



2025

WISPAMERICA™

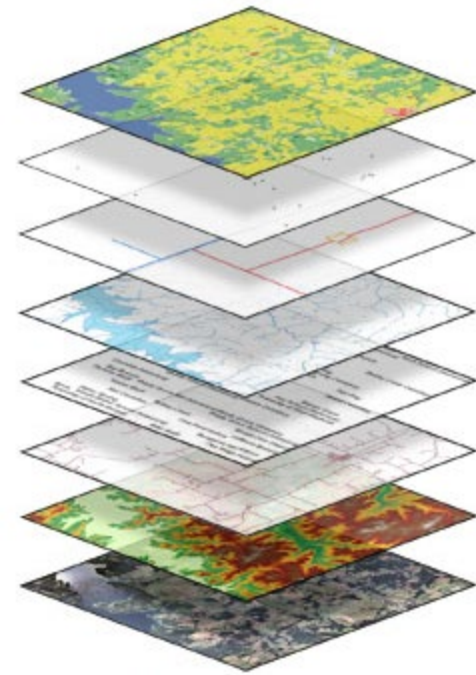
BROADBAND WITHOUT BOUNDARIES



Harnessing GIS For Smarter Network Planning and Operations

Seth Poche and Nicholas Pena

Introduction to GIS



What really is GIS?

- “Geographic Information Systems”
 - Marriage of geography and computer systems
- Geography is more than maps (cartography)
 - If History is the study of events over time, then Geography is the study of events over space.

GIS 101: Coordinate Systems

- Geographic vs Projected

- Geographic Coordinate Systems

- Three-dimensional
 - Center point of the earth (datum)
 - Angles from that center point that traverse...
 - East to West (horizontal) lines - **latitude**
 - North to South (vertical) lines - **longitude**

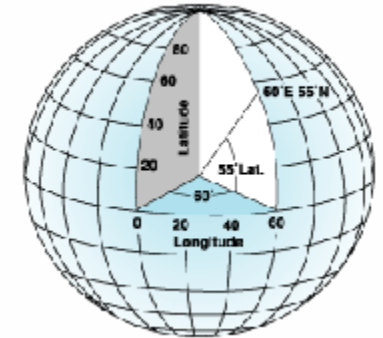
- Source: <https://desktop.arcgis.com/en/arcmap/latest/map/projections/about-geographic-coordinate-systems.htm>

- Pros

- Good for large areas
 - Single global reference

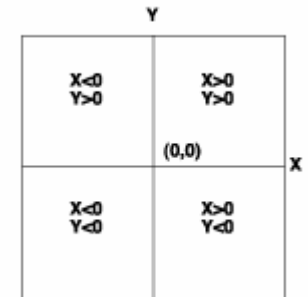
- Cons

- Problematic when accuracy is paramount
 - Working in degrees is not intuitive and changes as you travel from the equator to the poles...as the Earth bulges at the center.



GIS 101: Coordinate Systems (cont.)

- Projected Coordinate Systems
 - Two-dimensional (flattened map)
 - Gridded area with equally sized, spaced cells
- Pros
 - Units of measure tend to be intuitive (e.g. meters, feet,...) instead of degrees.
 - Can be very accurate
- Cons
 - The definitions of projected coordinate systems can be complex and are not uniform.
 - It is easy to get lost or confused.



Coordinate Systems in QGIS

(Demonstration)

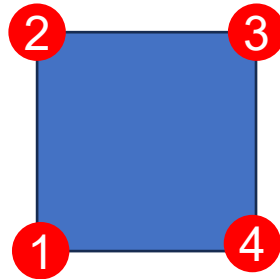
GIS 101: Data Types

- Vector vs Raster

- Vector

- Points, Lines, Polygons
 - Defined with vertices and paths
 - Polygon example using GeoJSON (excerpt):

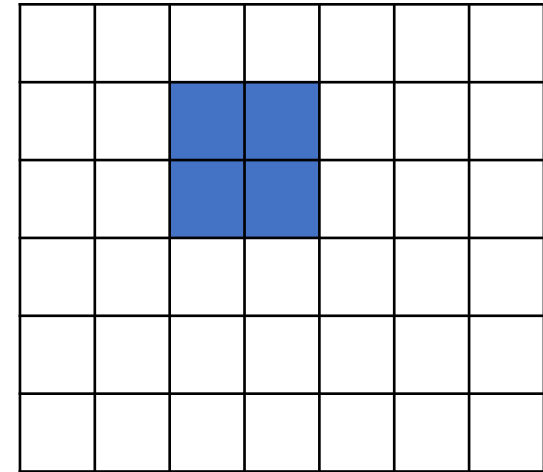
```
"coordinates": [  
  [  
    [-75.0, 40.0],  
    [-75.0, 40.1],  
    [-74.9, 40.1],  
    [-74.9, 40.0],  
    [-75.0, 40.0]  
  ]  
]
```



- Precise, but complexity can balloon out of proportion for large datasets.

GIS 101: Data Types (cont.)

- Raster
 - Gridded
 - Images with pixels
 - More straightforward but not always conducive to GIS operations



Vector and Raster Data in QGIS

(Demonstration)

Available Tools

GIS is a field, not a tool!

Much like medicine or mathematics, there are many tools and applications.

General tools:



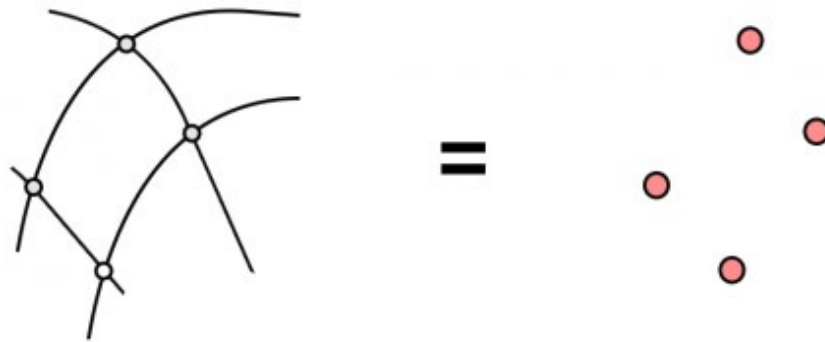
Purpose Built Tools:



GIS makes geometry another attribute of a record to be analyzed.

ID	Name	Address	Lat	Lon	Type	Geometry
1	John Smith	123 Oak Way	38.8951	-77.0364	SFU	XXXXXXXX
2	Amy Johnson	435 Smith St.	38.8951	-77.0364	SFU	XXXXXXXX
3	John Aime	678 Martin Ave	38.8951	-77.0364	MDU	XXXXXXXX

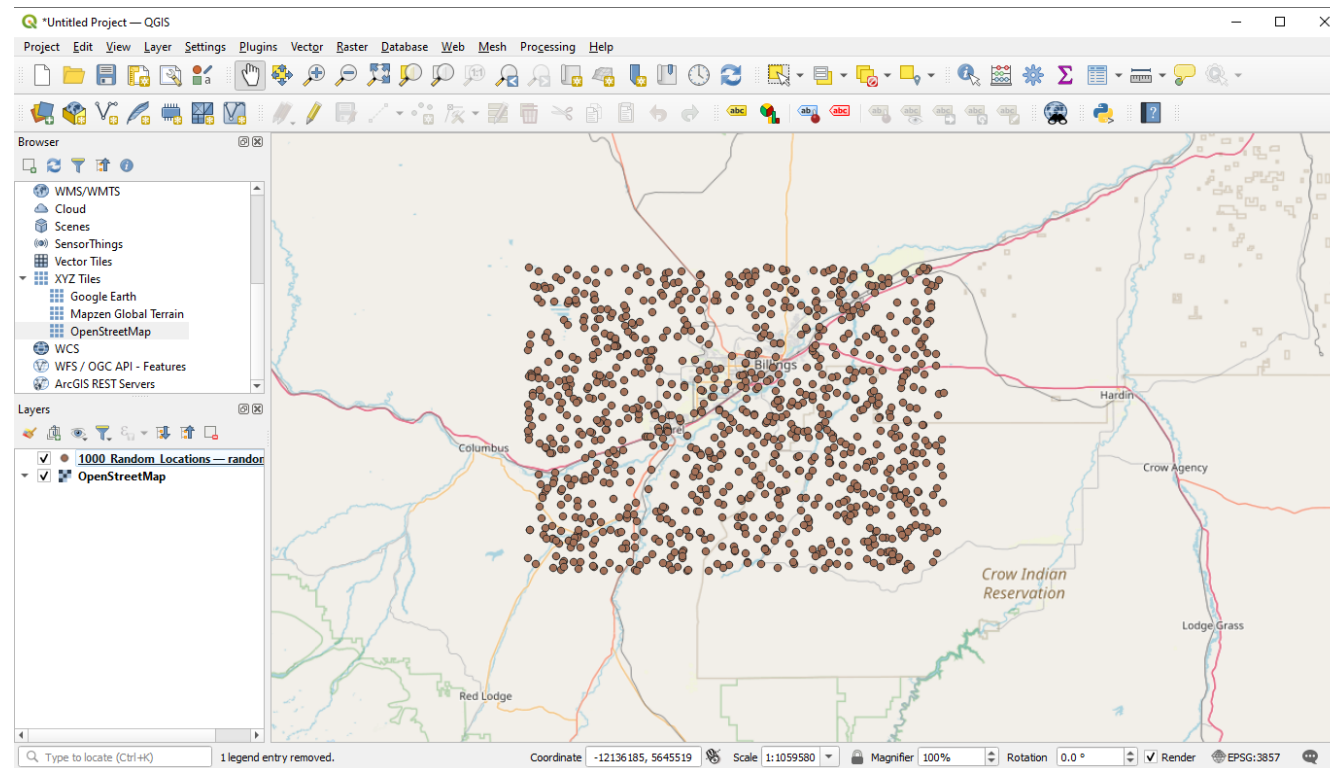
Simple GIS Operation: Intersect



Wireless Planning

Tower Site Selection

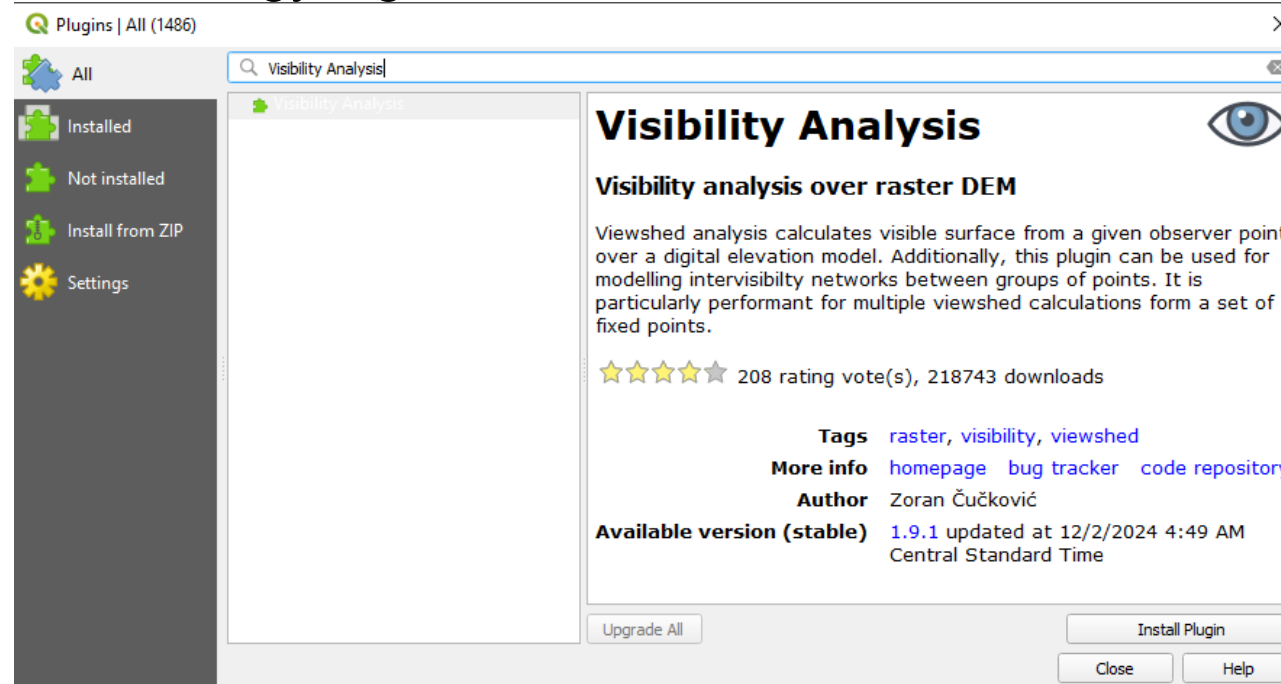
- Problem Statement: Given a set of customers to connect, where is the best place to put a tower?



1000 Random Locations around Billings, MT.

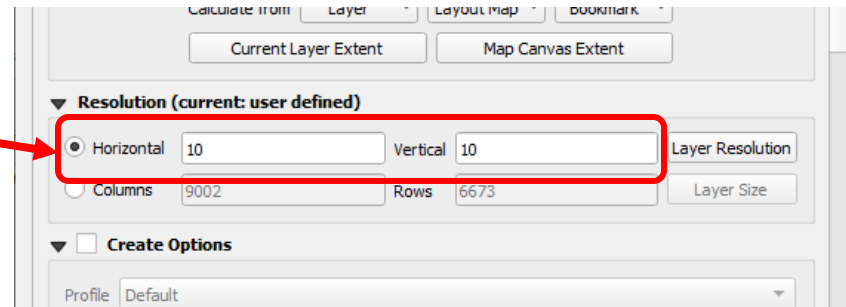
Reverse Viewshed Analysis

- “Where do I need to place a tower to see all the most customers?”
- QGIS Visibility analysis plugin
- <https://landscapearchaeology.org/2020/viewshed-tutorial/>

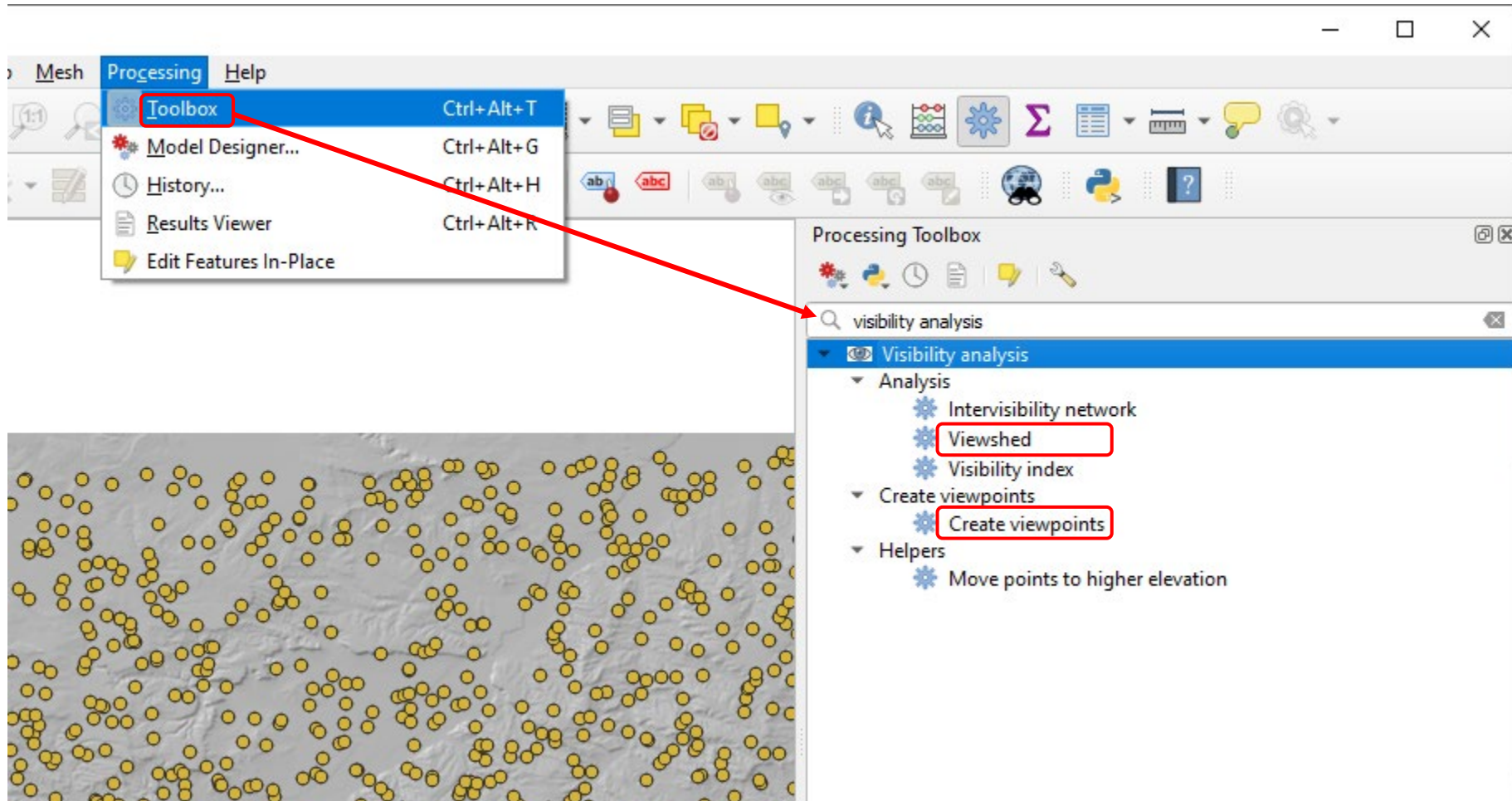


Acquiring DEM terrain data

- US: (The National Map-<https://apps.nationalmap.gov/downloader/>)
 - 1m LiDAR derived (3DEP)
 - 1/9 arcsecond (3m)
 - 1/3 arcsecond (10m NED)
- Globally:
 - SRTM
 - Aster
 - AW3D
- Note: Be sure to convert any Geographic Coordinate System terrain data to Projected Coordinated System.
 - UTM Zone => $(\text{Longitude} + 180) / 6$
 - Make the pixels square!



Accessing Plugins in QGIS



QGIS Visibility Plugin

• Step 1: Create viewpoints

Create viewpoints

This is the first step for the visibility analysis. The result will be written as a geopackage file with standardised field names and reprojected to match the elevation model used (if needed).

Parameters

Observer IDs: viewpoints can be assigned individual names or id numbers, stored in the associated table. Otherwise, internal ids will be used (sequential numbers).

Observer height: in meters.

Target height: height value to be added to all terrain areas checked for visibility from the observer point.

Radius of analysis: maximum distance for visibility testing, in meters.

For other parameters, see [help online](#)

If you find this tool useful, consider to :

[Buy me a coffee](#)

! This GIS tool is intended for **peaceful use**

• Step 2: Viewshed

Viewshed

Produces a visibility map where each observer point on a terrain model. The output can be:

Binary viewshed: visible/not visible (1/0).

Depth below horizon: height that each location should attain in order to become visible.

Horizon: outer edges of a viewshed.

Terrain model used should be in the same projection system as viewpoints file (preferably the one used in "Create viewpoints" routine).

When multiple observer points are used, individual viewsheds will be combined according to the Combining multiple outputs option.

Parameters

Observer locations: viewpoints created by the "Create viewpoints" routine.

Digital elevation model: DEM in the same projection system as viewpoints file.

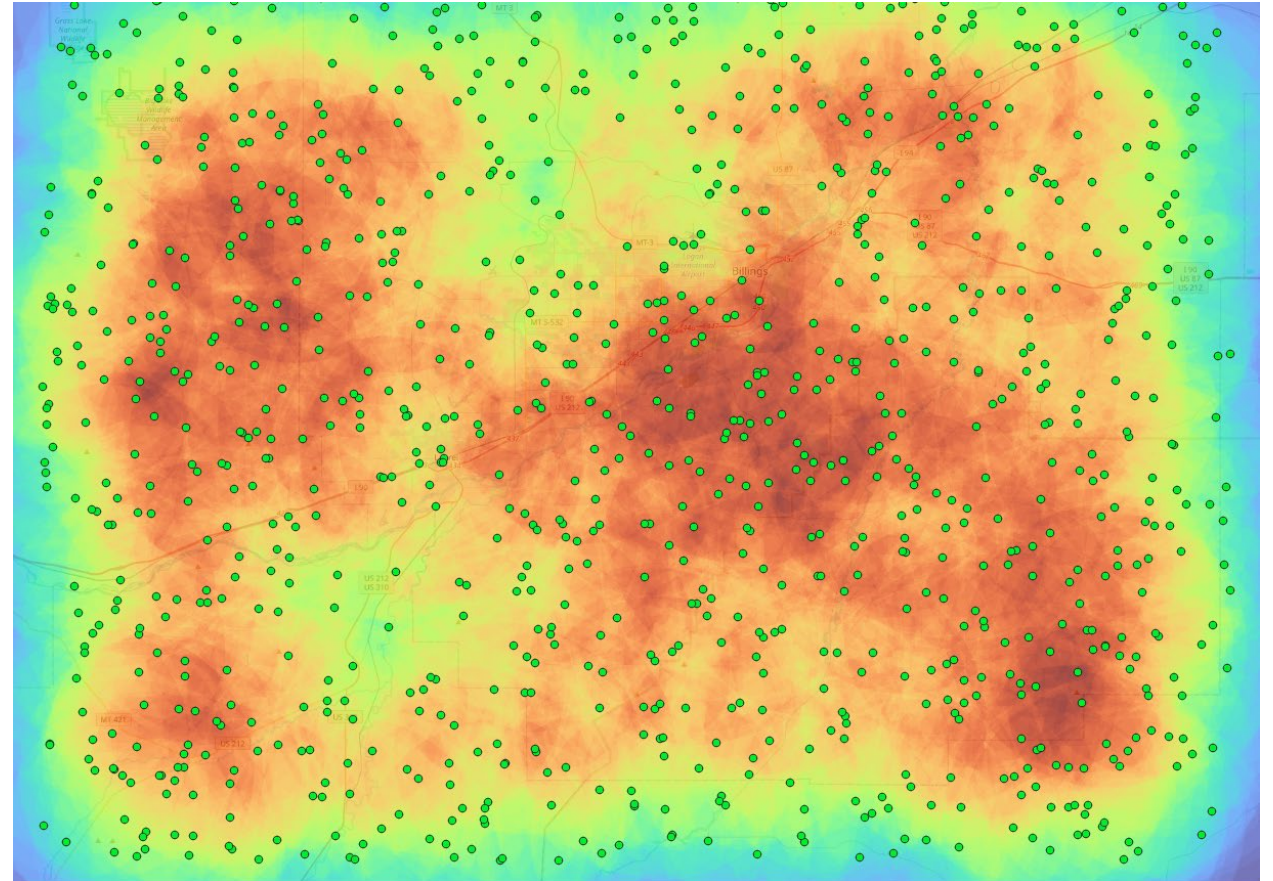
For more see [help online](#).

If you find this tool useful, consider to :

[Buy me a coffee](#)

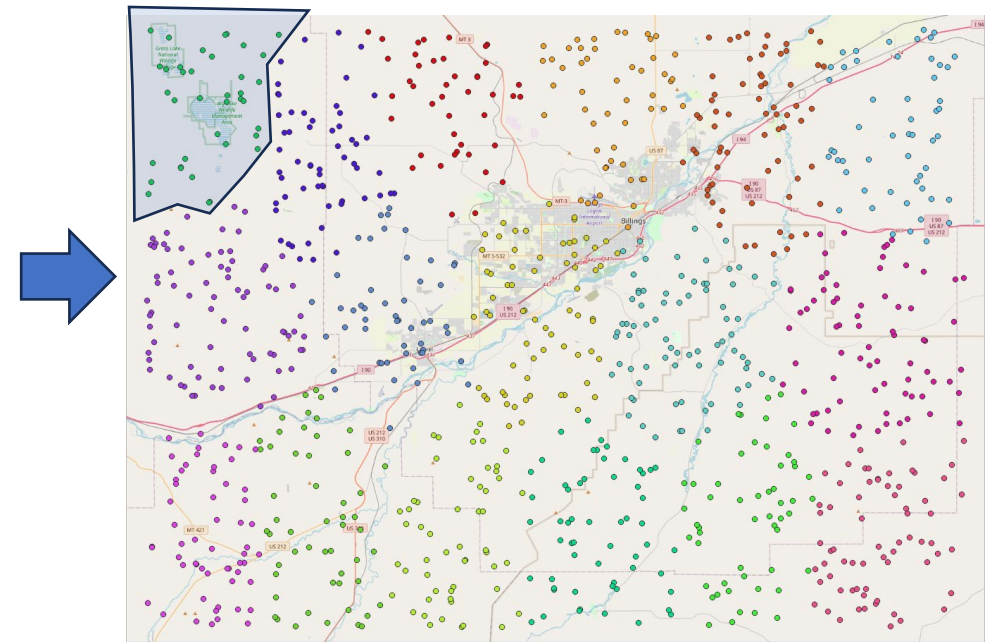
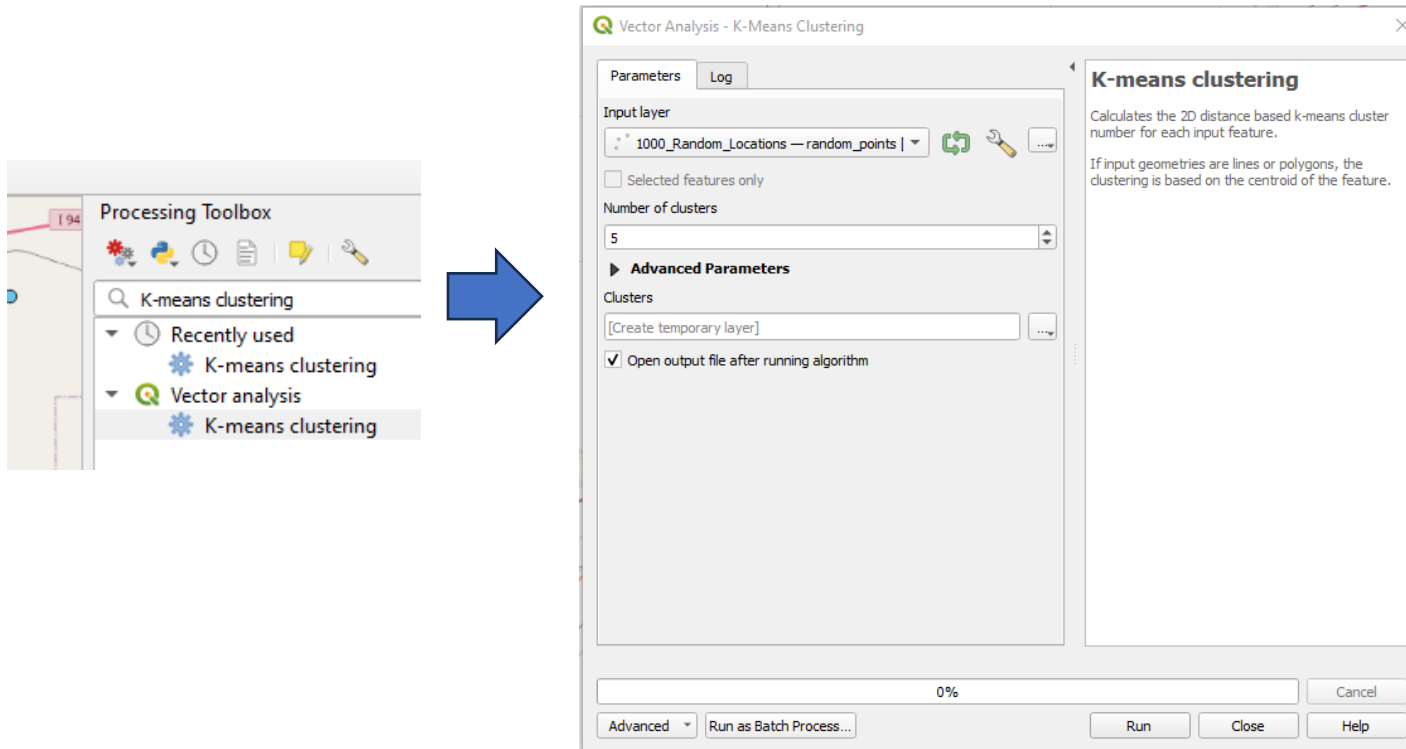
QGIS Visibility Plugin

- Results:
 - Not really what we wanted.
 - Showing the best place to put a SINGLE site, but one tower isn't going to cover the entire area. Starting with a first best tower location could cause us to split up the area ineffectively and lead to more towers than required.



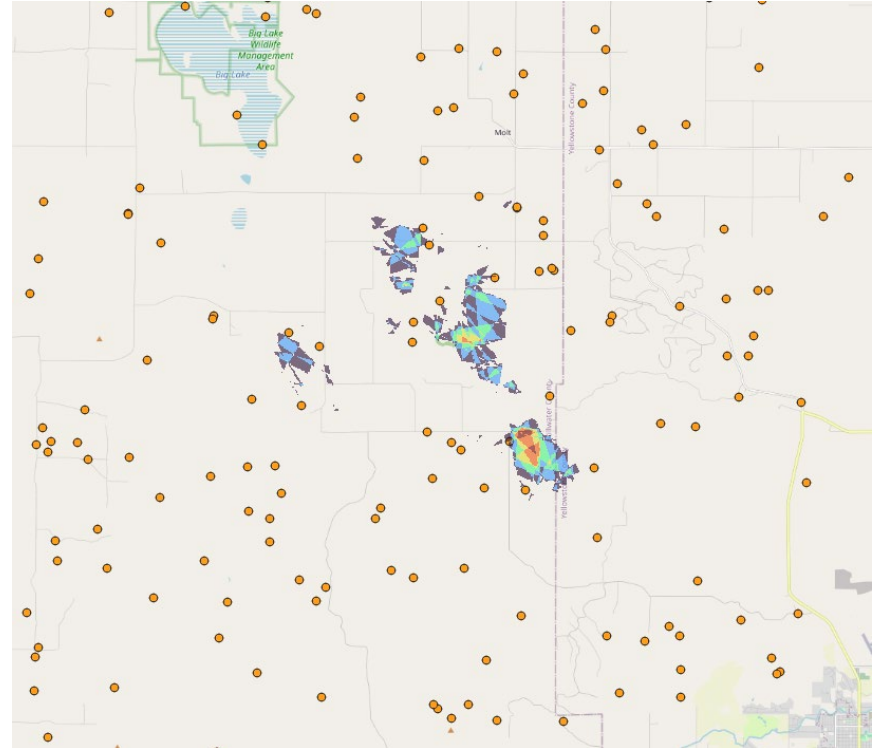
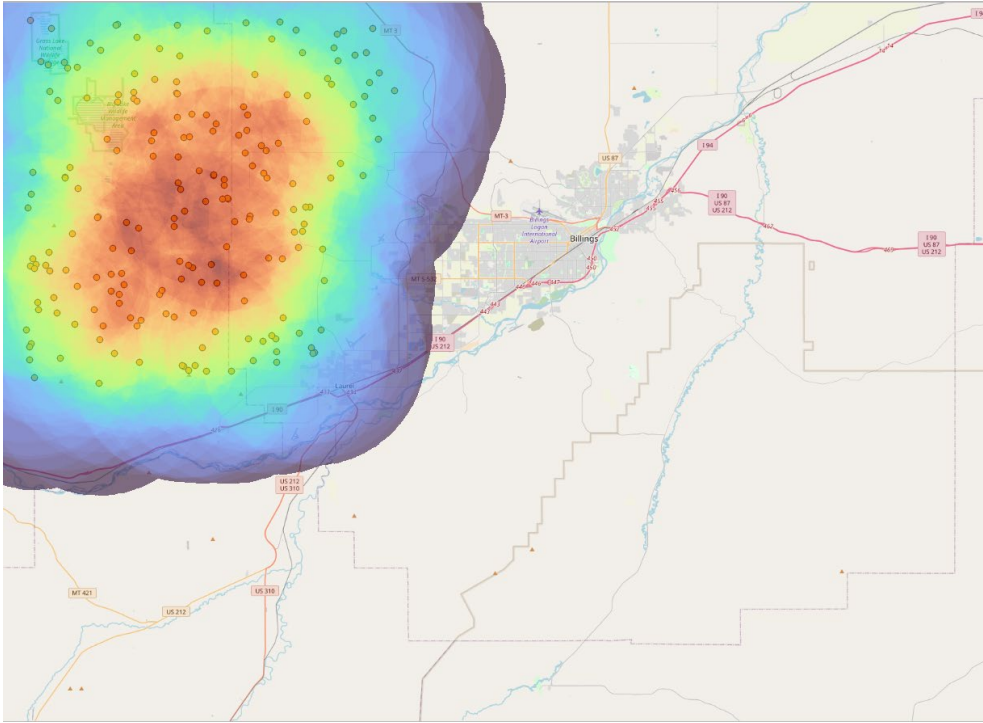
K-means clustering

- Use the built-in “K-means clustering” tool to bring up the project.



Note: 17 Clusters Shown Here...for effect.

Attempt #2 with only 1 of 5 clusters



- Filtering out the lower levels of coverage and zooming in we start to see ideal areas for a new tower.

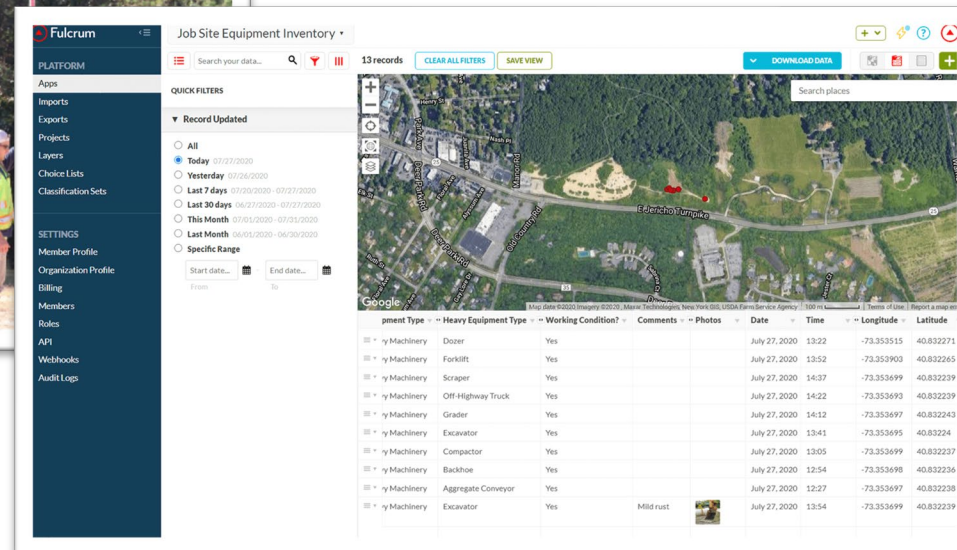
Fiber Planning & Management

High Level Design & Routing



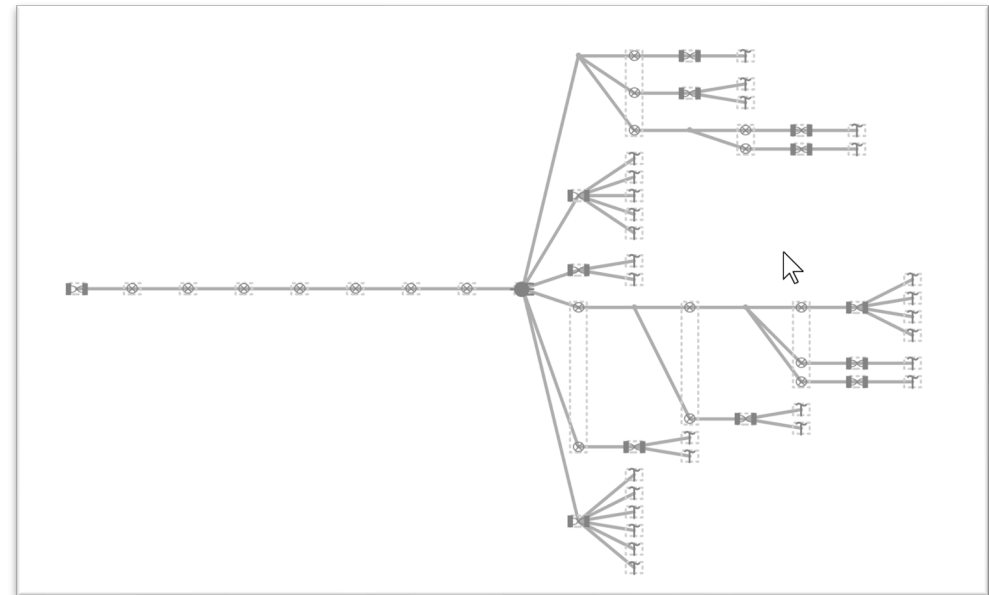
Biarri Networks

Field Collection

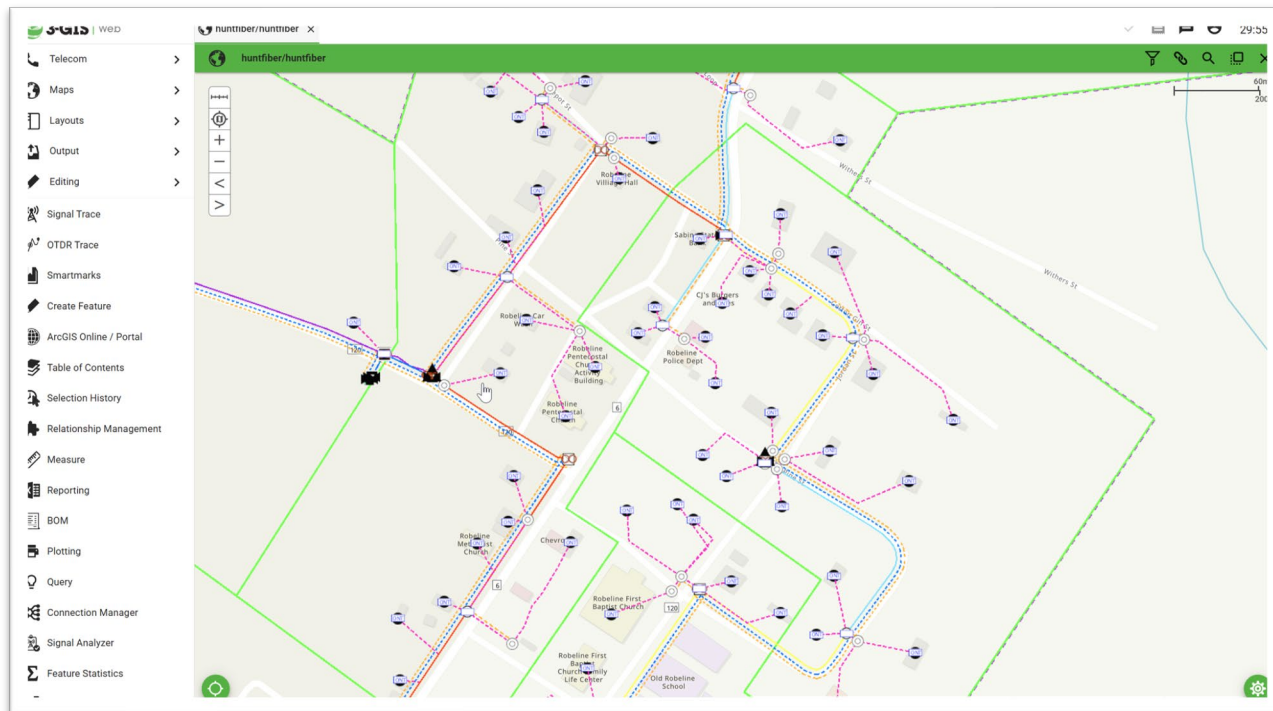


Low Level Design & Plant Record Management

IQGeo®



Low Level Design & Plant Record Management



Info
Connection Manager

Structure/Splice
SpliceClosure:ERATE-007(452296)

FIBERCABLE 1238496 FIBERCABLE 1238497 FIBERCABLE 1220108

Sequentials Sequentials Sequentials

Detailed Existing Signal Trace Connection Notes Complement

FIBER Range 1 FIBER Range (1) FIBER Range (1) FIBER Range Enter Range

Show Color

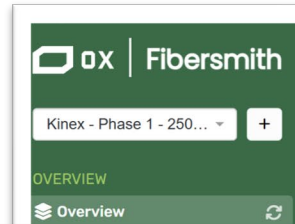
1238496		1238497		1220108		Connection Information	
Buffer	Fiber	Buffer	Fiber	Buffer	Fiber	Splice Type	Tray #
	2		2			Pass Thru	
	3		3			Pass Thru	
	4		4			Pass Thru	
	5		5			Pass Thru	
	6		6			Pass Thru	
	7					Fusion	
	9		9		2	Fusion	
	10		10			Pass Thru	
	11		11			Pass Thru	
	12		12			Pass Thru	
2	13	2	13			Pass Thru	

Low Level Design & Plant Record Management



The screenshot displays the VETRO FiberMap software interface. A central window titled "DEMO-HUB-00001189" shows a fiber connection diagram between two hubs: "DEMO-SC-00022818" on the left and "DEMO-HH-00002818" on the right. Each hub has a vertical stack of 22 fiber ports, numbered 1 to 22. The ports are color-coded and connected by lines representing fiber paths. The left hub is connected to the right hub via a series of lines that fan out and then converge. The interface also shows a "Feature Info" panel on the left with attributes like Latitude, Longitude, Project, Plan, Created Time, Last Edited Time, Status, Stored Fiber Paths (11), Splicing, Equipment Connections, and Instruction History. A map in the background shows the physical layout of the hubs and fibers, with labels like "ID: DEMO-LA-00196963 (W)", "ID: DEMO-HH-00002818", and "ID: DEMO-HUB-00001189".

Construction Management



Overall overview

Reports Settings Nicholas Pena EN ?

DEVIATING TIME PLANS

7



CHECKED IN TEAMS

0



CHANGE REQUESTS

0



ACTION REQUIRED

102



Task not completed & due date past

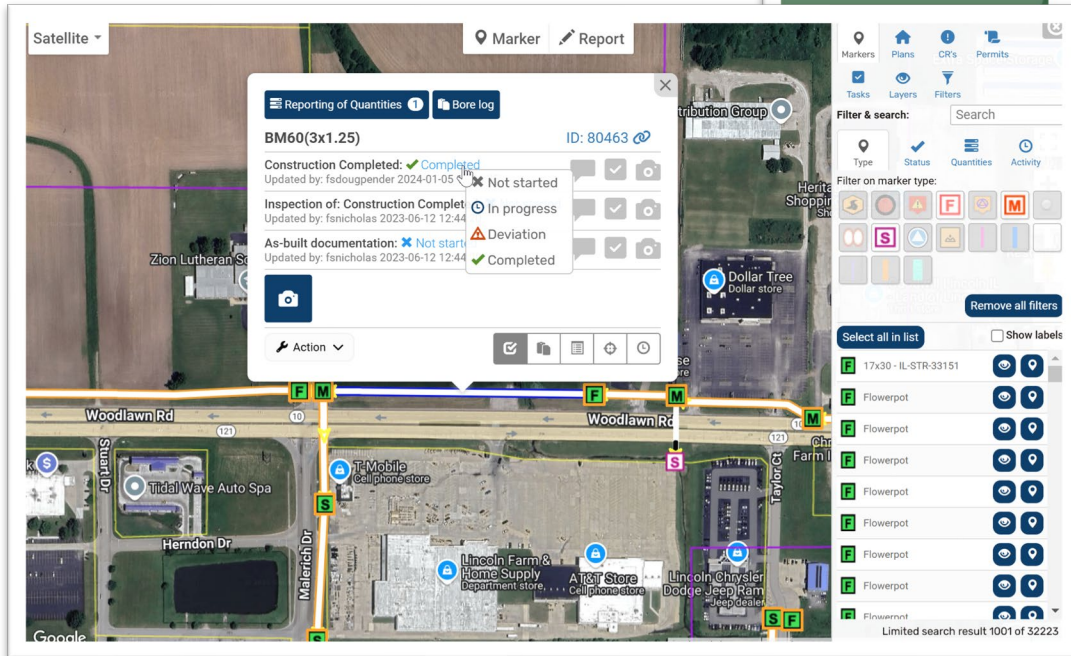
Project	Number of tasks
West Carroll County	1
FY23 App1	1

User activity

Reporting of Q CR's Man Electronic staff

Latest events

	Today	7 days	30 days
1 ea MST - 8 Port - 50 ft (BM51(08x0050)) complete			yesterday 14:56
1 ea Buried Splice Closure - Medium w/Split (HBF0(0:			yesterday 14:48
27 ea Fusion Splice - Single Strand (H01) completed (yesterday 14:48
1610 ft Directional bore - 1x1.25" SDR 11 (BM60(1x1.25			yesterday 13:33
1228 ft Directional bore - 1x1.25" SDR 11 (BM60(1x1.25			yesterday 13:33
550 ft Directional bore - 1x1.25" SDR 11 (BM60(1x1.25'			yesterday 13:32



3-GIS & Ocius

(Demonstration)

Final Thoughts:

Are we really tapping into the power of GIS?

The image is a graphic design with a white background. In the upper right corner, there is a semi-circular cutout showing a city skyline at sunset, with buildings like the Empire State Building illuminated. A large, white, curved shape, resembling a speech bubble tail, points towards the center. The text "THANK YOU" is written in a bold, black, sans-serif font across the middle of the white area. At the bottom, a dark grey horizontal bar contains a row of ten colorful, upward-pointing arrow icons in shades of red, orange, and yellow.

THANK YOU