Ella Weil
GEOG 493
Final Project
Abstract

Drainage Analysis: The use of sinks in determining patterns of drainage in developed headwater areas.

In hydrologic modeling its common practice to fill sinks prior to running analysis tools to enforce flow lines in certain types of terrain. The purpose of this research is to determine how sinks can be used to understand drainage patterns in a developed headwaters area. This study uses three types of analysis to identify areas with drainage issues and assess neighborhood drainage basins or "streetsheds." This analysis focuses on Tryon Creek headwaters in SW Portland. The area is characterized by moderate to high residential development and will see an increase in transportation development over the next few years. This research is meant to be used as a tool for planners who will need to take into consideration the complicated drainage needs of the area. The data employed in this study include a 1 meter DEM, USGS contour lines (10ft and 100ft), and data of citizen reported drainage issues. The methods included a combination of flow direction analysis, flow accumulation, sink identification, point density analysis, and watershed delineation. Sink density patterns revealed that sinks tend to cluster in flatter areas and around headwater streams. The research found a correlation between reported drainage issues and sinks with 58% of drainage complaints occurring in areas with high sink density, 42% in areas of medium sink density, and no complaints in areas with low sink density. Visual analysis of "Streetshed" delineation reveals the impact of roads, ditches, yards and houses on neighborhood drainage patterns. Further analysis could include hydric soils and hydric plants to verify a correlation between wetlands and sinks. This study has concluded that sink analysis should be taken into consideration when planning for development in upstream riparian areas.

Drainage Analysis

For developed headwaters and wetland areas

Ella Weil

What exactly is a Sink?

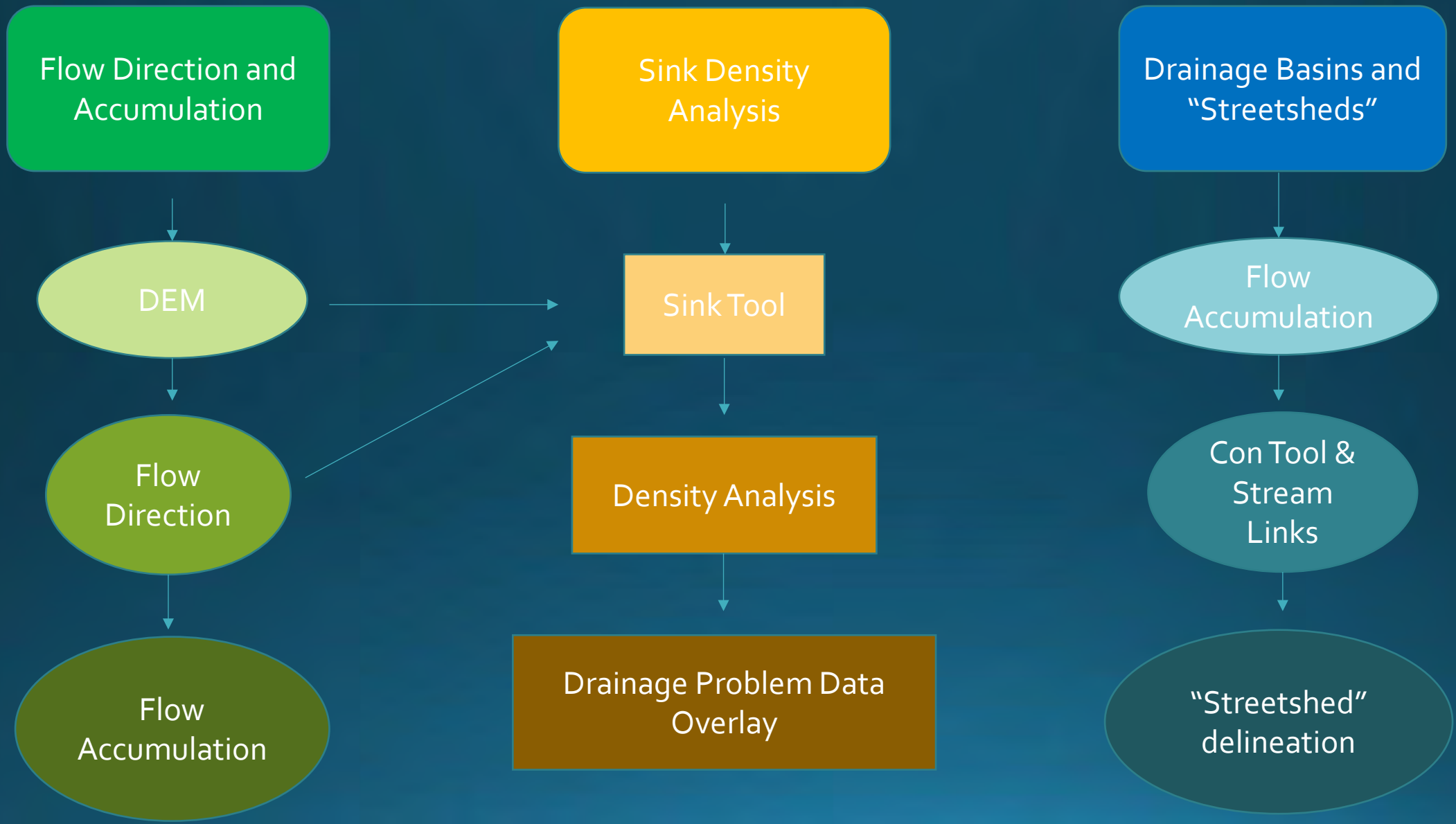
Derived from the Flow Direction tool

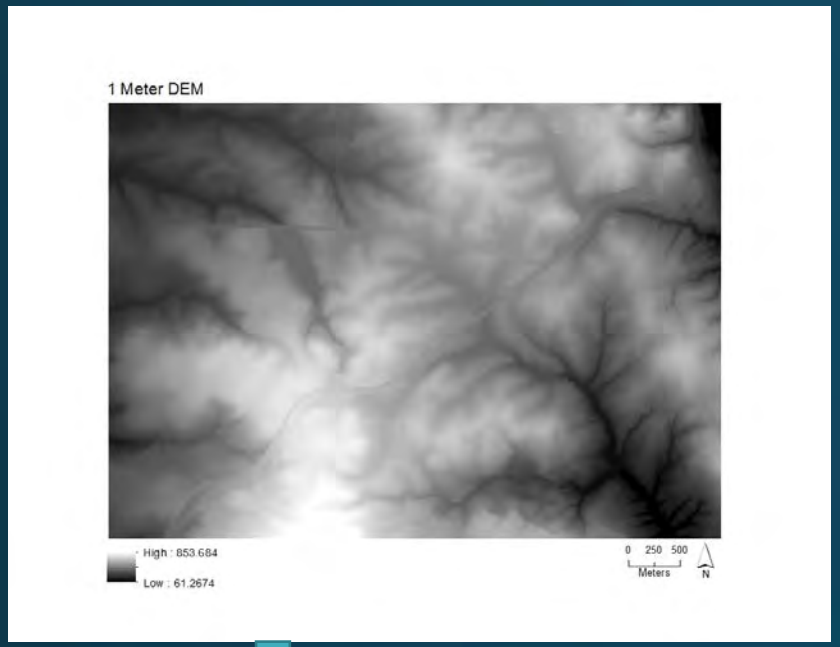
Cells with undefined flow direction

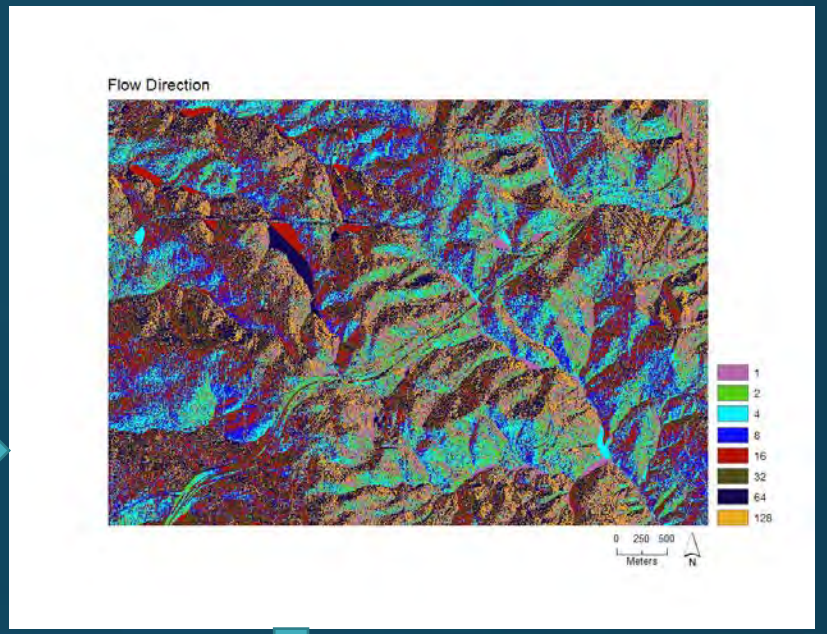
With the exception of sinks as a geomorphological feature, they are considered artificial and usually filled in the interest of finding continuity in a drainage network.

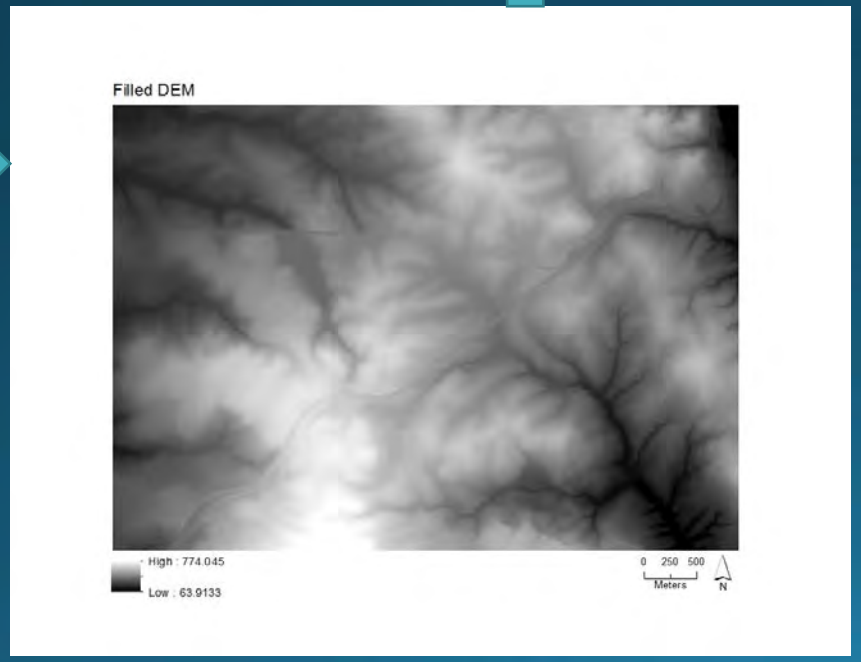
Research Question:

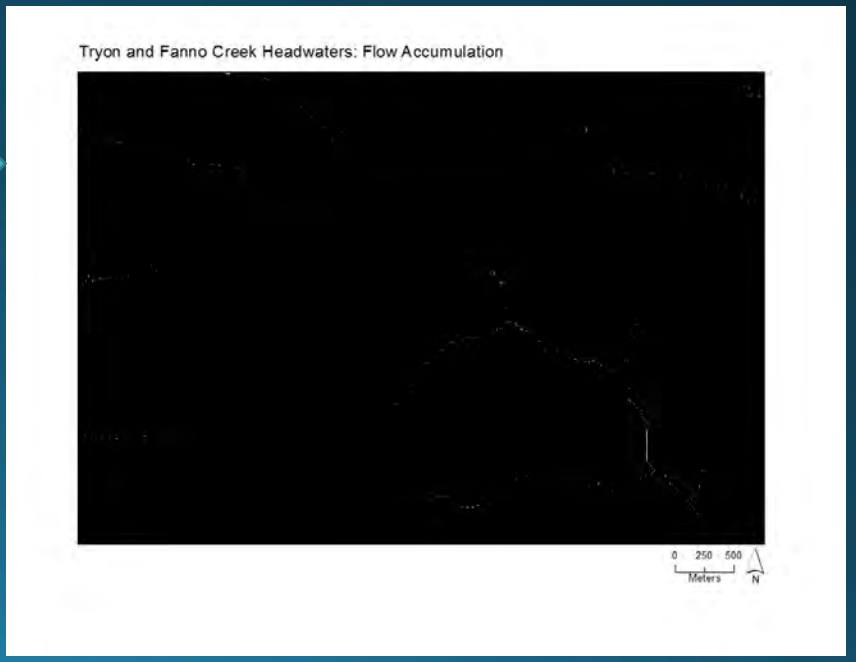
Can hydrological analysis without filling sinks be useful for understanding the more complicated drainage patterns of headwater streams in developed areas?


Flow Direction and Accumulation
DEM
Flow Direction
Flow Accumulation
Sink Density Analysis
Sink Tool
Density Analysis
Drainage Problem Data Overlay
Drainage Basins and "Streetsheds"
Flow Accumulation
Con Tool & Stream Links
"Streetshed" delineation









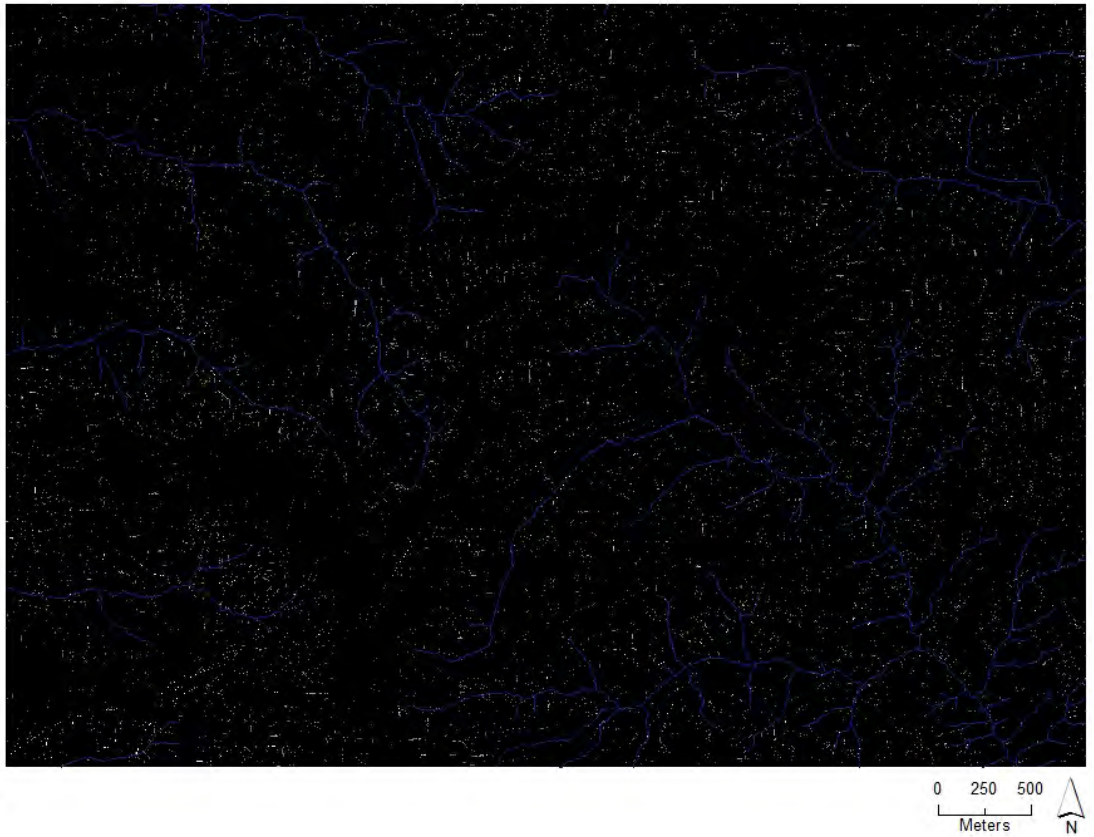
Typical Drainage analysis:

- Fill
- Flow Direction
- Flow Accumulation

Tryon and Fanno Creek Headwaters: Flow Accumulation

Flow Accumulation derived will sinks filled.

Tryon and Fanno Creek Headwaters: Flow Accumulation



Flow Accumulation derived without filling sinks.

Tryon and Fanno Creek Headwaters: Flow Accumulation

Wetlands

0 20 40
Meters

N

Clear differences between the filled model and the model with sinks.

Filled model forces all Accumulation strait to main Streams.

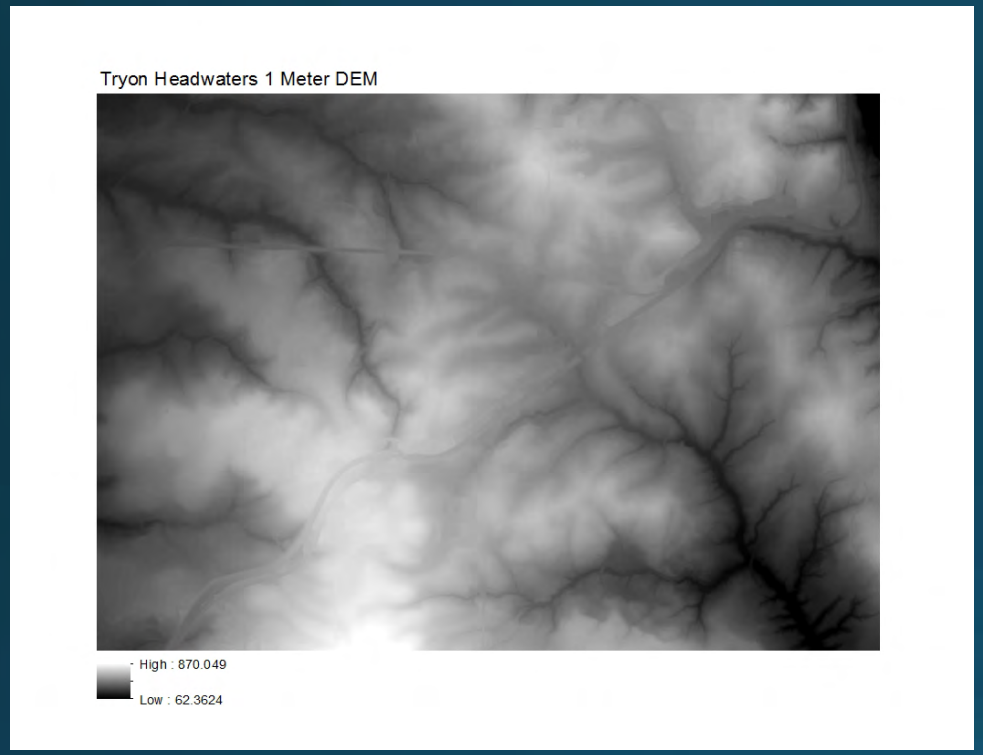
Model with sinks included has less continuity but provides insight on how storm water flows from streets, houses and yards.

Spring Garden Park has a daylighted stream passing through it.

The model with the sinks shows the stream and its drainage.

The filled model does not.

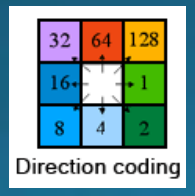
Identifying Patterns: Workflow



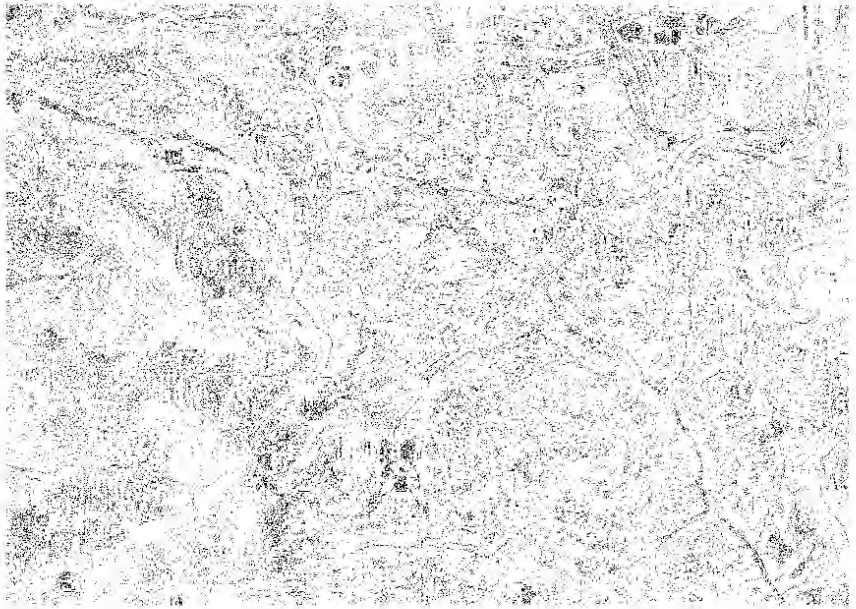
Run unfilled DEM through the Flow Direction tool to find sinks.

ArcGIS says: sinks must be filled to get an accurate Flow direction output.

You know you have sinks when…..



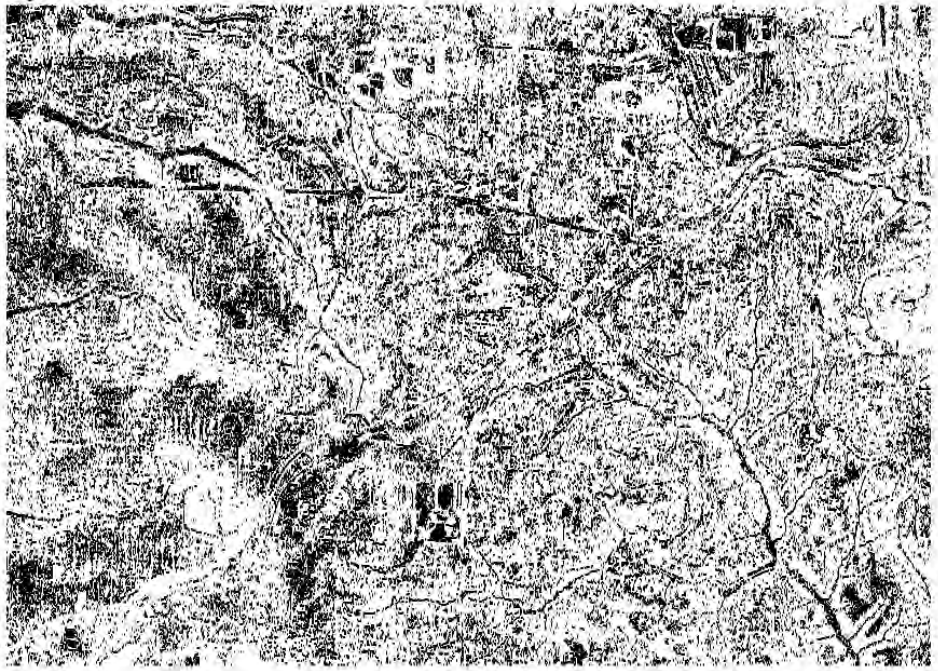
Tryon Headwaters Sink Raster



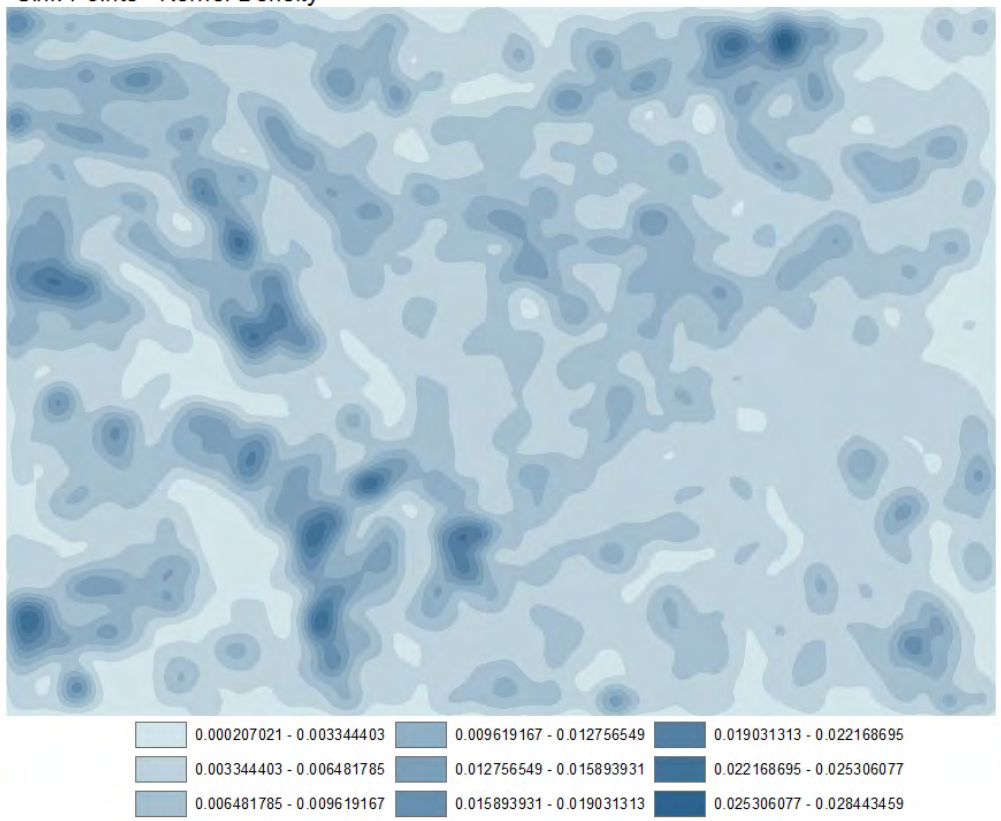
Sink Tool Output

Point Feature Class

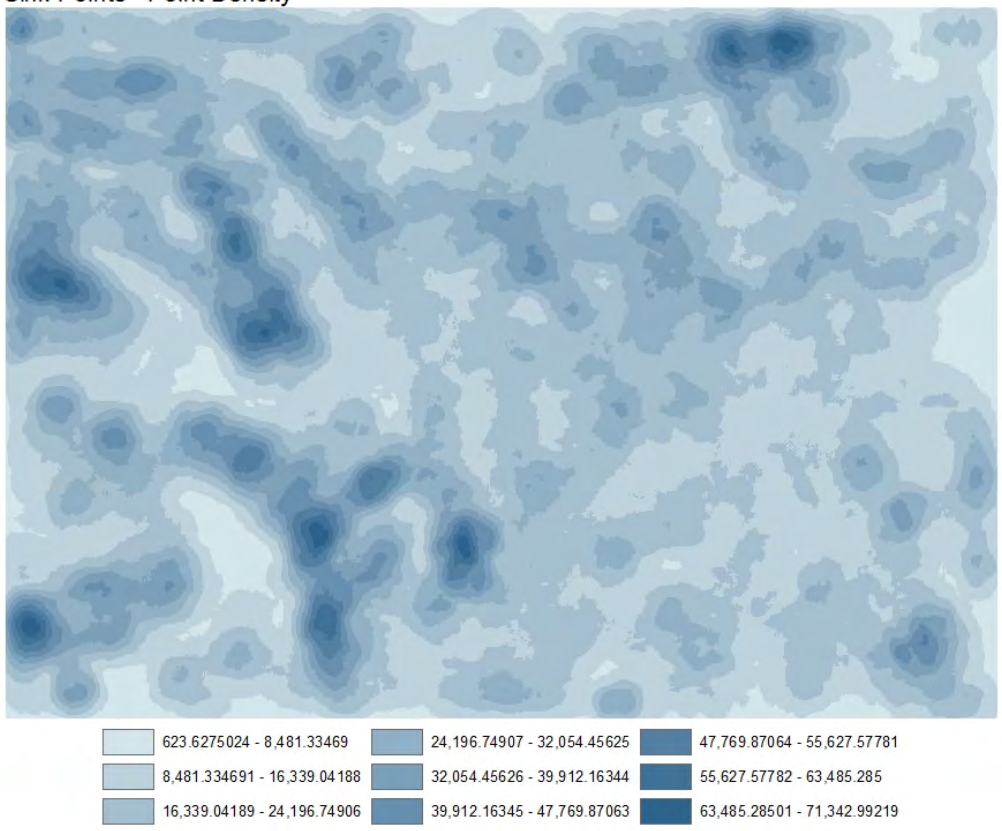
Tryon Headwaters Sink Points



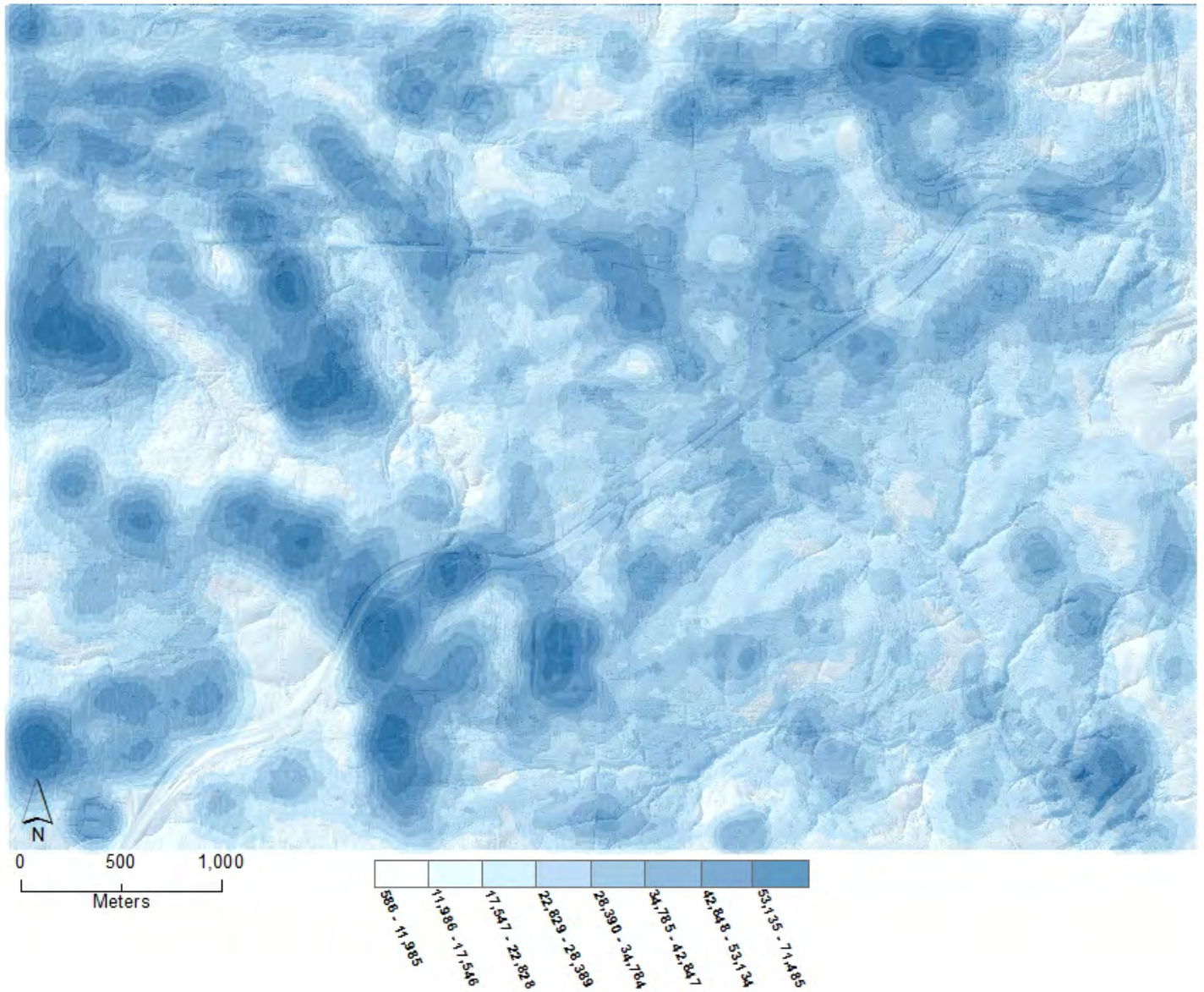
Sink Points - Kernel Density



Sink Points - Point Density



Tryon and Fanno Creek Headwaters: Sink Density

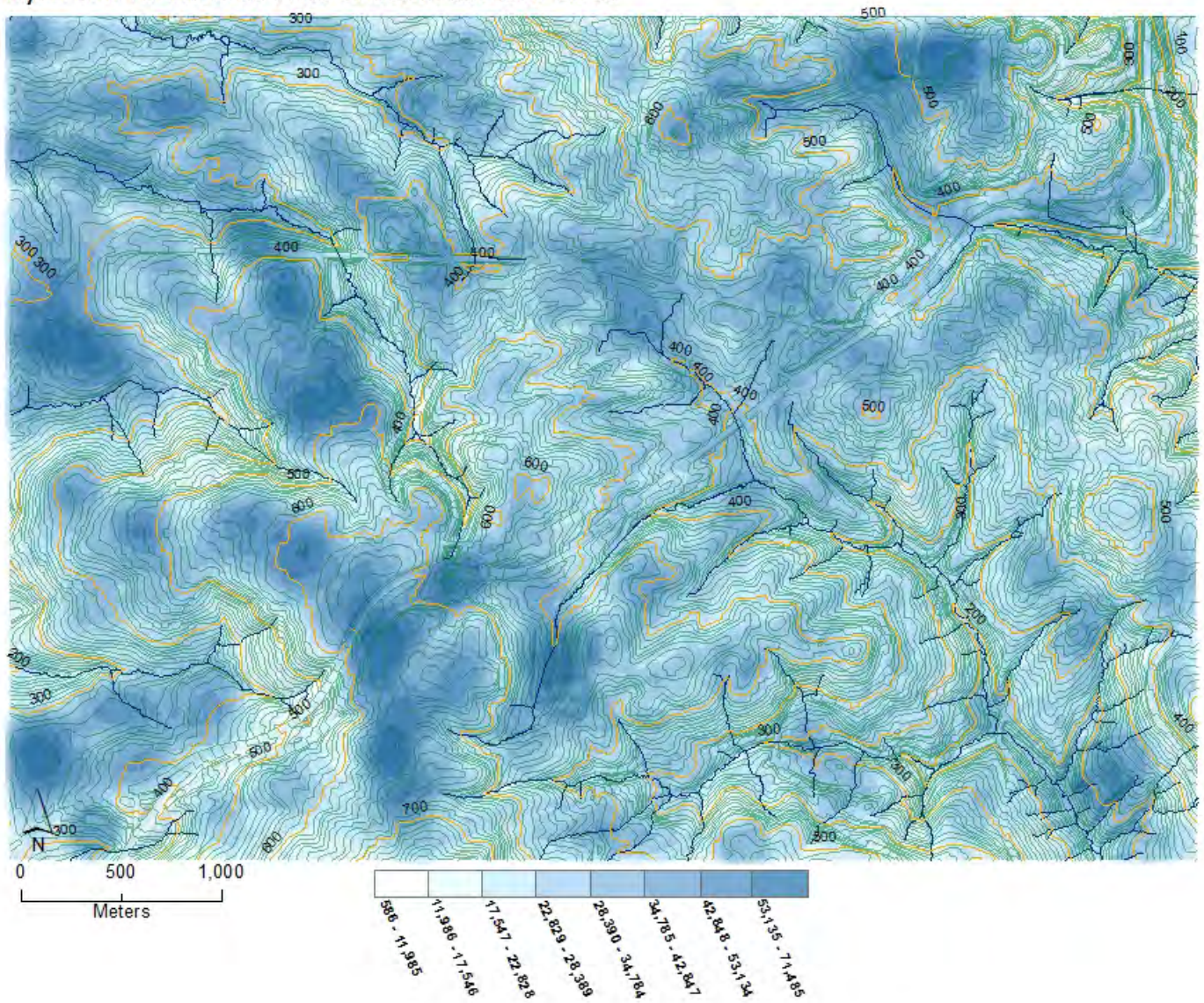


Patterns?

Where are sinks clustered?

Where are they absent?

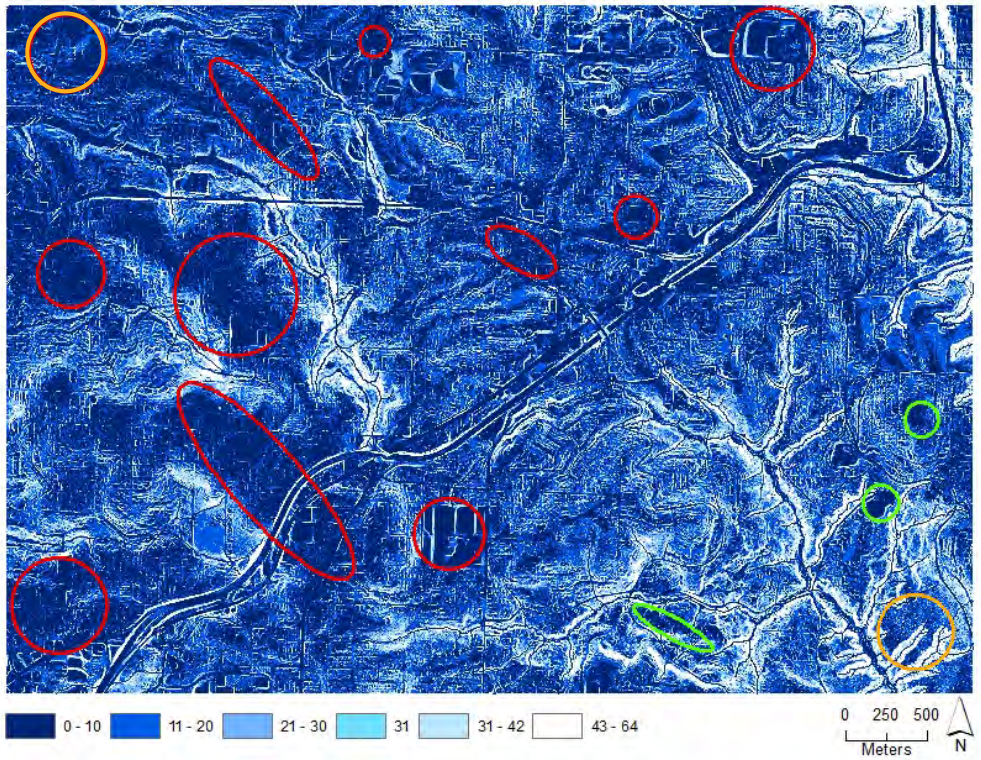
Tryon and Fanno Creek Headwaters: Contour Lines



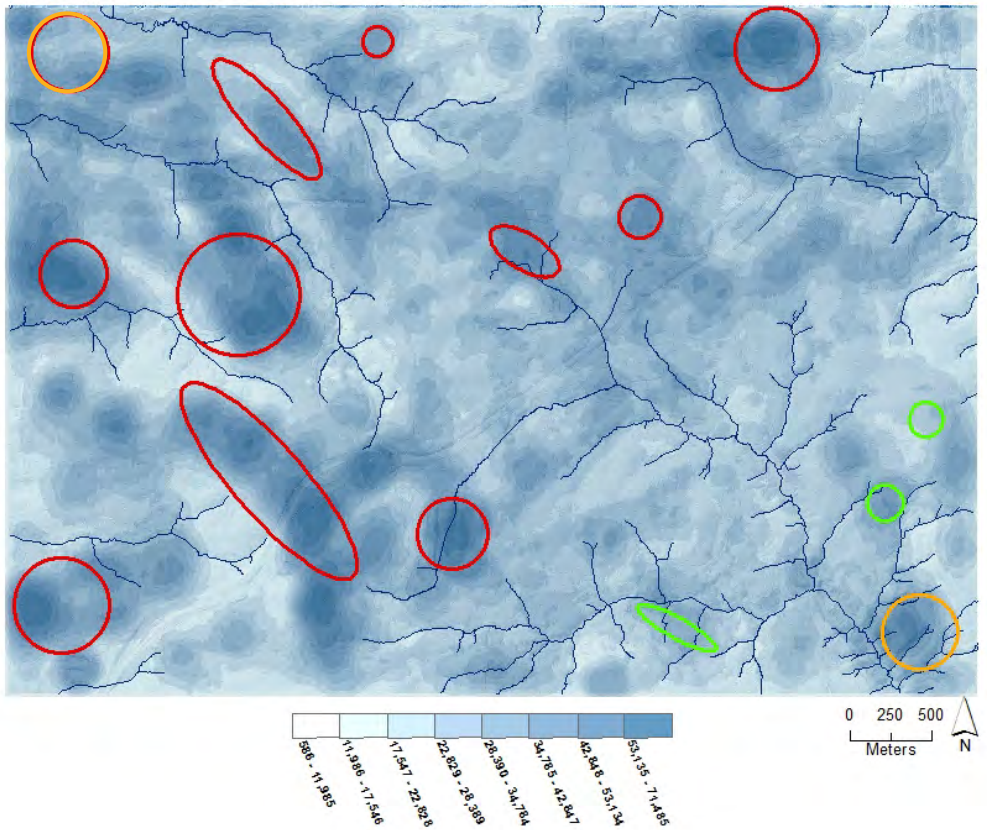
More sinks in flatter areas.

Less sinks in steeper areas.

Fanno and Tryon Creek Headwaters: Percent Slope

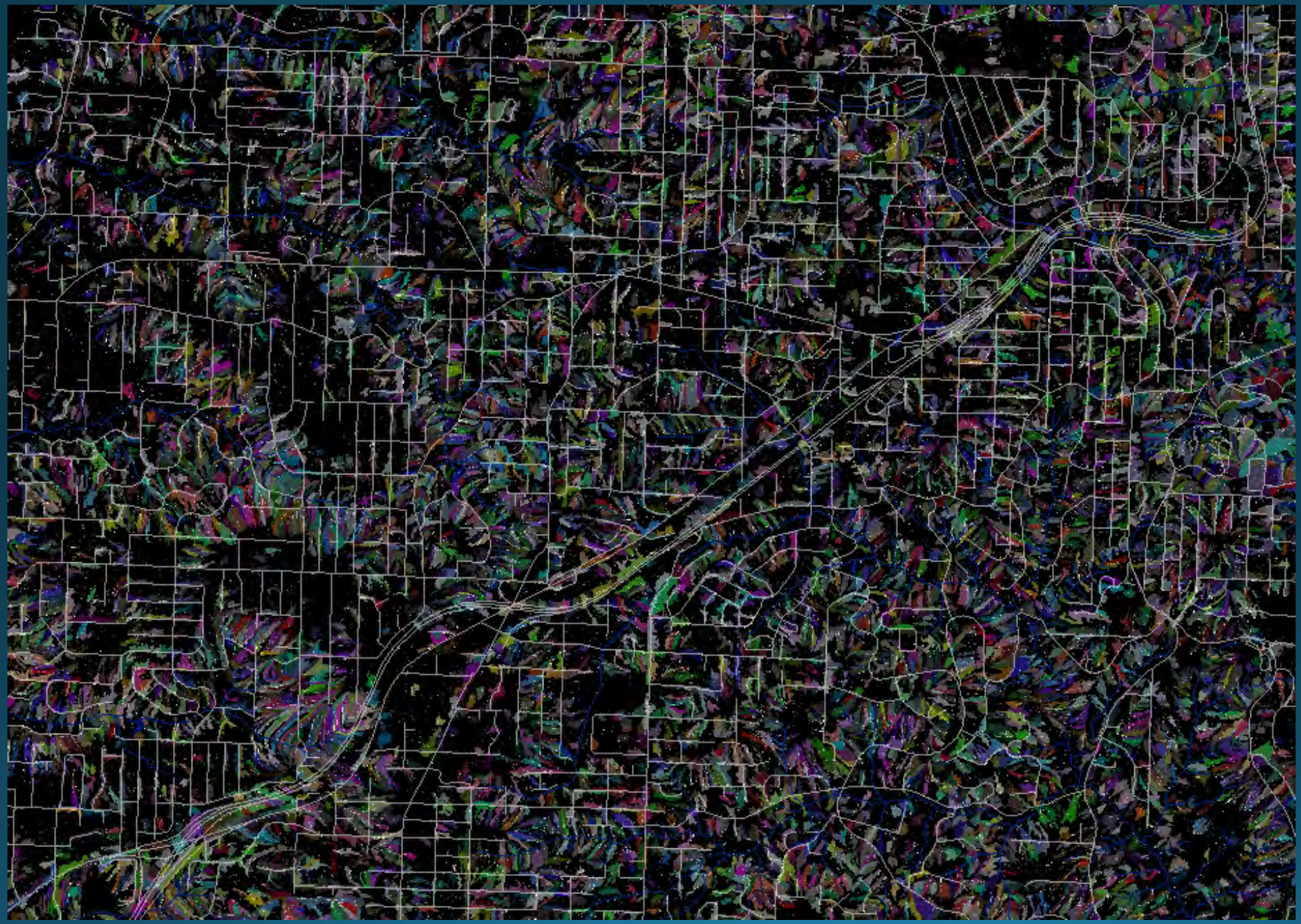


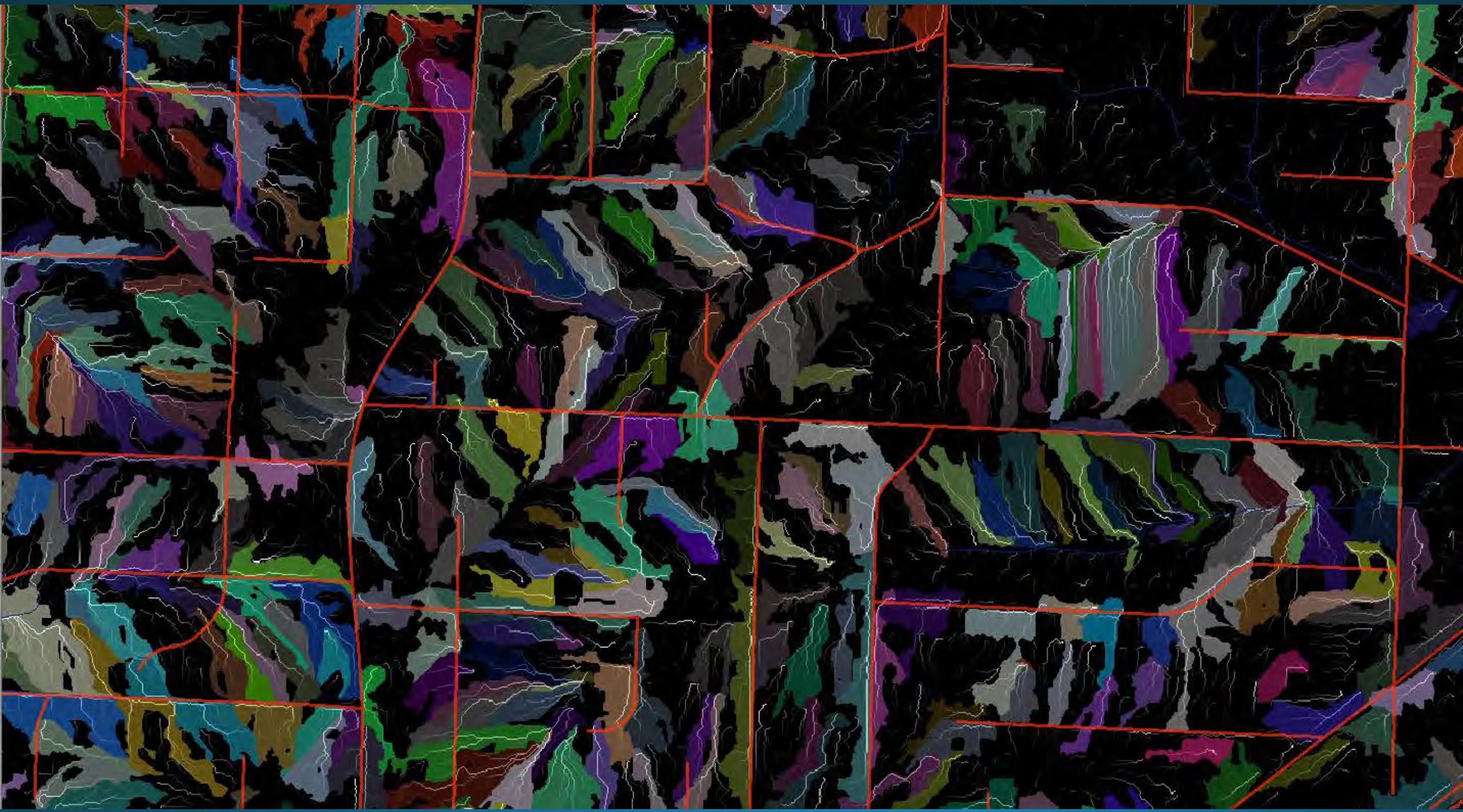
Fanno and Tryon Creek Headwaters: Sink Point Density

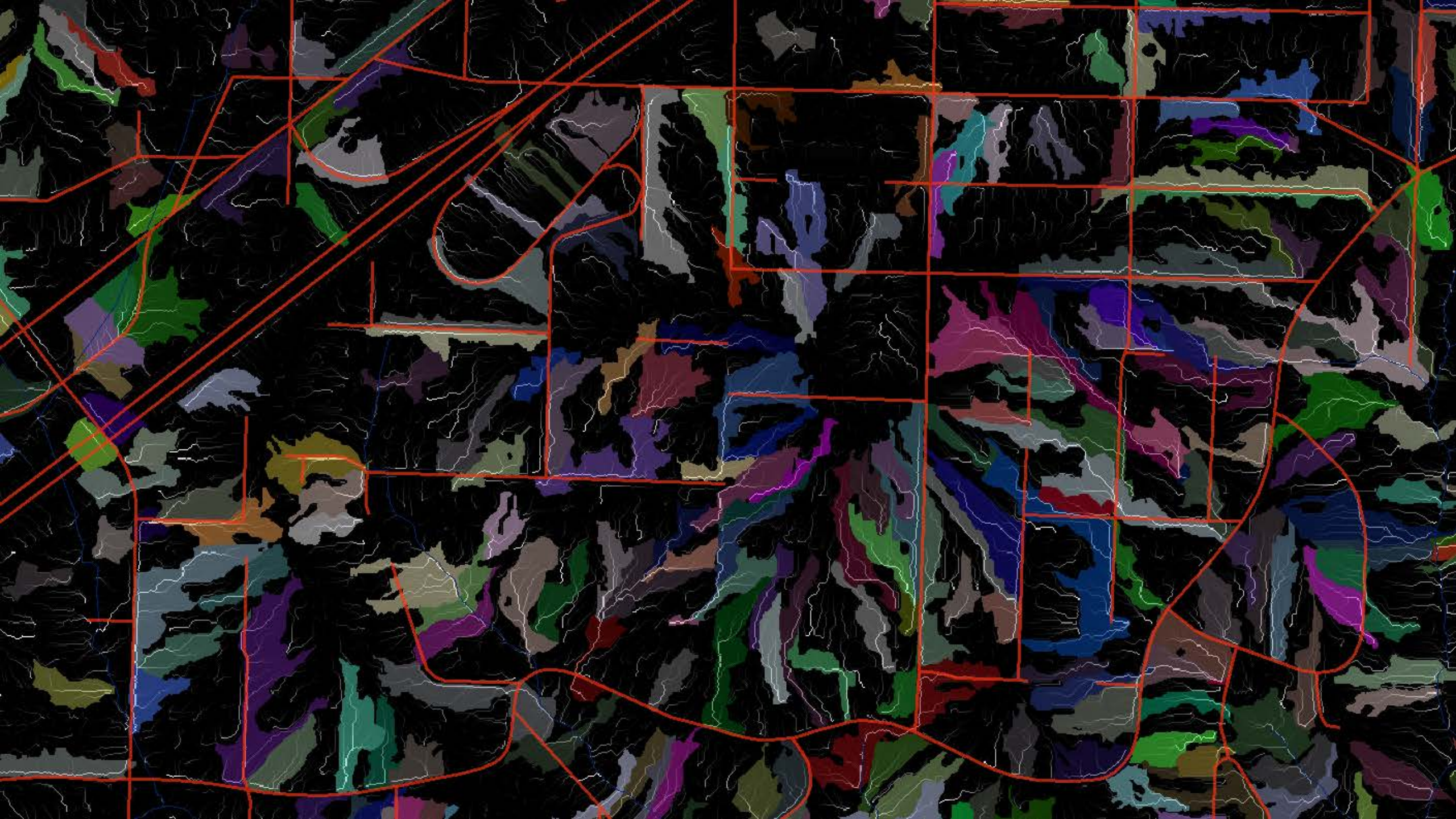


Sinks and slope correlate more in the headwaters area and less downstream.

Headwaters areas: 0-10% slope matched higher sink density areas.
Downstream: less consistent







Conducting analysis without filling sinks can be potentially useful for:

- Identifying areas with drainage issues
- Stormwater analysis and streetshed delineation
- Wetland delineation
- A better understanding of how headwaters in developed areas are functioning

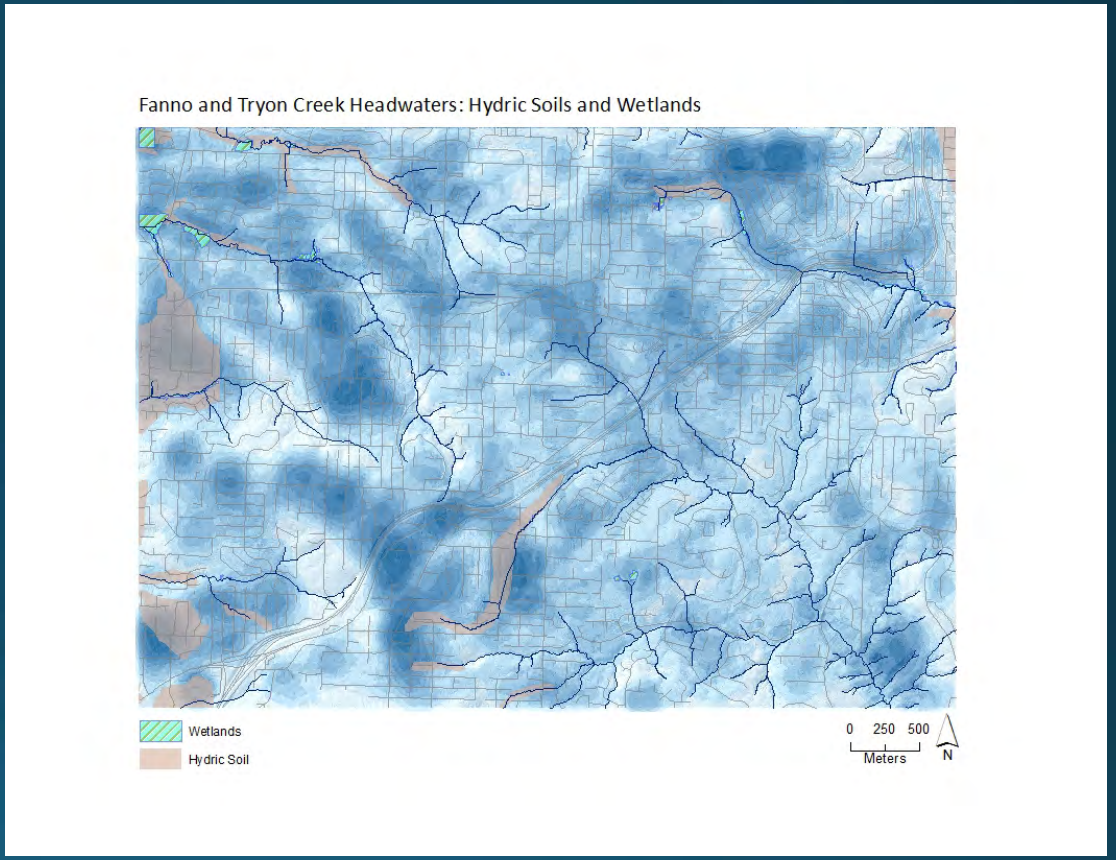
Further Analysis

Wetland delineation

- Overlay hydric soils and plants

Identify stormwater drainage needs

- Include street drainage (culverts, stormwater facilities, street drains)



Data Sources and References

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