

# Spatial Analysis in Your Browser



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# Goals

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1. **Understand what spatial analysis is.**
2. **Understand why spatial analysis is a unique characteristics of GIS and why it is powerful in education and in greater society.**
3. **Build skills in spatial analysis using ArcGIS Online.**

# What is GIS I?

**1. Classical Definition: GIS is a tool that can access, integrate, and distribute layers of map information. The five parts of a GIS include hardware, software, data, procedures, and people.**

**2. A more Modern Definition (?): GIS lets us visualize, question, analyze, interpret, and understand data in new ways. This can reveal relationships, patterns, and trends.**

## What is spatial thinking and analysis?

### My working definition of spatial thinking:

“Identifying, analyzing, and understanding the location, scale, patterns, and trends of the geographic and temporal relationships among data, phenomena, and issues.”

**Esri Definition of Spatial Analysis:** “The process of examining the locations, attributes, and relationships of features in spatial data through overlay and other analytical techniques in order to address a question or gain useful knowledge. Spatial analysis extracts or creates new information from spatial data.

Or: It is how we understand our world — mapping where things are, how they relate, what it all means, and what actions to take.

# Components of Spatial Analysis

- Understanding where.
- Measuring size, shape, distribution
- Determining how places are related
- Finding the best locations and paths
- Detecting and quantifying patterns
- Making predictions



<http://www.esri.com/products/technology-topics/spatial-analysis>

[https://dl.dropboxusercontent.com/u/91042629/The\\_Language\\_of\\_Spatial\\_Analysis\\_2013.pdf](https://dl.dropboxusercontent.com/u/91042629/The_Language_of_Spatial_Analysis_2013.pdf)

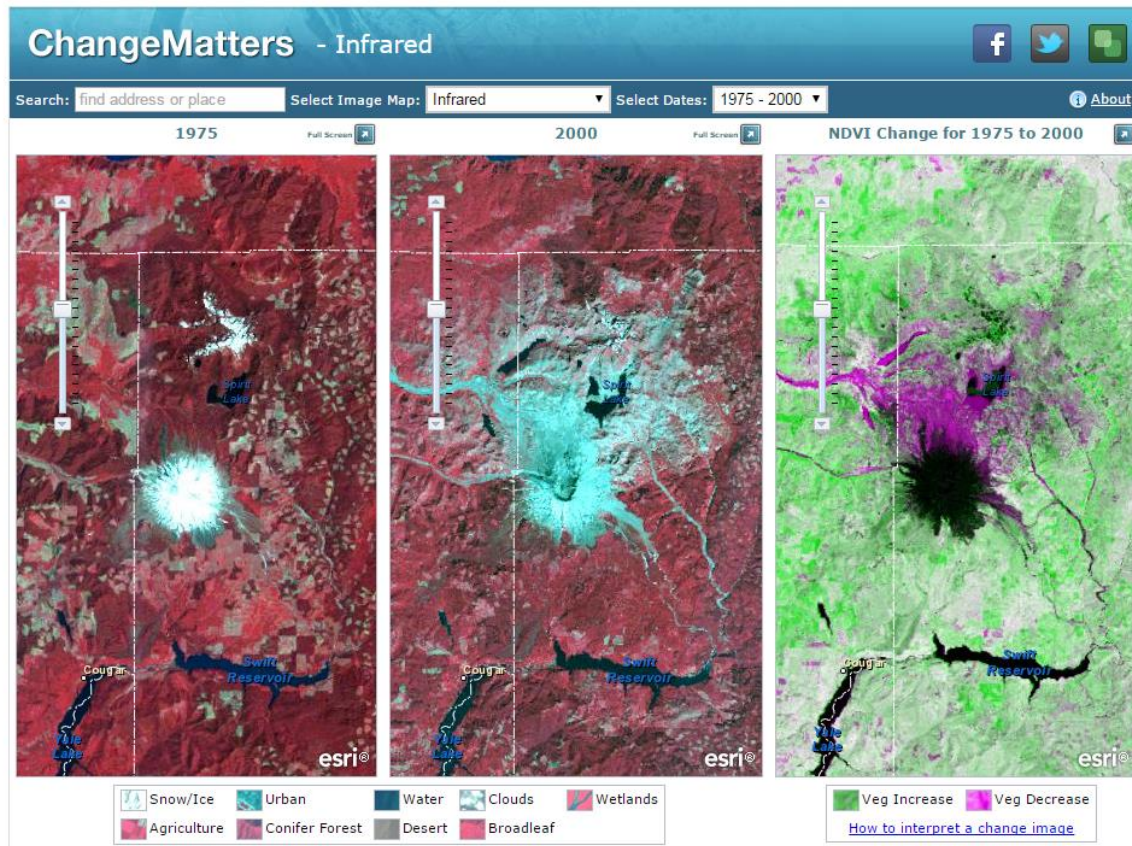
# Is this spatial analysis?

## ChangeMatters Viewer

Pan and zoom around the maps to understand earth changes that have happened over time. Advanced change detection tools are also available by clicking any full screen button.

[Instructions](#)

[View larger](#)



# You need data and tools to do spatial analysis!

## Finding and Using Spatial Data

### Old Paradigm

--Download data → Unzip → Format → Project → Tabular Manipulation → Use.

### New Paradigm

--Access data in cloud → Use.

We are not *quite* to the point of fully using the new paradigm ... yet.

## Thus, best practice today is still the hybrid model:

1. Start with ArcGIS Online to search for data.
2. Search local, state, national, international data depositories and portals.

### Examples:

Local: Boulder County CO, Los Angeles County CA

State: [www.tnris.org](http://www.tnris.org) (Texas), CASIL (California), RIGIS (RI)

National: USGS, NASA, Census Bureau, NOAA, EPA, US DOT, USFWS, BLM, USFS, FAA, National Atlas, LINZ (New Zealand), IBGE (Brazil), OS (UK)

International: WRI, WWF, UNEP, World Bank, Natural Earth Data



# What kinds of data can you add to ArcGIS Online?

Data Type	Open in ArcGIS Online	Open in ArcGIS Desktop
Map Notes	X	
Tables (CSV)	X	X
Zipped Shapefiles	X	X Unzip first
Zipped other data	X after unzipping and serving	X after unzipping
Images (JPG, PNG, TIF)	X	X
Feature services	X	X
Layer package, map package		X

# Data Types and Sources

- 1) **Vector:** Shapefiles, geodatabases, feature services, other vector formats.
- 2) **Raster:** ArcGrids, GeoTiffs and other images, Tiled image services.
- 3) **Tabular:** Excel tables, CSVs, TXT files, other formats.
- 4) **Ground images:** Wikipedia and other creative commons sources.

# Data Sources and Issues (privacy, crowdsourcing, cloud vs. desktop, copyright, and how to use).

- *The GIS Guide to Public Domain Data*, by Joseph Kerski and Jill Clark, Esri Press
- <http://spatialreserves.wordpress.com>



The image is a screenshot of the 'Spatial Reserves' website. The page title is 'Spatial Reserves' with the subtitle 'A guide to public domain spatial data'. The main content is a blog post titled 'Listing of Free GIS Data Sources from Robin Wilson' dated November 10, 2013, by Joseph Kerski. The post discusses the history of GIS data sources and the utility of crowdsourcing tools. It includes a link to the resource 'Free GIS Data' and a screenshot of the website's interface. The website interface shows a navigation menu, a search bar, and social media links for RSS and Twitter. The 'Recent Posts' section lists several articles, including 'The secret lives of phones: someone, somewhere knows where you are' and 'Digital Preservation and Formats from the US Library of Congress'. The 'Recent Comments' section shows a comment from 'Digital'.

# 10 Spatial Analysis Exercises in the Public Domain Data Book

## Exercises for GIS Guide to Public Domain Data book

These 10 exercises for the GIS Guide to Public Domain Data book build skills in discovering, assessing, formatting, and using spatial data in a GIS environment, as well as analysis to make real-world decisions with those data. For more information, see <http://spatialreserves.wordpress.com>

Switch to  
builder mode

A story map



### Exercise 3

Siting a fire tower  
in Loess Hills,  
Nebraska



Exercise 3: Siting a  
fire tower in the  
Loess Hills of  
Nebraska, USA

In Exercise 3, you determine the optimal site for a fire tower in the Loess Hills of Nebraska, USA, by examining elevation, slope, aspect, land cover, and distance to streams using data from the USGS and a data conversion program. *The GIS Guide to Public Domain Data*



Exercise 1: Assessing the impacts of potential



Exercise 2: Siting a high-speed Internet cafe in



Exercise 3: Siting a fire tower in the Loess Hills



Exercise 4: Analyzing floods and floodplains



Exercise 5: Assessing potential hurricane



Exercise 6: Analyzing land use and



Exercise 7: Creating a map for an ecotourism



Exercise 8: Citizen Science invasive species

# Finding and using data on ArcGIS Online

- Often helpful to narrow the search, such as:  
quotes “riparian zones”
- Keywords:  
<search string> owner:jjkerski or tags: “bike  
lanes”
- Use Boolean operators:  
“recent fires” OR fires  
owner:esri AND tags:streets
- search in your specific map extent or in your  
organization

More tips on: Using Search – Fields:

<http://resources.arcgis.com/en/help/arcgisonline/index.html#/010q0000000n000000>

## ◆ Accessing and using data portals

# Access Boulder County GIS Portal

The screenshot shows the Boulder County GIS Portal website. The browser address bar displays [www.bouldercounty.org/gov/data/pages/gisdldata.aspx](http://www.bouldercounty.org/gov/data/pages/gisdldata.aspx). The page header includes the Boulder County logo and navigation links: 2013 Flood | Home | Contact | Departments | Government | Elections | Jobs & Volunteer. A navigation bar contains links for Families & Adults, Open Space & Recreation, Property & Land, Roads & Transportation, Environment, Safety & Law, and Licenses, Permits & Records. A left sidebar lists various government categories, with 'Maps & Data' expanded to show 'GIS Downloadable Data'. The main content area is titled 'Geographic Information Systems (GIS) Downloadable Data' and includes instructions on how to access the data using ArcGIS Explorer or Google Earth. Below the instructions is a table of downloadable files.

	Metadata (HTM)	Google Earth (KMZ)	ESRI Layer Package (LPK)	ESRI Shapefiles (ZIP)
<b>Buildings</b>				
Building Footprints	<a href="#">HTM (13 KB)</a>	<a href="#">KMZ (6.5 MB)</a>	<a href="#">LPK (3.2 MB)</a>	<a href="#">ZIP (4.6 MB)</a>
<b>Comprehensive Plan</b>				
Archaeologically Sensitive Areas	<a href="#">HTM (16 KB)</a>	<a href="#">KMZ (50 KB)</a>	<a href="#">LPK (340 KB)</a>	<a href="#">ZIP (78 KB)</a>
Environmental Conservation Areas	<a href="#">HTM (53 KB)</a>	<a href="#">KMZ (176 KB)</a>	<a href="#">LPK (285 KB)</a>	<a href="#">ZIP (557 KB)</a>
Geological Hazards	<a href="#">HTM (15 KB)</a>	<a href="#">KMZ (699 KB)</a>	<a href="#">LPK (1.0 MB)</a>	<a href="#">ZIP (706 KB)</a>
Mineral Resource Areas	<a href="#">HTM (15 KB)</a>	<a href="#">KMZ (64 KB)</a>	<a href="#">LPK (134 KB)</a>	<a href="#">ZIP (66 KB)</a>
Natural Communities, Rare Plants, Riparian Corridors, Critical Wildlife Habitat	<a href="#">HTM (519 KB)</a>	<a href="#">KMZ (130 KB)</a>	<a href="#">LPK (203 KB)</a>	<a href="#">ZIP (261 KB)</a>
Significant Agricultural Land	<a href="#">HTM (17 KB)</a>	<a href="#">KMZ (150 KB)</a>	<a href="#">LPK (409 KB)</a>	<a href="#">ZIP (151 KB)</a>

At the bottom of the browser window, a download bar shows 'Floodplain (1).zip' and a 'Show all downloads...' link.



# Save data sets locally, Add to ArcGIS Online via “My Content”

The screenshot shows the ArcGIS Online 'My Content' interface. A dialog box titled 'Add Item' is open in the foreground, allowing a user to upload a file. The dialog includes the following fields and options:

- Add Item** (Title)
- Add an item from your computer or reference an item on the Web.** (Instruction)
- The item is:** On my computer (Dropdown menu)
- File:** Choose File Floodplain.zip
- Supported Items** (Link)
- Contents:** Shapefile (Dropdown menu)
- Publish this file as a feature service** (Adds a feature service item with the same name.)
- Title:** Floodplain
- Tags:** Boulder x County x floodplains x
- ADD ITEM** (Button)
- CANCEL** (Button)

The background shows a list of content items with columns for Title, Type, Modified, and Shared. A file named 'Floodplain (1).zip' is visible in the download bar at the bottom.

# Using ArcGIS Online Analytical Tools

- ◆ **ArcGIS Online is a cloud-based GIS, not just an online set of web maps. Hence, you can use it for conducting spatial analysis.**
- ◆ **The spatial analysis capabilities of ArcGIS Desktop still far exceed that of ArcGIS Online, given its 30 year head start, but more analytical capabilities are being added quarterly to ArcGIS Online.**
- ◆ **The spatial analytical tools in ArcGIS Online are easy to use. They are accessed from the arrows to the right of specific layers. Whether you see the analytical tools depends on (1) if you are using an ArcGIS Online organizational subscription, and (2) how the data are served in ArcGIS Online (i.e. ideally, as services)**



# Activity 1: Cholera Analysis, London 1854

- ◆ **Using Analytical capabilities in ArcGIS Online**
- ◆ **Problem Statement: What percentage of the cholera outbreak cases are associated with the Broad Street and other pumps?**

**You will consider public water pumps, and locations with cholera cases in your assessment.**

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**Contents**

- Public water pumps
- Locations with 1 or more cholera deaths
- Dr. Snow's map of cholera deaths
- Topographic



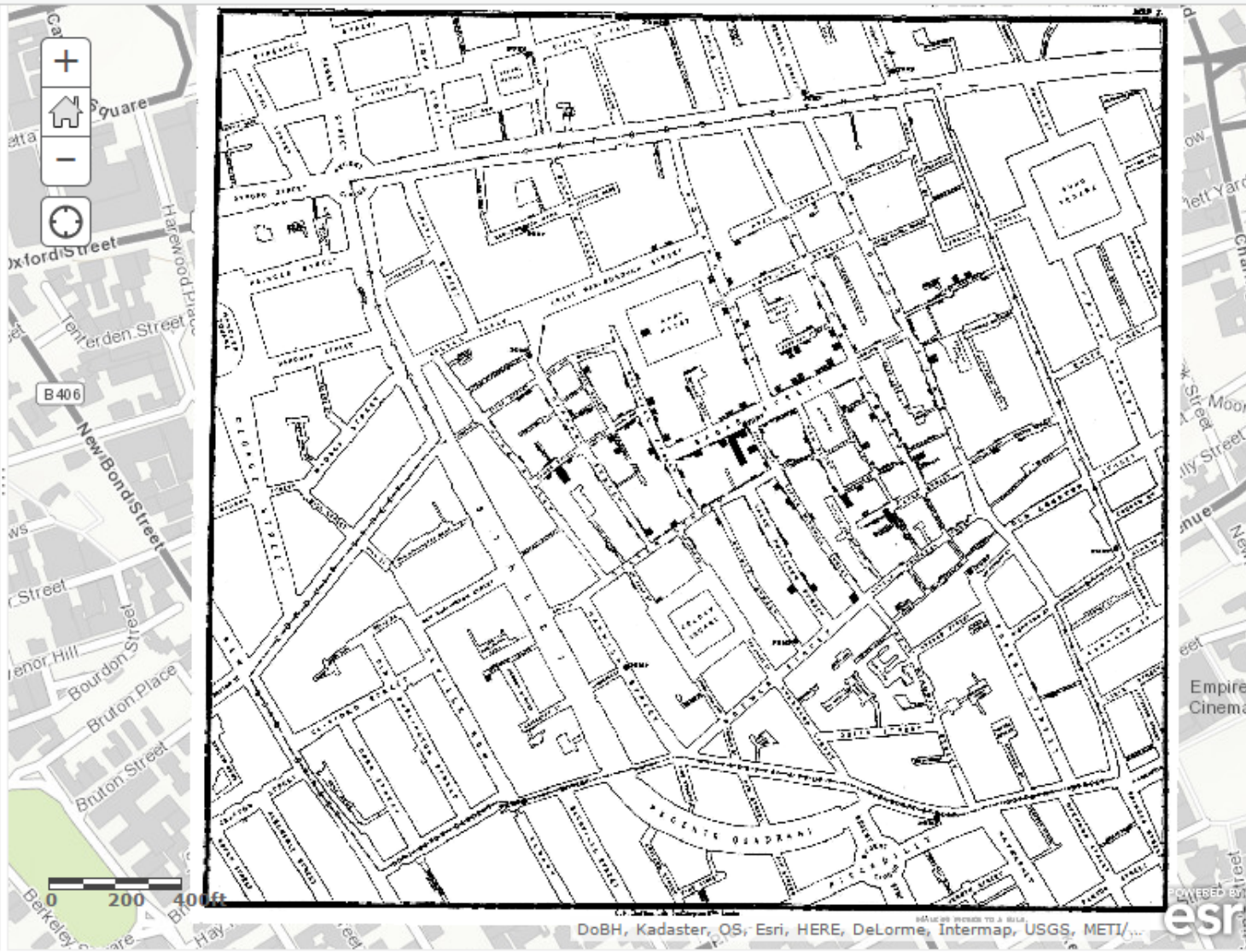
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- Contents**
- Public water pumps
  - Locations with 1 or more cholera deaths
  - Dr. Snow's map of cholera deaths
  - Topographic

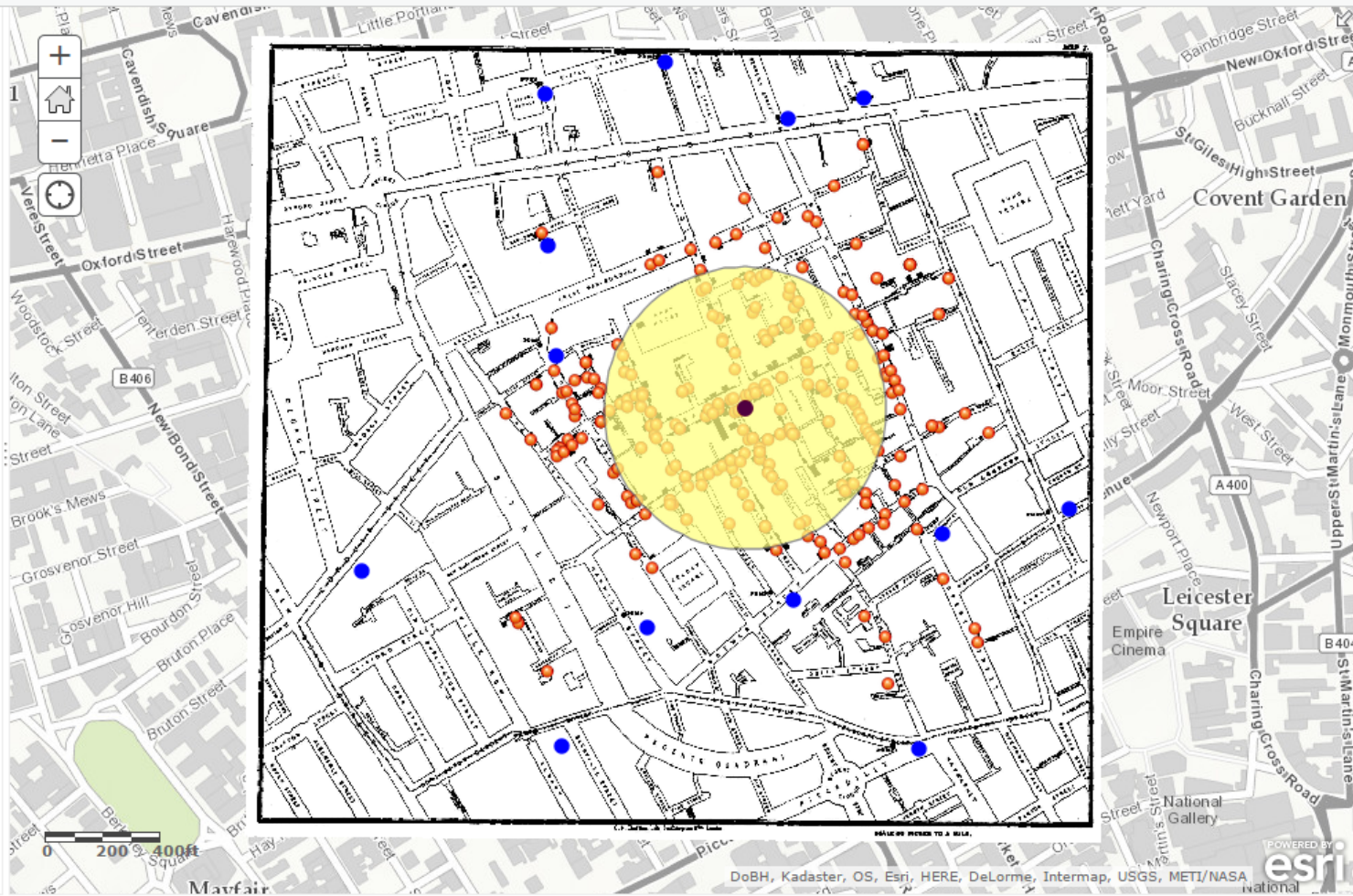


**14 water pumps**  
**322 data points**  
**578 cholera cases**

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- Contents**
- Aggregation of Locations with 1 or more cholera deaths to Buffer 500ft Public water pumps JJK
  - Public water pumps
  - Locations with 1 or more cholera deaths
  - Map - temp
  - Dr. Snow's map of cholera deaths
  - Topographic

**201 of 322 data points are within 500 feet of Broad Street pump**



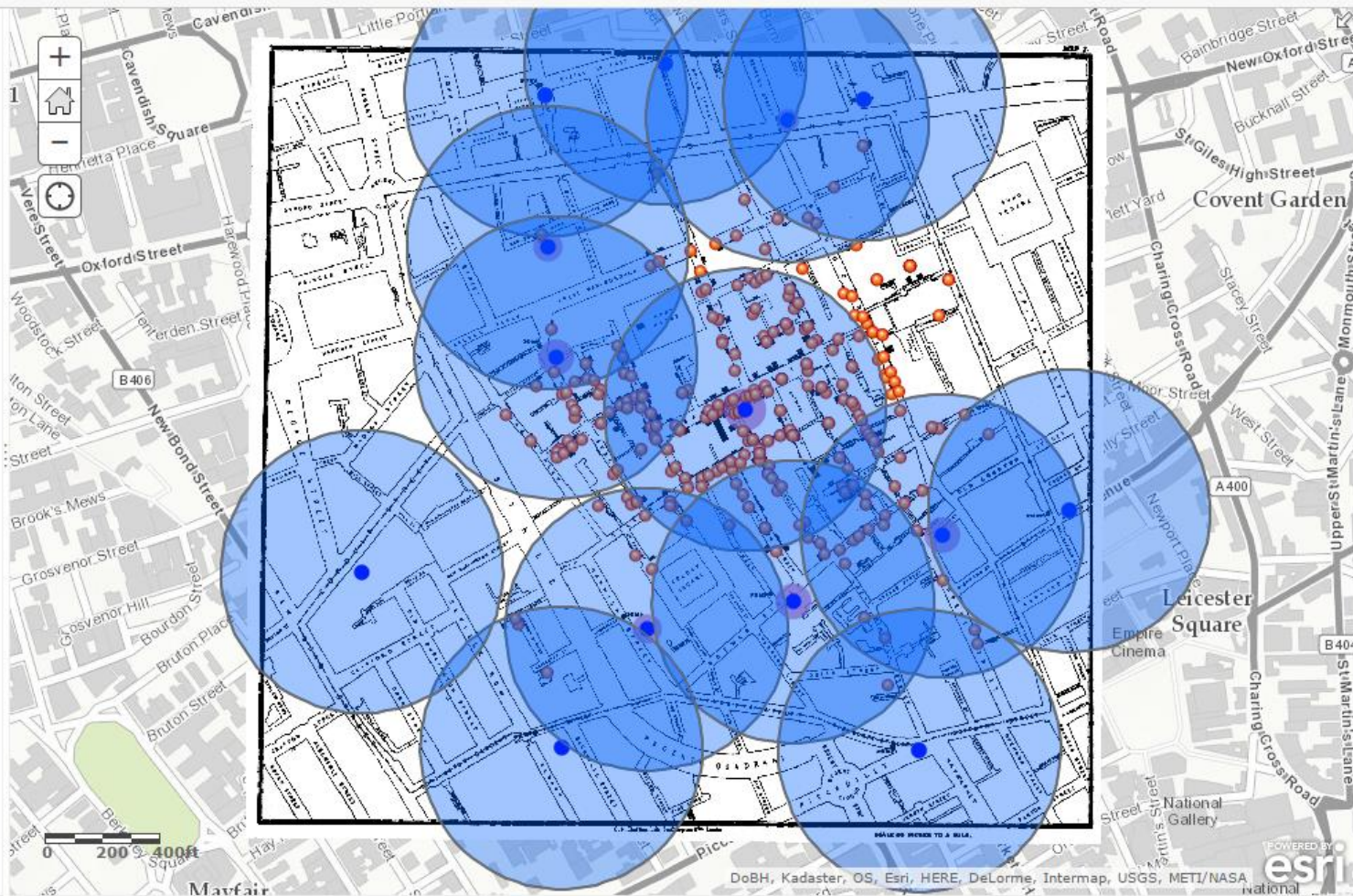


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[Save](#)
[Share](#)
[Print](#)
[Directions](#)
[Measure](#)
[Bookmarks](#)

[i](#)
[Layers](#)
[Menu](#)

Contents

- Buffer ALL public water pumps
- Public water pumps
- Locations with 1 or more cholera deaths
- Aggregation of Locations with 1 or more cholera deaths to Buffer of Public water pumps 2
- Dr. Snow's map of cholera deaths
- Topographic



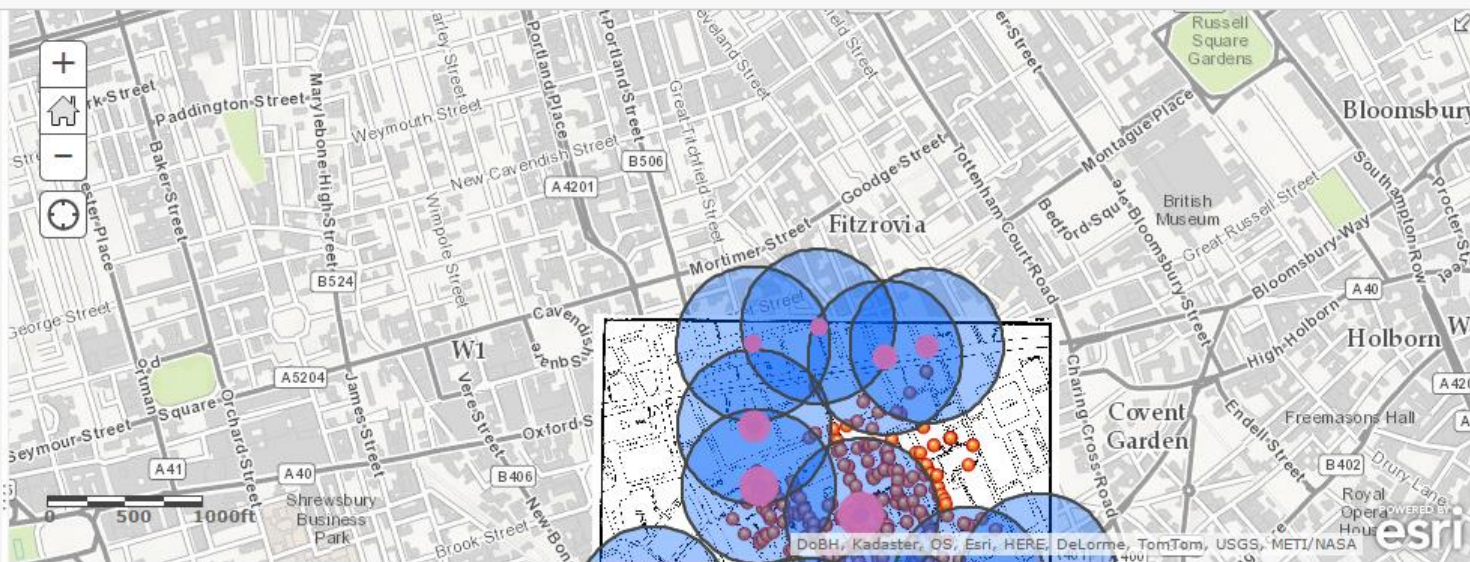
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- Contents
- Aggregation points within ALL buffers CASES
  - Aggregation of points within ALL buffers
  - Buffer ALL public water pumps
  - Public water pumps
  - Locations with 1 or more cholera deaths
  - Dr. Snow's map of cholera deaths
  - Topographic



**395 of 578 cases within 500' of Broad Street pump.**

**117 cases within 500' of Carnaby Street pump.**

**75 cases within 500' of Rupert Street pump.**

Aggregation points within ALL buffers CASES (14 features, 0 selected)

Count of Points_1	Sum Num_Cases	Point Count	OBJECTID	AREA	PERIMETER	PUMPS	PUMPS ID	RECNO	PUMP
201	395.0000	201	7	0.0000	0.0000	7.0000	7.0000	7	1
66	117.0000	66	6	0.0000	0.0000	6.0000	6.0000	6	1
41	75.0000	45	10	0.0000	0.0000	10.0000	10.0000	10	1
43	70.0000	46	9	0.0000	0.0000	9.0000	9.0000	9	1
15	26.0000	15	5	0.0000	0.0000	5.0000	5.0000	5	1
16	22.0000	19	8	0.0000	0.0000	8.0000	8.0000	8	1

# Activity 2: Boulder County Flood Analysis

- ◆ **Using Analytical capabilities in ArcGIS Online**

- ◆ **Problem Statement: Because of recent devastating floods that occurred in September 2013, the Boulder County Office of Emergency Preparedness, hearing of your excellent GIS skills, has asked you to prepare an assessment of the most vulnerable lands in the county to future flooding and the people on those lands.**

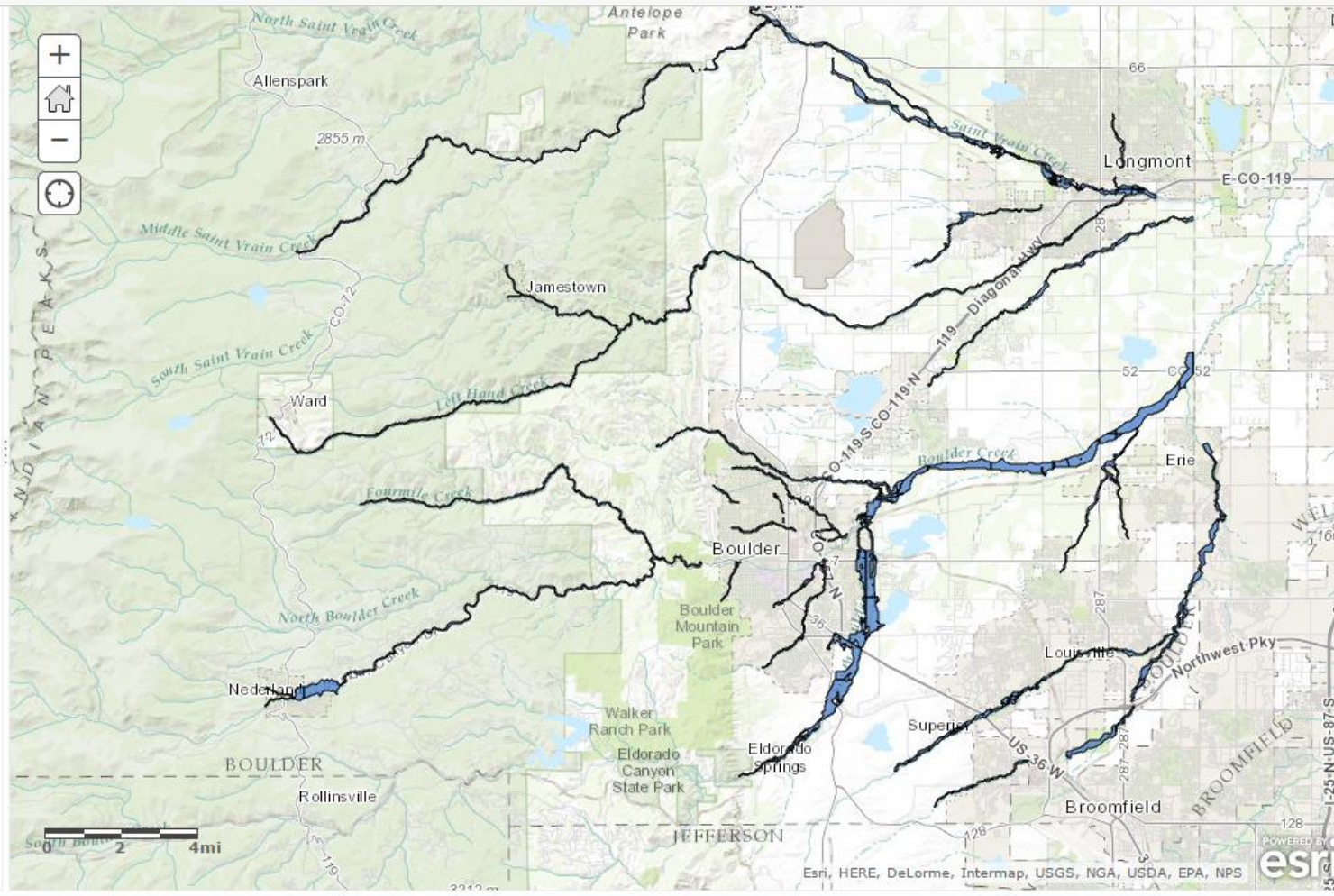
**You will consider floodplains, geologic hazards, land cover, soils, and demographics in your assessment.**



# Analysis Workflow

- ◆ 1. Filter Floodplains layer to only consider the true floodplains. Filter geologic hazards layer to only consider Major Hazards.
- ◆ 2. Proximity → Buffer floodplains by 200 meters.
- ◆ 3. Dissolve the buffer's internal polygons.
- ◆ 4. Manage Data → Overlay → Intersect the dissolved floodplain buffers with Major Geologic Hazards.
- ◆ 5. Sort on Analysis Area and only consider the largest polygons.
- ◆ 6. Data Enrichment, with Group Quarters and % Wetlands.

- Contents**
- Enriched Intersect Floodplains
  - Major Geologic Hazards
  - Intersect Floodplains Major Geologic Hazards
  - Floodplains 200m Buffer Dissolve
  - Floodplains 200m Buffer
  - Geologic Hazards Layer
  - Floodplains Layer
  - Topographic



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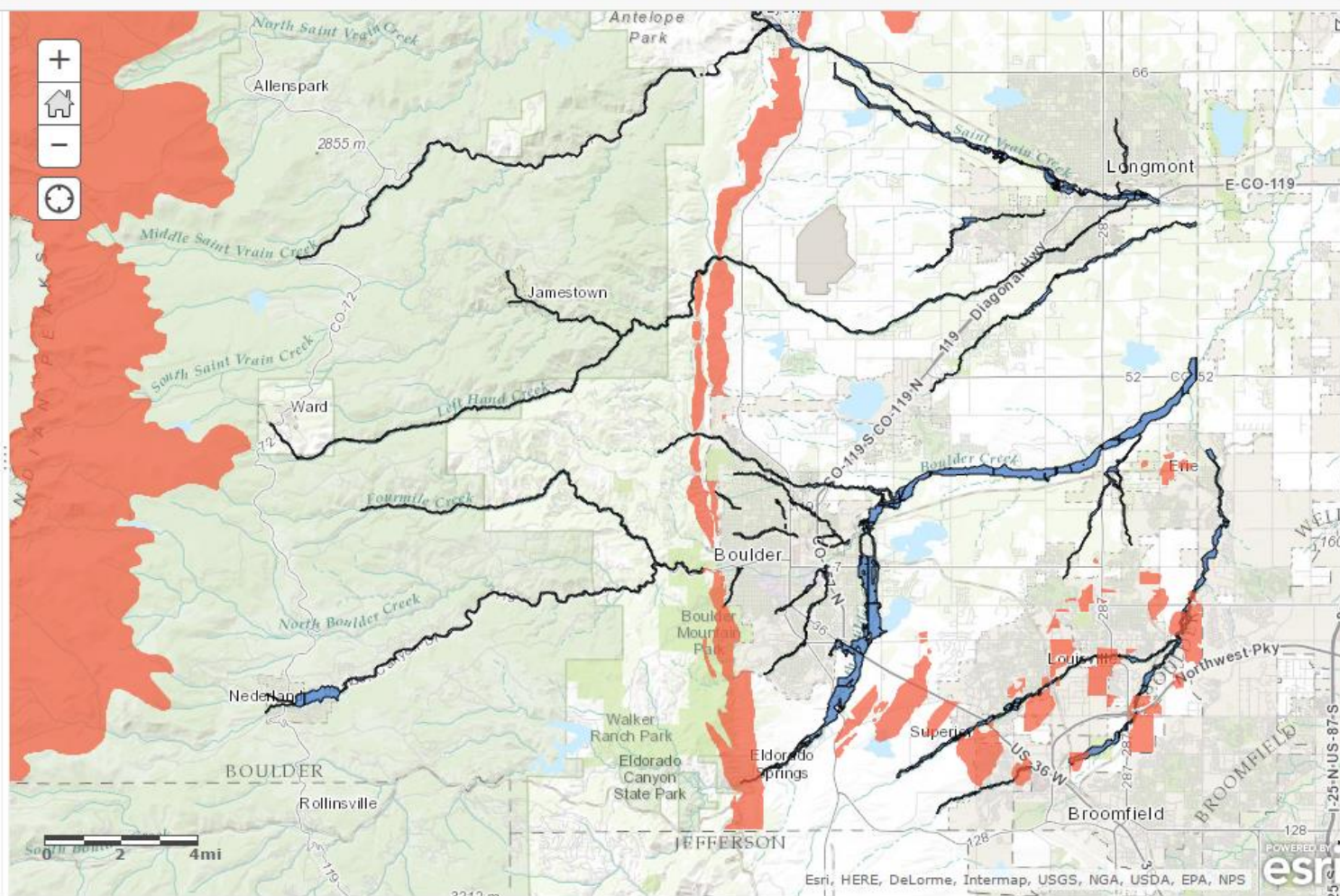




- Home
- Gallery
- Scene
- Groups
- My Content
- My Organization

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- Floodplains 200m Buffer Dissolve
- Floodplains 200m Buffer ▾
- Geologic Hazards Layer ▾
- Floodplains Layer ▾
- Topographic ▾



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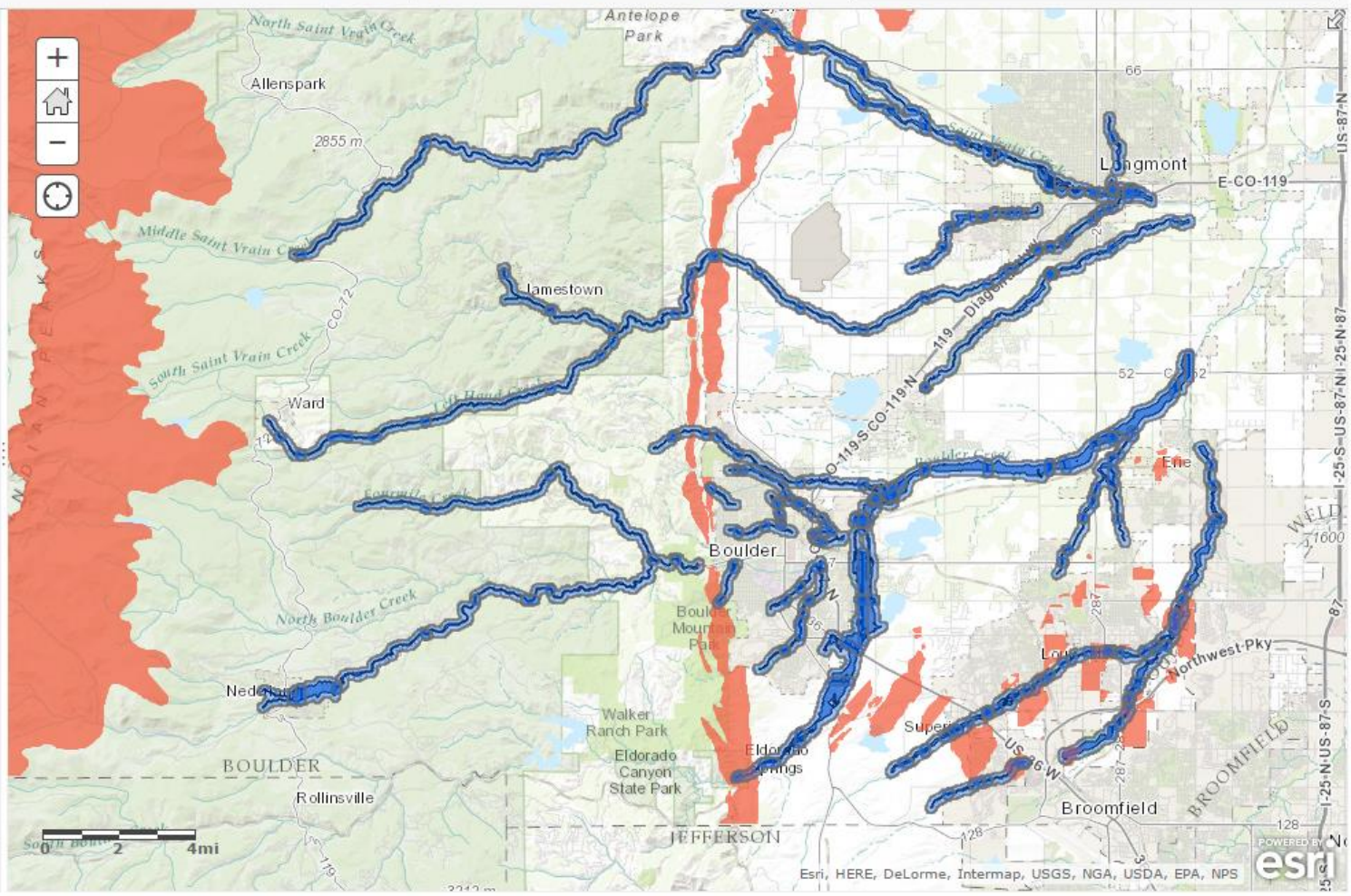
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Contents

- Enriched Intersect Floodplains
- Major Geologic Hazards
- Intersect Floodplains Major Geologic Hazards
- Floodplains 200m Buffer Dissolve
- Floodplains 200m Buffer
- Geologic Hazards Layer
- Floodplains Layer
- Topographic

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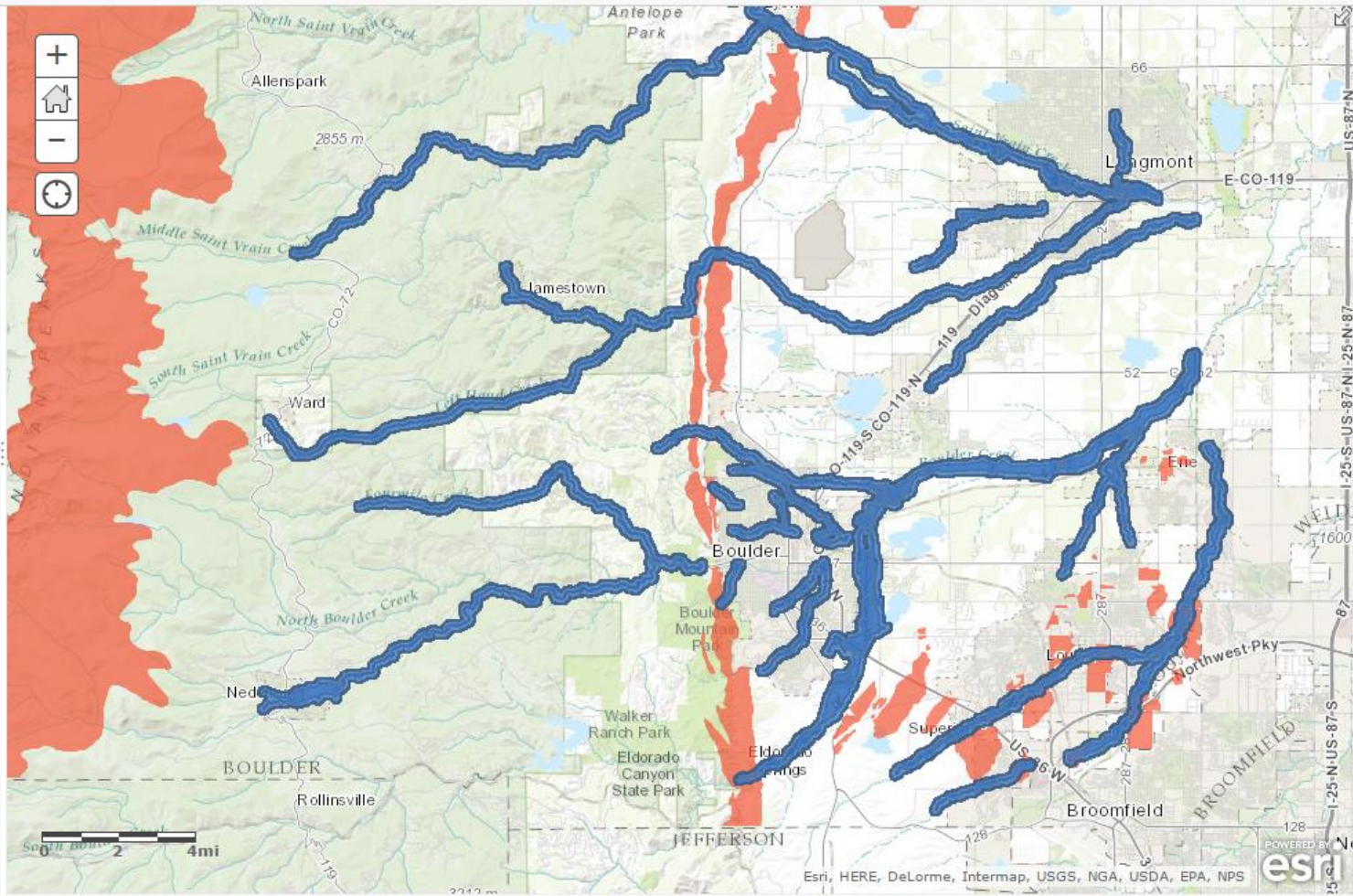






Contents




- Enriched Intersect Floodplains Major Geologic Hazards
- Intersect Floodplains Major Geologic Hazards
- Floodplains 200m Buffer Dissolve
- Floodplains 200m Buffer
- Geologic Hazards Layer
- Floodplains Layer
- Topographic



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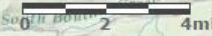


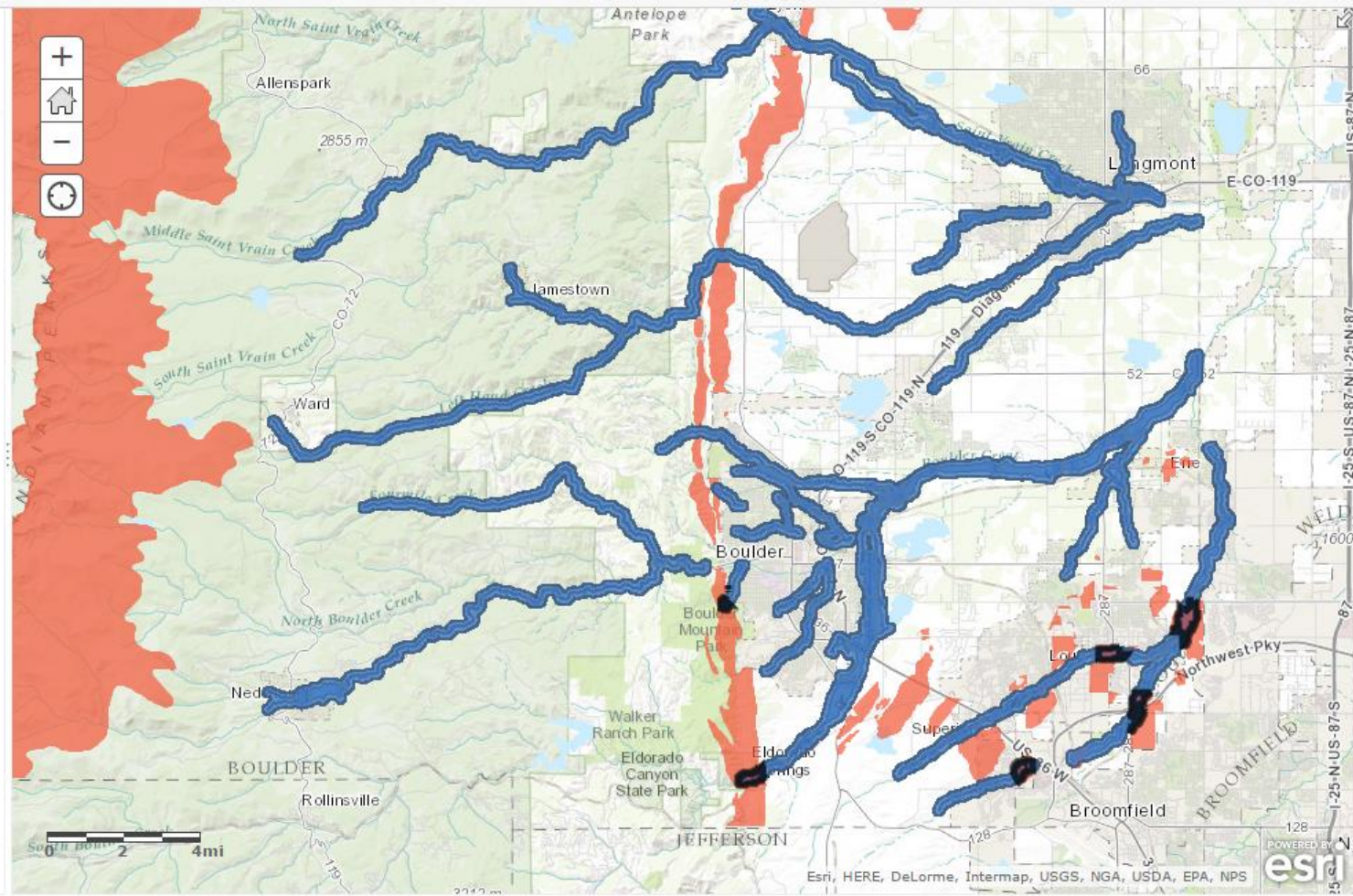
 Details
  Add ▾
  Basemap
  Save ▾
  Share
  Print
  Directions
  Measure
  Bookmarks
 



Contents

- Enriched Intersect Floodplains Major Geologic Hazards
- Intersect Floodplains Major Geologic Hazards
- Floodplains 200m Buffer Dissolve
- Floodplains 200m Buffer
- Geologic Hazards Layer
- Floodplains Layer
- Topographic


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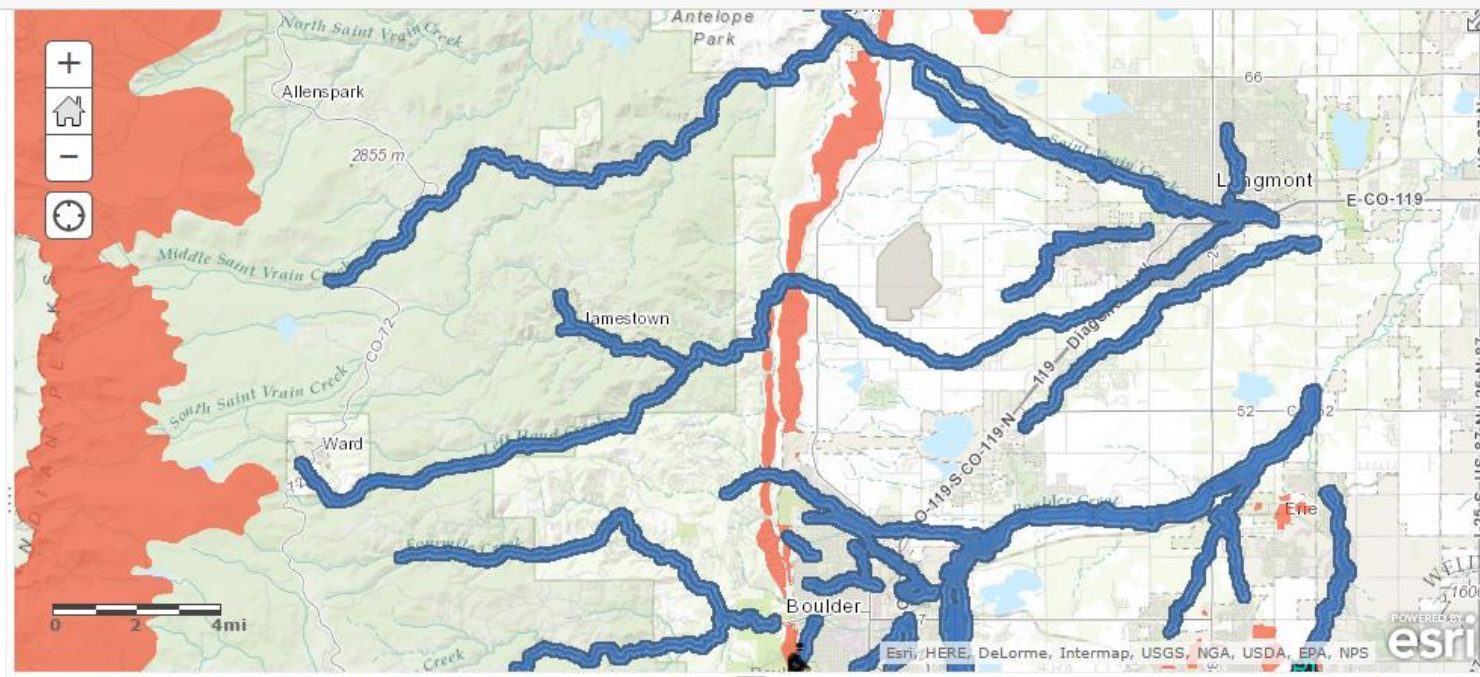
 Details
  Add ▾
  Basemap

 Save ▾
  Share
  Print
  Directions
  Measure
  Bookmarks
 



- Contents
- Enriched Intersect Floodplains Major Geologic Hazards
  - Intersect Floodplains Major Geologic Hazards
  - Floodplains 200m Buffer Dissolve
  - Floodplains 200m Buffer
  - Geologic Hazards Layer
  - Floodplains Layer
  - Topographic



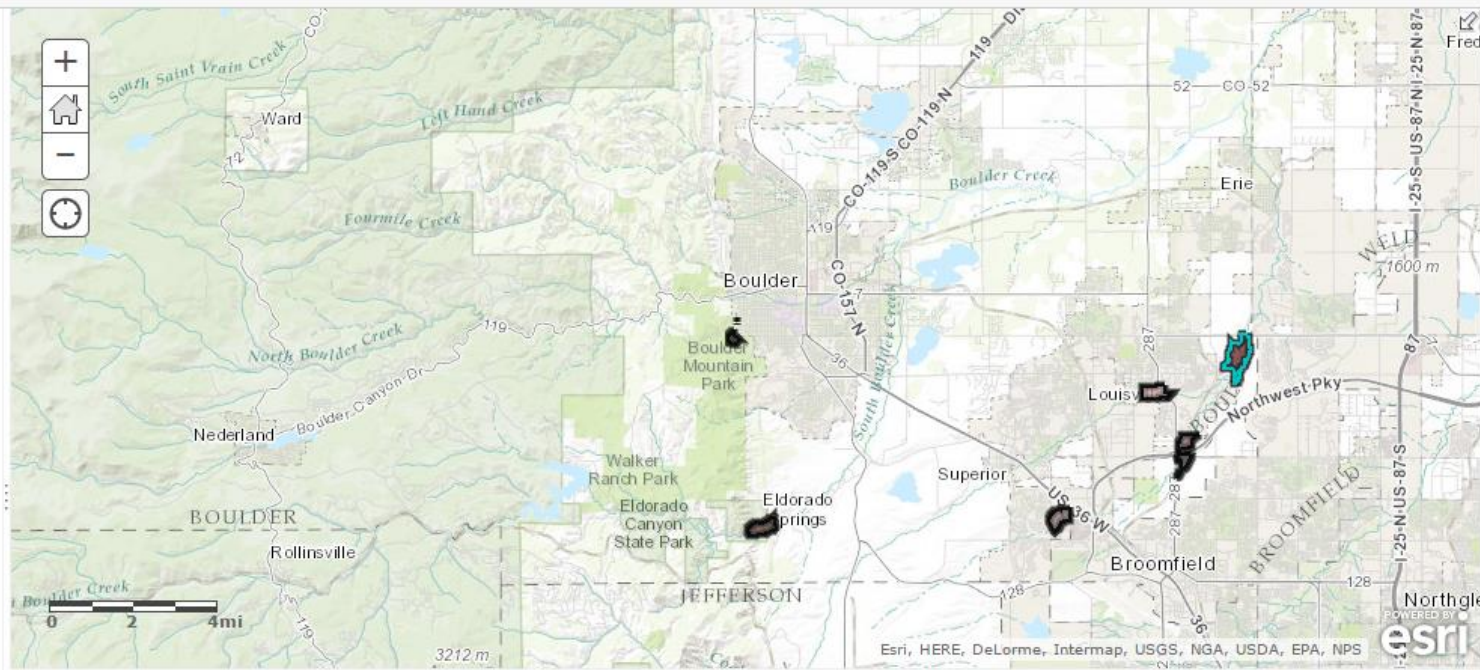
**Enriched Intersect Floodplains Major Geologic Hazards (5 features, 1 selected)** Table Options ▾

FID_FloodplainCount_	AnalysisLength	AnalysisArea	FID_Geologic_	BOCO_GEOHA	GHCA_	GHCA_ID	SHADE_	DESCRIP
1	252	592,195.33	0.96	29	25,646,647.59	197.00	1.00	Major Haz
1	252	592,195.33	0.63	175	130,365,929.94	186.00	1.00	Major Haz
1	252	592,195.33	0.51	188	22,554,106.95	245.00	1.00	Major Haz



Details
Add ▾
Basemap
Save ▾
Share
Print
Directions
Measure
Bookmarks

- Contents**
- Enriched Intersect Floodplains Major Geologic Hazards
  - Intersect Floodplains Major Geologic Hazards
  - Floodplains 200m Buffer Dissolve
  - Floodplains 200m Buffer
  - Geologic Hazards Layer
  - Floodplains Layer
  - Topographic



**Enriched Intersect Floodplains Major Geologic Hazards (5 features, 1 selected)** Table Options ▾

ID	SHADE_	DESCRIPTIO	ENRICH_FID	ID	sourceCountry	HasData	% Wetlands (NLCD)	2010 Population in Group Qtrs	2013 Dominant Tapestry Segment
	1.00	Major Hazard	2	1	US	1	2.74	0.00	22.00
	1.00	Major Hazard	3	2	US	1	9.73	2.00	9.00
	1.00	Major Hazard	4	3	US	1	5.00	0.00	41.00





# Activity 3: A new road through the Serengeti?

## ◆ Using Analytical capabilities in ArcGIS Online

◆ **Problem Statement:** A new road is proposed through the Serengeti to link ports on the Indian Ocean with Lake Victoria. You will use spatial analysis to examine the route of two proposed roads, assessing the impact of each on wildlife migration and on the local ecoregions, and examining alternatives to the roads themselves.

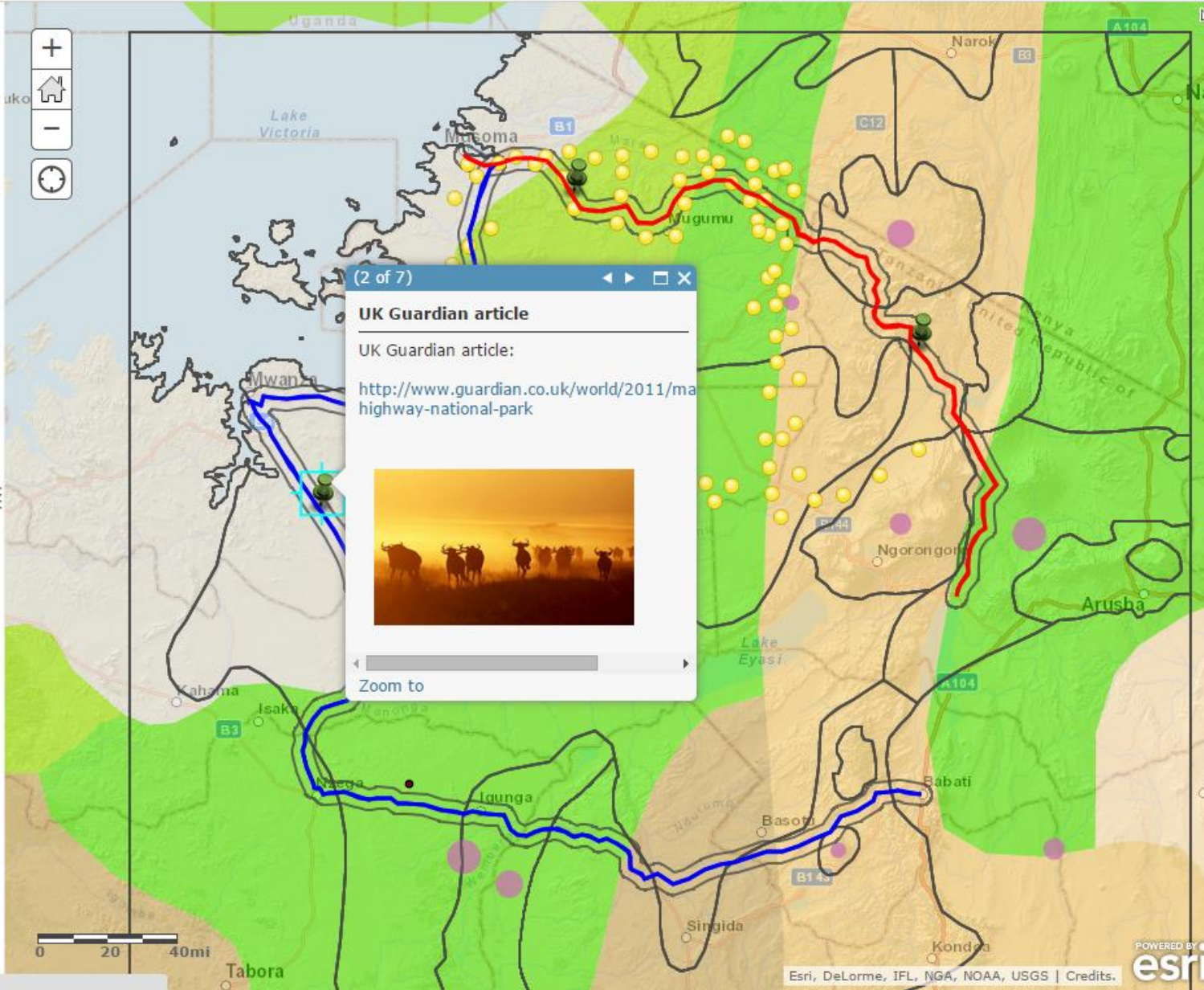
You will consider the two routes proposed, wildlife migration, ecoregion, elevation, total length. Specifically: wildlife migration within 5 km from proposed roads, length of roads within each ecoregion.

- Home
- Features
- Layers
- Gallery
- Help

- Proposed Roads in Serengeti 1
- Proposed Roads in Serengeti 2
- Information about the Proposed Roads
- Wildlife Migration Route Points
- Summarize Wildlife Migration Route Points Near Route 2
  - 8
- Summarize Wildlife Migration Route Points near Road 1
- Summarize Proposed Road 2 in Serengeti Ecoregions
  - 0
  - 1.87026985 - 1.870270
  - 1.870271 - 14.079171
  - 14.079172 - 46.299763
  - 46.299764 - 183.213635
  - 183.213636 - 512.421870
- Summarize Proposed Road 1 in Serengeti Ecoregions
- Proposed Roads in Serengeti BOTH
- Extension of the World

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(2 of 7)

**UK Guardian article**

UK Guardian article:  
<http://www.guardian.co.uk/world/2011/mar/highway-national-park>

Zoom to

# Instructional Considerations

- ◆ You can have students perform the analysis.
- Or -
- ◆ You can perform the analysis and have the students analyze the results (as I do often with the Serengeti lesson).
- Or –
- ◆ A combination of the two.
- Or –
- ◆ Teach with visual analysis of patterns, linkages, and trends, without the quantitative measures.

# Next Steps

- ◆ Access these maps in ArcGIS Online. They are all public. Go through some of these analytical steps.
- ◆ Take the Going Places with Spatial Analysis MOOC – Esri – Mar 2015.
- ◆ Examine “How to teach with the ArcGIS Platform” documents, including video on spatial analysis tools:

<http://www.esri.com/landing-pages/industries/education/higher-education/teach-with-arcgis-platform>

- ◆ Review video tutorials: A Deeper Dive with ArcGIS Online:  
See playlist : <http://www.youtube.com/geographyuberalles>



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