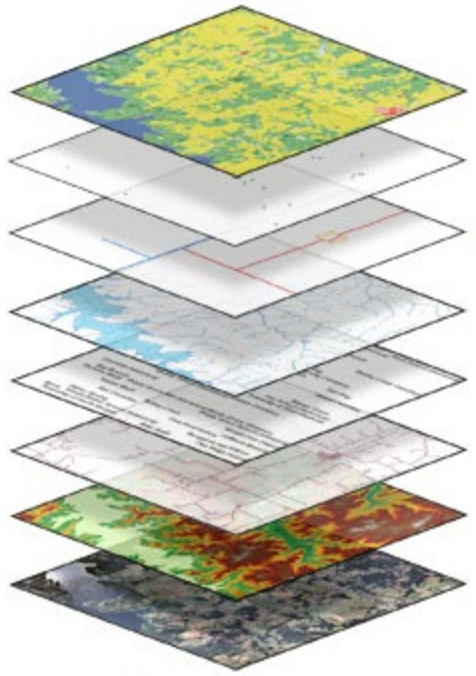

2025
WISPAMERICA™
BROADBAND WITHOUT BOUNDARIES

Harnessing GIS For Smarter Network Planning and Operations

Seth Poche and Nicholas Pena

2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

Introduction to GIS



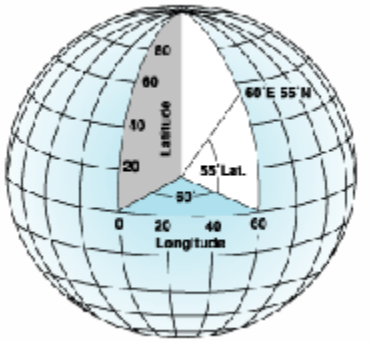
What really is GIS?

- “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*.

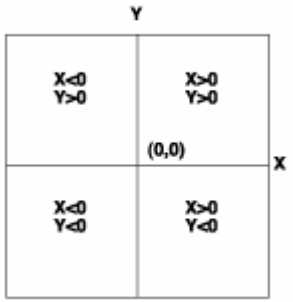
GIS 101: Coordinate Systems

- 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.



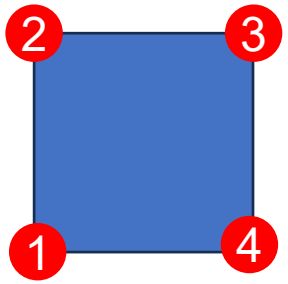
Coordinate Systems in QGIS

(Demonstration)

GIS 101: Data Types

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

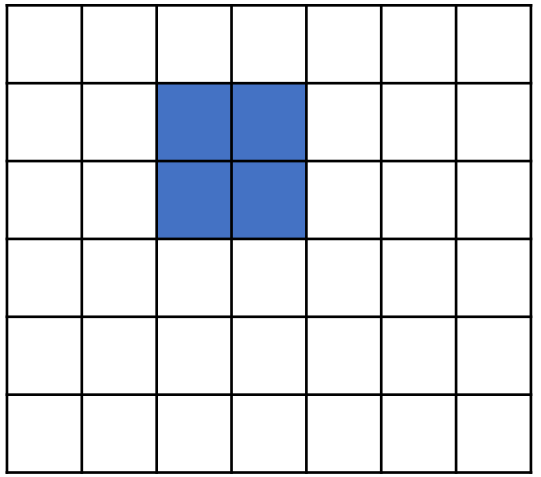
```
"coordinates": [
    [
      [-75.0, 40.0],
      [-75.0, 40.1],
      [-74.9, 40.1],
      [-74.9, 40.0],
      [-75.0, 40.0]
    ]
```



    - 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.

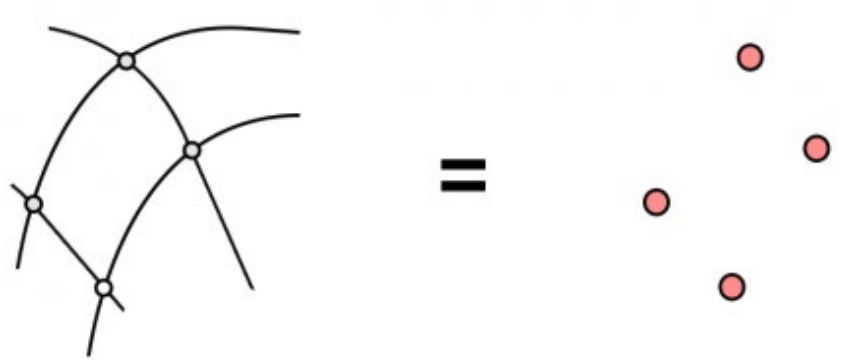
General tools:

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 Johnsc	435 Smith St.	38.8951	-77.0364	SFU	XXXXXXXX
3	John Aime	678 Martin Ave	38.8951	-77.0364	MDU	XXXXXXXX

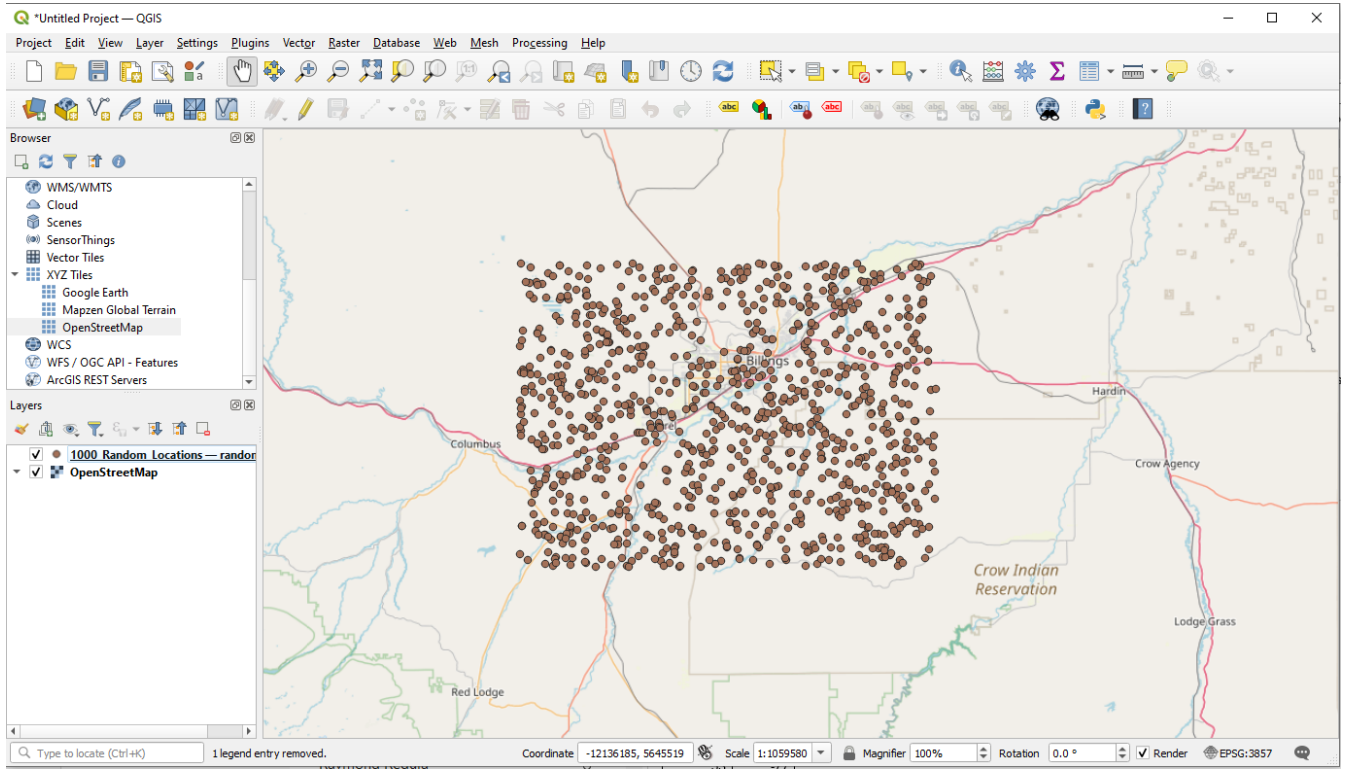
Simple GIS Operation: Intersect



Wireless Planning

Tower Site Selection

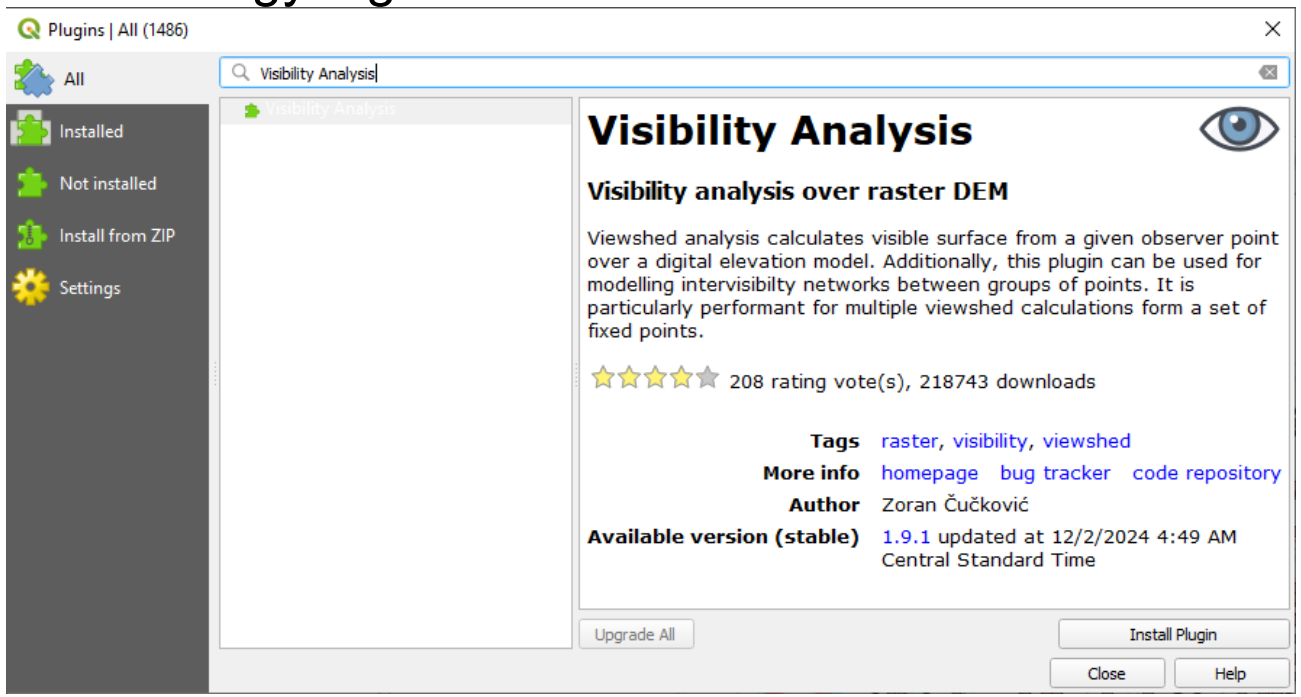
- Problem Statement: Given a set of customers to connect, where is the best place to put a tower?



1000 Random Locations around Billings, MT.

Reverse Viewshed Analysis

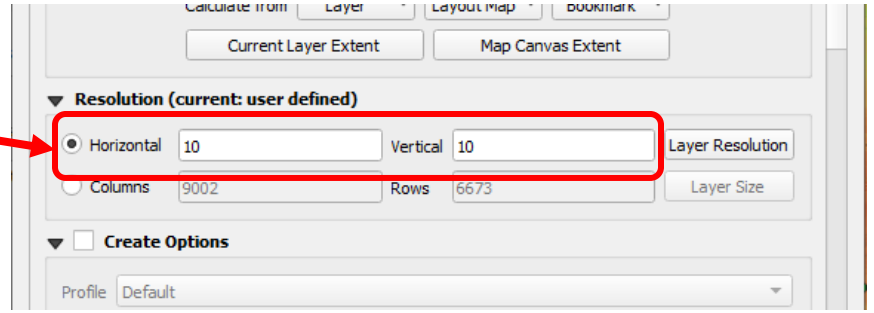
- “Where do I need to place a tower to see all the most customers?”
- QGIS Visibility analysis plugin
- https://landscapearchaeology.org/2020/viewshed-tutorial/



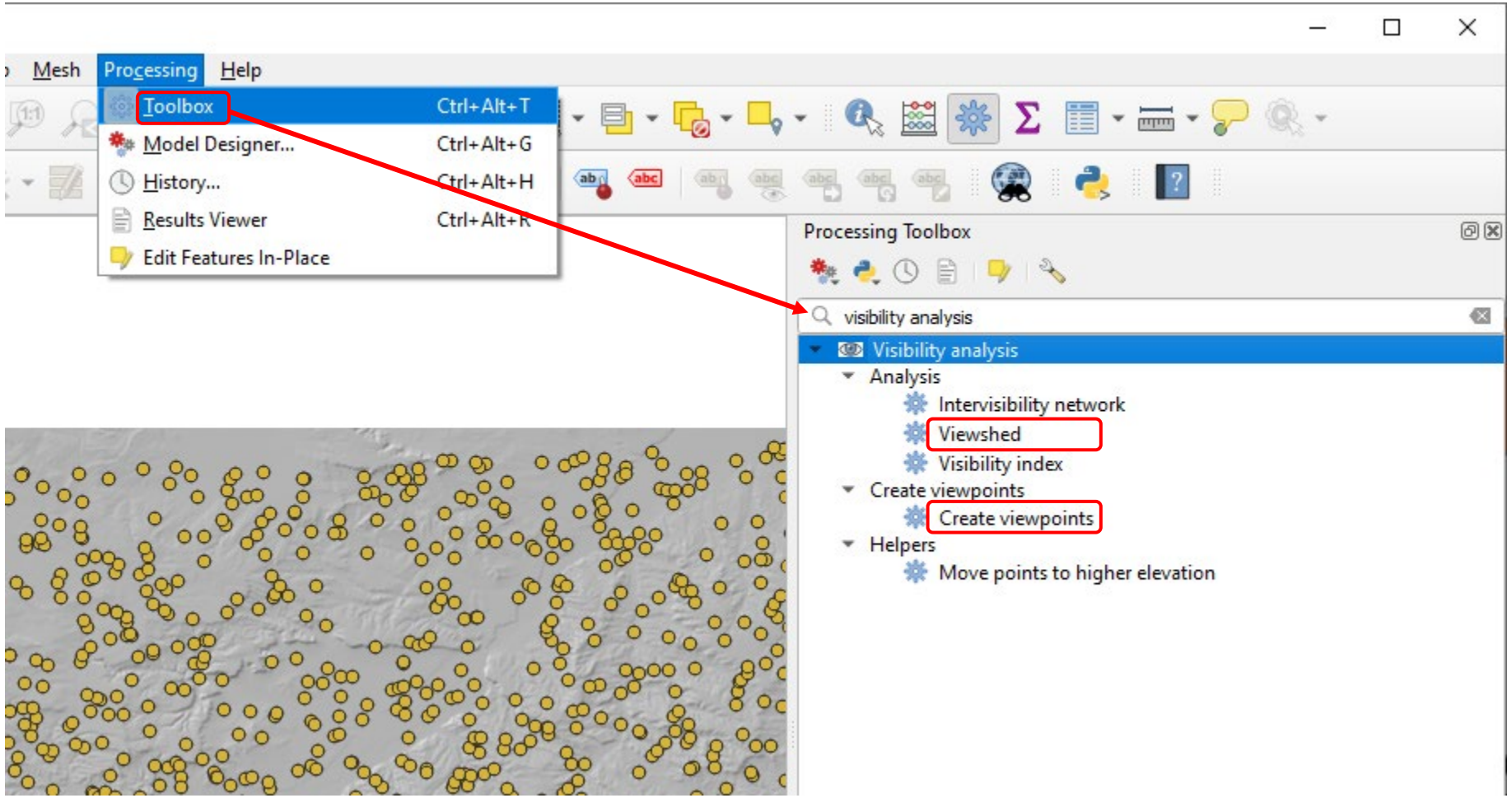
Acquiring DEM terrain data

- 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 => (Longitude + 180) / 6
  - Make the pixels square!

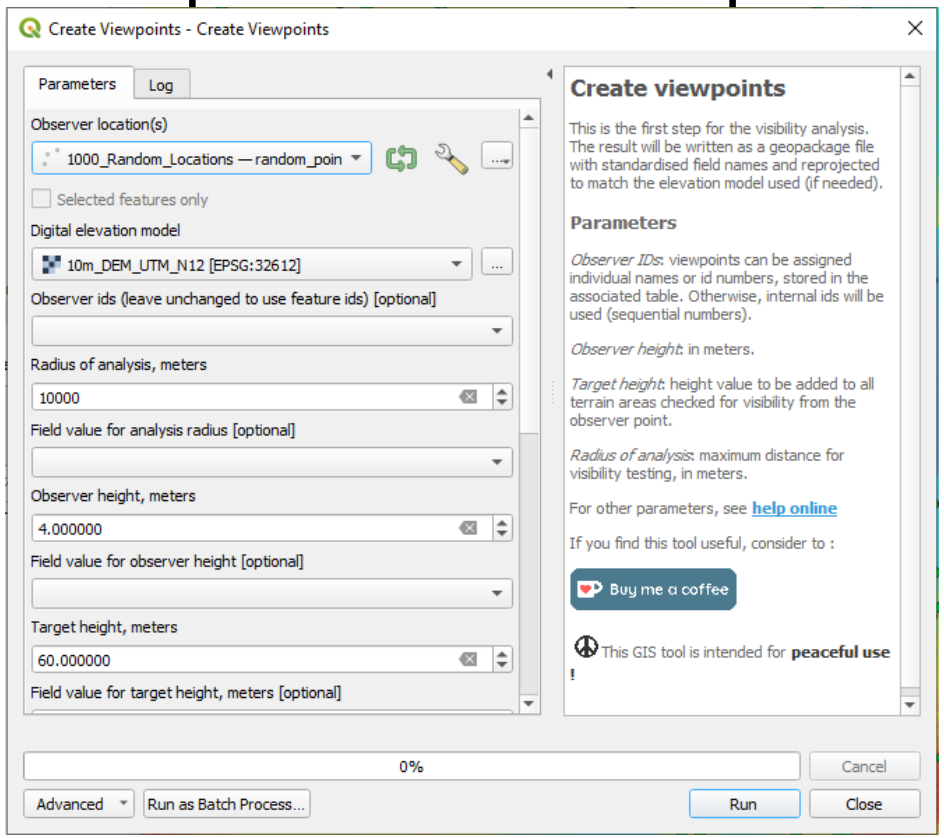


Accessing Plugins in QGIS

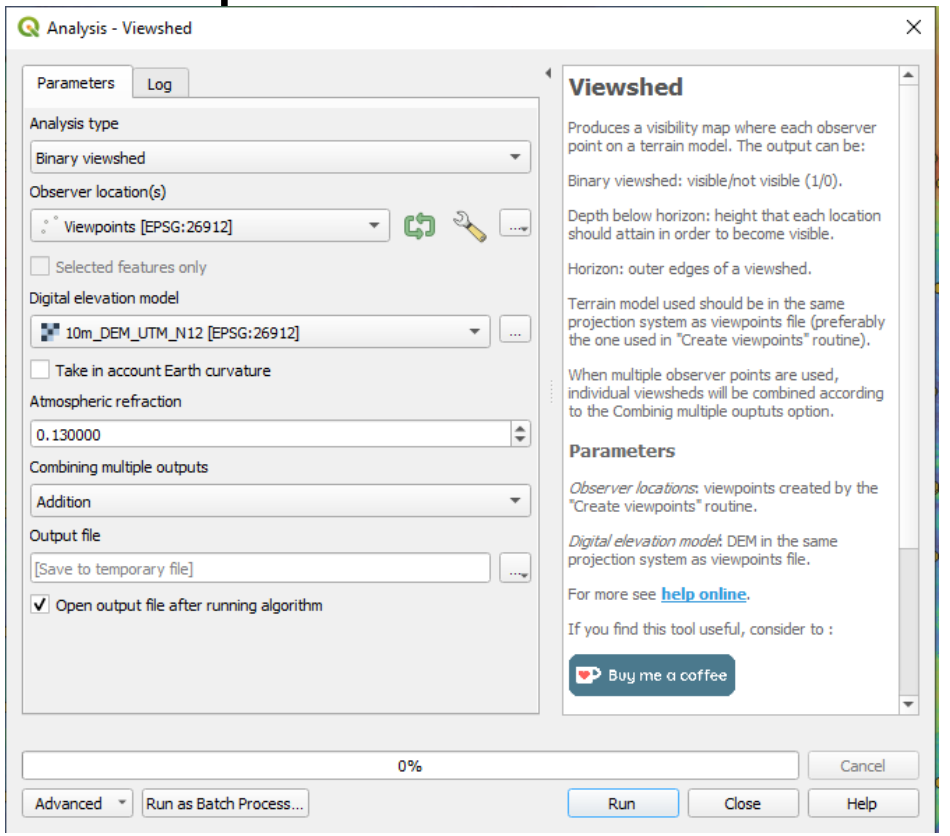


QGIS Visibility Plugin

- Step 1: Create viewpoints



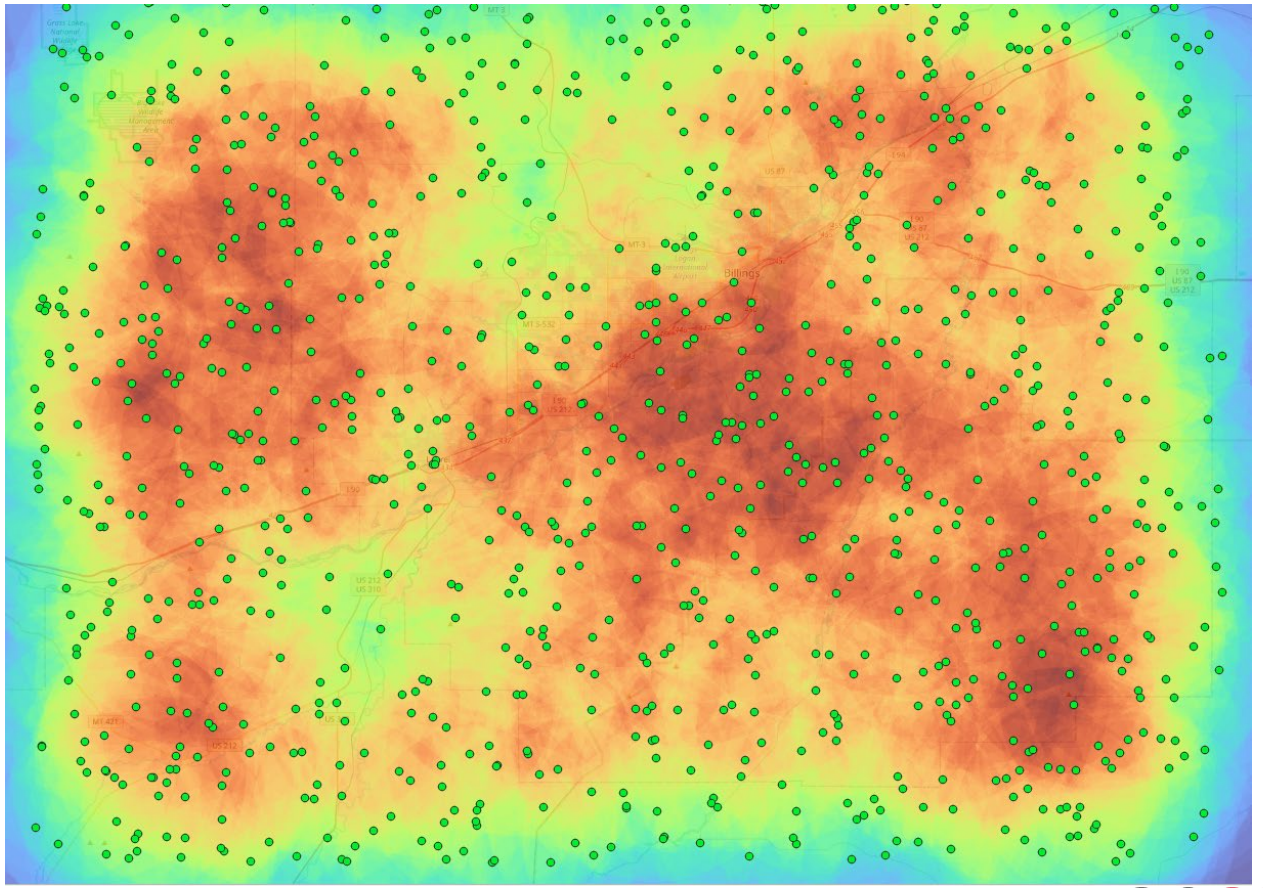
- Step 2: Viewshed



2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

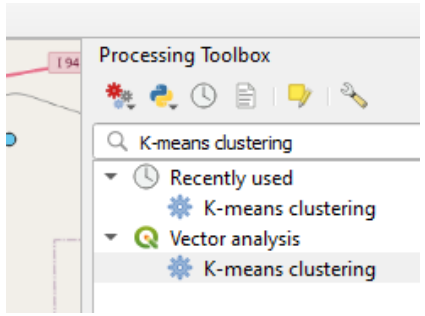
QGIS Visibility Plugin

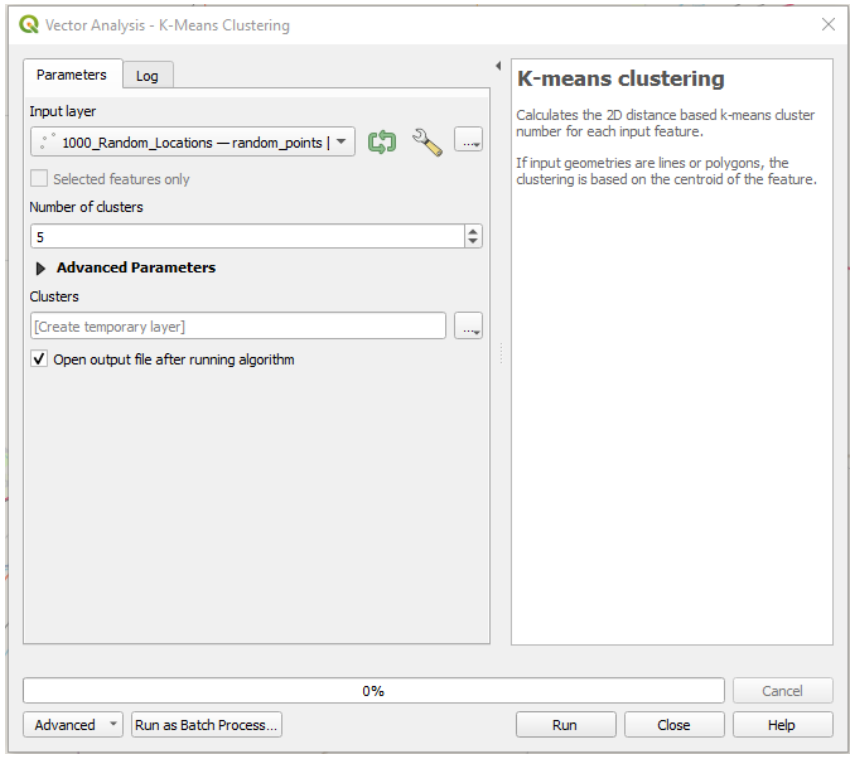
- Results:
  - Not really what we wanted.
  - Showing the best place to put a *SINGLE* site, but one tower isn't going to cover the entire area. Starting with a first best tower location could cause us to split up the area ineffectively and lead to more towers than required.

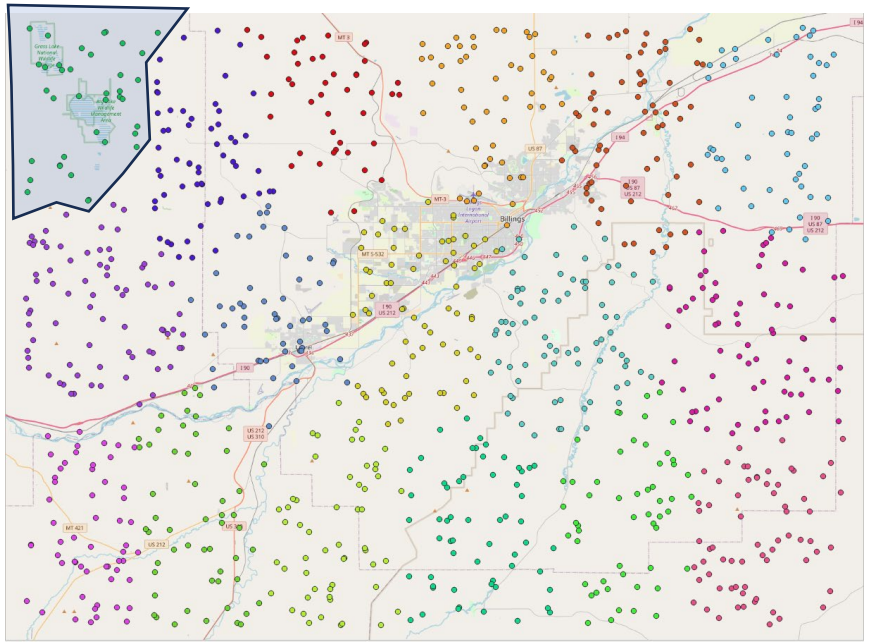


K-means clustering

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

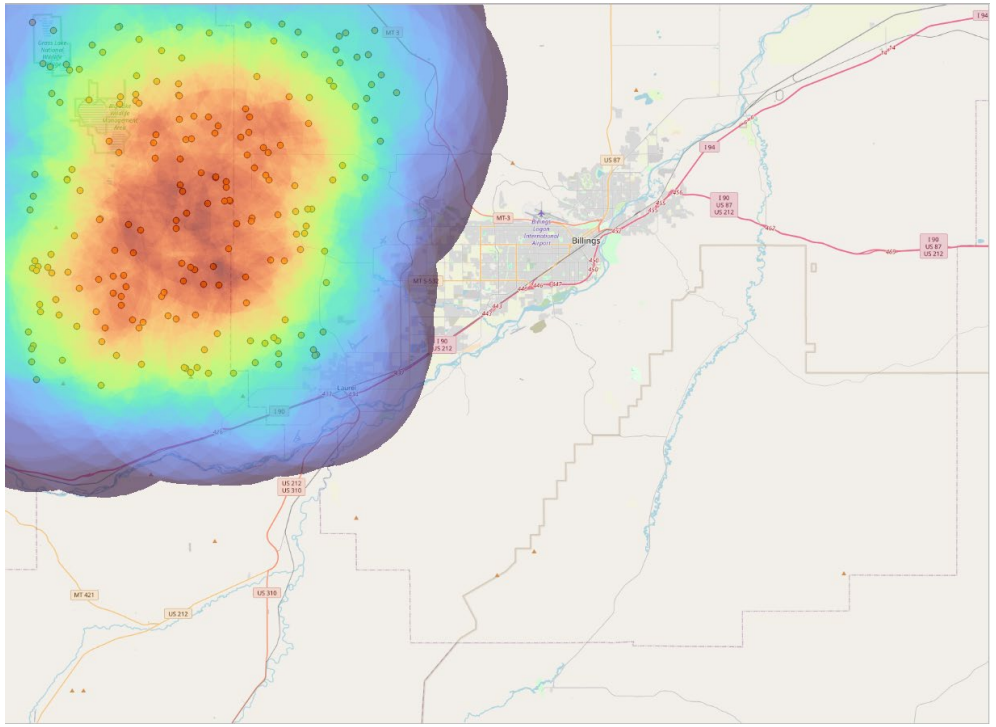


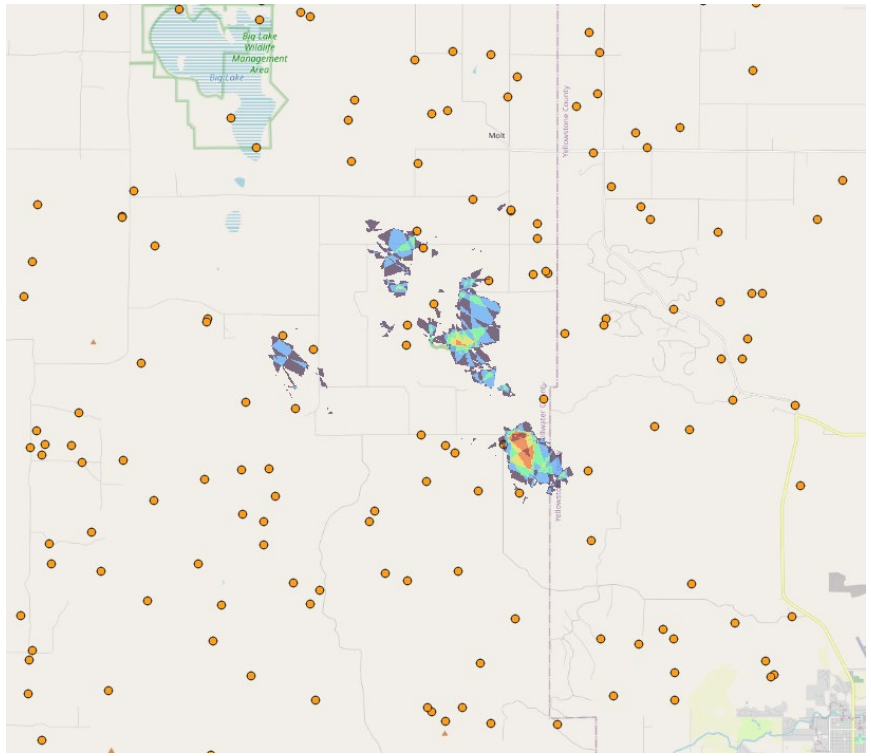




Note: 17 Clusters Shown Here…for effect.

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

COMSOF FIBER

Setics STTAR

Biarri Networks

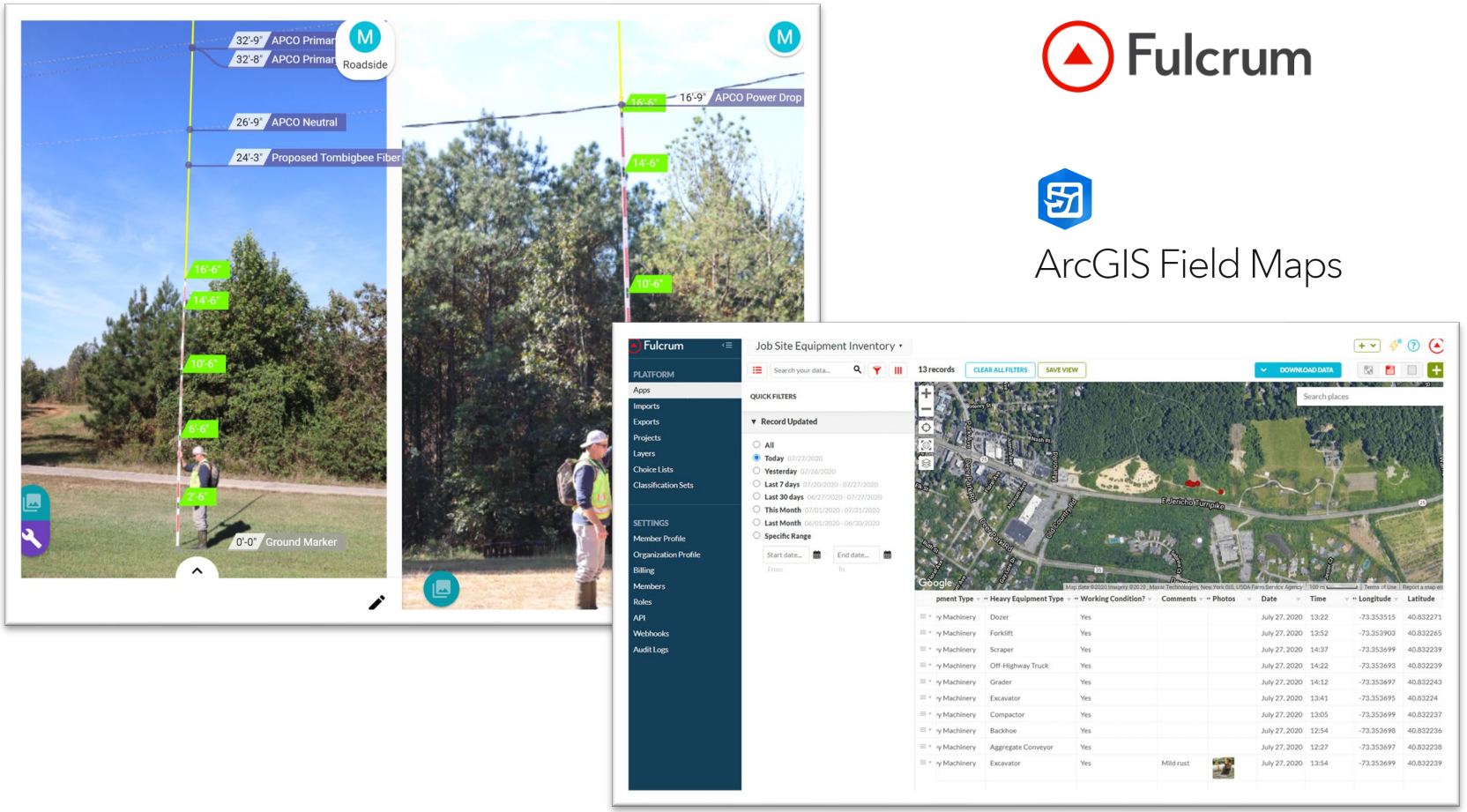
2025 WISPAMERICA BROADBAND WITHOUT BOUNDARIES

Field Collection

katapult

Fulcrum

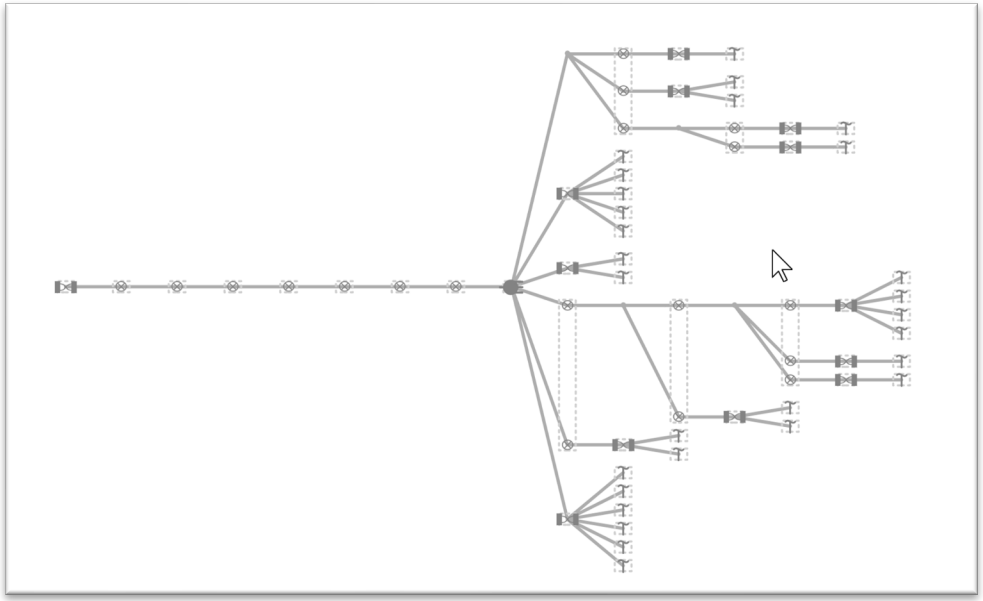
ArcGIS Field Maps



2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

Low Level Design & Plant Record Management

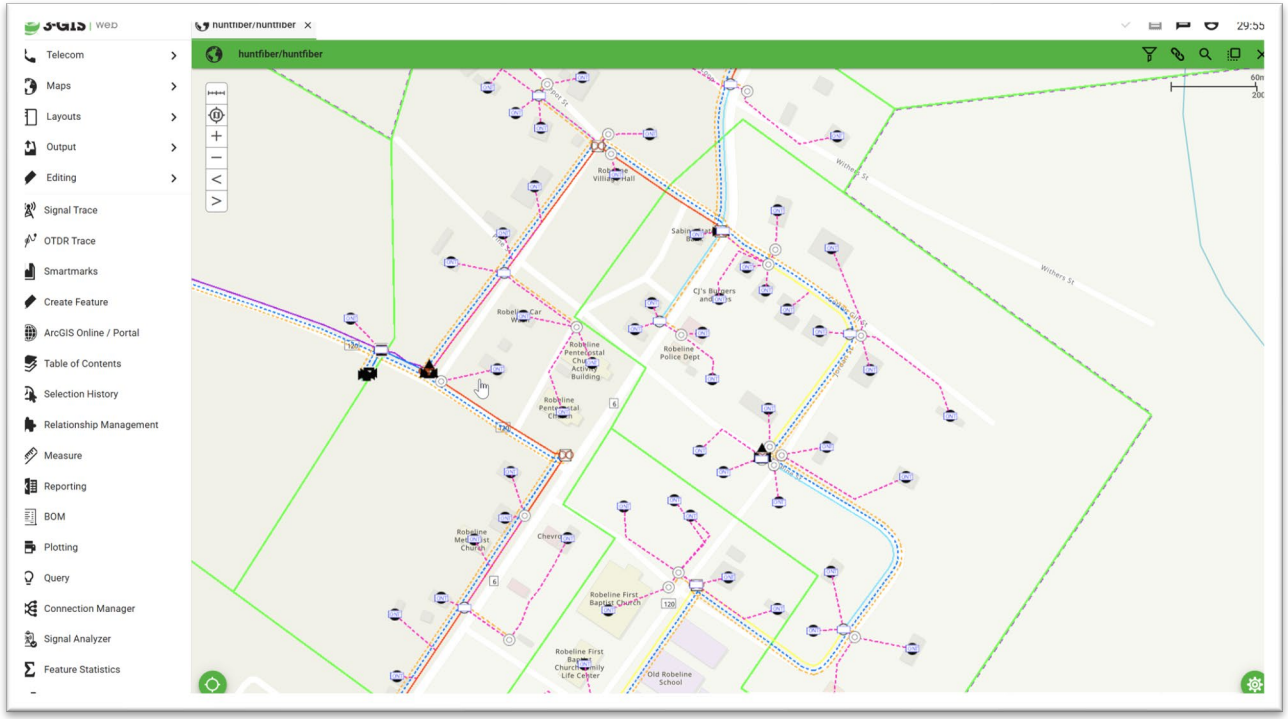
IQGeo

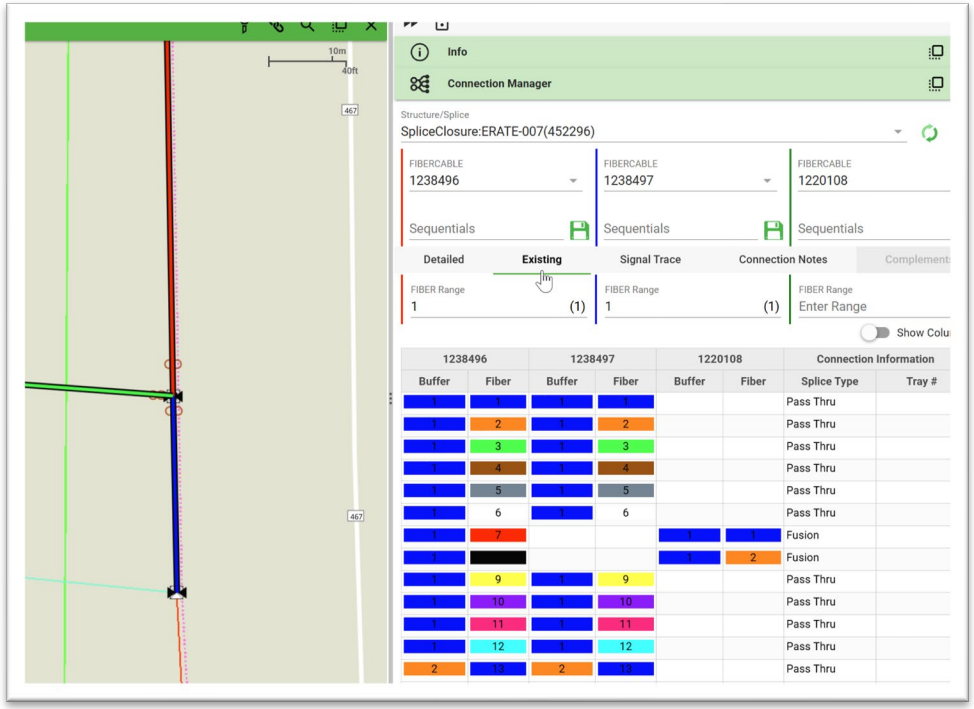


2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

Low Level Design & Plant Record Management

3-GIS BY SSP INNOVATIONS

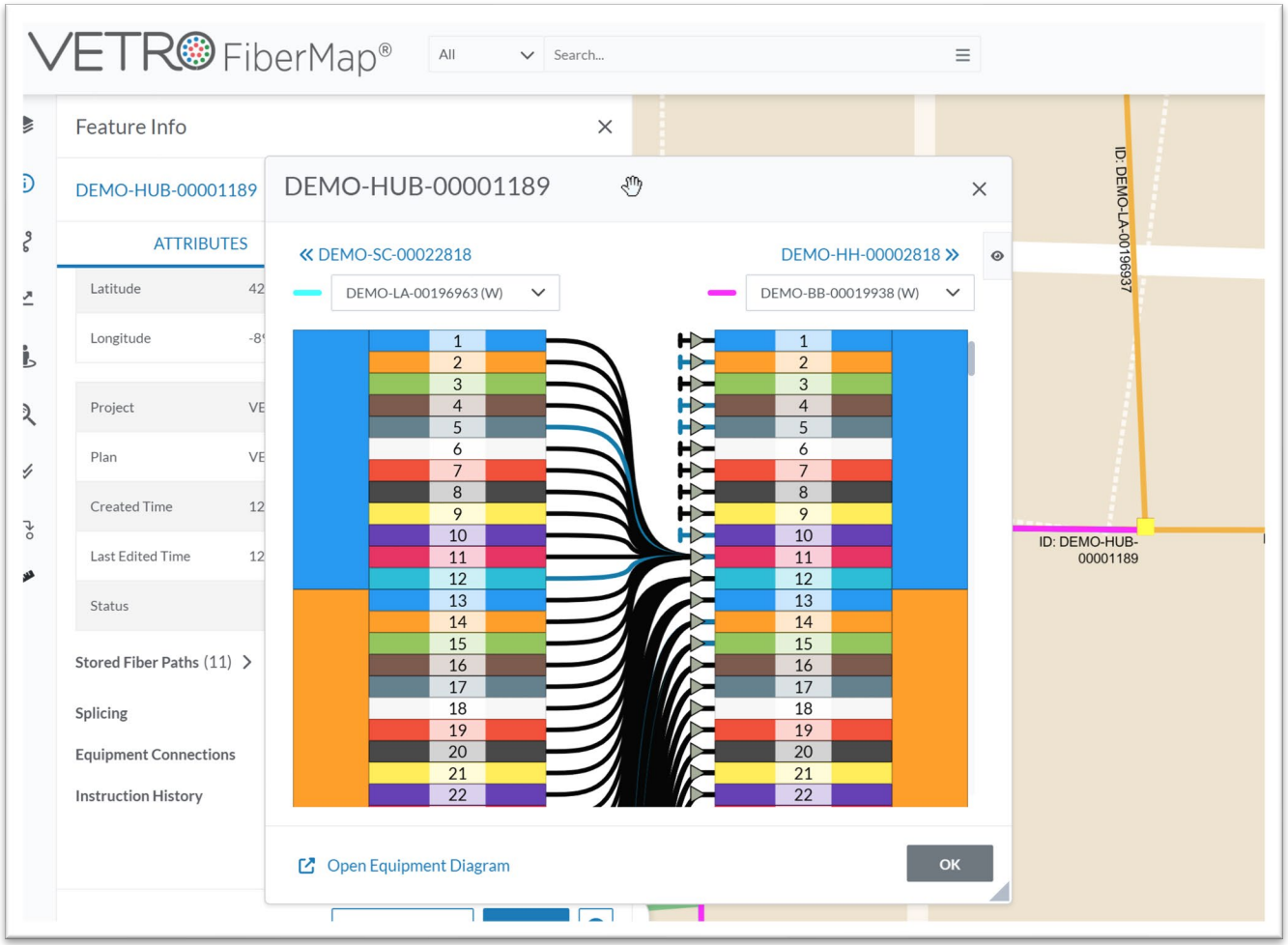




2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

Low Level Design & Plant Record Management

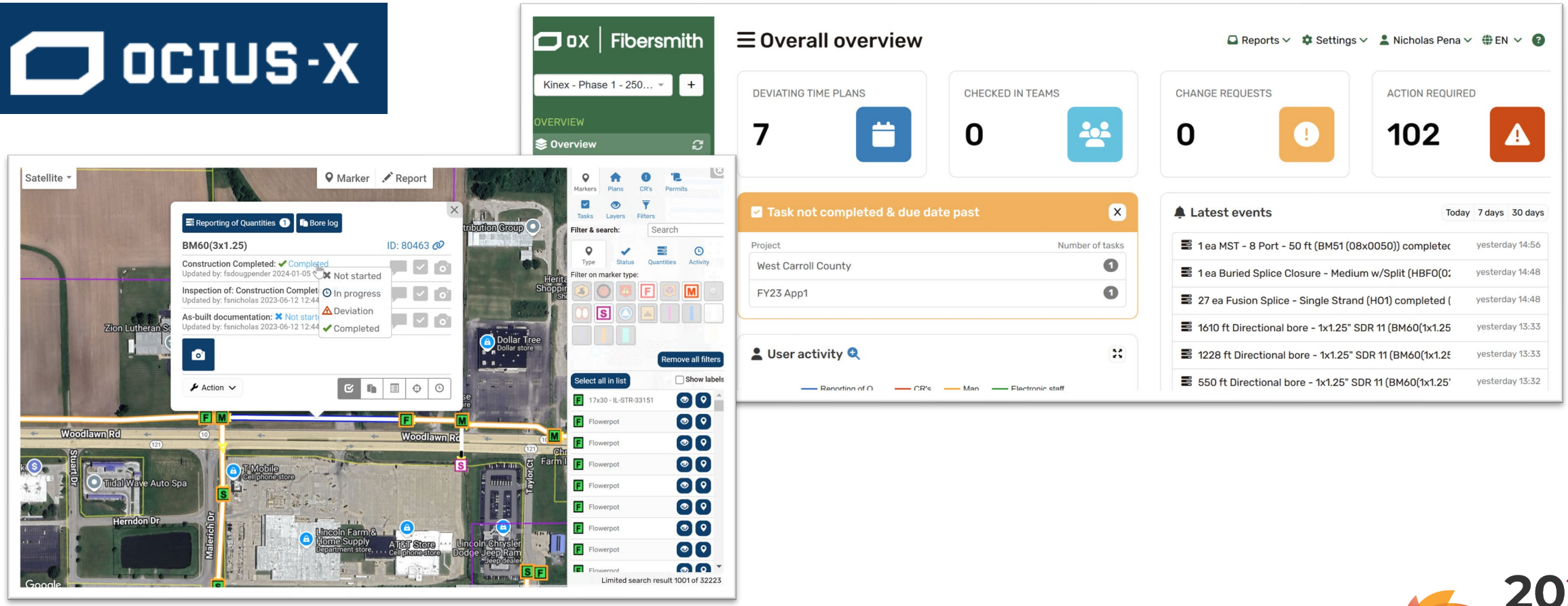
VETRO



2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

Construction Management

OCIUS-X



2025 WISPAMERICA
BROADBAND WITHOUT BOUNDARIES

3-GIS & Ocius

(Demonstration)

Final Thoughts:

Are we really tapping into the power of GIS?


THANK YOU