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CENTER FOR GEOSPATIAL INFORMATION TECHNOLOGY

Attribute Standardization of Car Crashes and Its Potential Uses

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Attribute Standardization

The Center for Geospatial Information Technology at Virginia Tech (CGIT) is working in support of the Virginia Department of Motor Vehicles Highway Safety Office to standardize the location attributes of all police-reported crashes in the Commonwealth of Virginia. This data is used by highway safety officials to identify particularly dangerous intersections and road segments across the commonwealth.

All Car Crashes 2018
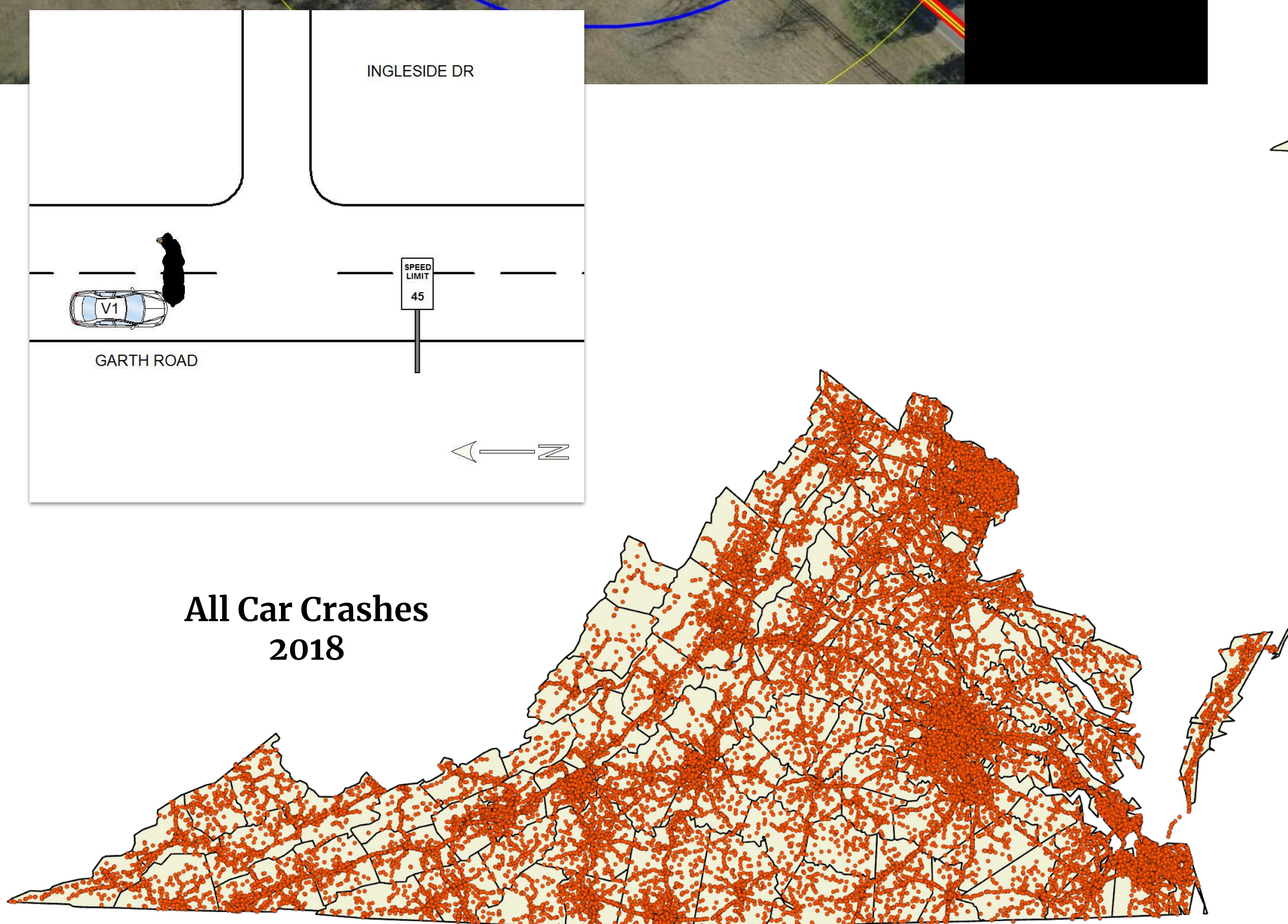
The attribute standardization processes begins with interpreting the provided crash documentation to identify the best location to describe the first harmful event of a crash. Attributes from authoritative datasets, from organizations such as the Virginia Department of Transportation and the Virginia Geographic Information Network, are assigned in order to provide a standardized record for each crash. The data created by CGIT is appended to the official crash documentation in TREDS (Traffic Records Electronic Data System), becoming available for highway safety officials across Virginia.

Data Exploration

Because so many attributes are collected from each crash and standardized to be comparable to one another on a state level, there is a wide variety of analyses that can be done with this data. Some examples include:

Alcohol Related Crashes 2018

Speed Related Crashes 2018
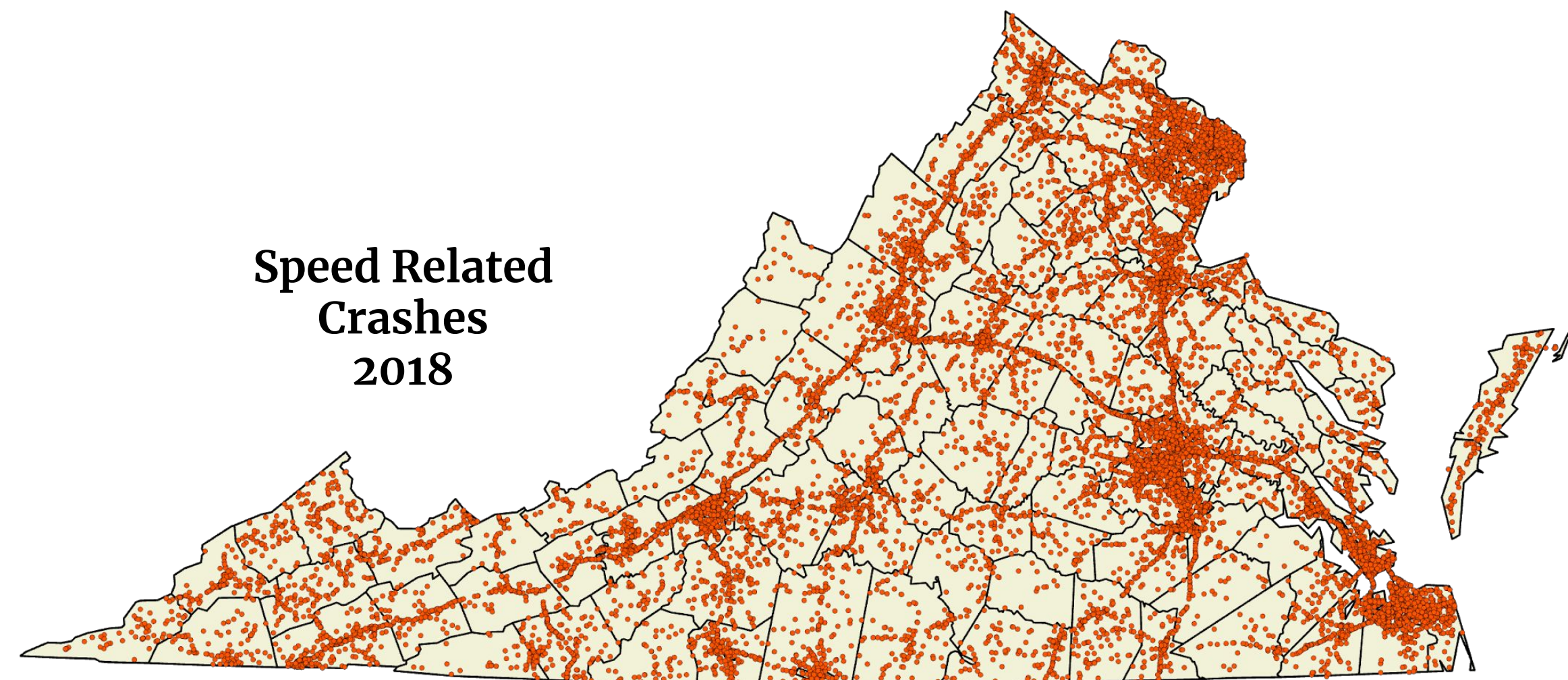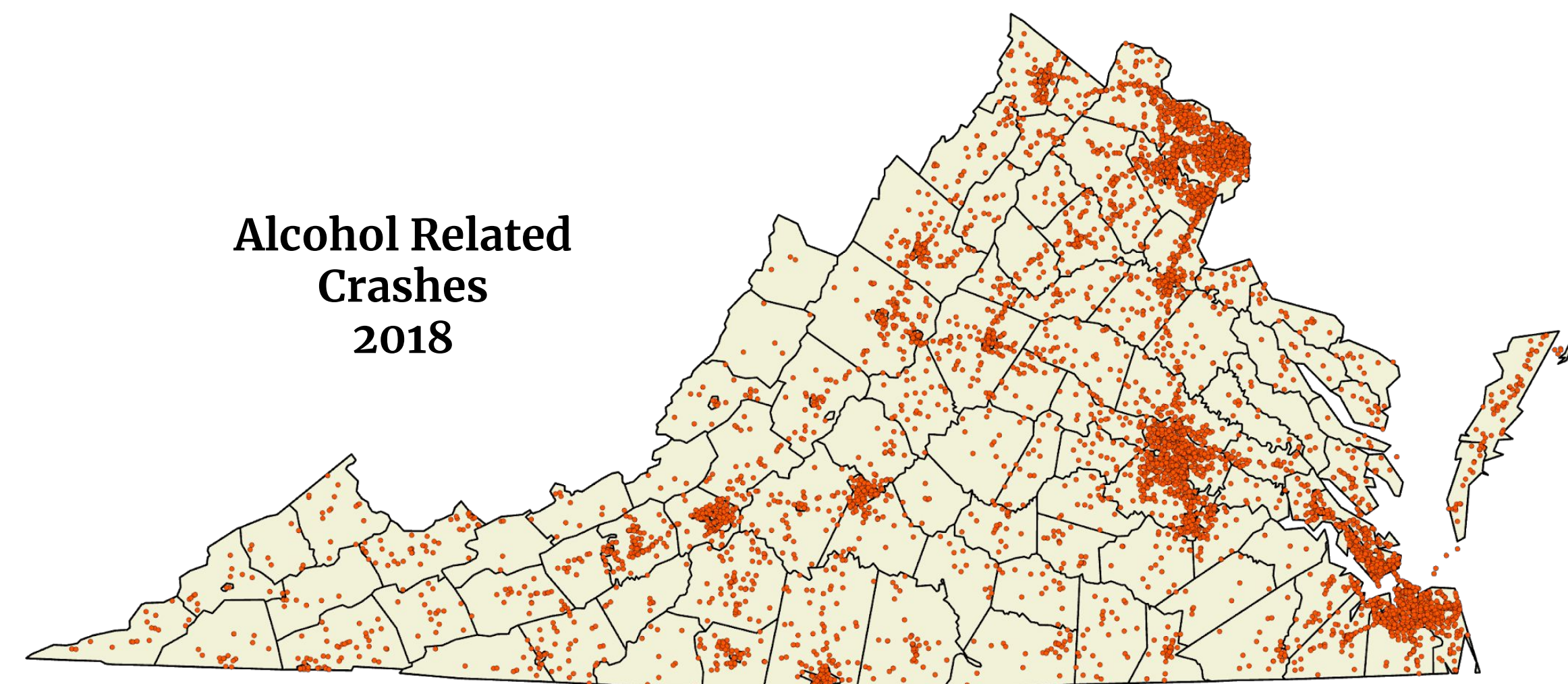
Based on a recent pattern, bear-related crashes were examined. Animal-vehicle collisions are not uncommon, especially thanks to deer, but there is little literature on animal-vehicle collisions involving bears. Due to the veracity of the data from standardizing attributes, it was possible to conduct an exploratory analysis into the matter of black bear (*Ursus americanus*) crashes.

WUI Census Blocks and Bear-Related Crashes

- verified bear crash locations
- WUI
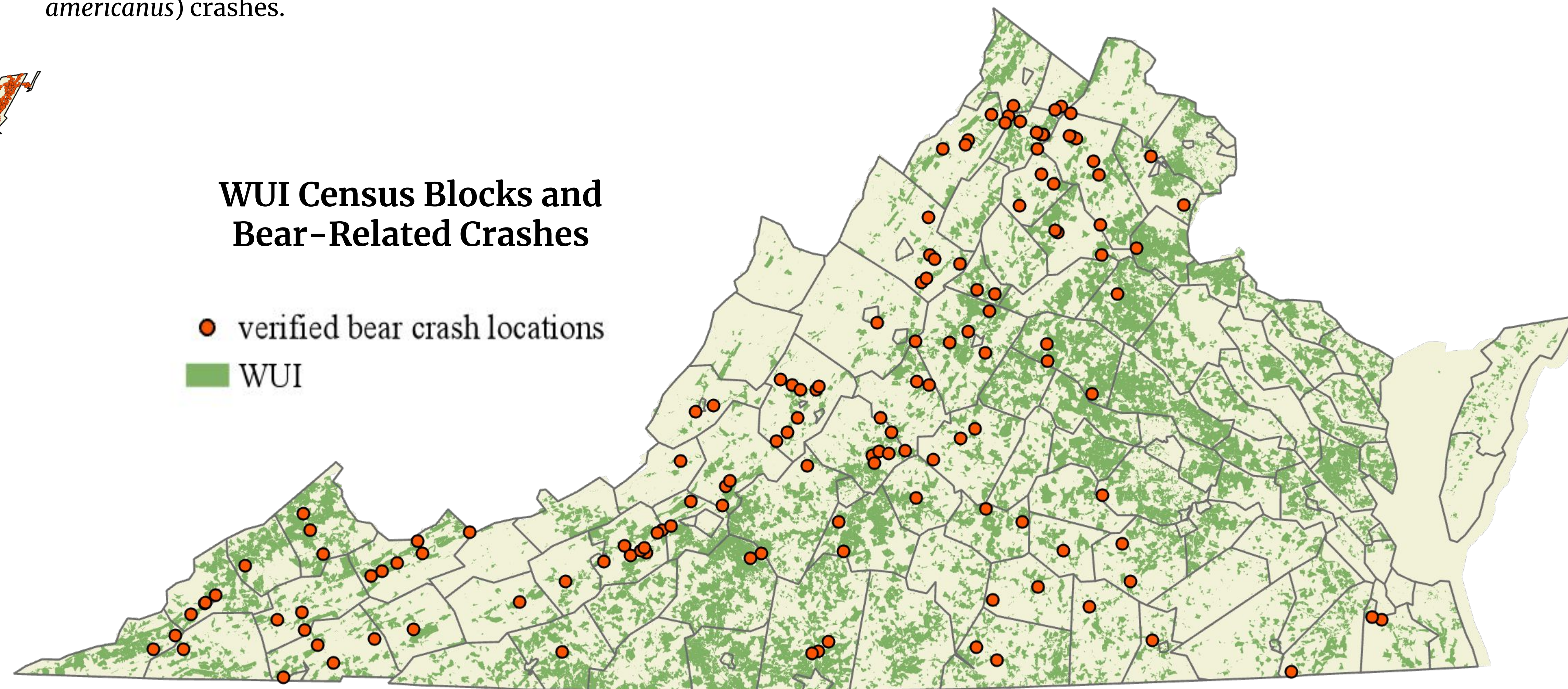
Black Bear Crashes

Finding Crashes Involving Bears

Search for the keyword "bear" in all crash narratives

↓

Read through the narratives for each selected crash

↓

Separate the crashes that actually involve bears from the ones that don't

↓

Use "Crash_ID" to retrieve point data for the crashes involving bears

Determining Distance to WUI Census Blocks

Use NLCD and US Census data to find Census Blocks with ≥6.17 housing density and >50% vegetation cover

↓

Overlay point data of crashes involving bears

↓

Use "Near" tool

↓

Create a histogram of distances generated by the "Near" tool

Finding "Hot Spots"

Use "Optimal Hot Spot Analysis" tool

Aggregate using hexagon shaped neighborhoods

Aggregate using county boundaries

Analysis

Distance to WUI Census Block
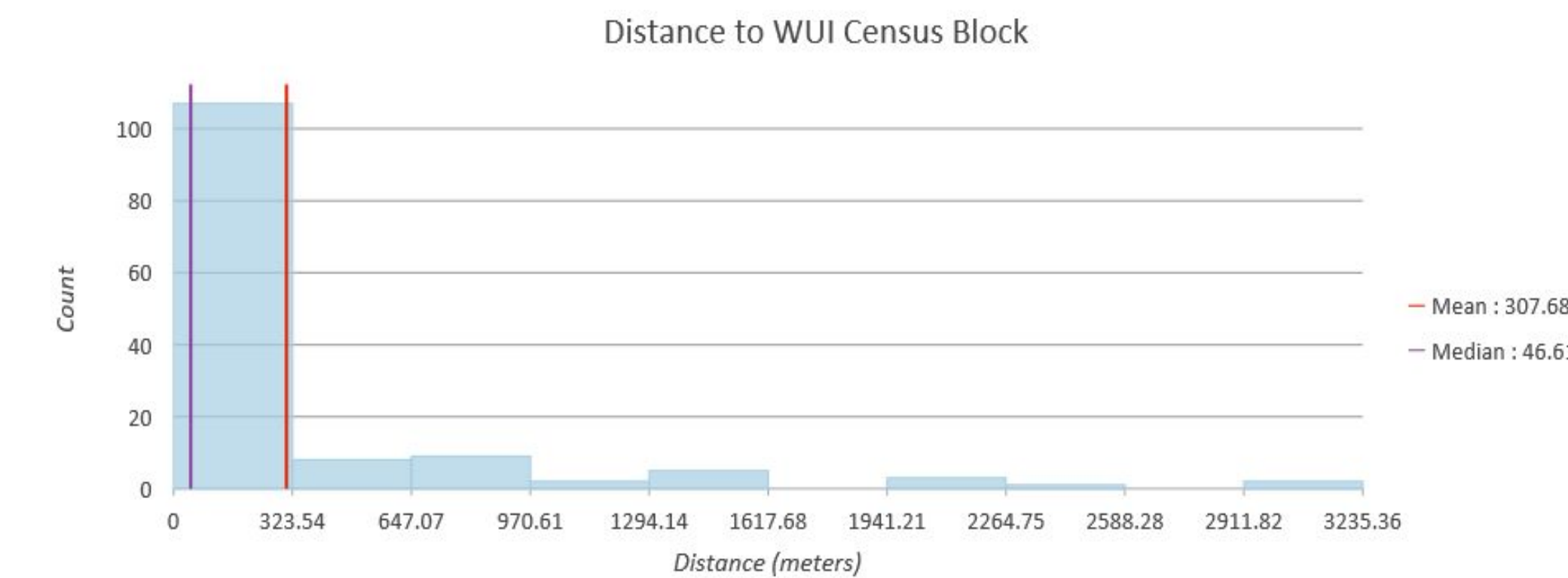
The "Near" tool in ArcPro allowed for determining how close each black bear related crash was to a WUI Census Block. The majority of the accidents were within about 325 meters. The mean value was 307 meters. This implies that areas around WUI Census Blocks may be more susceptible to car accidents involving bears. However, further analysis and more data would be required to determine if this is truly a pattern.

Hot Spot Analysis–Aggregated with Hexagonal Neighborhoods
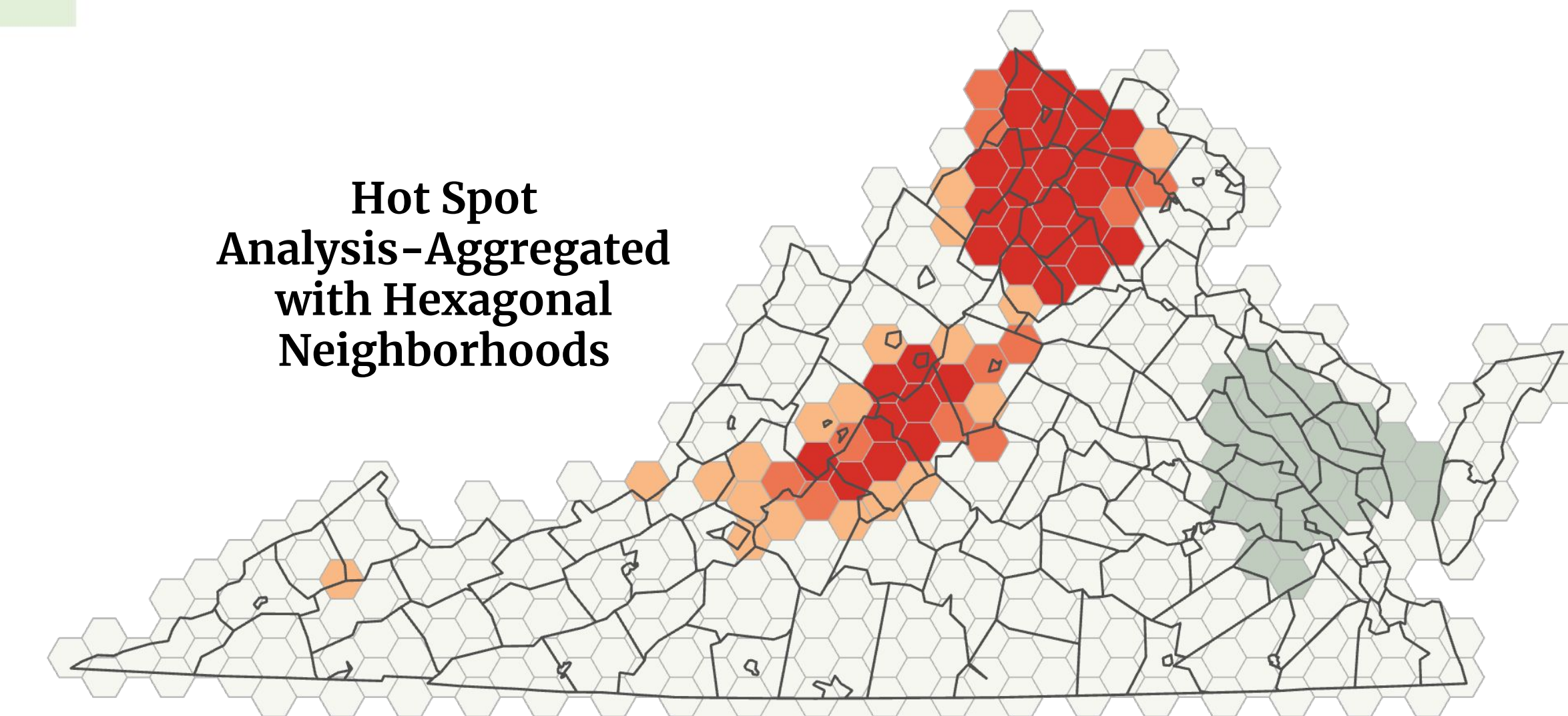
The "Optimized Hot Spot" tool in ArcPro determines statistically significant clusters of point data to find "hot spots" and "cold spots". The vital part of this is choosing a aggregation method, as it can drastically change the results. This is apparent in the analysis. Aggregating my a political boundary, such as counties, would not be appropriate since this is not political data. Aggregating with the hexagon is appropriate in this case. This Hot Spot Analysis shows the Winchester area as a hot-spot for bear-related crashes.

Potential Research

- Identifying specific sections of roads with high counts of bear related car accidents
- Evaluating trends over the course of several years
- Exploring possible reasons for bears to cross roads when they are known to avoid roads and other urban areas
- Establish a benchmark to assess abnormalities

Exploratory Analysis of Car Accidents Involving the American Black Bear

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Center for Geospatial Information Technology

Background

We have been working on one of the Center for Geospatial Information Technology's longest-running projects since 2017. This centers around standardizing the spatial attributes of police-reported crash records in the Commonwealth of Virginia. The Center for Geospatial Information Technology at Virginia Tech (CGIT) is working in support of the Virginia Department of Motor Vehicles Highway Safety Office's mission to improve public safety. This data is used by highway safety officials to identify particularly dangerous intersections and road segments across the commonwealth.

The standardized attributes range from road segment to weather conditions to jurisdiction. This plethora of information means that the data is amenable to all kinds of studies and exploratory analyses.

Purpose

We evaluated the crash factors and characteristics present in the dataset to better understand the potential that geospatial techniques can provide to the highway safety community. We elected to analyze crashes involving the black bear (*Ursus Americanus)* to see what observation could be made.

Animal-vehicle collisions are not uncommon by any stretch of the imagination. There are deer signs all over the commonwealth meant to mitigate the danger they pose to unsuspecting motorists. However, we began to pick up on another type of semi-common vehicle collision - those involve black bears. Many in the commonwealth are unaware that bears even live in Virginia, let alone pose a danger to motorists. Making matters worse, they exist in spades along the busy Interstate 81 corridor, are black and easily blend into the dark, and there are no signs warning motorists of the danger they pose.

Wanting to help address the issue, we chose to conduct some exploratory analyses to lay out a baseline for future studies.

Preparing the Data

Armed with the aforementioned geocoding data from 2018, we sought to explore where and how these collisions happen. To start, it was necessary to define the criteria to identify crashes involving bears. This was initially done manually by using an SQL request to obtain all records from 2018 crash data where the word 'bear' is referenced in the officer's narrative. From there, we conducted a manual sort of the remaining data to help craft future, more efficient SQL requests for other years.

After rendering the 2018 data in ArcGIS, we conducted some analyses. These included identifying routes with high incidences of bear-related crashes, overlaying crashes with known Wildlife Urban Interface zones (where housing density >6.17 housing units/km² and vegetation cover >50%), and overlaid the crashes with the known habitats of the black bear in the commonwealth to see if and how they differed.

Methods

After looking at our options for a basic, exploratory analysis, we decided to look at distance to WUI (Wildland Urban Interface) Census Blocks and an Optimized Hot Spot Analysis.

- Distance to WUI
  - WUI mapping
    - Used NLCD and U.S. Census data to identify Census Blocks that have a at least 50% vegetation cover and housing densities 6.17 units or more
  - Overlaid bear-related crash point features
  - Used the "Near" tool in ArcPro to find distance to closest WUI from each point
- Hot Spot Analysis
  - Used the "Optimized Hot Spot Analysis" tool in ArcPro
    - Aggregated by county
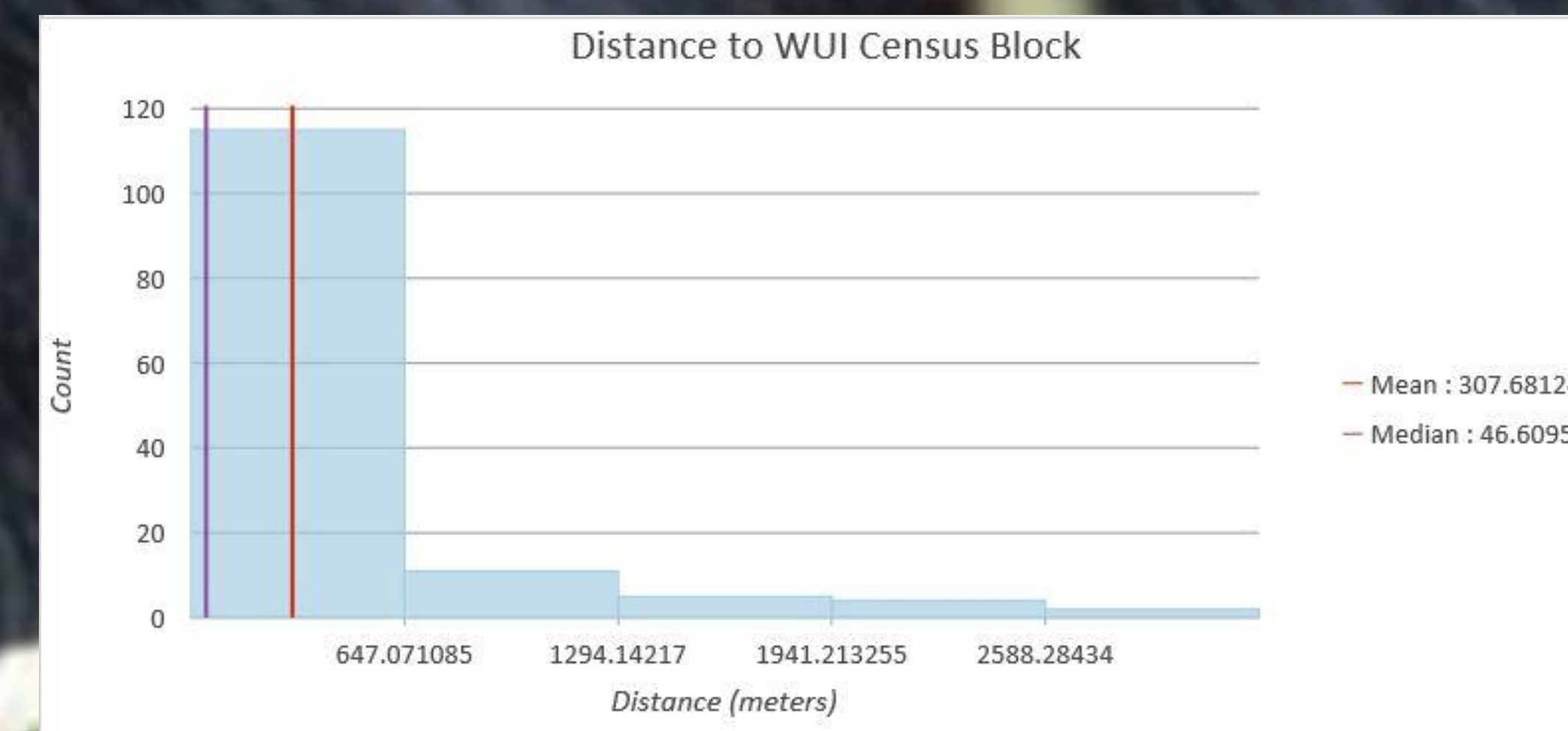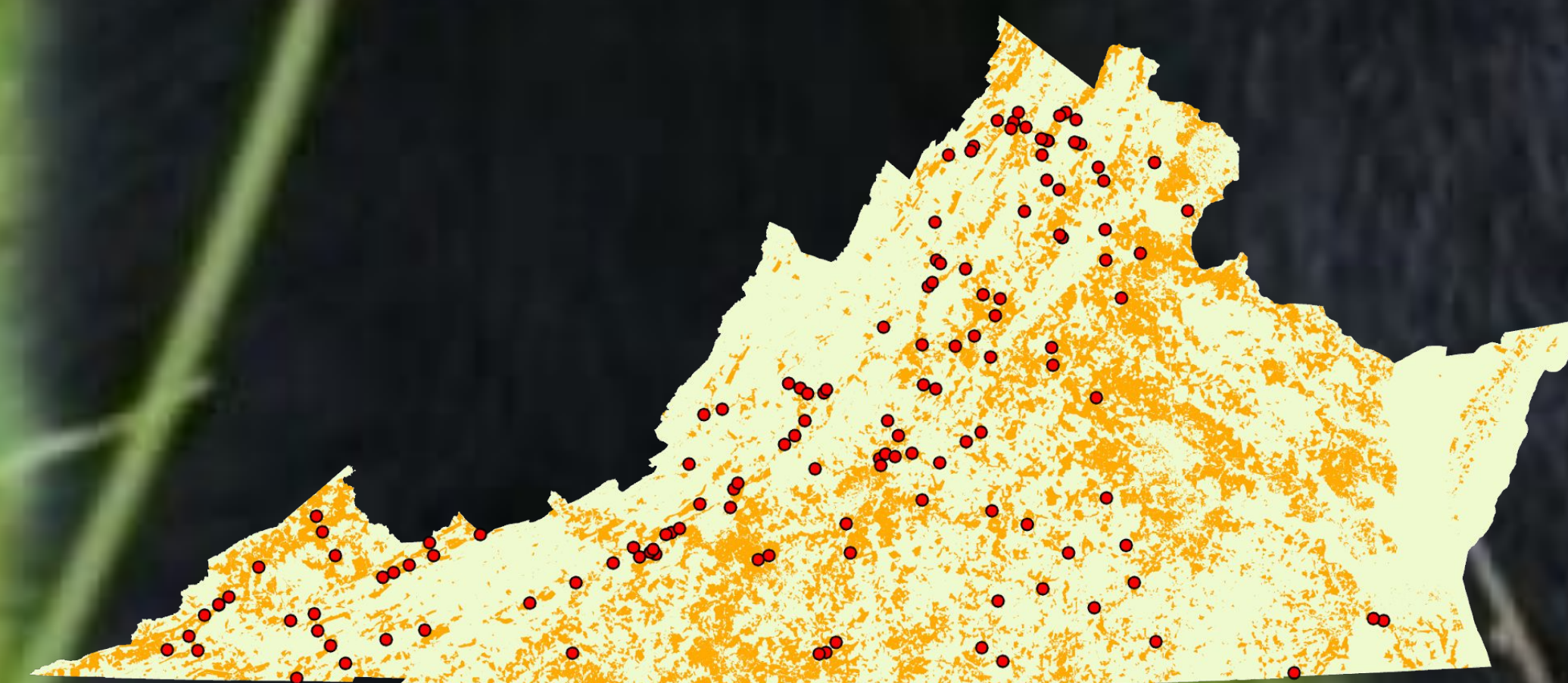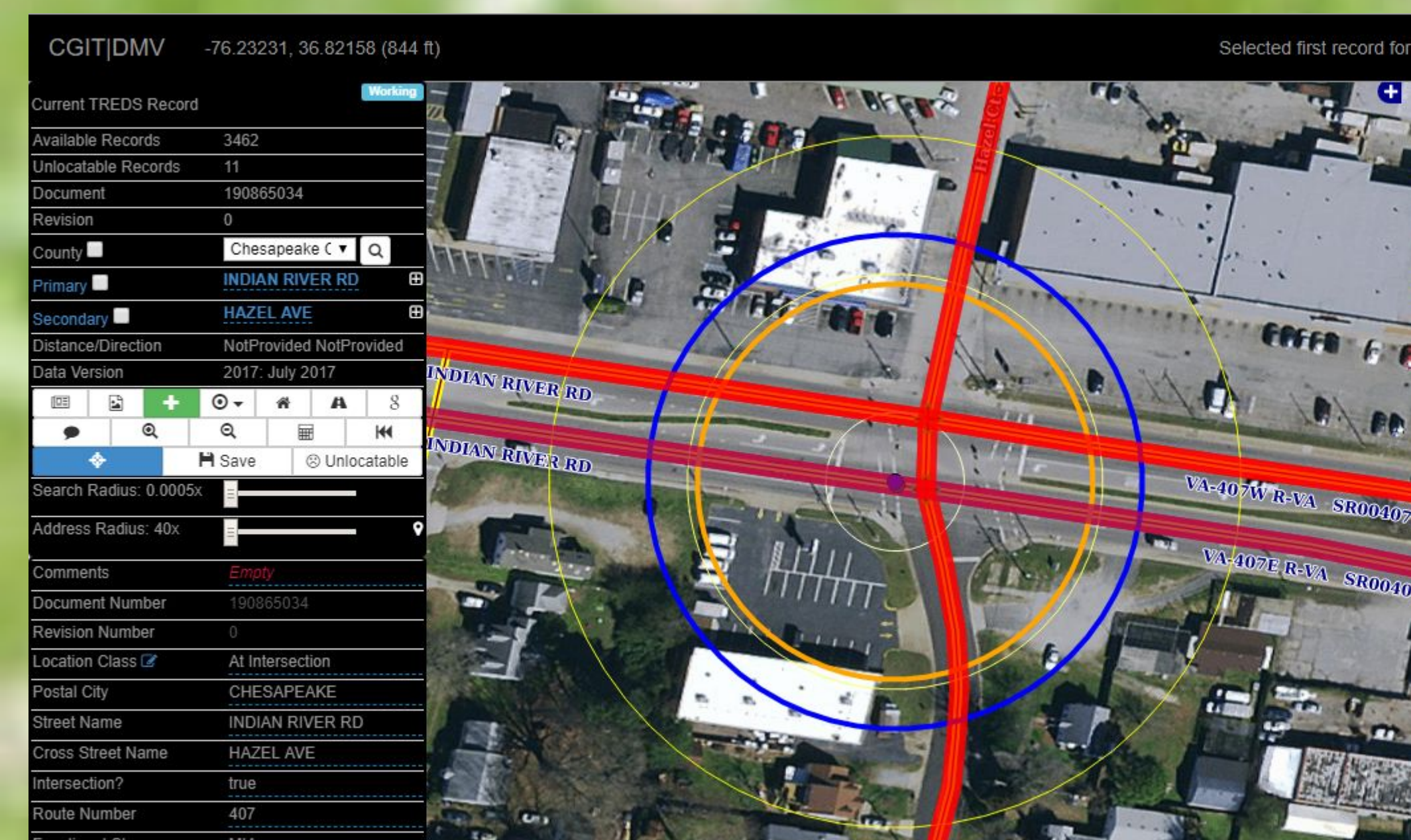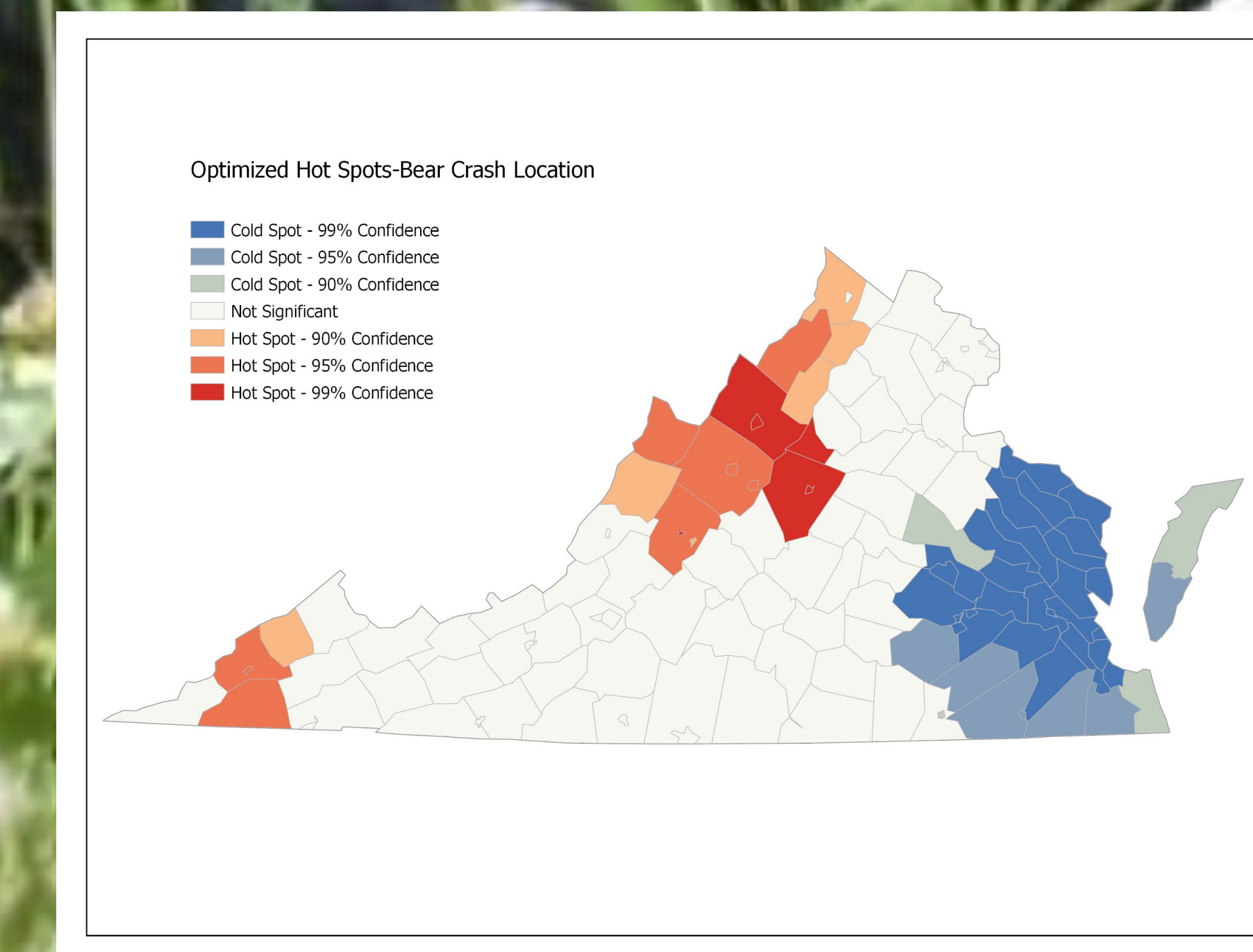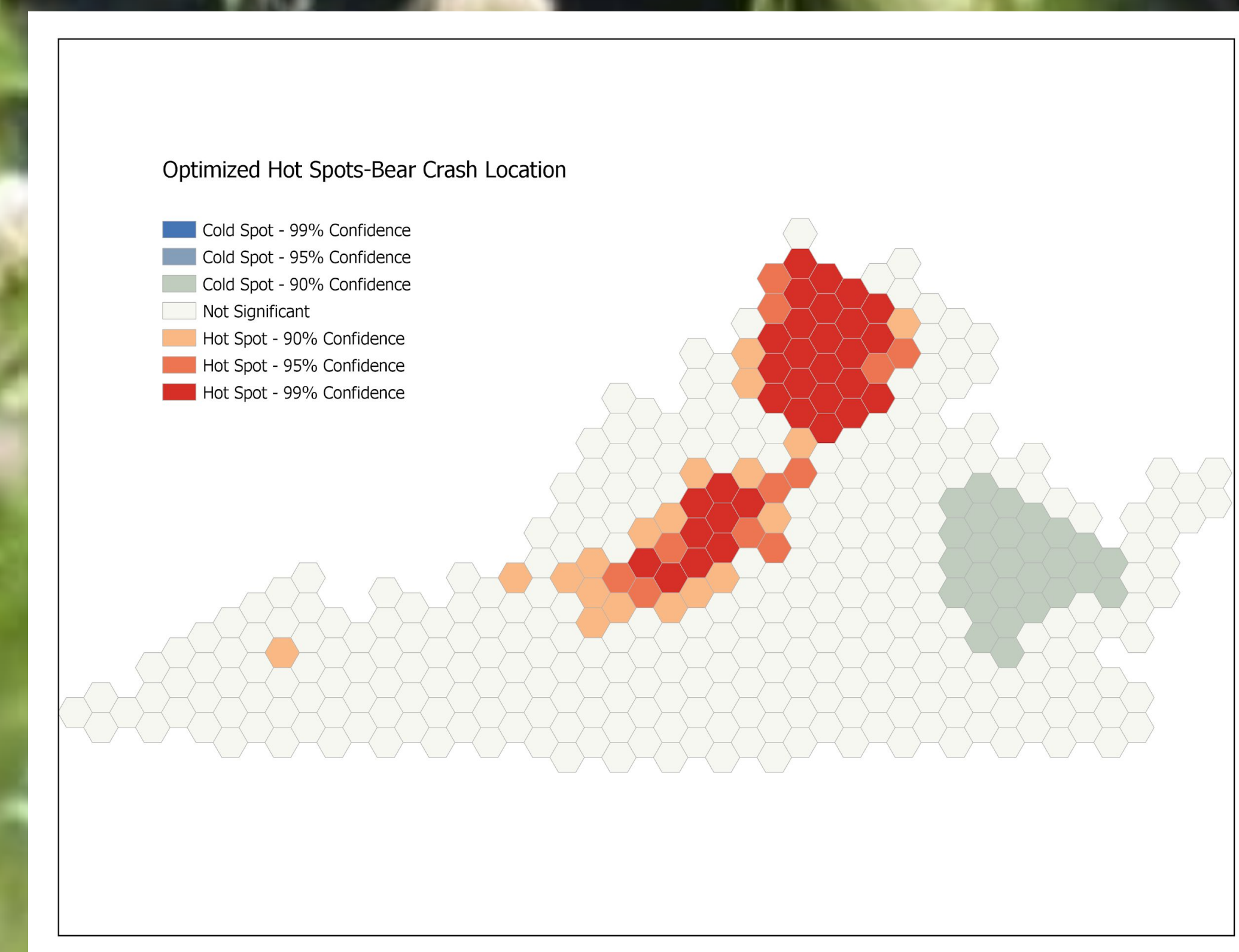   - Aggregated by hexagonal neighborhoods

Discussion

WUI Discussion:

After mapping out the Census Blocks considered WUI and overlaid the point layer of bear related car accidents, we wanted to see if these accidents occured in or near these Census Blocks. The "Near" tool in ArcPro allowed this. The majority of the accidents were within about 650 meters. The mean value was 307 meters. This implies that areas around WUI Census Blocks may be more susceptible to car accidents involving bears. However, further analysis and more data would be required to determine if this is truly a pattern.

Hot Spot Analysis:

The "Optimized Hot Spot" tool in ArcPro determines statistically significant clusters of point data to find "hot spots" and "cold spots". The vital part of this is choosing a aggregation method, as it can drastically change the results. This is apparent in our analysis. When aggregating by county, the area surrounding Rockingham County is highlighted as a hotspot. However, aggregating with the hexagon shows that the Winchester area is a hotspot. Since this data does not directly pertain to political boundaries, the hexagon aggregation is a more accurate picture.

Challenges and Limitations

- Limited to 2018 car accidents because of data constraints
  - Unsure if this is a normal pattern or trend
- No benchmark to assess abnormalities

Moving Forward

- Identifying specific sections of roads with high counts of bear related car accidents
- Evaluating trends over the course of several years

Distance to WUI Census Block
Mean : 307.681244
Median : 46.609554

Optimized Hot Spots-Bear Crash Location

Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence

Optimized Hot Spots-Bear Crash Location

Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence