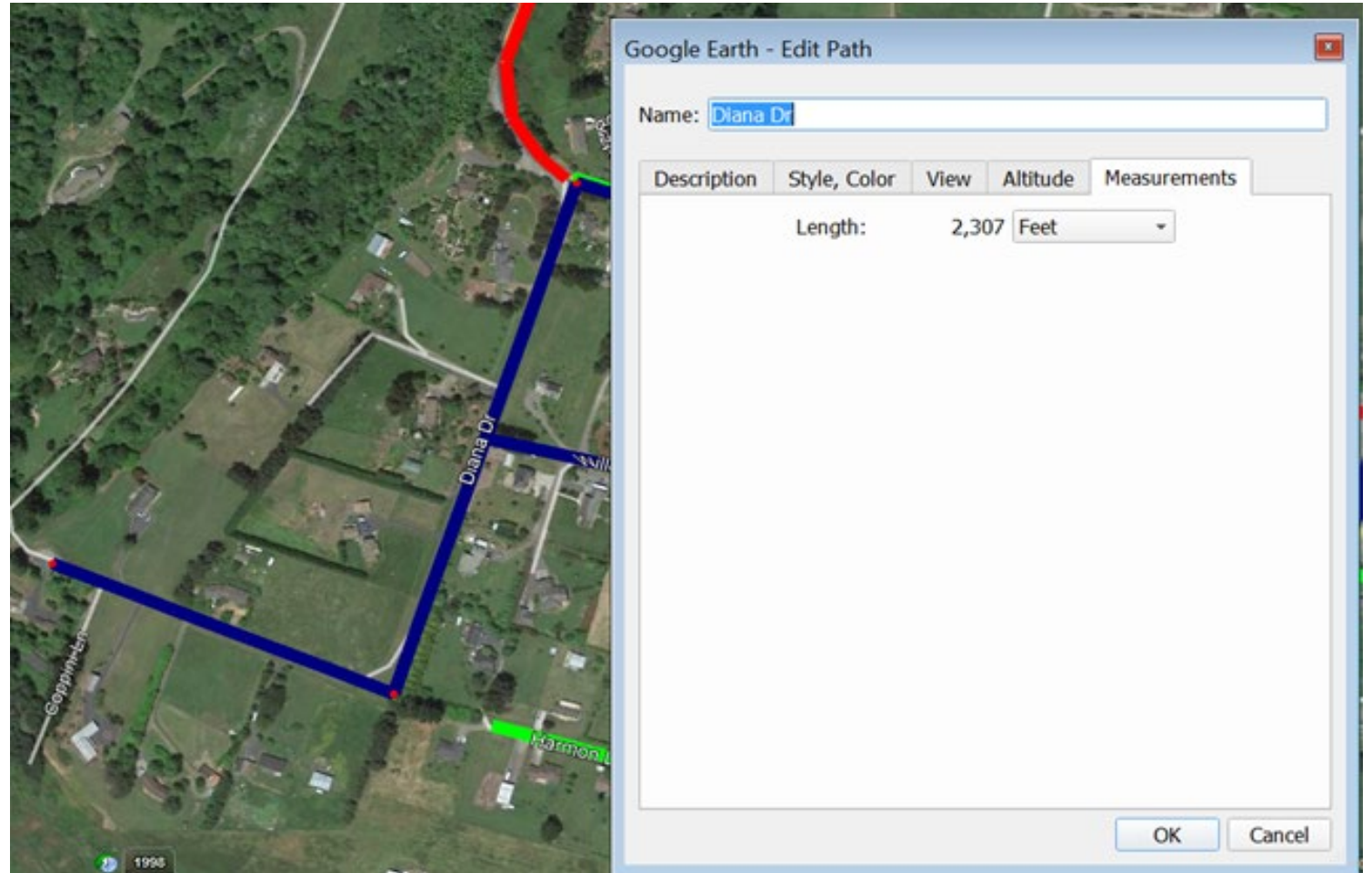


# Edit Path = Edit Pipe

The image displays the Google Earth interface with several windows open for editing a path (pipe). A red arrow points to the 'Edit Path' icon in the top toolbar. The 'Google Earth - Edit Path' window on the left shows the 'Name' field set to 'p2-8"', the 'Length' as 1,169 Feet, and a list of layers including 'AC 8-in', 'p3-4"', 'PVC 4-in', 'P4-6"', 'Tank Feed', 'AC 8-inc', and 'Hyd-1'. The 'Google Earth - Edit Path' window in the center shows the 'Name' field set to 'p2-8"', 'Add link...' and 'Add image...' buttons, and a description field containing 'AC 8-in'. The 'Google Earth - Edit Path' window on the right shows the 'Name' field set to 'p2-8"', 'Lines' section with 'Color: Red', 'Width: 6.5', and 'Opacity: 100%', and a 'Choose Line Color' dialog box with a color picker and RGB values (Hue: 0, Sat: 255, Val: 255, Alpha channel: 255). The background shows an aerial view of a residential area with a red pipe labeled 'Hyd-1' and a green pipe. The bottom right corner features the RCAC logo and website address: RCAC www.rcac.org.

# Measure Path = Measure Pipe

For previously created pipe:  
Click on the  
“Measurements  
Tab” in the  
properties box to  
view the path/pipe  
length.



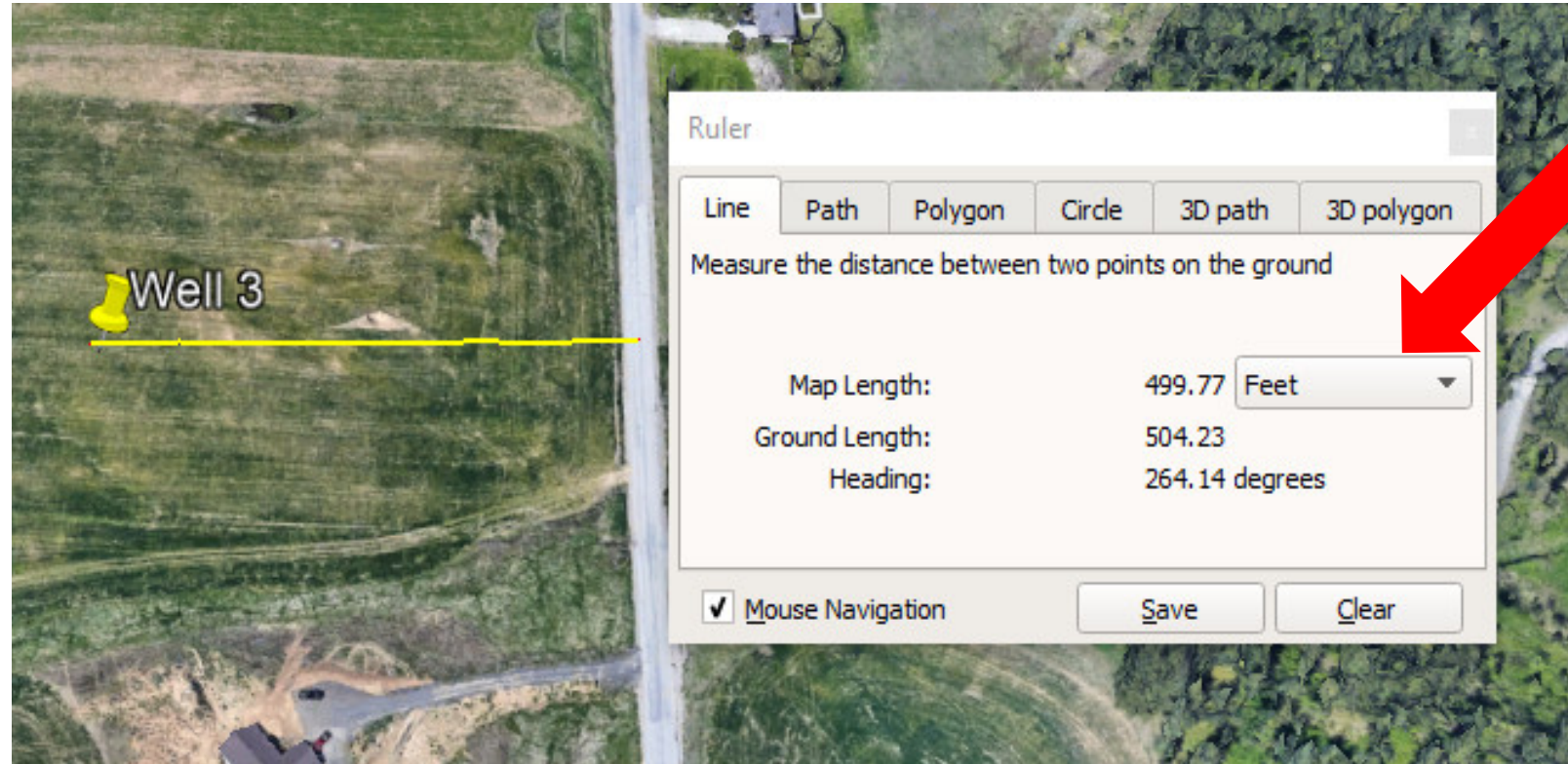
# Ruler

Make a:

- Path
- Polygon
- Circle

With a set length  
or diameter

Save as a new  
path



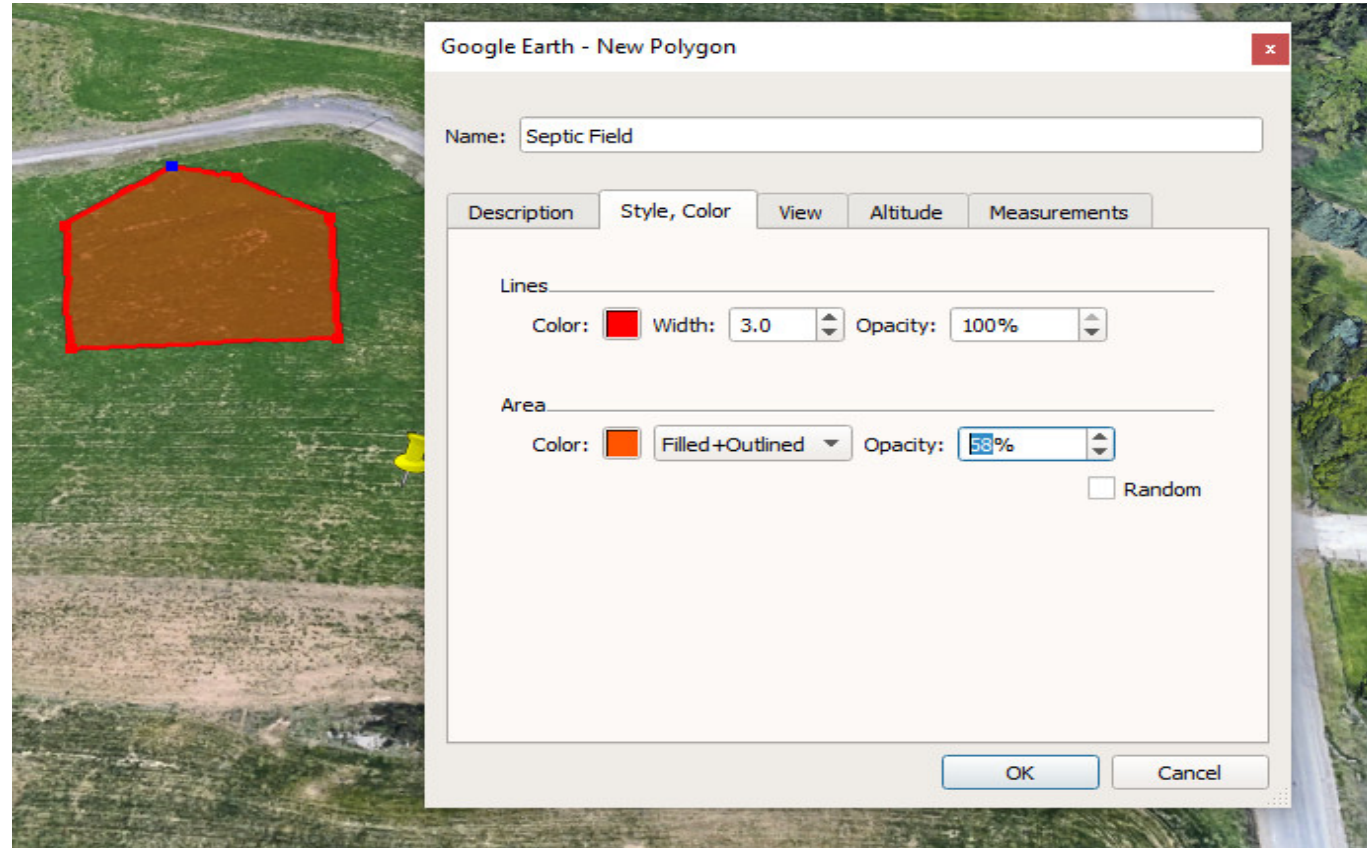
# Add Radius

## Ruler:

- Chose “Circle”
- Click of center of circle and hold down left mouse button.
- Drag out to the distance needed.
- Save and name.



# Add Polygon



# Add Image Overlay

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1. Click “Add Image Overlay” and select a photo (jpg).
2. Use the green cross hairs and edges to position the photo over the satellite image, matching roads and other landscape features.
3. Move the map by holding on the center cross hair lines.
4. Stretch any corner to “rubber sheet” the photo to match the satellite image.
5. Rotate the photo by holding on the green diamond.
6. Adjust the transparency slider bar to see through the photo.
7. The map overlay’s primary purpose is to transfer known locations on the map to the GIS coordinate system by visual matching. Once the photo matches the underlying satellite image, the approximate latitude and longitude can be derived for anything shown on the photo overlay.

# Add Image Overlay

**Left Click & Hold Edge Marks to Stretch Image**

**Left Click & Hold Center Mark to Move**

Google Earth - Edit Image Overlay

Name:

Link:

Transparency:

Clear

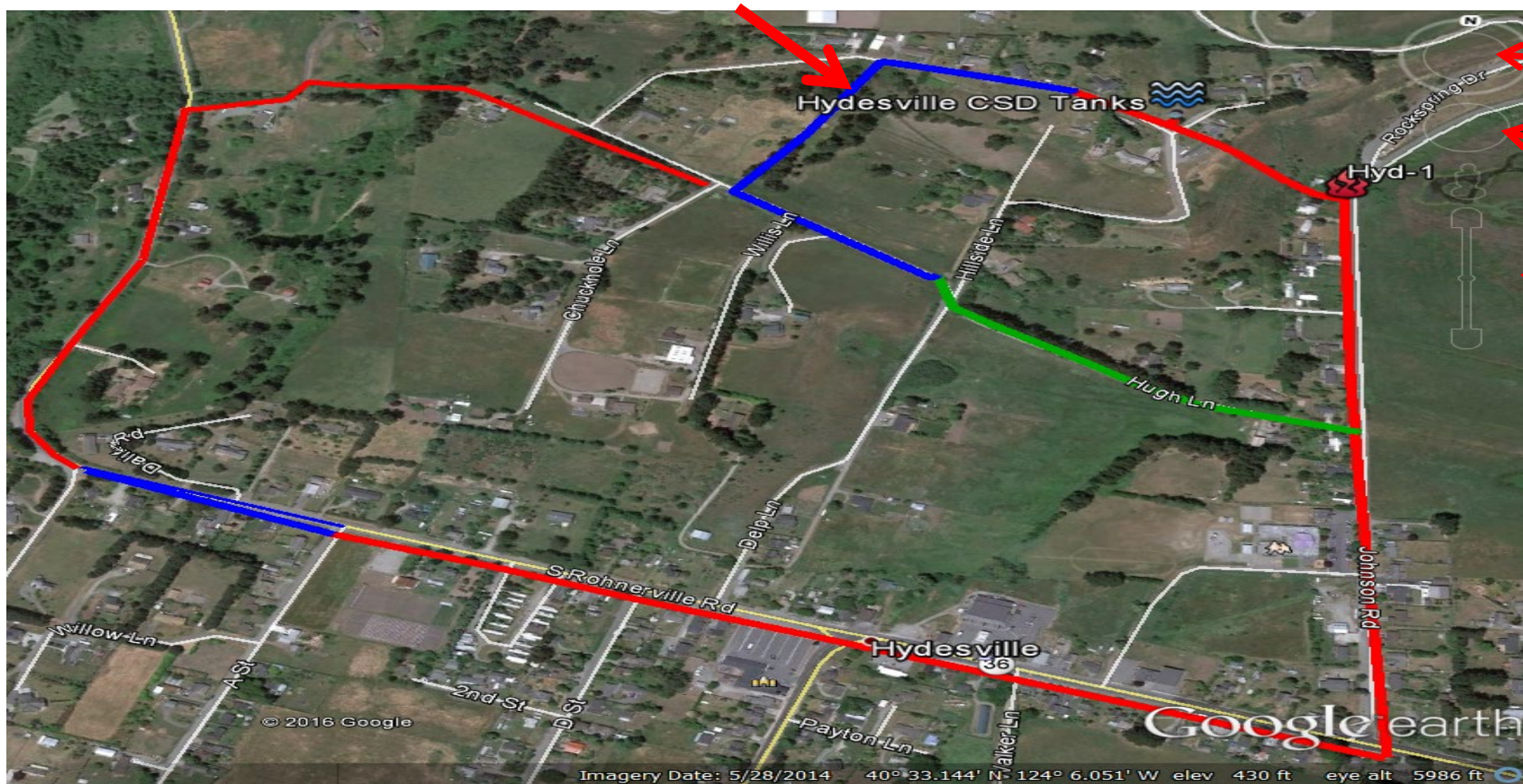
Description

Photo of wall map in HCWD of

© 2016 Google

Imagery Date: 5/28/2014 40° 33.049' N 124° 5.476' W elev 342 ft

# Draw Path/Pipe on Overlay

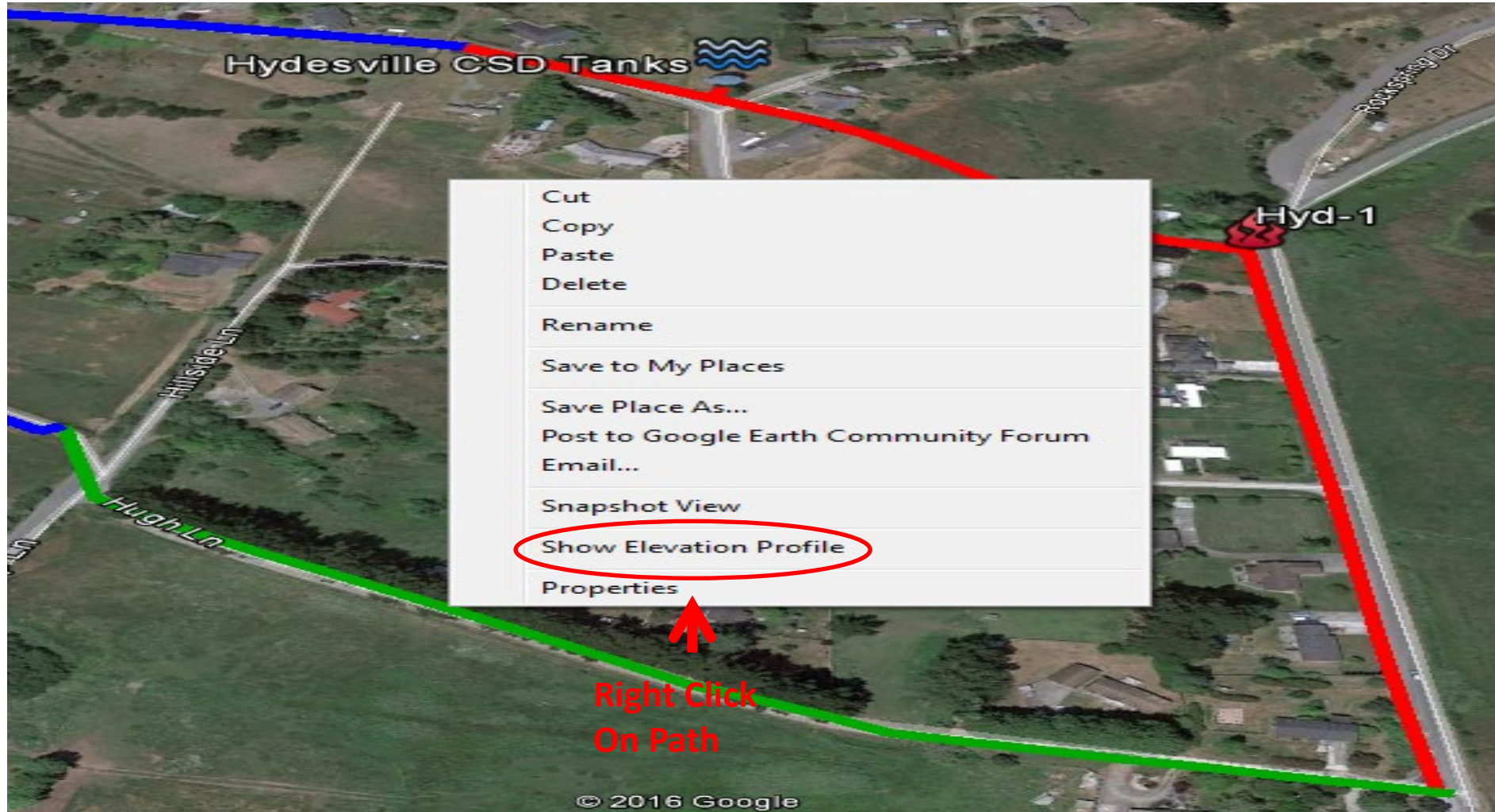


Tilt 3D  
Rotate  
Move  
View

Zoom  
in/out



# Show Elevation Profile



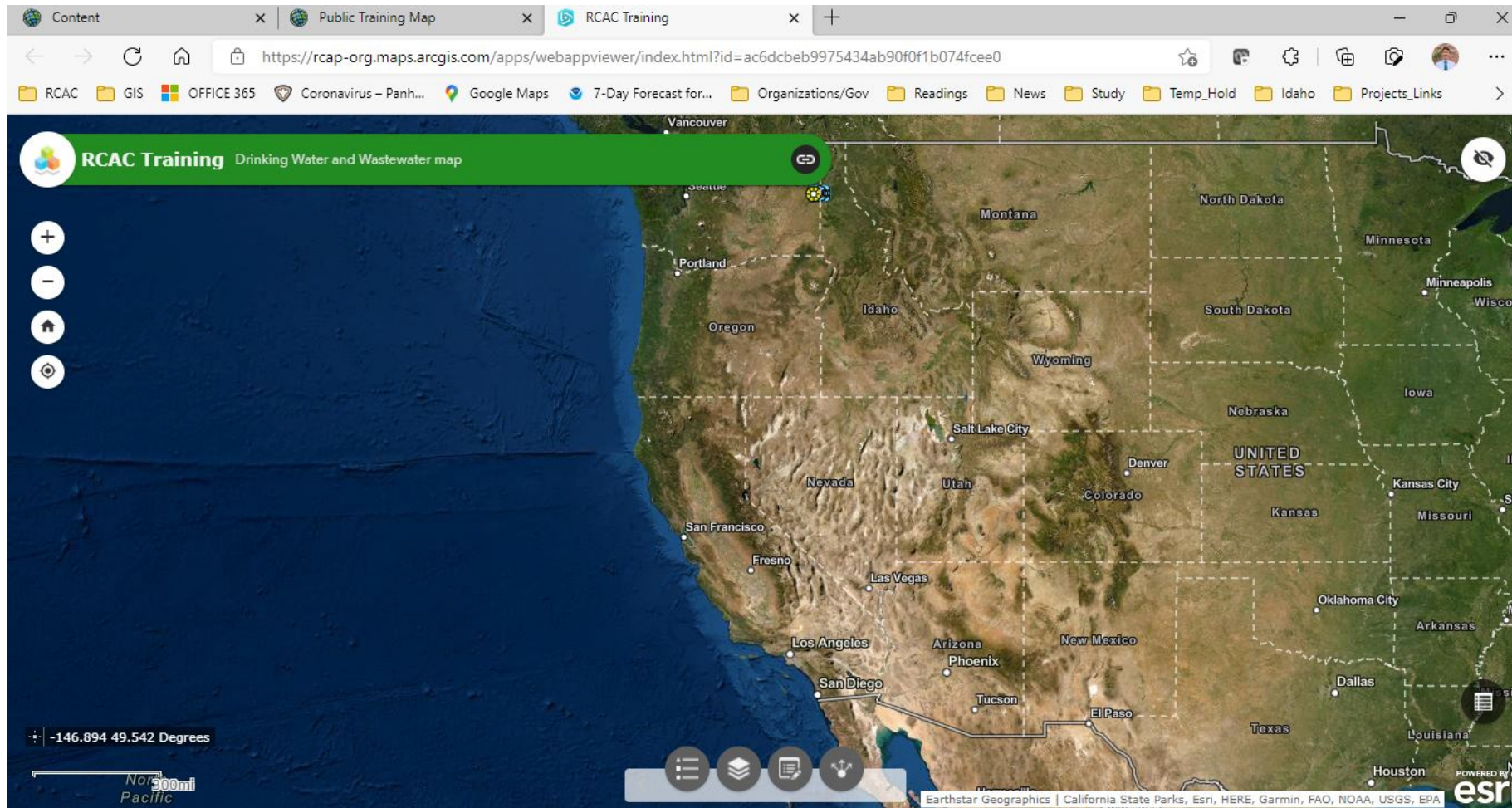
# Show Elevation Profile



# GIS Mapping in ArcGIS Online

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# ArcGIS Online – Link in Chat box



## Poll #4

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How do you feel about your ability to map your system with GIS?

- Yes! I am ready!
- I think I might be able to.
- I will probably need some more assistance/training.
- What was GEP again?

# Resources

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Where to find help and tools

# Resources

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## **EPA Asset Management Resources:**

<https://www.epa.gov/sustainable-water-infrastructure/asset-management-water-and-wastewater-utilities#resources>

## **RCAC AM spreadsheet and instructions:**

<https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/WaterSystemAssistance/DrinkingWaterStateRevolvingFundDWSRF>

# Resources

## Introduction to the System Inventory Worksheet

The following System Inventory Worksheet will help you:

- Identify all of your system's assets;
- Record the condition of your assets;
- Record the service history of your assets;
- Determine your assets' adjusted useful lives;
- Record your assets' ages; and,
- Estimate the remaining useful life of each of your assets. Usually, there are two steps to estimating useful life:
  1. Determine the expected useful life by using the manufacturer's recommendations or the estimates provided in the box to the right. Adjust these numbers based on the specific conditions and experiences of your system.
  2. Calculate an adjusted useful life by taking into account the service history and current condition of your asset.

Two copies of the worksheet are provided. The first copy is followed by instructions that will help you understand how to complete it. The second worksheet is an example. Appendix A has blank worksheets that you can photocopy and use.

### Estimated Useful Lives

Asset	Expected Useful Life (in years)
Intake Structures	35-45
Wells and Springs	25-35
Galleries and Tunnels	30-40
Chlorination Equipment	10-15
Other Treatment Equipment	10-15
Storage Tanks	30-60
Pumps	10-15
Buildings	30-60
Electrical Systems	7-10
Transmission Mains	35-40
Distribution Pipes	35-40
Valves	35-40
Blow-off Valves	35-40
Backflow Prevention	35-40
Meters	10-15
Service Lines	30-50
Hydrants	40-60
Lab/Monitoring Equipment	5-7
Tools and Shop Equipment	10-15
Landscaping/Grading	40-60
Office Furniture/Supplies	10
Computers	5
Transportation Equipment	10

Note: These numbers are ranges of expected useful lives drawn from a variety of sources. The ranges assume that assets have been properly maintained.

<https://www.epa.gov/dwcapacity/asset-management-resources-small-drinking-water-systems-0>



# Resources

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## **DOH Small Water System Management Program Guide:**

<https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/WaterSystemDesignandPlanning/SmallWaterSystemMgmt>

## **DOH Water System Planning Guidebook:**

<https://www.doh.wa.gov/Portals/1/Documents/Pubs/331-068.pdf>

# Resources

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## **GE Pro free download**

Using a desktop computer, download the free software:

<https://www.google.com/earth/versions/#earth-pro>

**Administrative permission may be required for installation!**

# For More Information

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