Urban Drainage Modeling for Storm Water Design

Using QL2 LIDAR

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GISP

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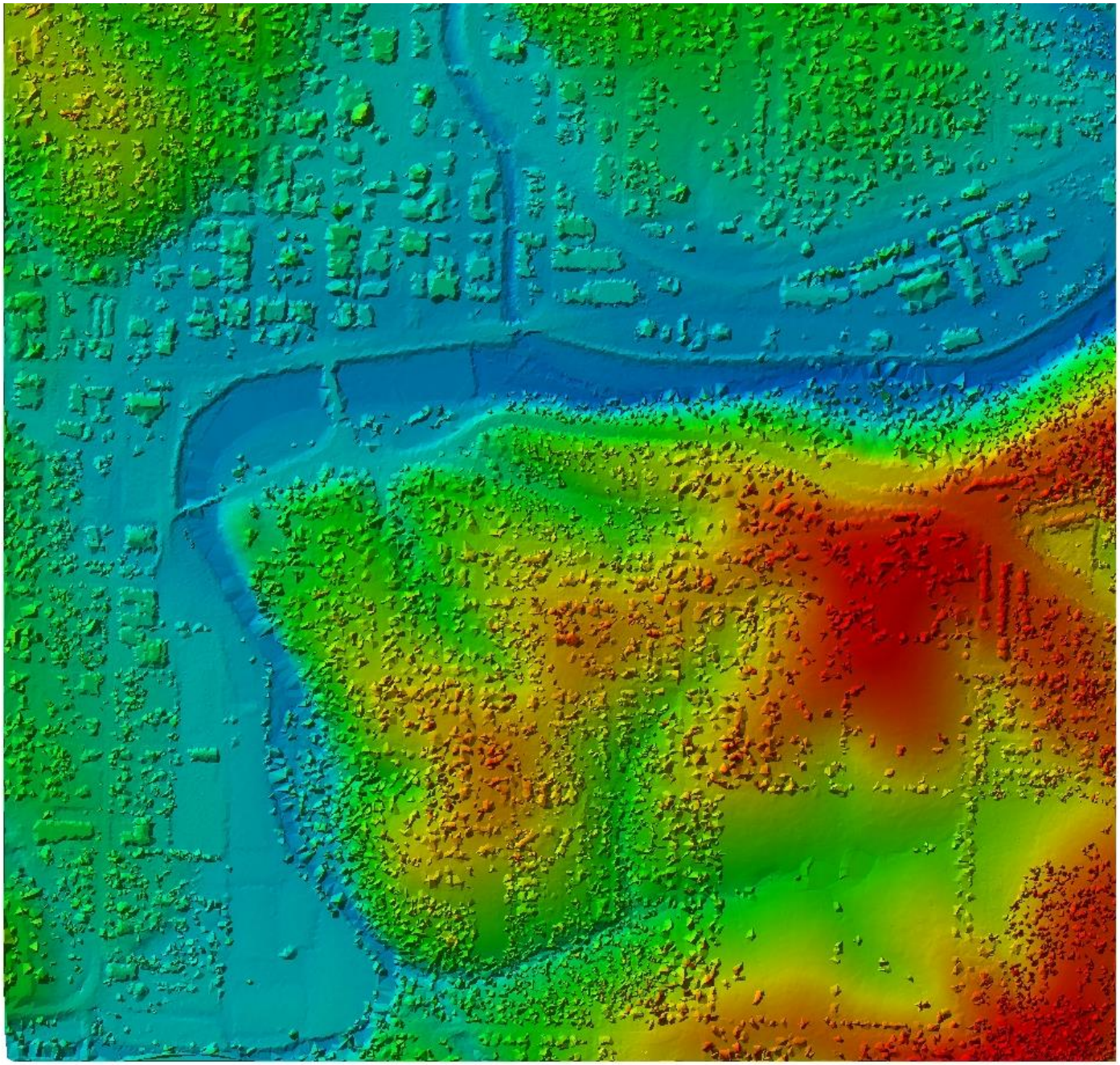

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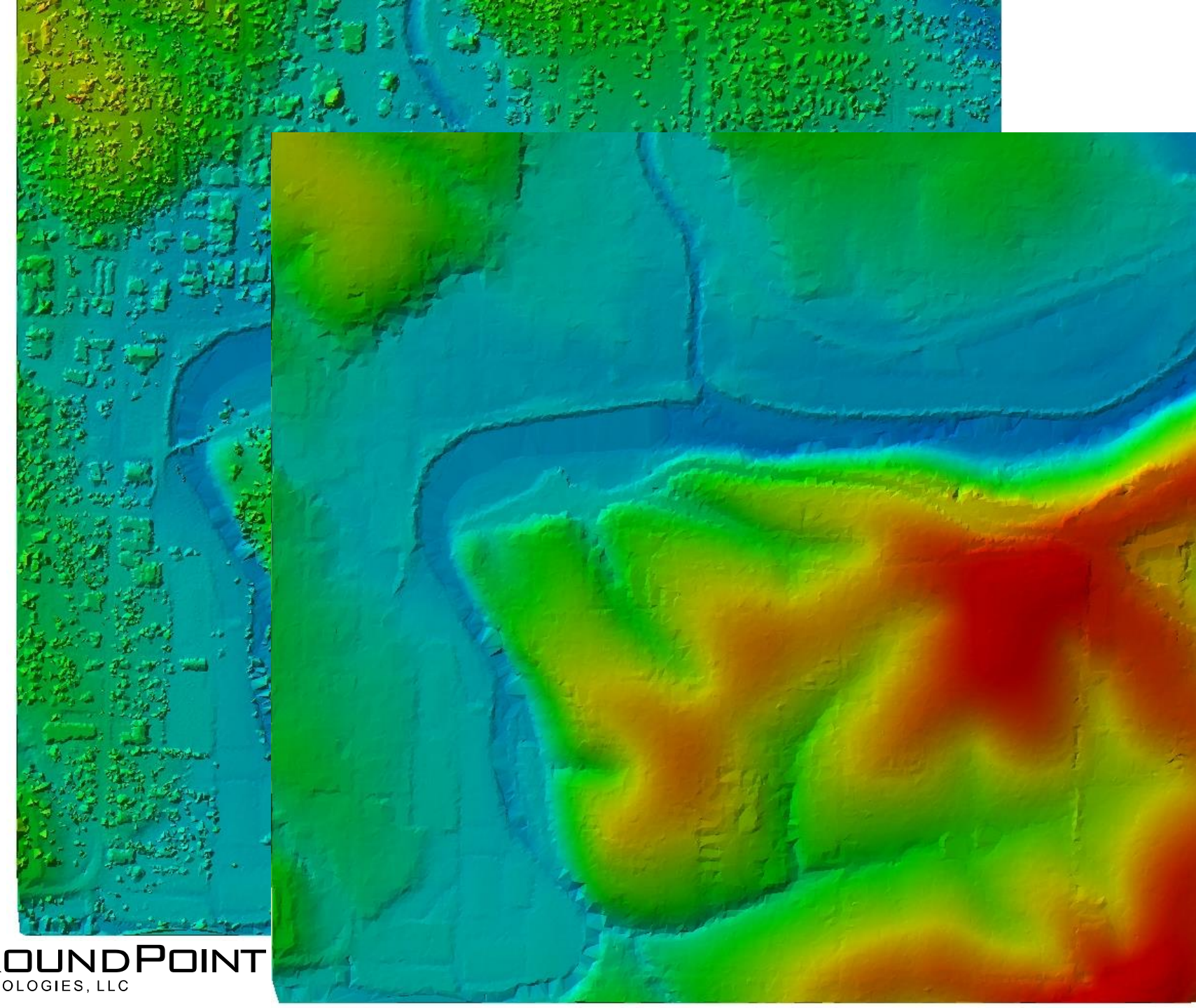

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What is QL2 LiDAR?

Table 1. Aggregate nominal pulse spacing and density, Quality Level 0–Quality Level 3.

[m, meters; pls/m^2, pulses per square meter; ≤, less than or equal to; ≥, greater than or equal to]

Quality Level (QL)	Aggregate nominal pulse spacing (ANPS) (m)	Aggregate nominal pulse density (ANPD) (pls/m^2)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

So What's the Big Deal?

- MS4 Permit Compliance
- Infrastructure design
- Flood response
- Catchment Characteristics

Infiltration islands in a parking lot in San Mateo, California, help reduce runoff. (Photo courtesy of John Kosco) water.epa.gov

Use ***LIDAR*** based elevation data to:

- Show the drainage network - where runoff flows over land.
- Develop drainage catchments
- Derive metrics
- Model flow

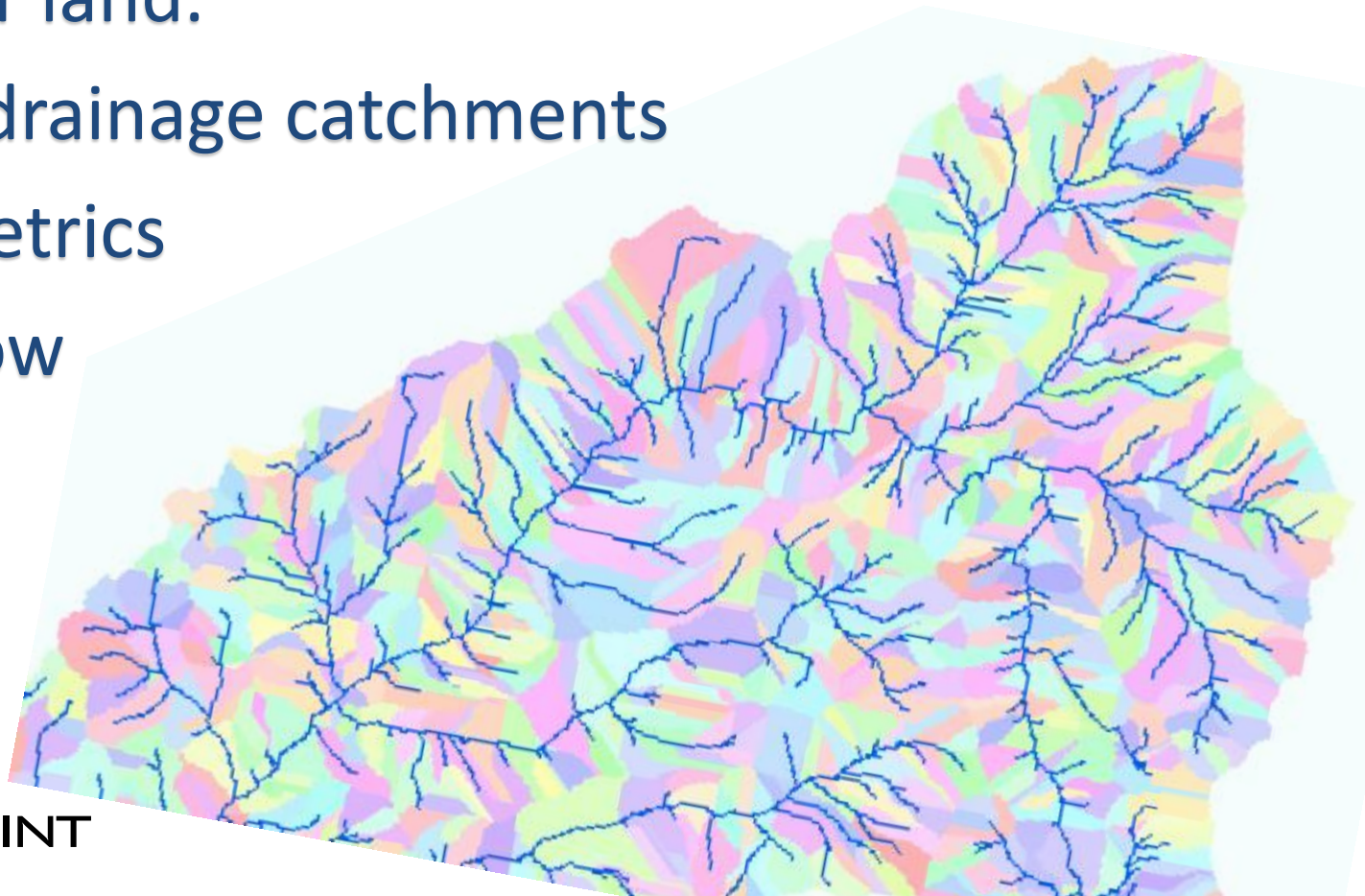

Image courtesy of hydrology.usu.edu
TauDEM 5.1 Quick Start Guide

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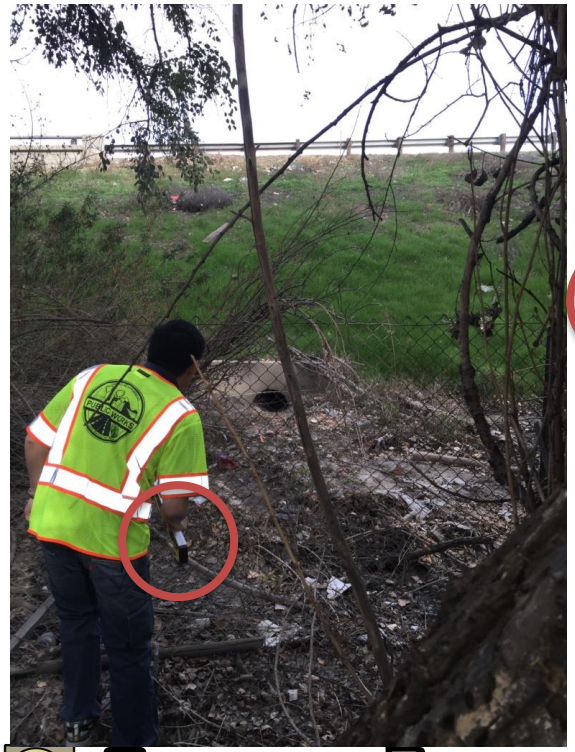
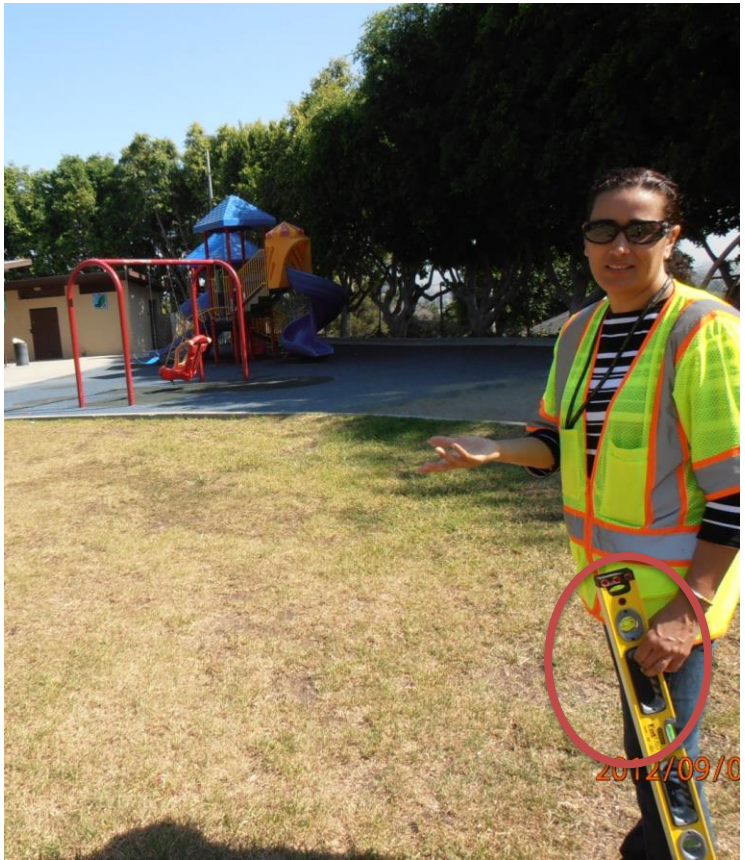
Significant Value Proposition

- Currently a very slow, labor intensive process.
  - Estimate: **~30 Years** to complete with traditional survey approach





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Current Projects

pennsylvania
DEPARTMENT OF TRANSPORTATION

Pitt

Salt Loading Assessment

750 acres

Squirrel Hill/9 Mile Run area

Compare PA Map to Allegheny County QL2

Urban drainage patterns

Current Projects

Ulster County

Cornell University

- Culvert Capacity Study
- Peak flow at inlet for design storm
- LiDAR supported parameters
  - Area, flow path, slope, t_c
- Land Cover supported parameters
  - CN

Current Projects

LOS ANGELES REGION
LAR|aC
imagery acquisition consortium

Los Angeles County DPW

- MS4 Storm Water Program
- EPA consent decree
- Catchments for storm water modeling
- Green infrastructure design

4000 square miles

- Pilot Project- methodology development
- Program training (6months)

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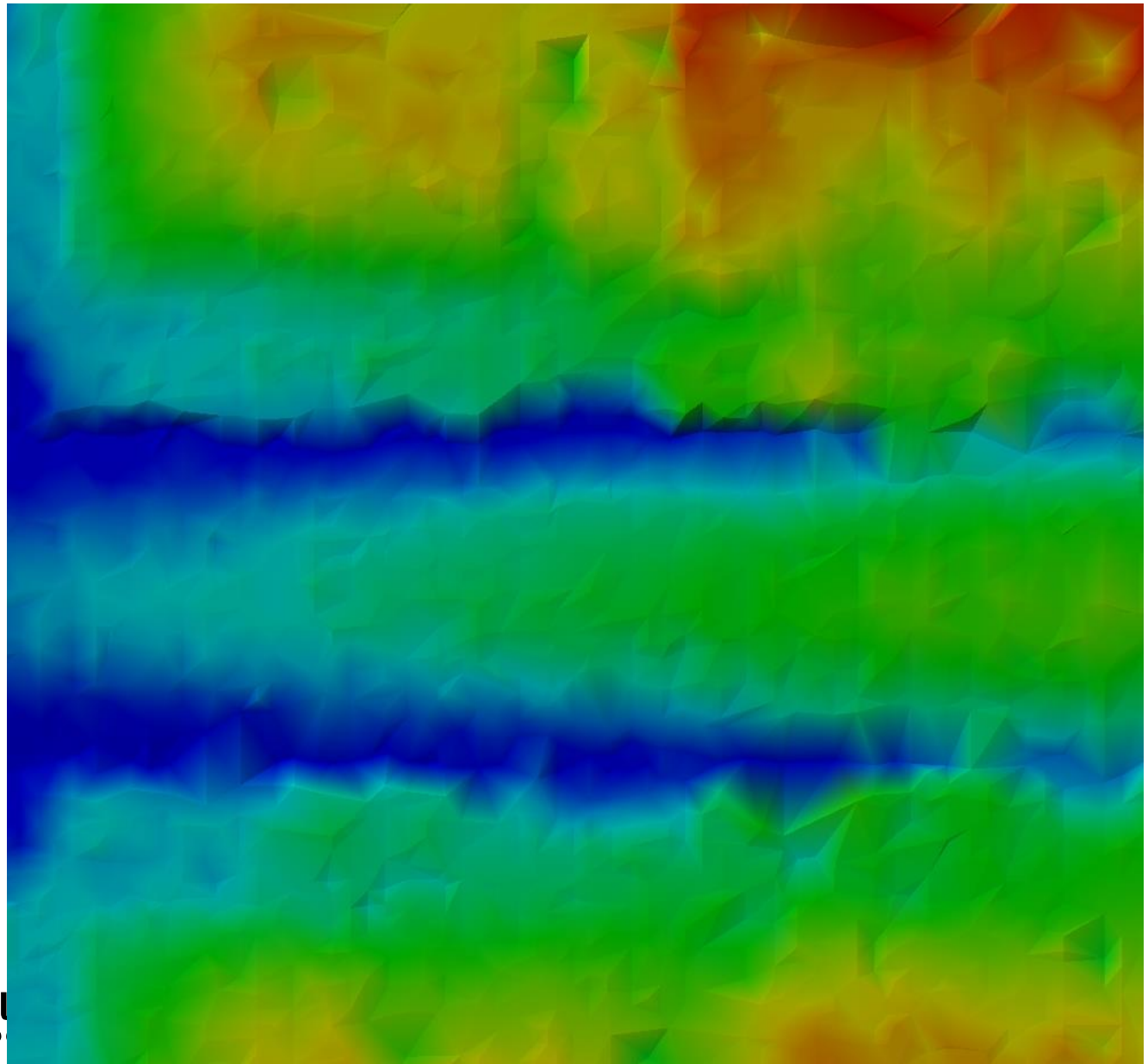
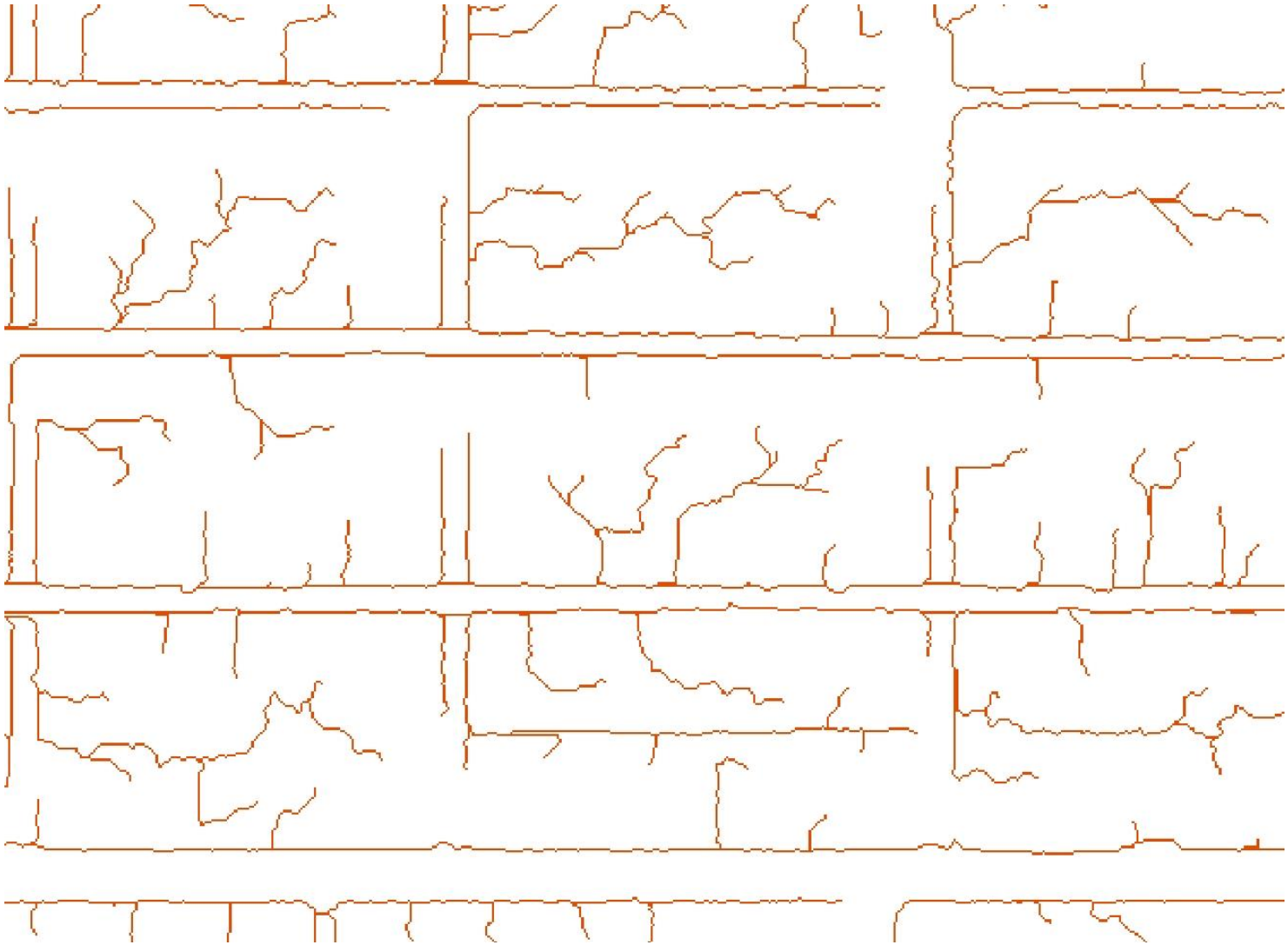
Point Density

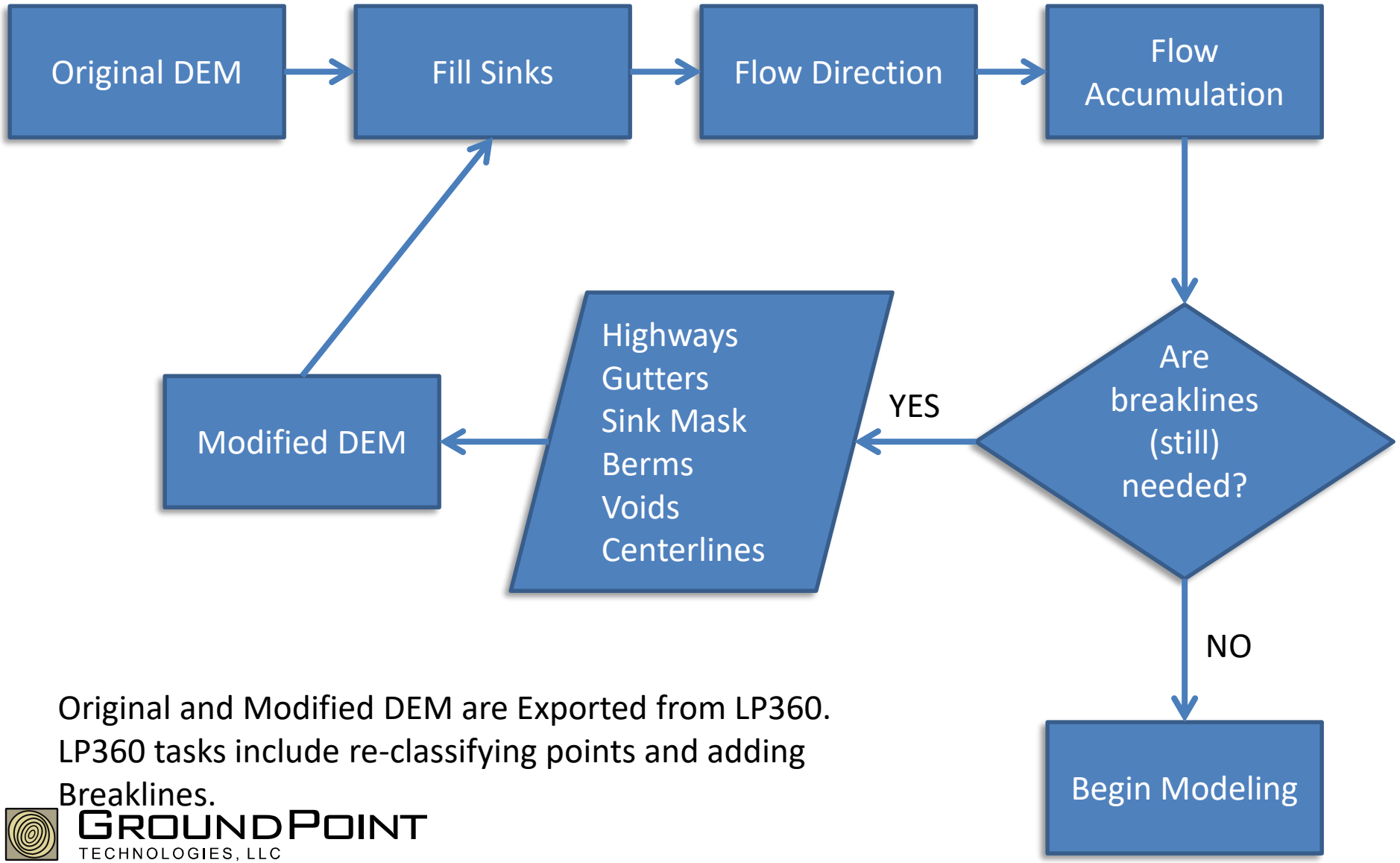
TIN Surface Model



Drainage Network Analysis



Workflow- Surface Prep



Original and Modified DEM are Exported from LP360. LP360 tasks include re-classifying points and adding Breaklines.

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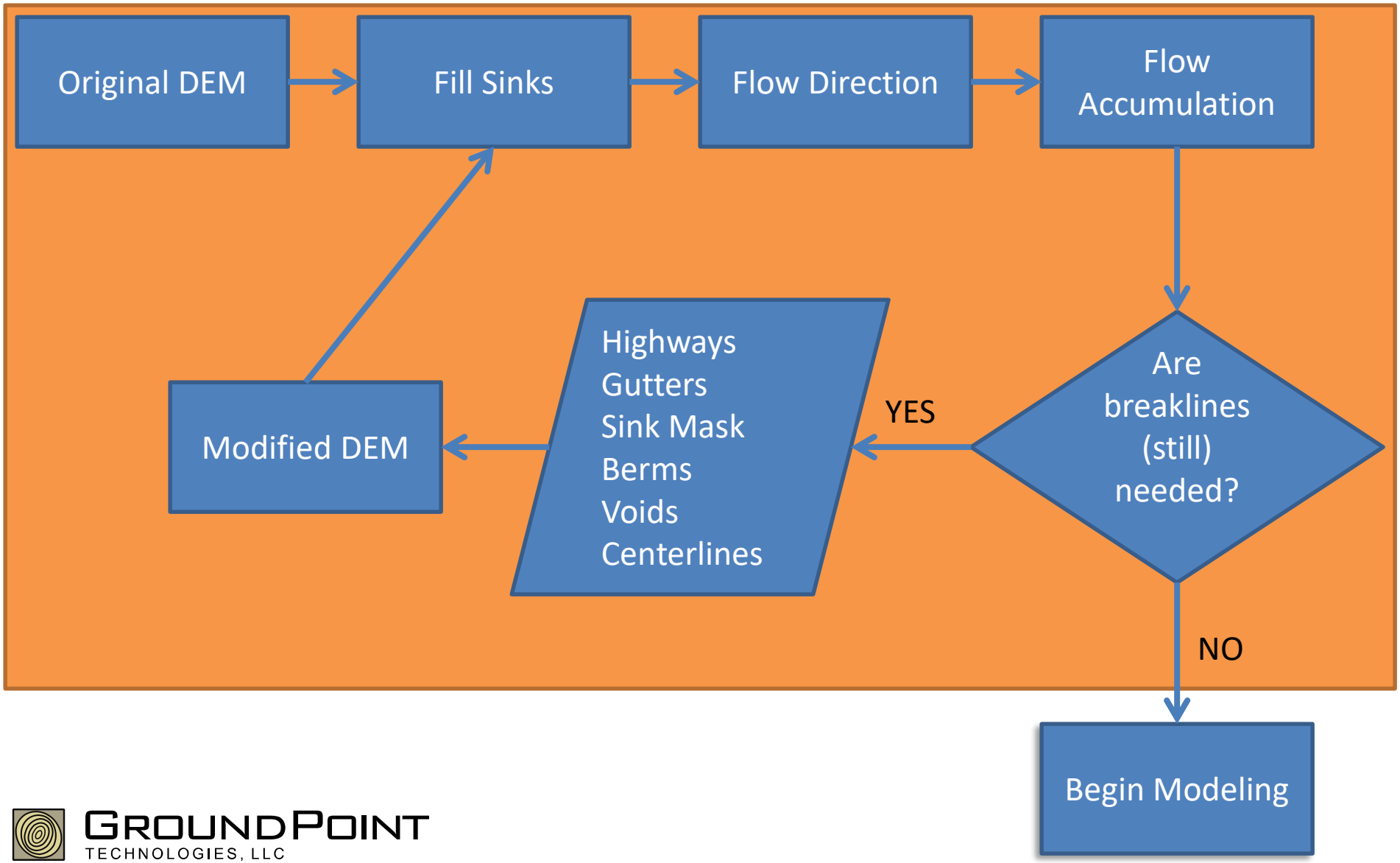
Workflow- Surface Prep



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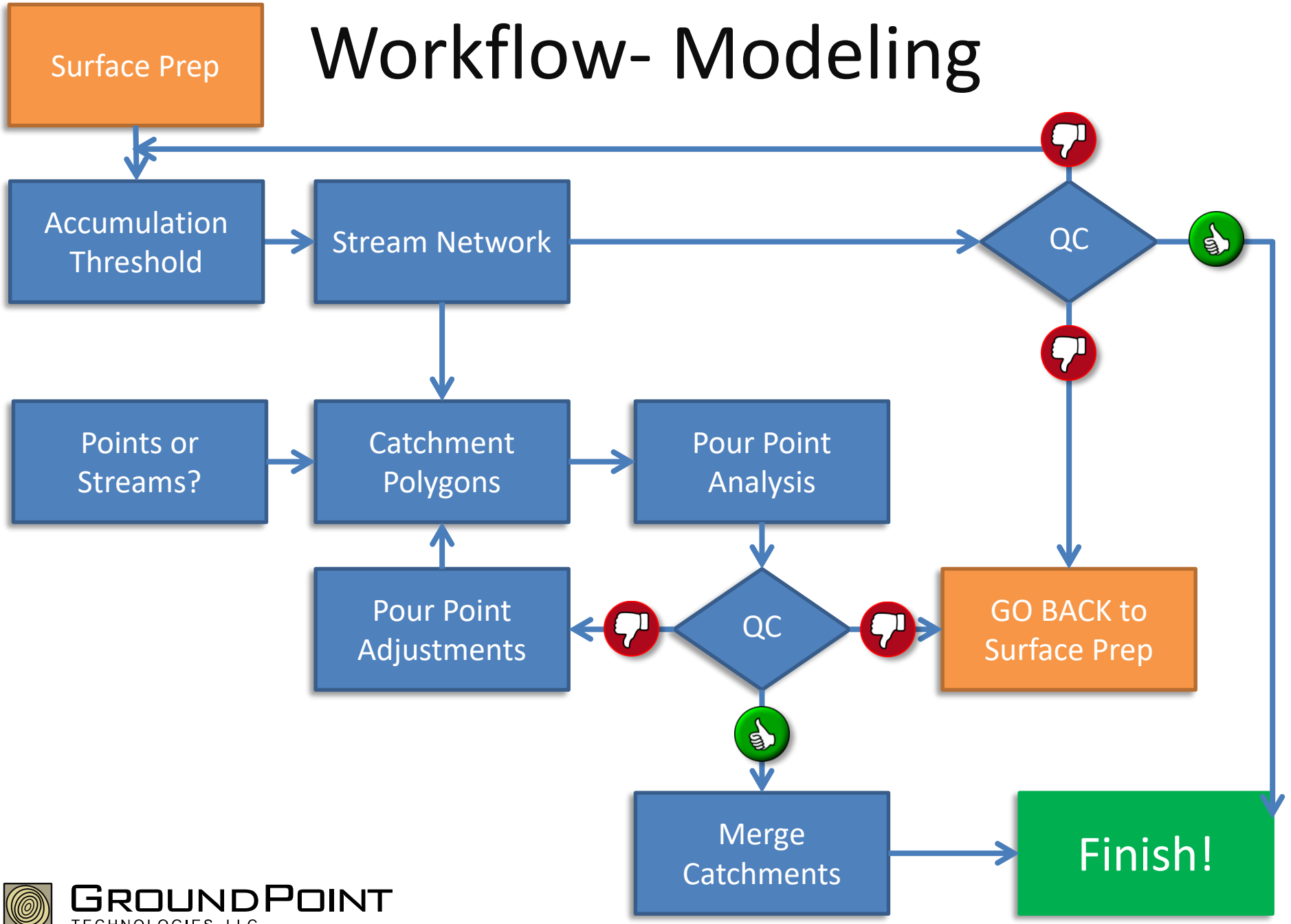
Workflow- Modeling



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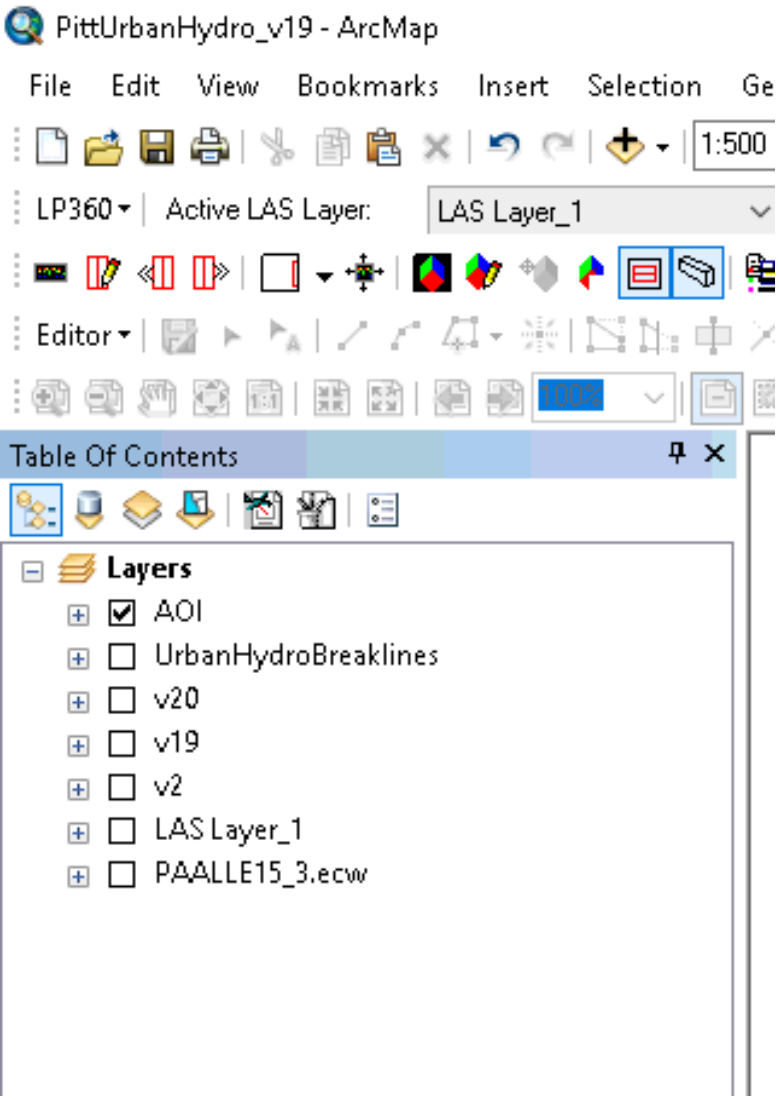

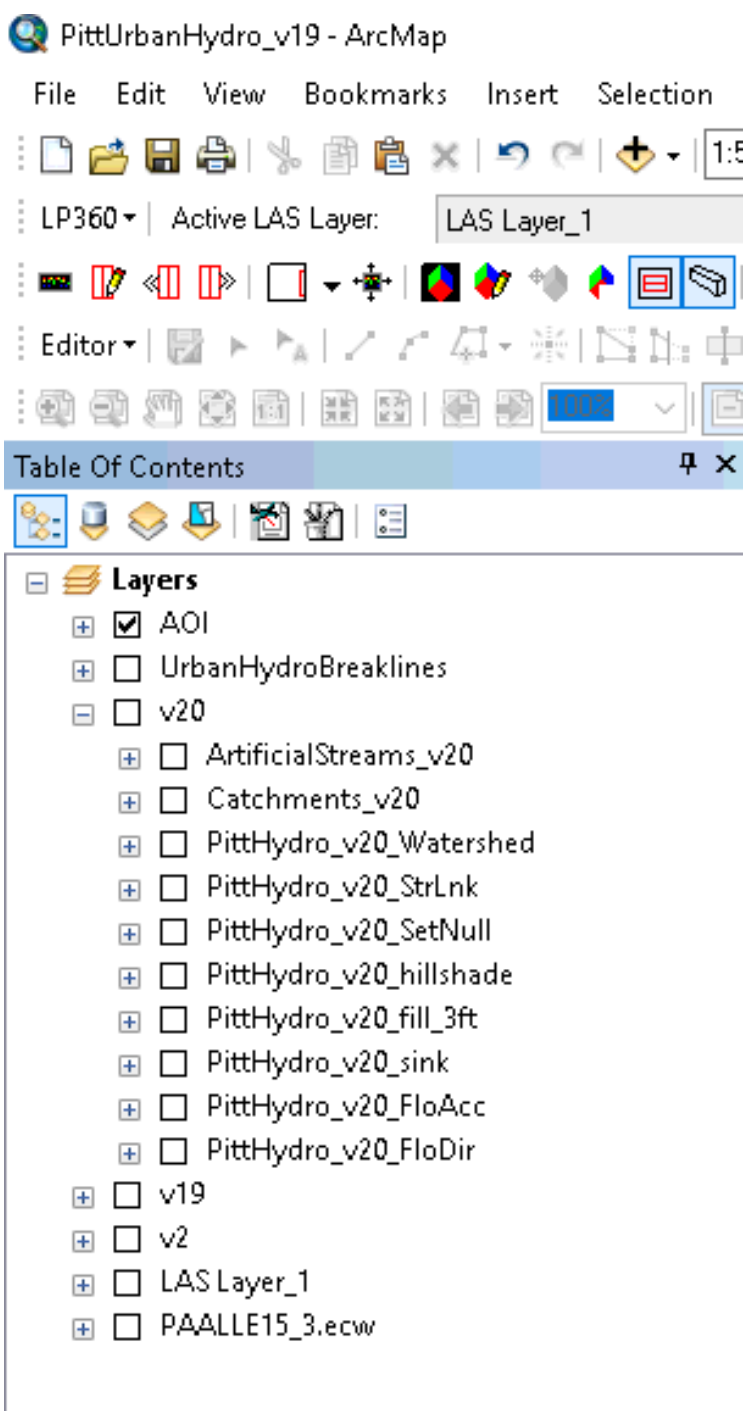

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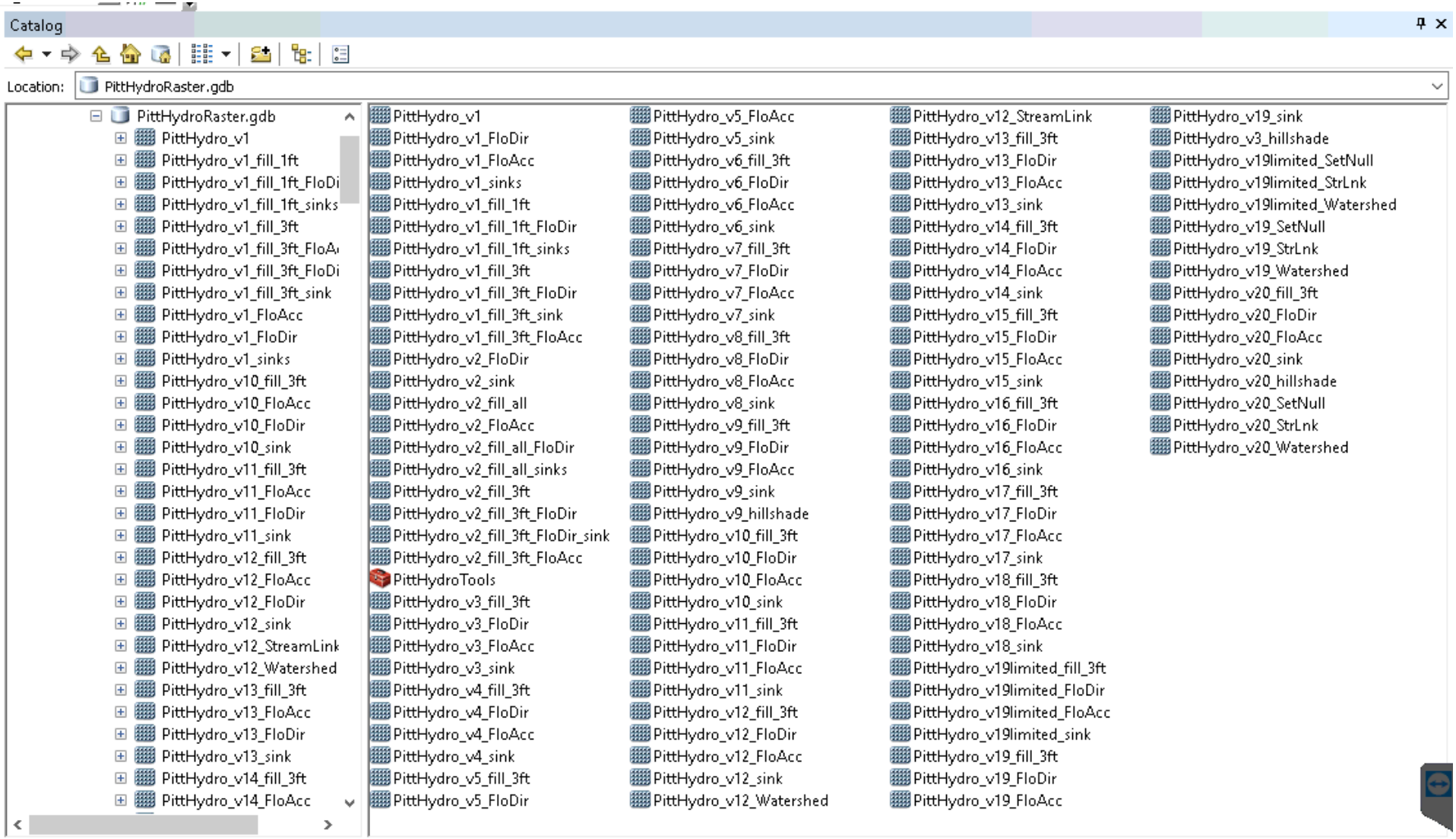
Catalog
Location: PittHydroRaster.gdb
PittHydroRaster.gdb
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PittHydro_v1_fill_1ft_FloDi
PittHydro_v1_fill_1ft_sinks
PittHydro_v1_fill_3ft
PittHydro_v1_fill_3ft_FloA
PittHydro_v1_fill_3ft_FloDi
PittHydro_v1_fill_3ft_sink
PittHydro_v1_FloAcc
PittHydro_v1_FloDir
PittHydro_v1_sinks
PittHydro_v10_fill_3ft
PittHydro_v10_FloAcc
PittHydro_v10_FloDir
PittHydro_v10_sink
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PittHydro_v12_FloDir
PittHydro_v12_sink
PittHydro_v12_StreamLink
PittHydro_v12_Watershed
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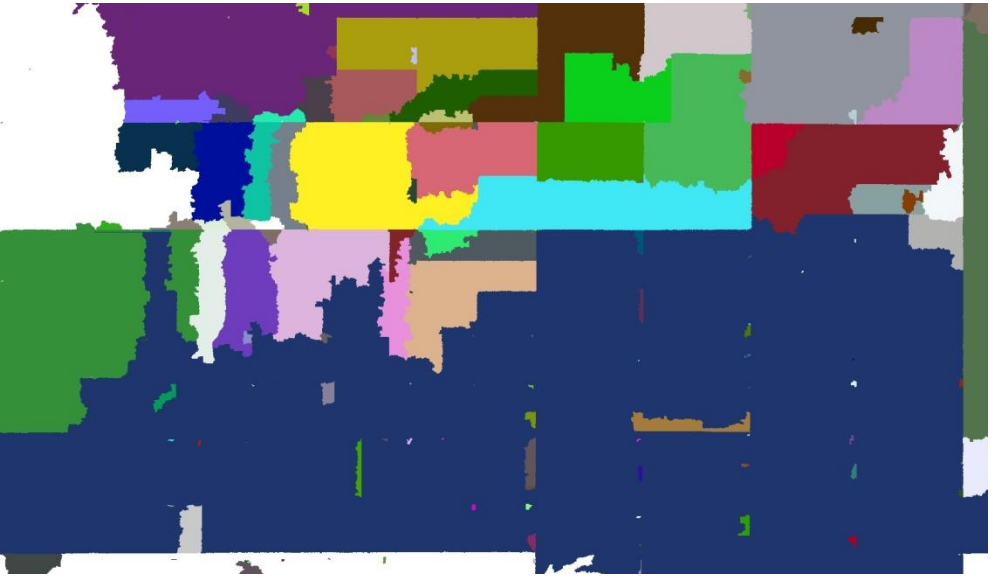
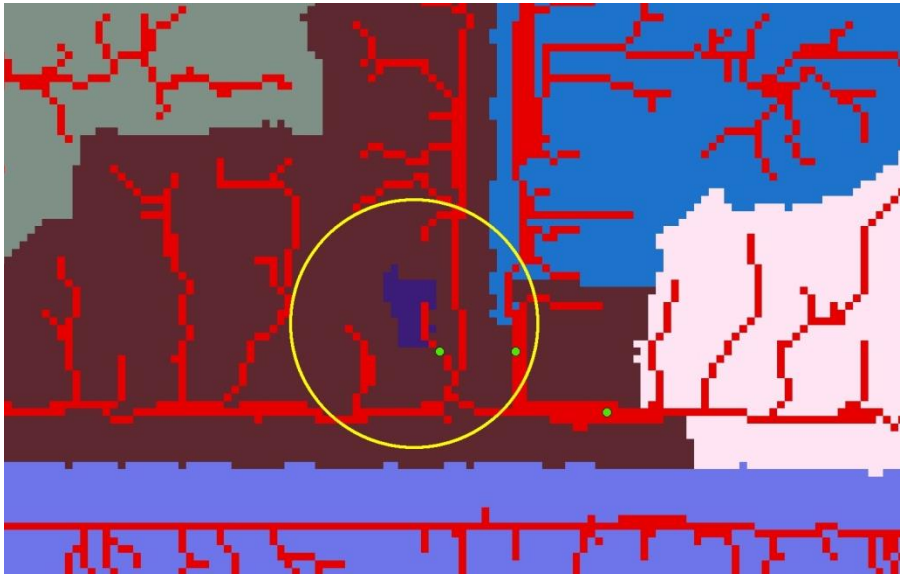
PittHydro_v20_Watershed

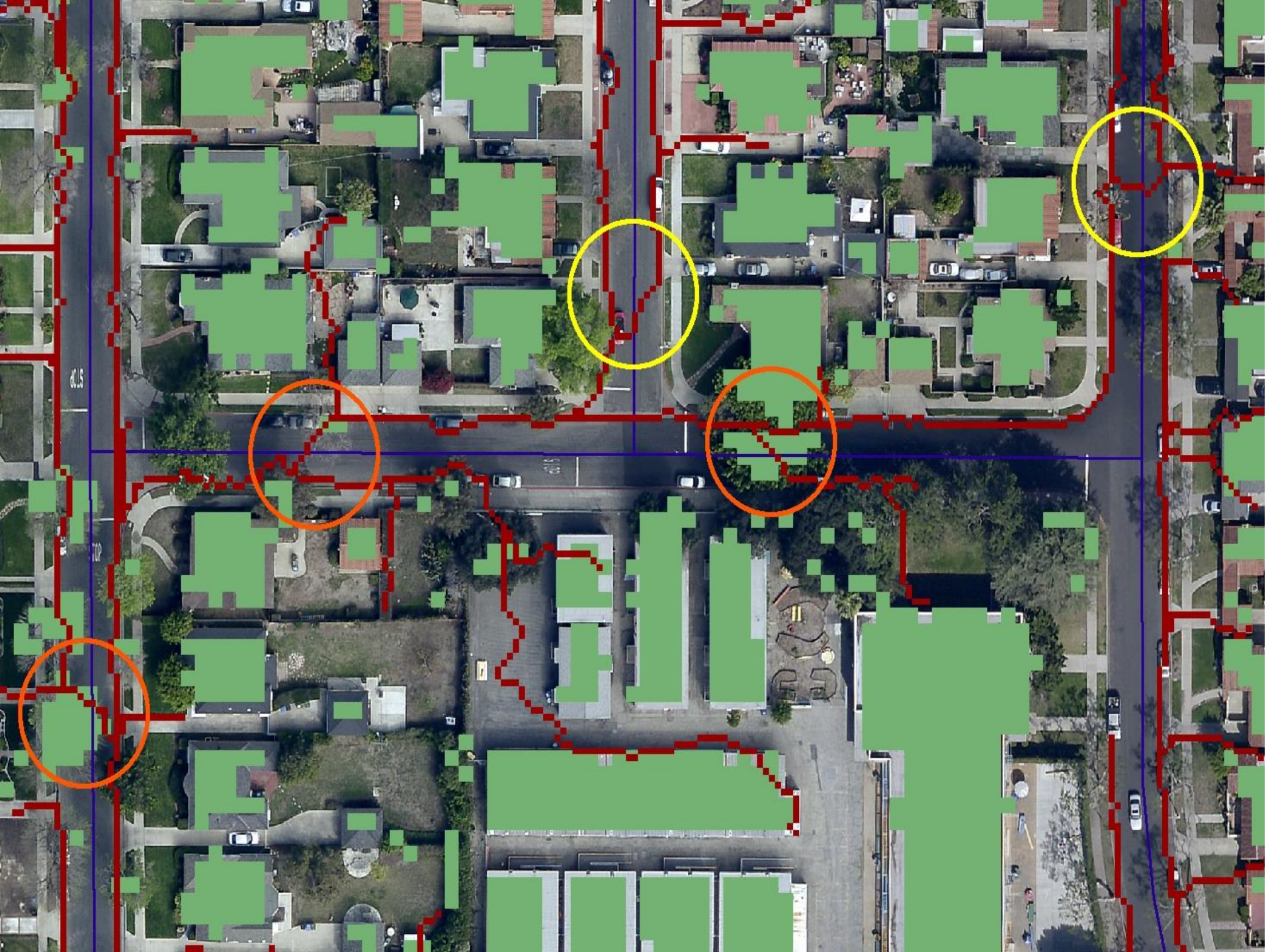
Unexpected Results

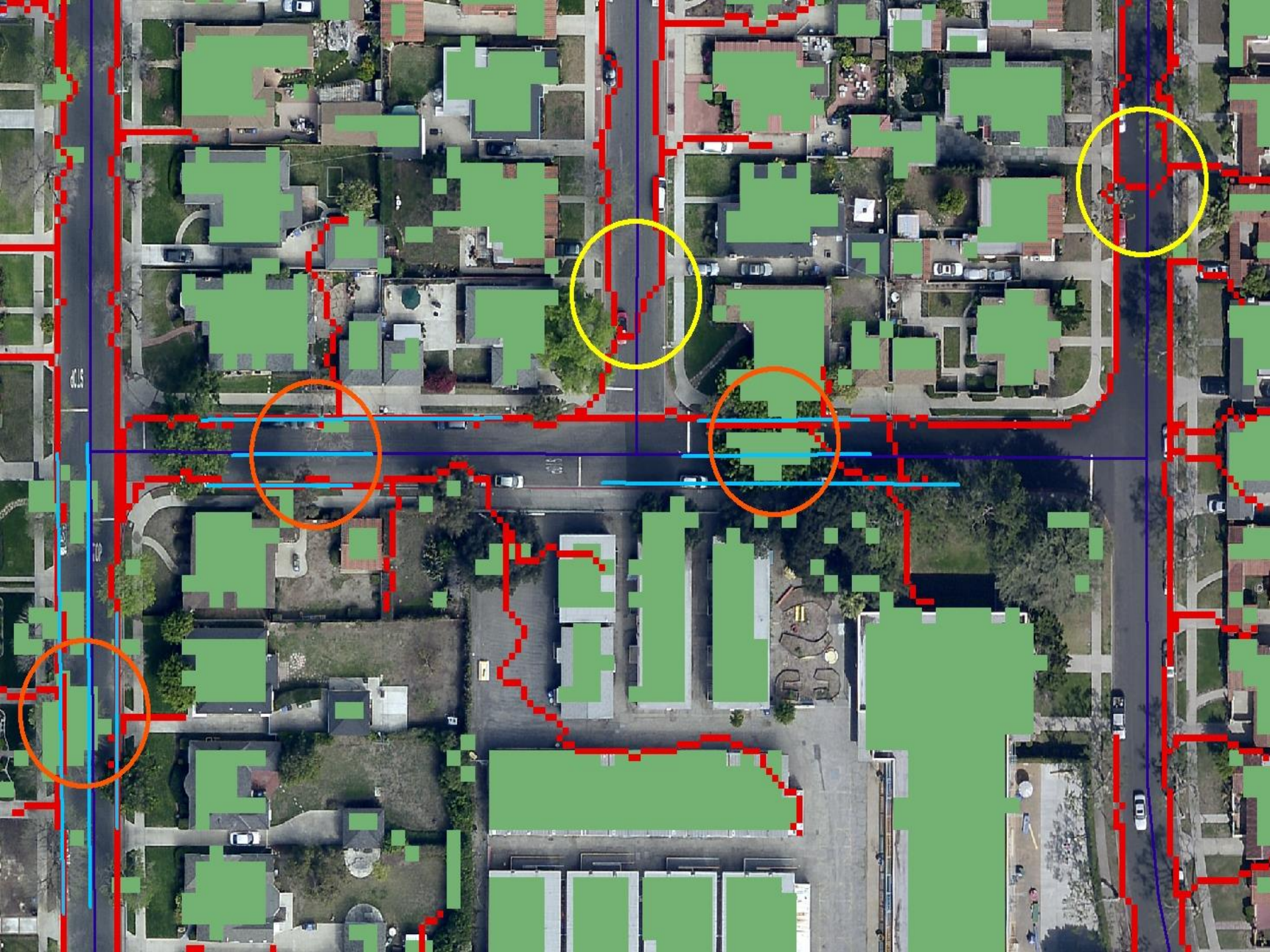


Dark Blue Watershed Too Large – surface prep issue – sinks are being over filled, need a sink mask.



Small Blue Watershed Too Small – surface is correct, point is in the wrong place, move to the right.





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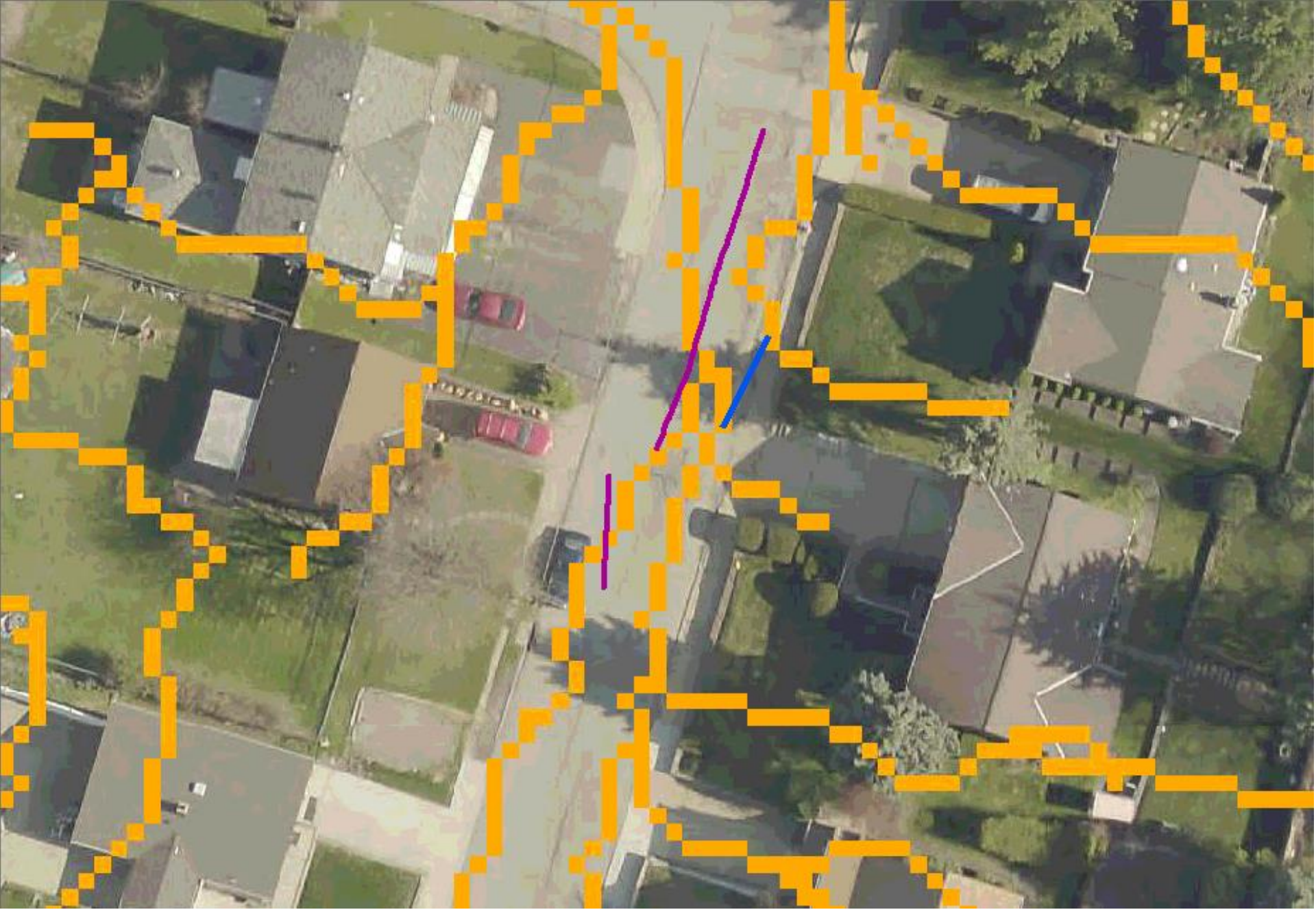

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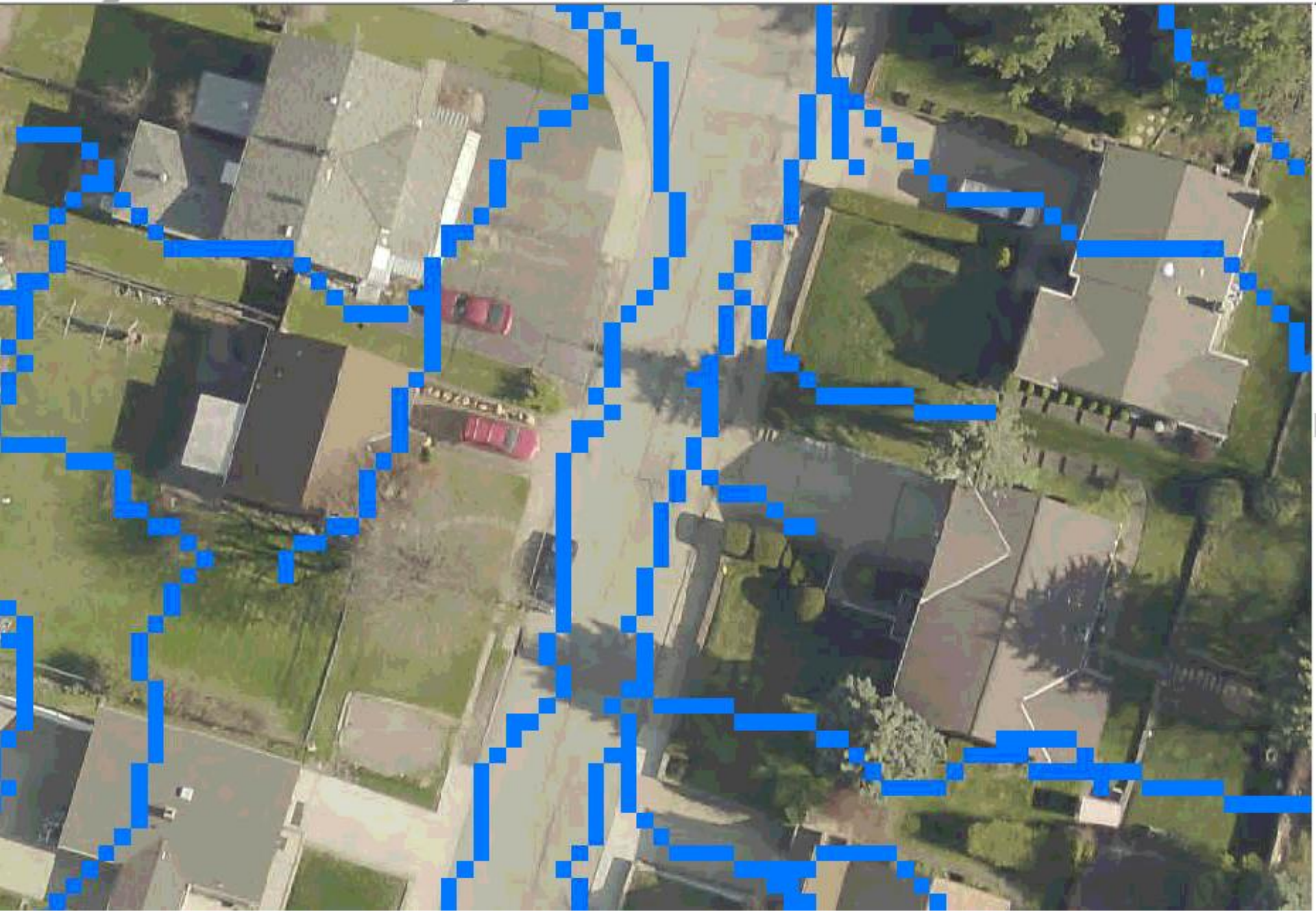

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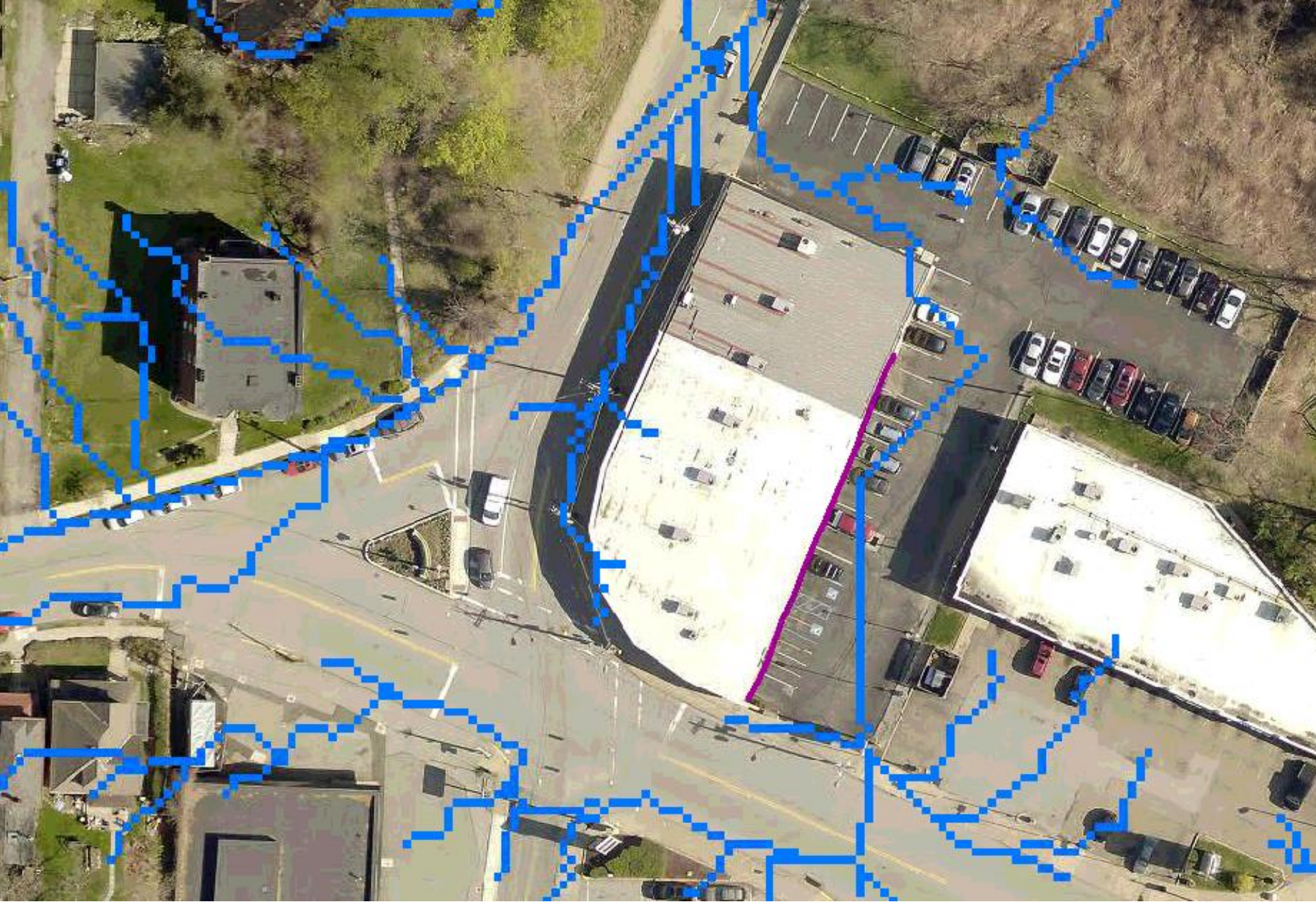

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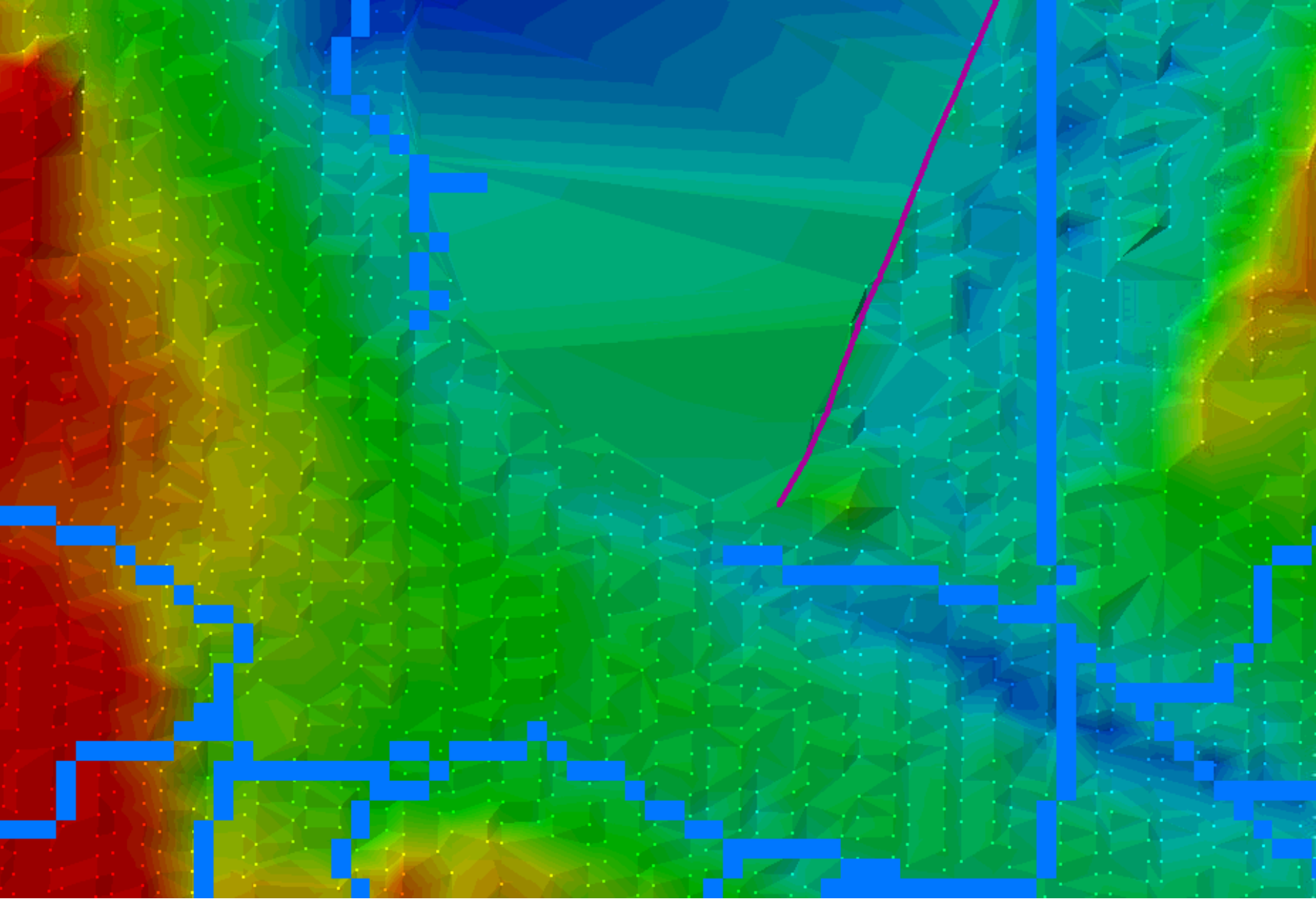

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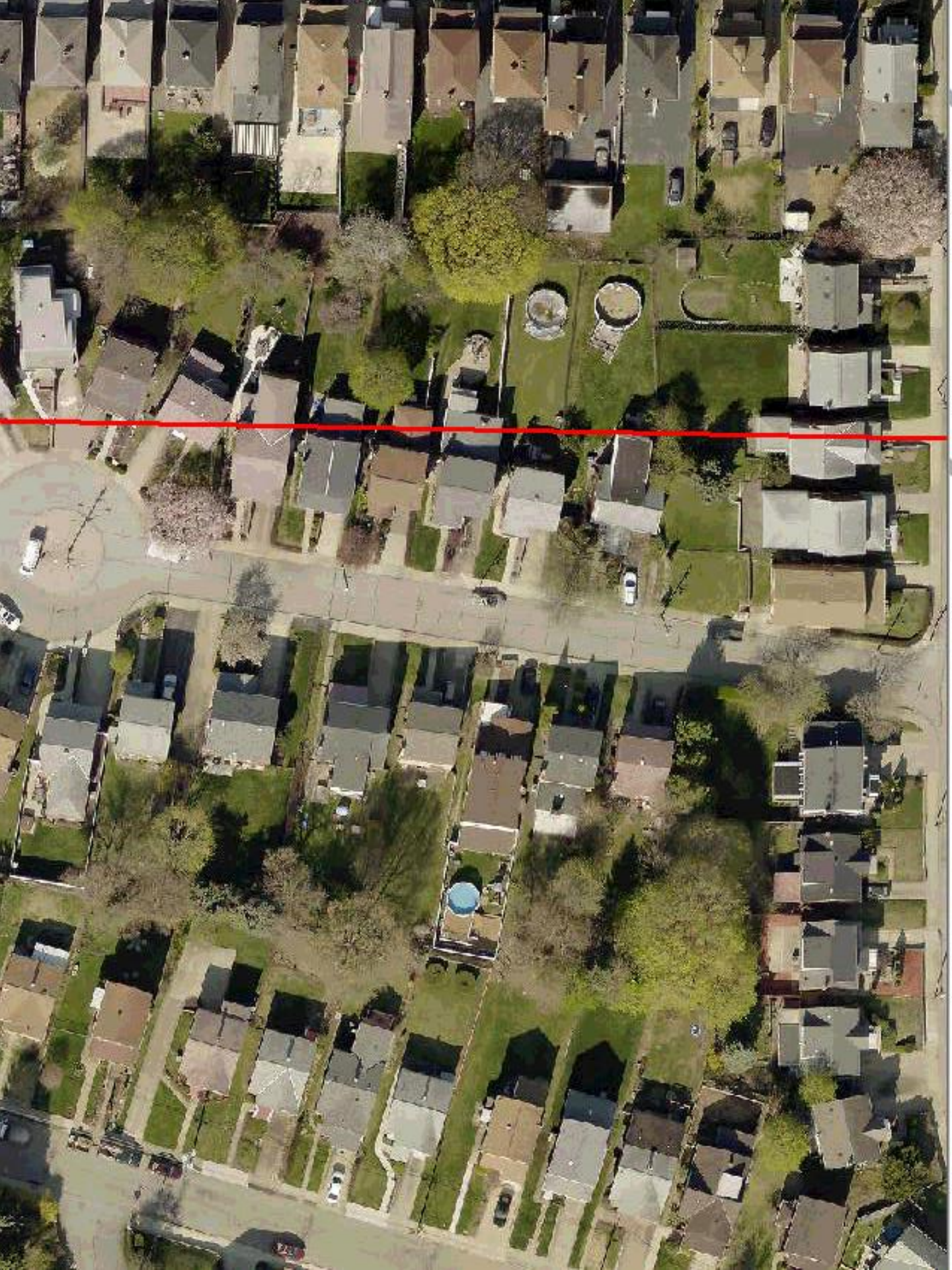
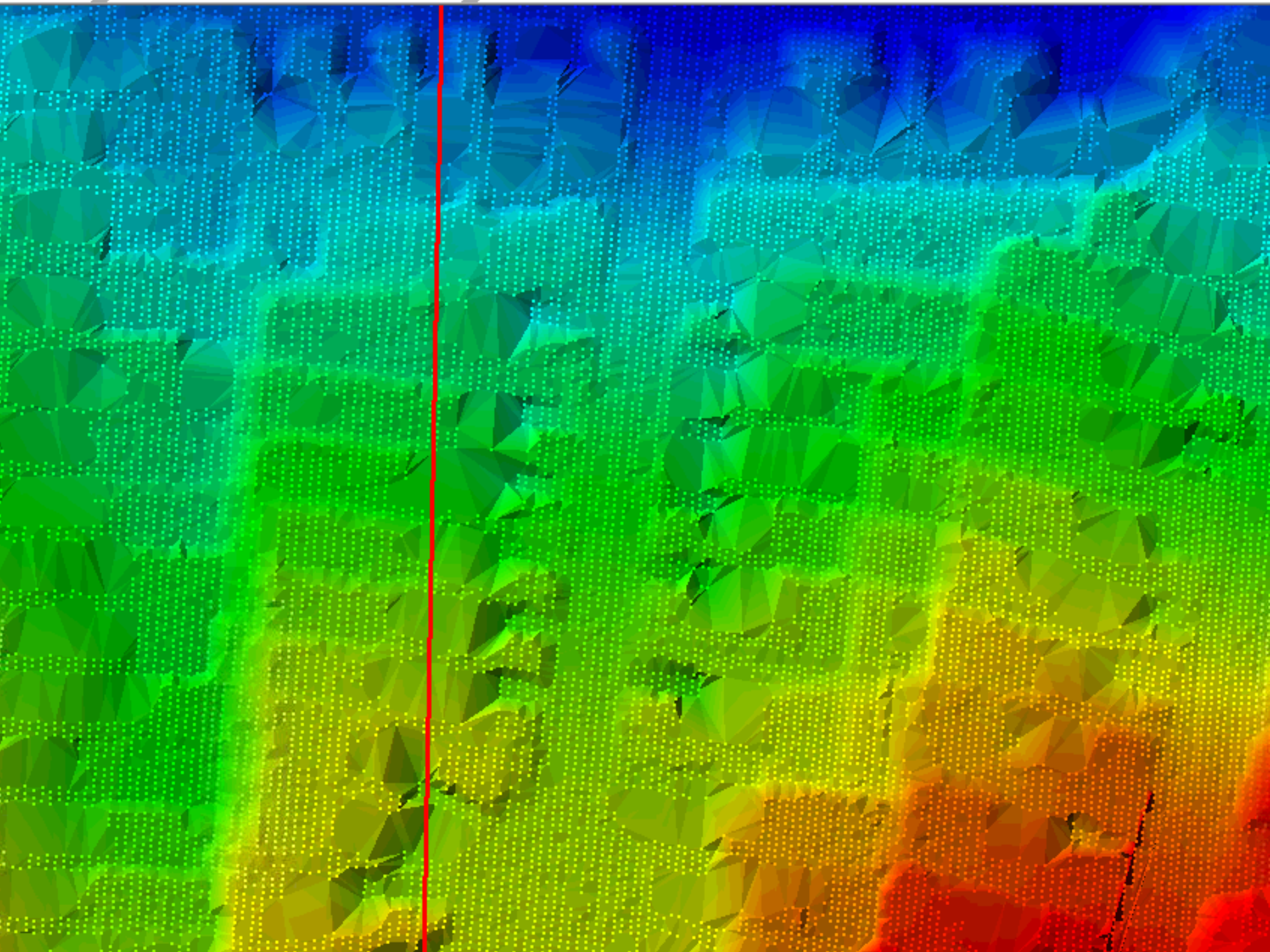
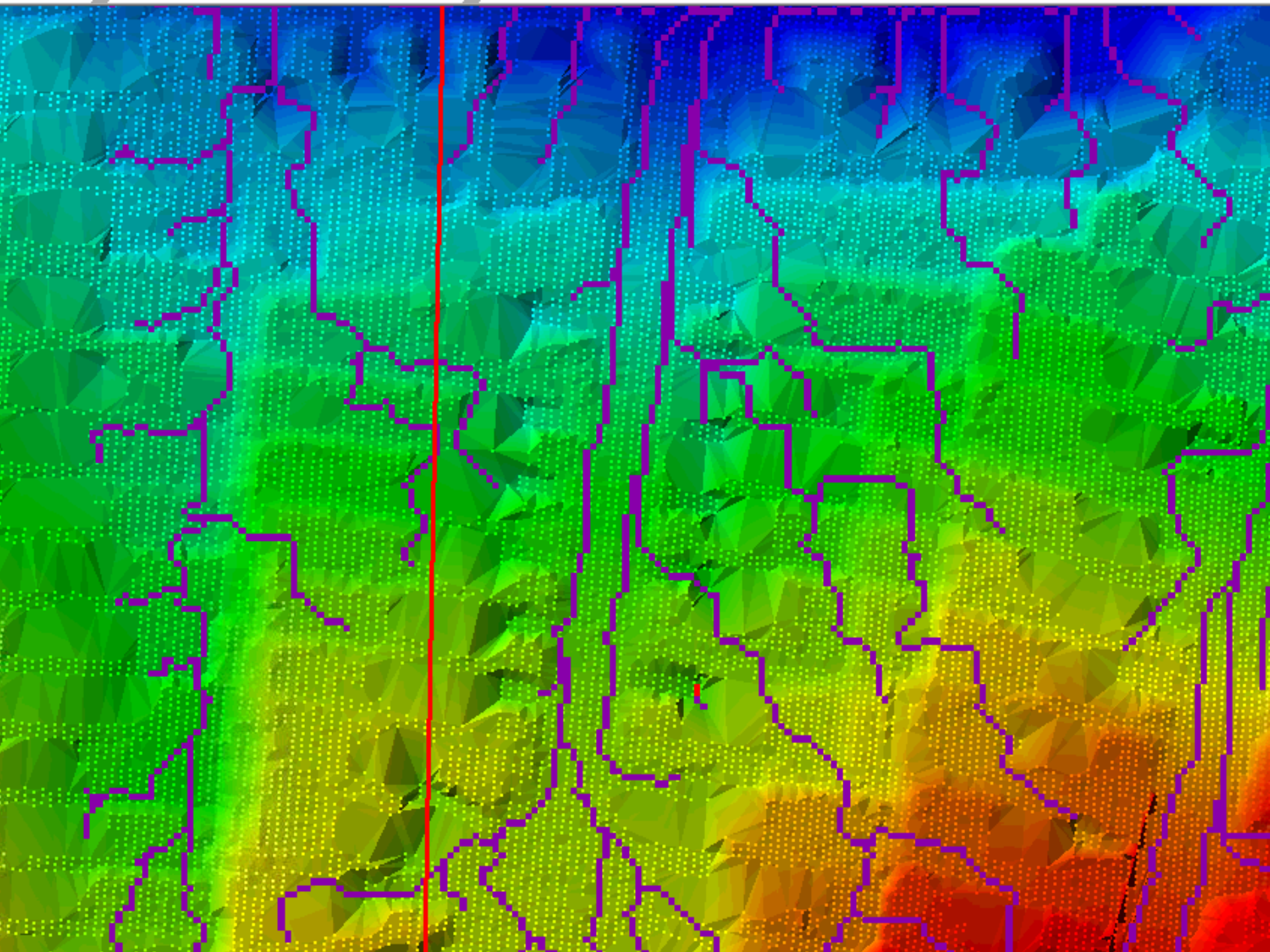
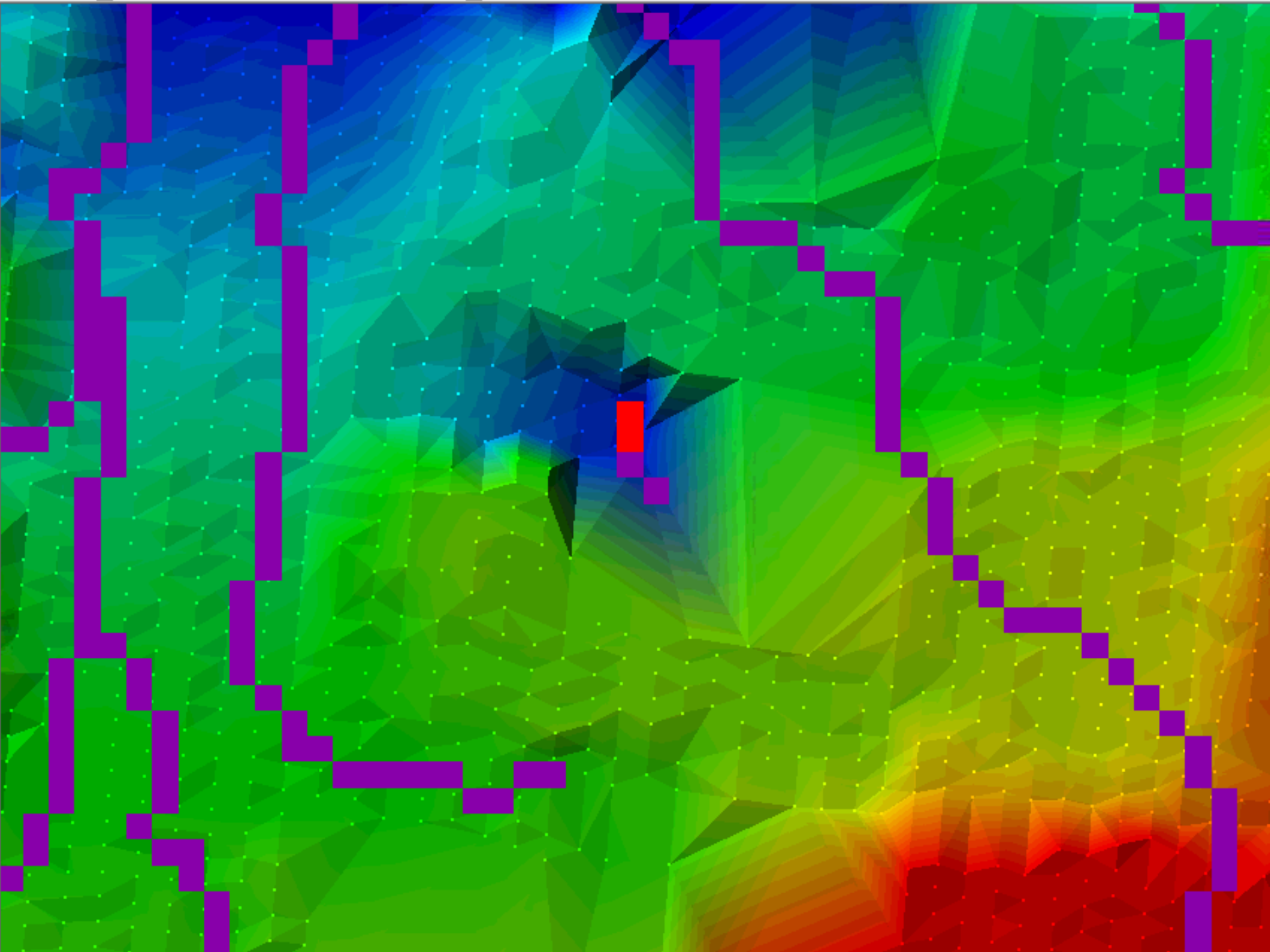
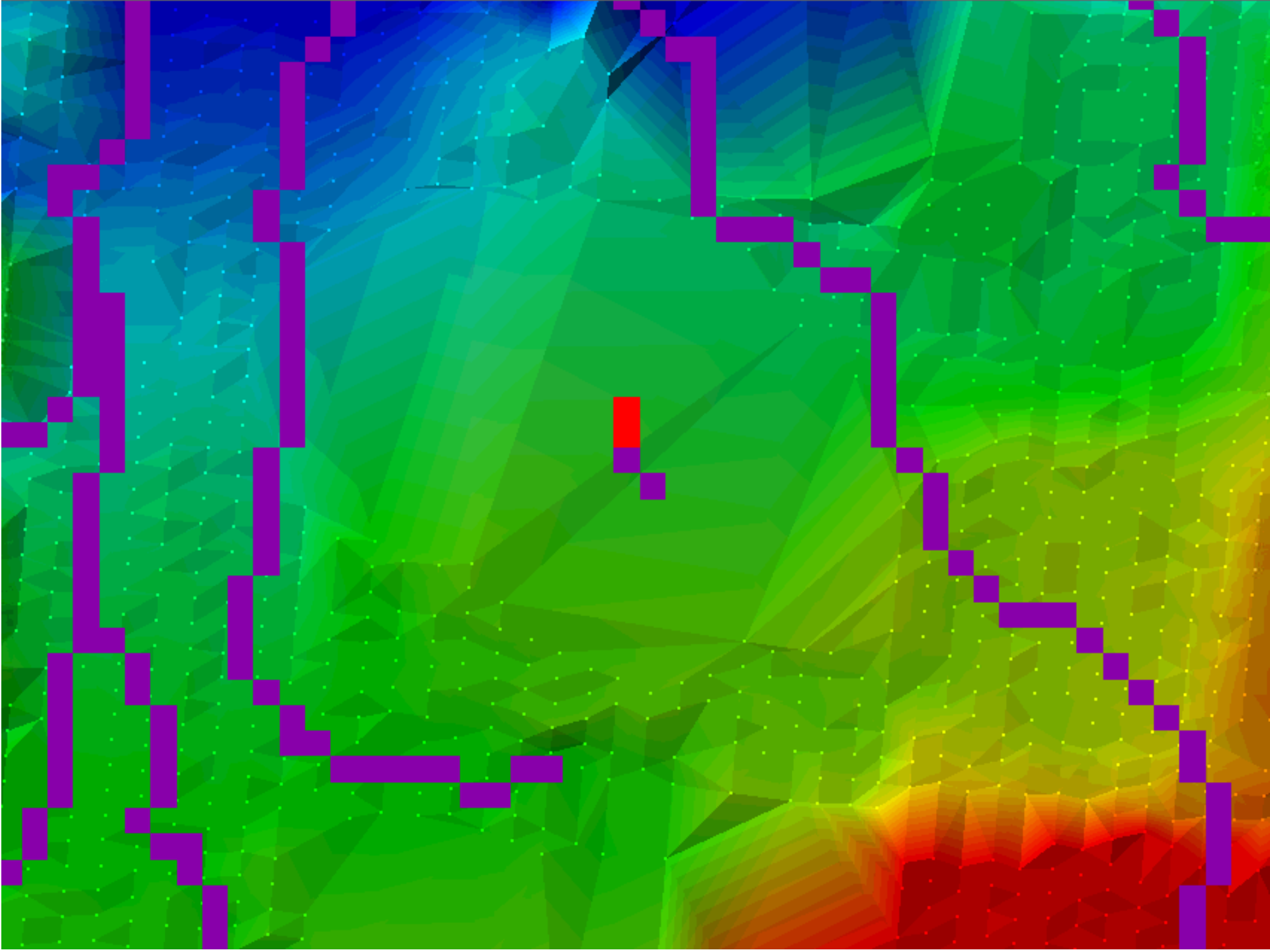
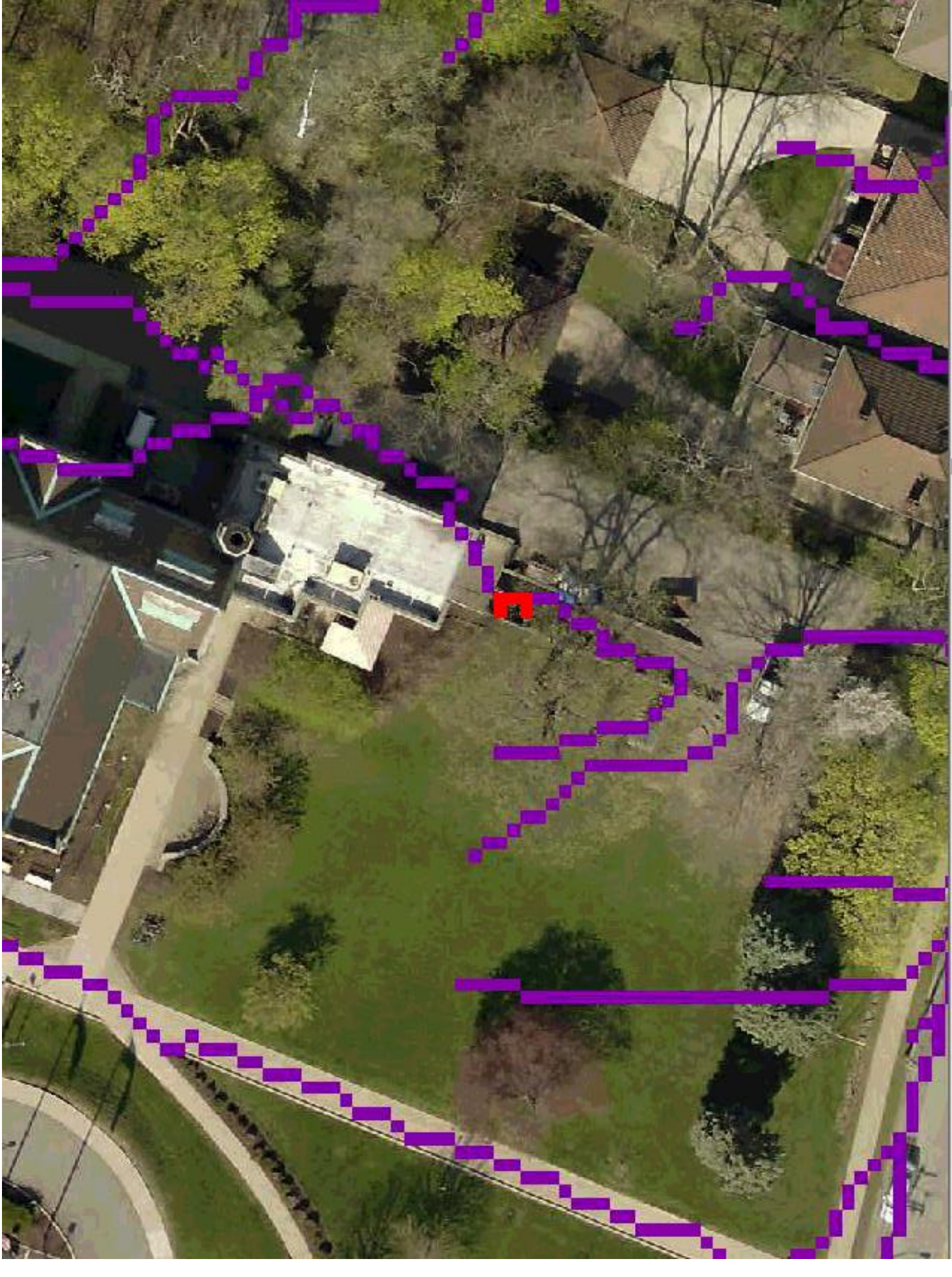


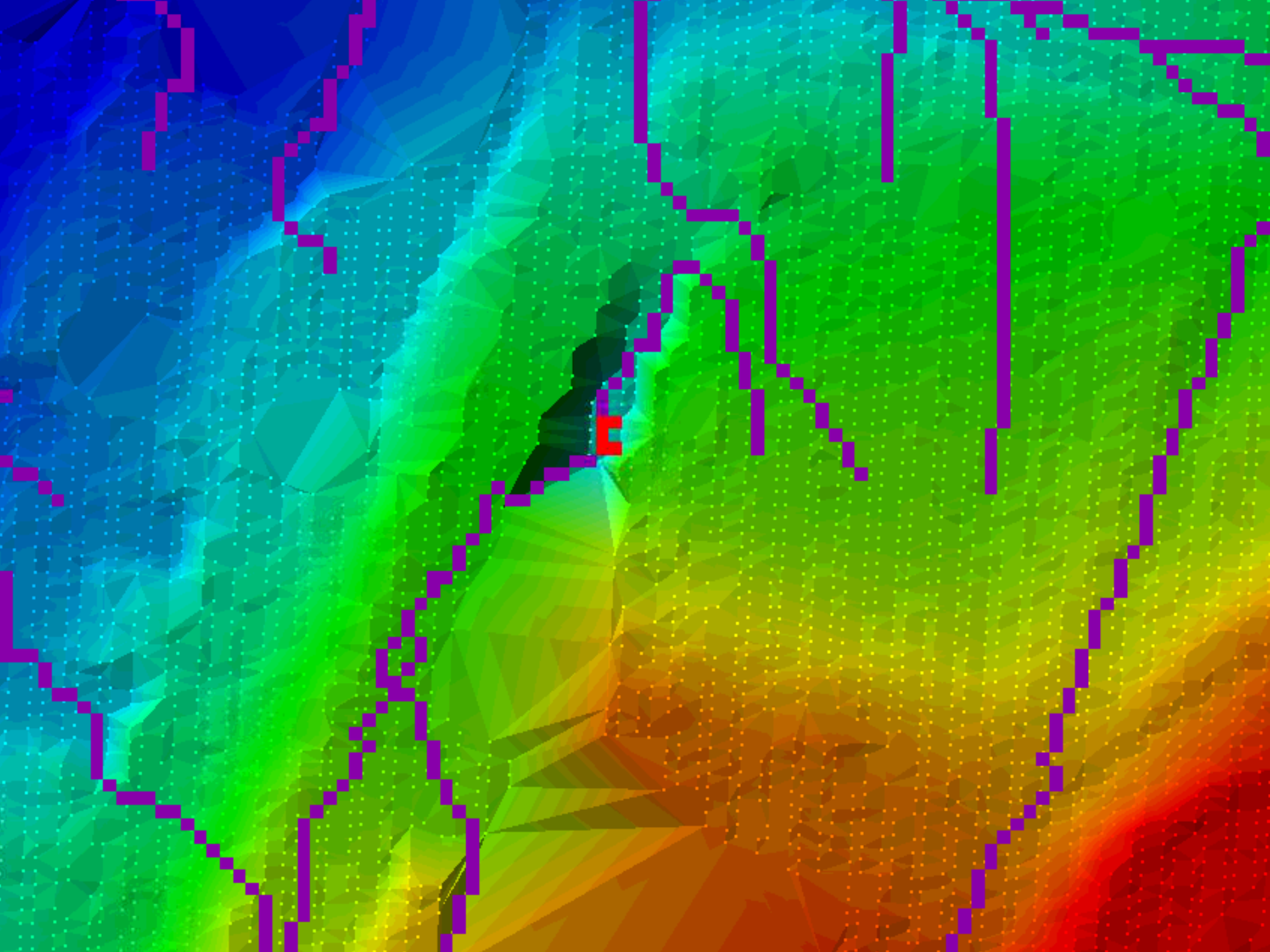


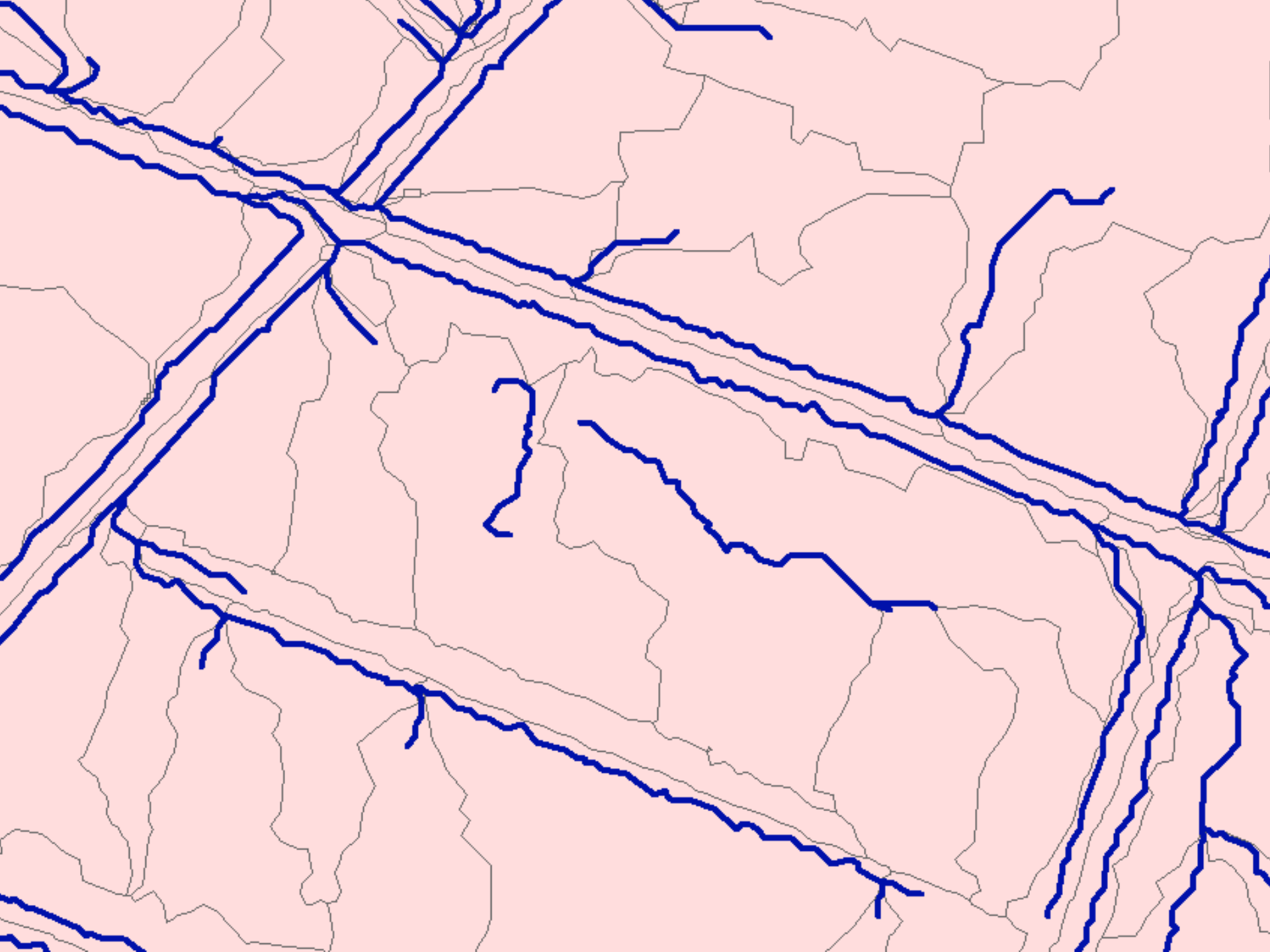


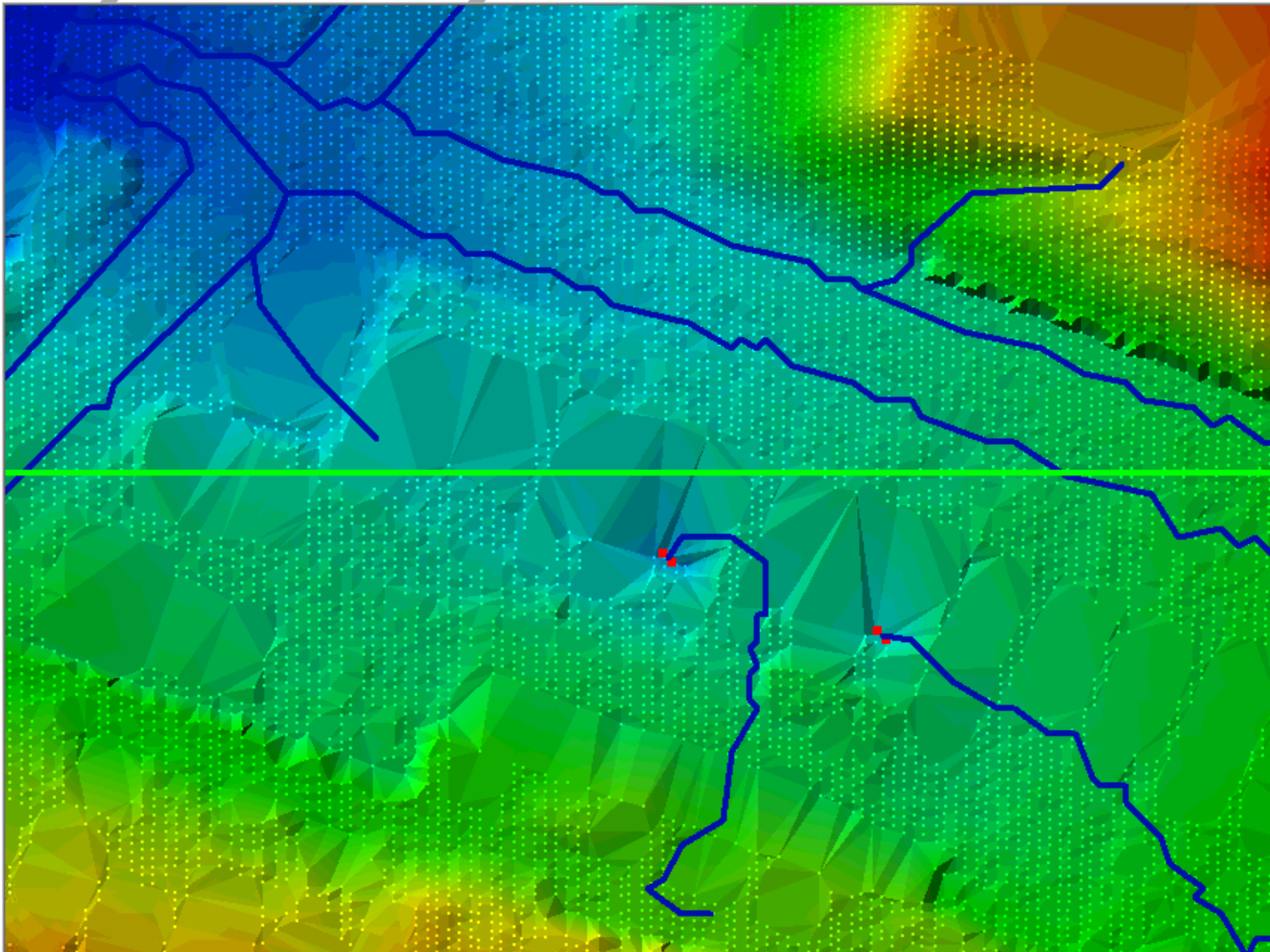


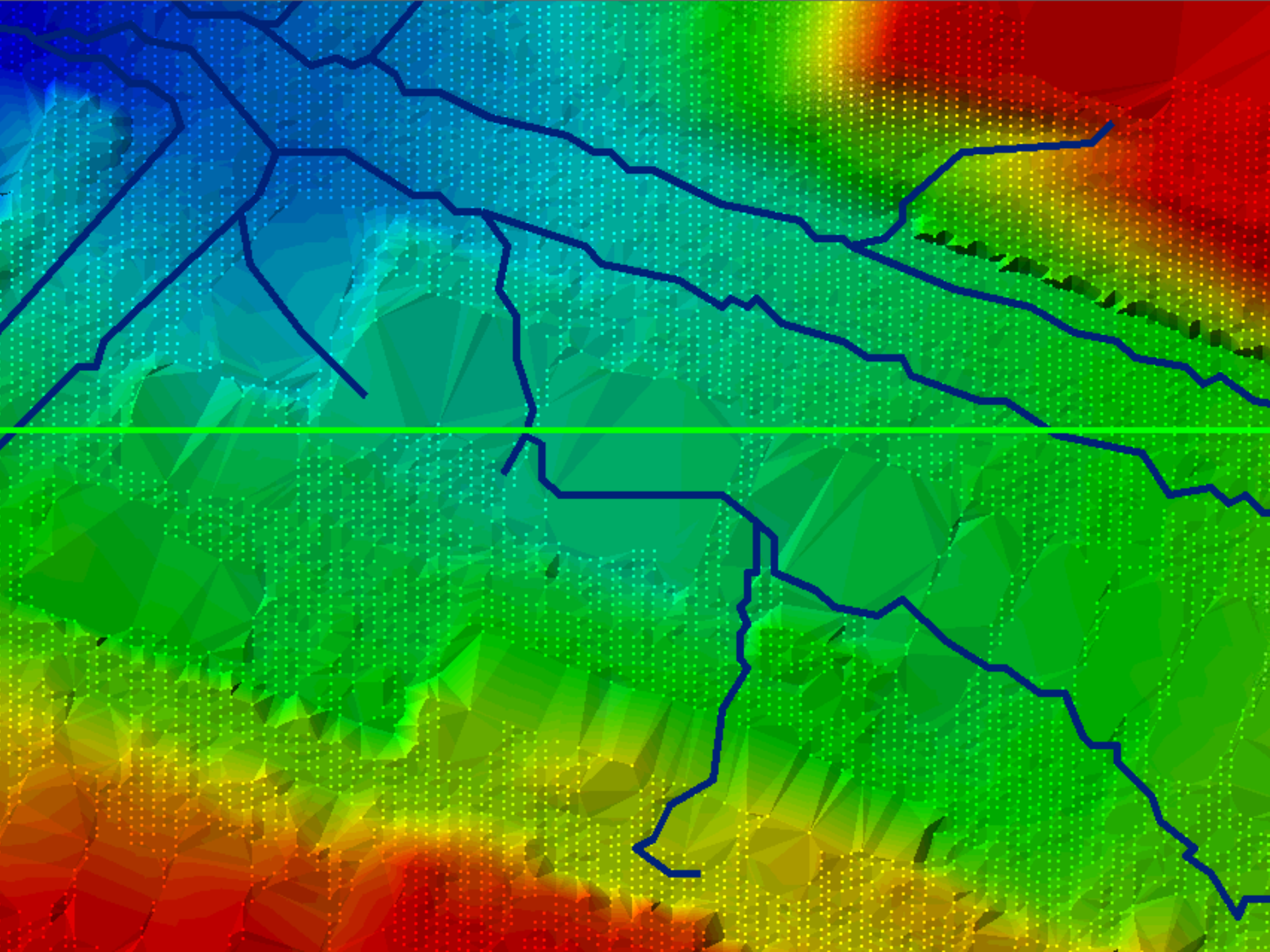




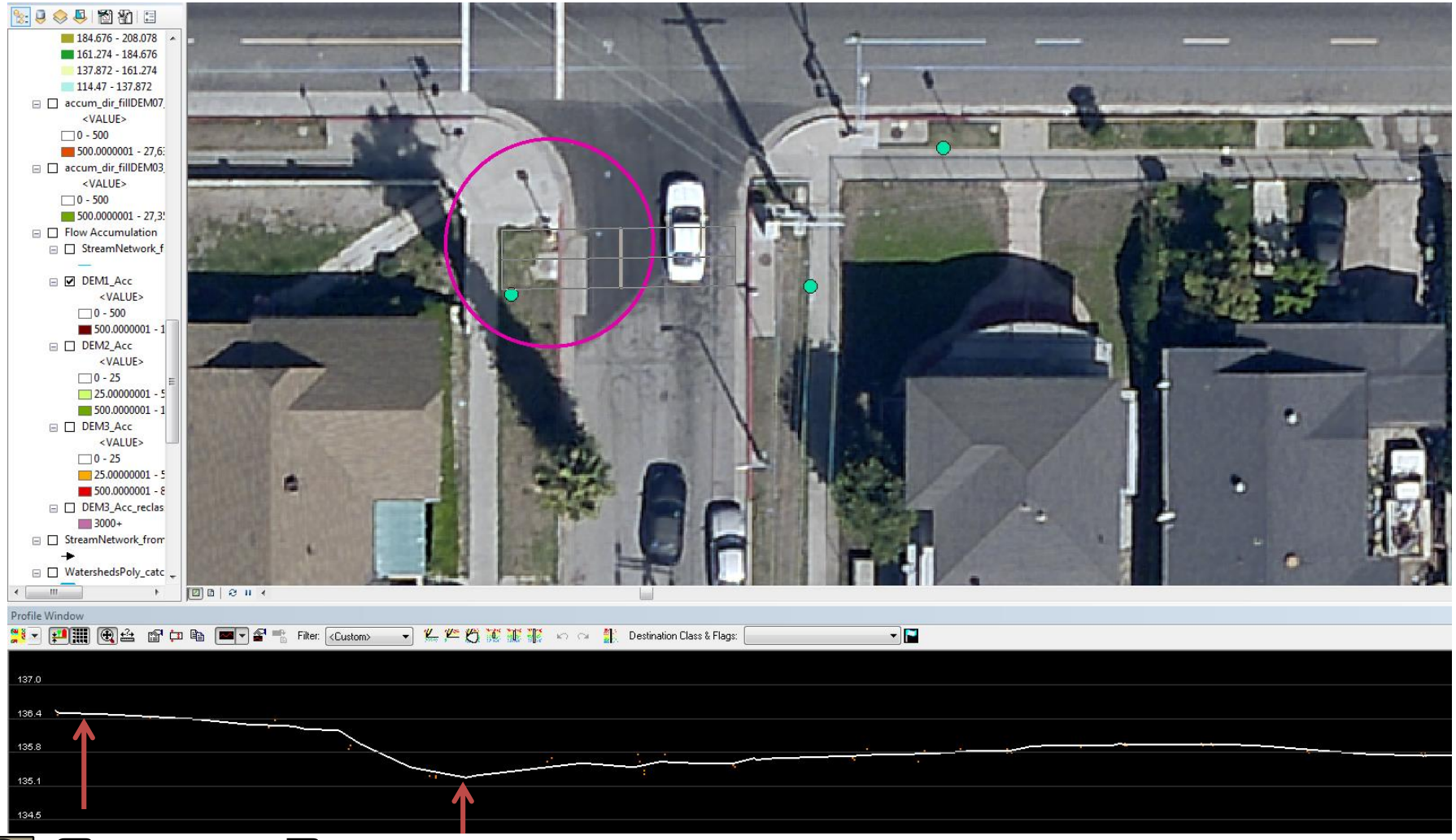








Catch Basin (Drain) Issues



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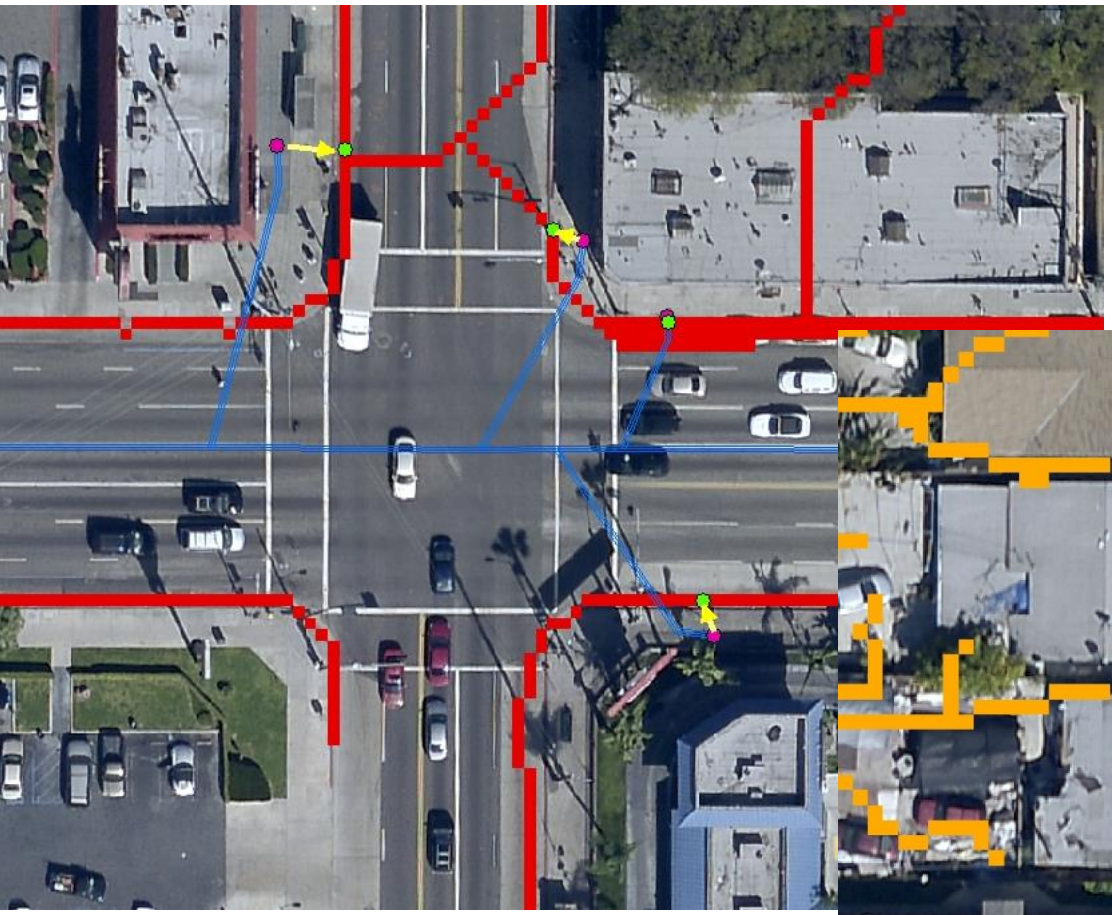
137.0
136.4
135.8
135.1
134.5

Catch Basin Points Must Be Moved



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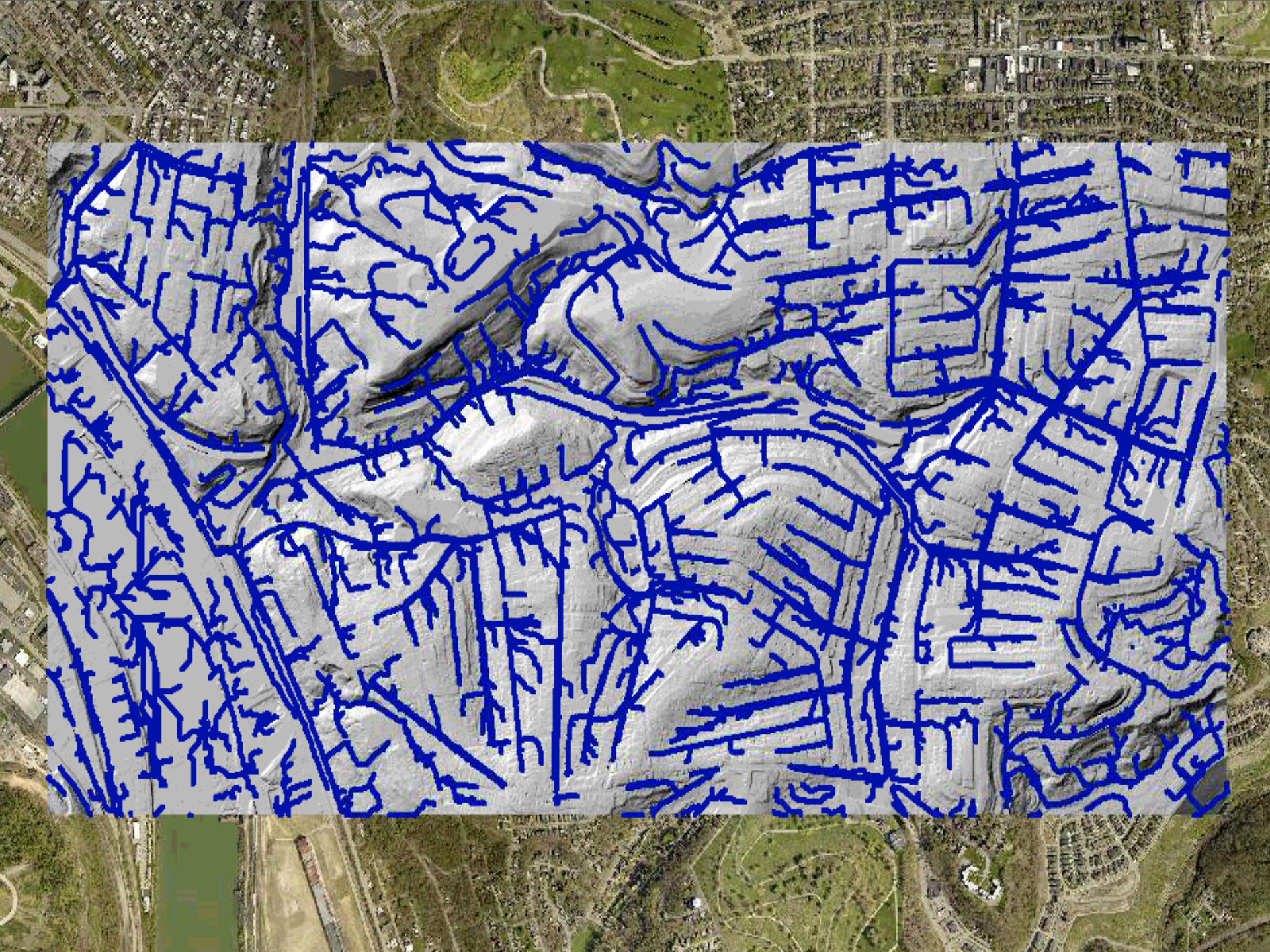
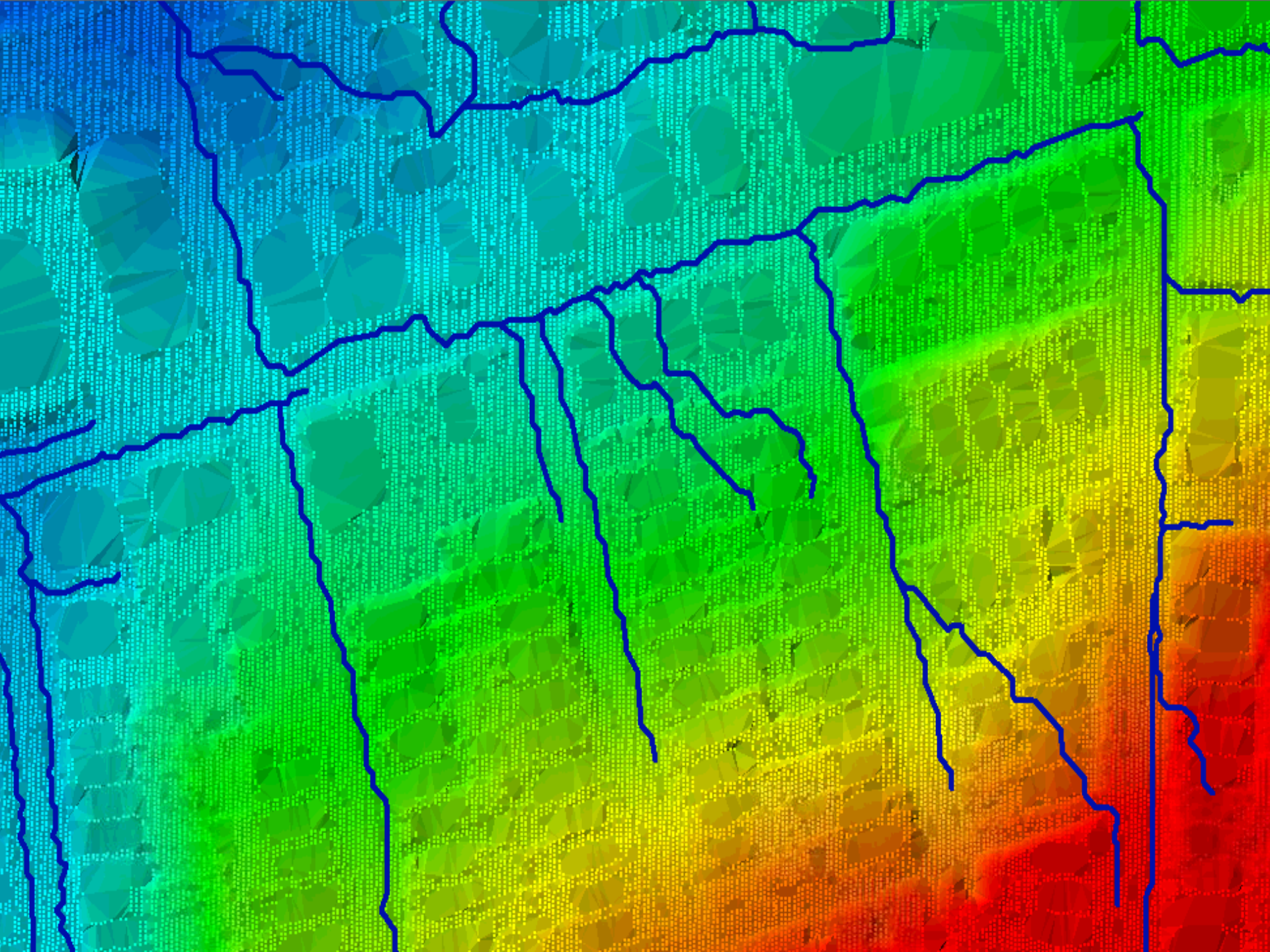
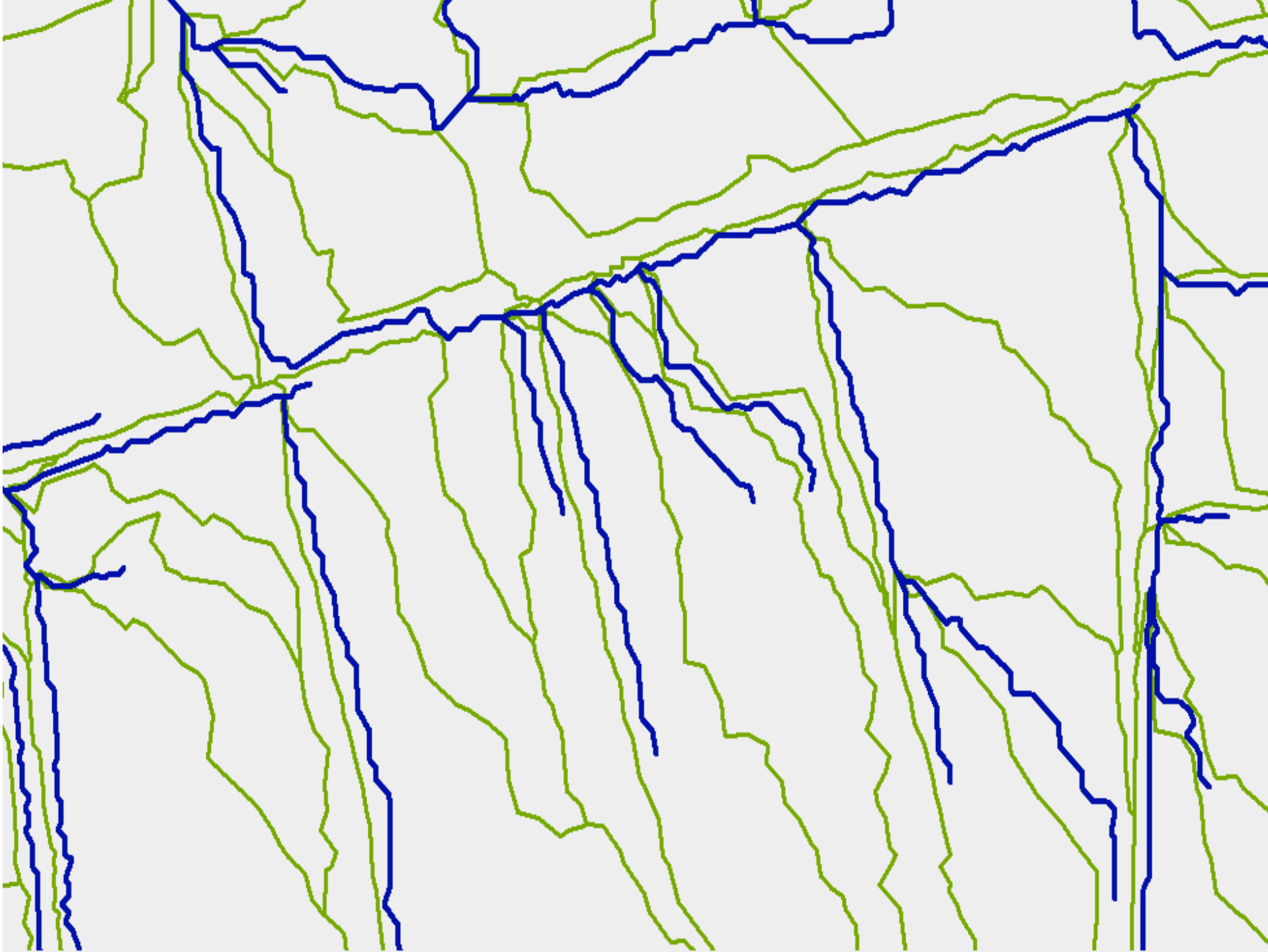
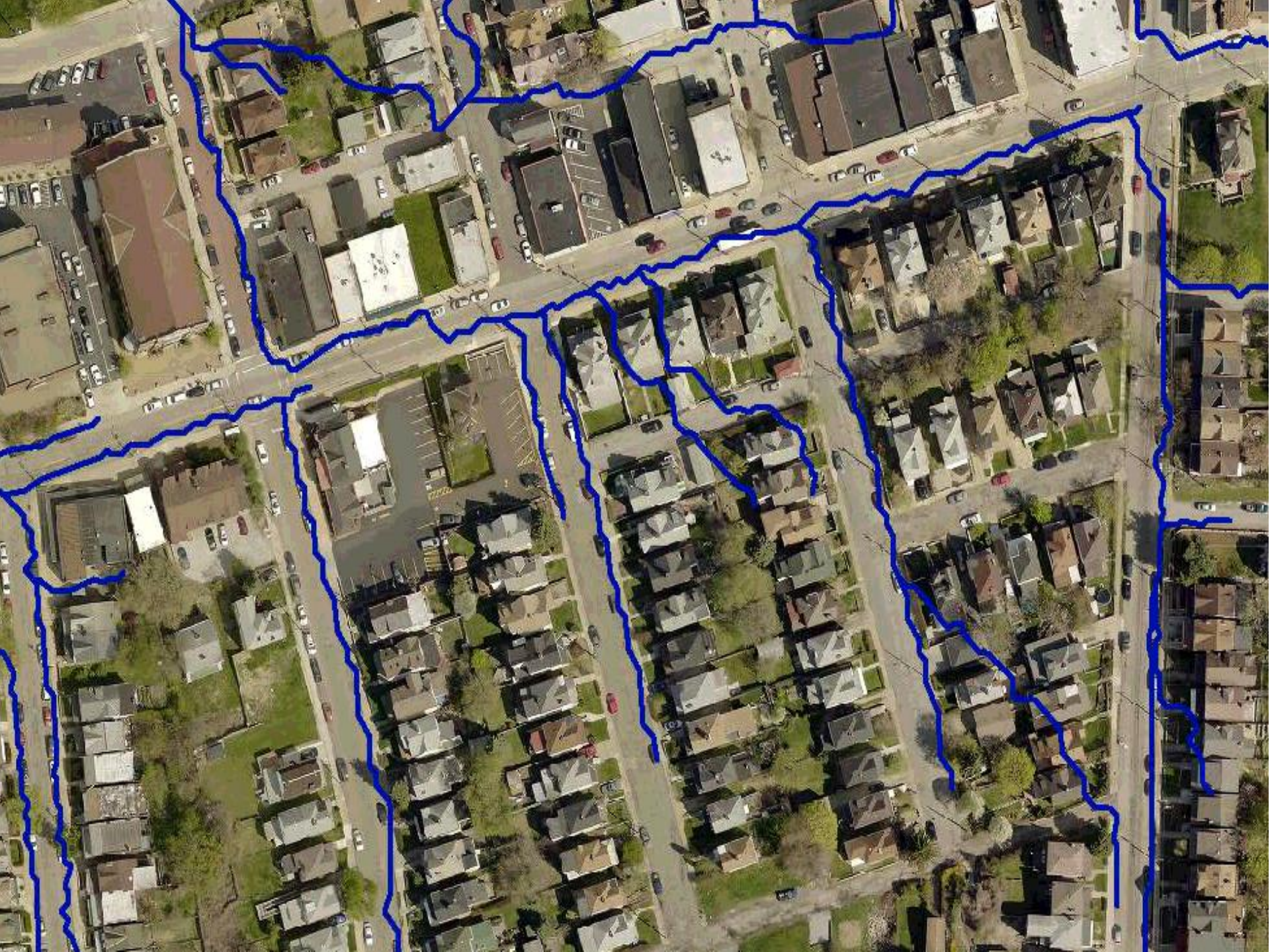


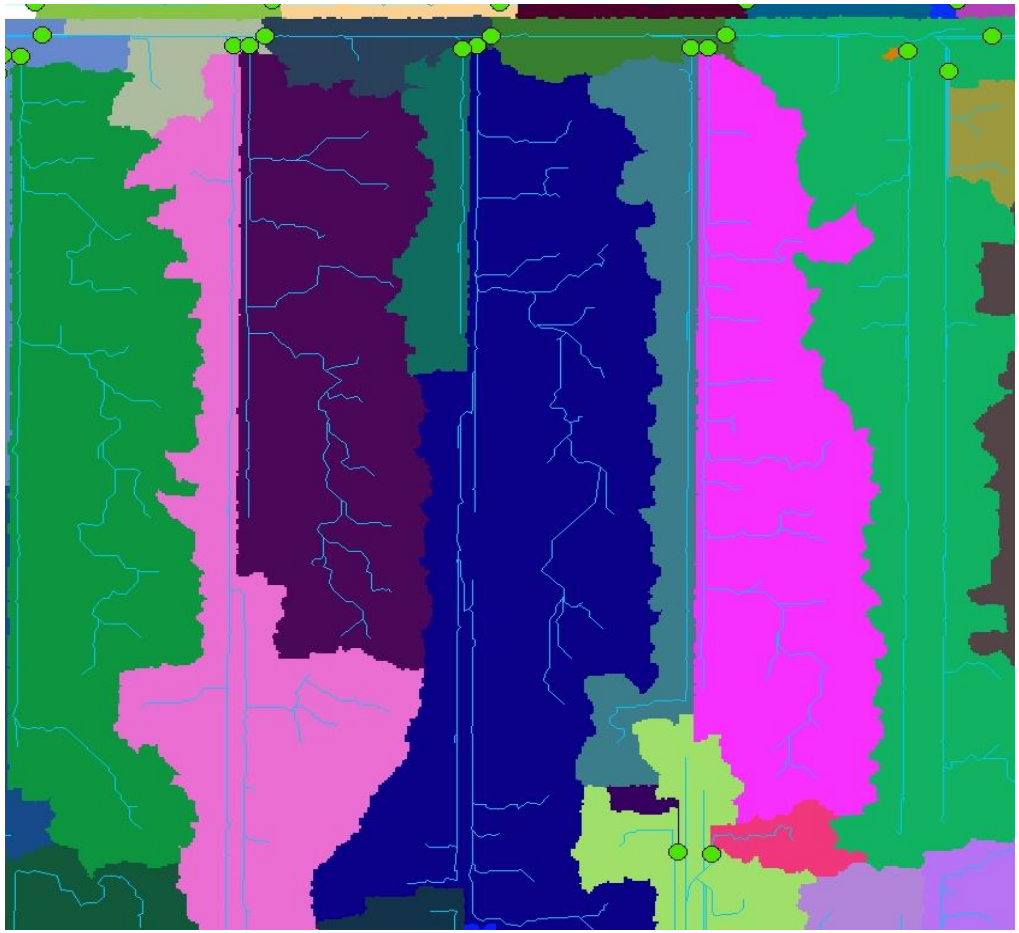






Conclusions

- Workflow is iterative
- Prepare the surface!
  - Prepare the surface
    - Prepare the surface
      - Prepare the surface



Lessons Learned

- **Stakeholder engagement**
  - **Get them involved in QC**
  - **Expectations: goals and priorities**
- **Process is iterative**
  - **You don't just line it up and hit the "GO" button!**
- **Not Perfect. But still FAR FAR better than field surveying method.**