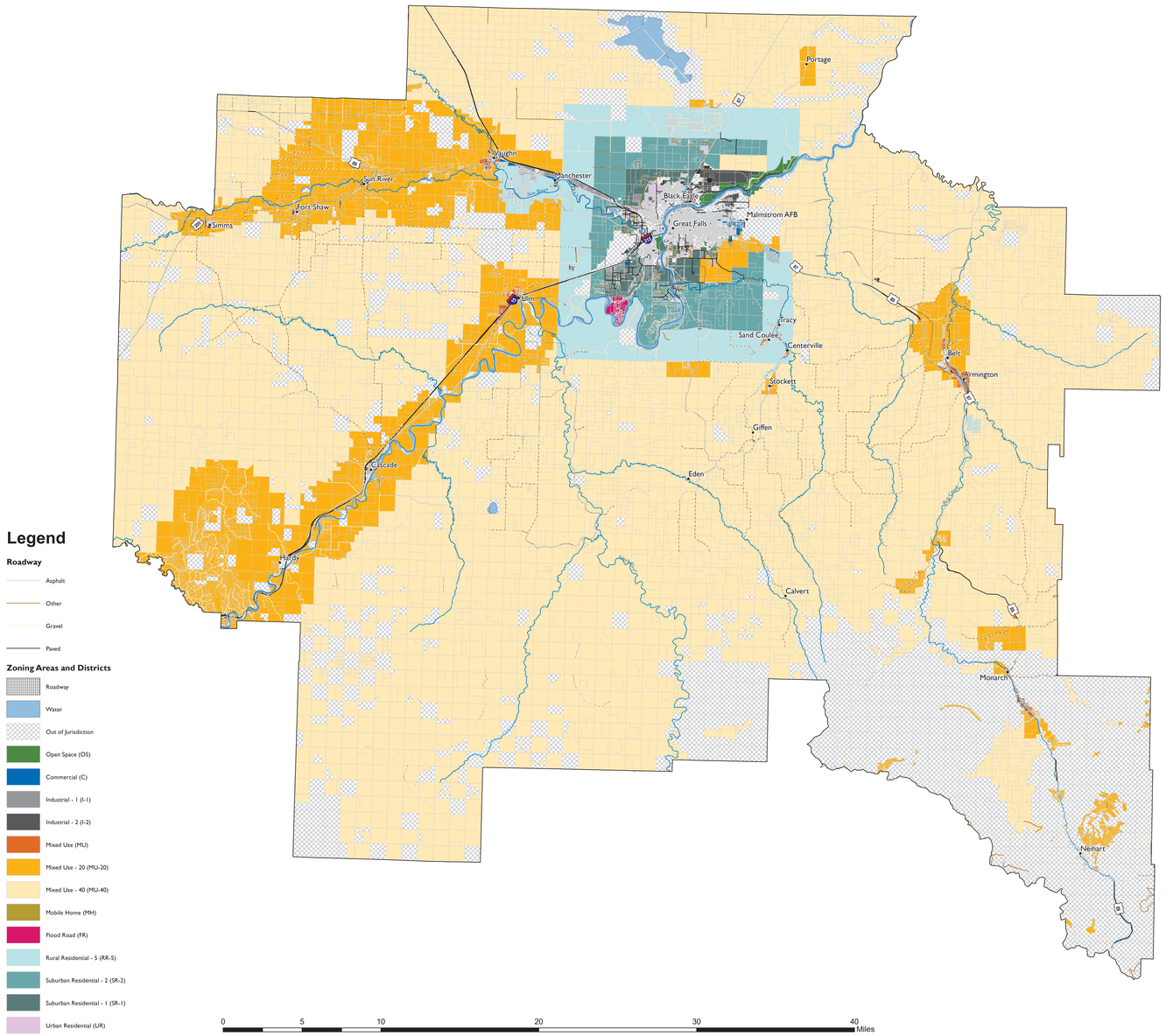
Splitting a Large Rural Zoning District Along Residential Lines



Introduction

One of the challenges for the Cascade County Planning Division is administering zoning over a large, diverse county with a changing economy and shifts in development patterns. Pre-existing towns and residential developments along with increasing demands for exurban and ranchette developments in agricultural areas produce conflict with agricultural activities and associated industrial activities. The Agricultural (A) District administered by the Cascade County Planning Division contains several areas where land use conflicts can erupt due to proximity. To address this issue, a split of the A District into two districts which divide allowed uses between them was proposed by planning staff. The splitting of the district geographically posed a problem due to the size of the district. Staff would need an efficient way to identify residential areas within the A District and delineate a boundary to buffer those areas (proposed Mixed Use – 20 District) from the surrounding areas (proposed Mixed Use – 40 District). This poster provides a demonstration of applied GIS methods aimed at providing a method for splitting a large rural zoning district in Cascade County, MT. As such, it provides a contribution to understanding the unique problems of rural planning and methods aimed at addressing them.

Problem

The Agricultural (A) District, administered by the Cascade County Planning Division, is a large district covering approximately 1,253,700 acres (an area larger than the state of Rhode Island) of private land and affecting approximately 9,480 landowners. The district extends from the outskirts of the City of Great Falls to the outer boundaries of the county with the exception of other incorporated cities (Neihart, Belt, and Cascade) and the Mixed Use Districts in other non-incorporated towns (Simms, Sun River, Monarch, etc.).

Staff observed that clear development patterns could be perceived along the Sun River and Missouri River corridors along MT 89 and I-15, respectively. The predominant land use in these areas tended to be residential with agricultural, industrial, and commercial uses being mixed throughout. With a mix of existing uses and a district character that would be more accurately reflected as a "mixed use" district, staff sought a method for splitting the A District that would produce a district around clustered residential areas of small lots and another district composed of sparsely populated, large lots.

The geography panels to the right provide three analyses that provided staff with a time-effective, efficient, empirically-driven basis for the proposed rezone districts of Mixed Use – 20 and Mixed Use – 40. Geography 1 provided a preliminary district division along residential lines indicated in the analysis. Geographies 2 and 3 provided supporting evidence for the output produced in Geography 1.

Results

The analyses described in this poster provide an efficient means of identifying residential cluster areas distributed throughout a large geographical area. The results of Geography 1 provided an empirical basis for delineating district lines along residential cluster areas effectively producing a buffer. Geographies 2 and 3 provided further evidence that the district lines would capture dense residential areas throughout the Agricultural District. The resulting proposed zoning districts are displayed in the map above. The Mixed Use - 20 and Mixed Use - 40 Districts, together, represent the current Agricultural District.

Sources

Cascade County Public Works Planning Division. Permits Database. Published 2018.
Microsoft. U.S. Building Footprints. Published 2018.
Montana State Library (MSL). Montana Cadastral Framework. Published 2018.
Montana State Library (MSL). Montana Hydrography Framework. Published 2018.
Montana State Library (MSL). Montana Landcover Framework. Published 2018.
Montana State Library (MSL). Montana Towns. Published 2010.
Montana State Library (MSL). Transportation Framework. Published 2018.
Cascade County Public Works Planning Division. Permits Database. Published 2018.
Cascade County Public Works Planning Division. Proposed Zoning Map. Published 2019.

Published 2019

Created by the Cascade County Planning Division

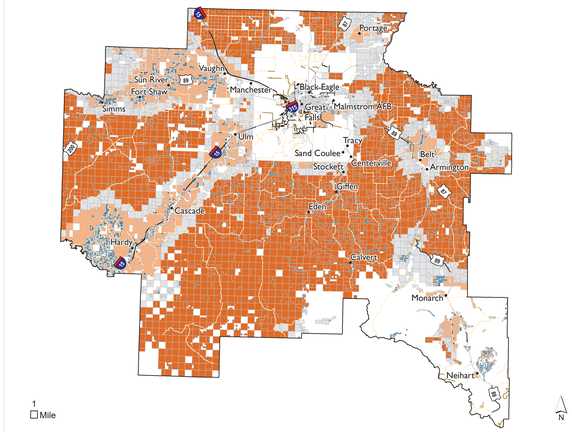
Geography 1
Cluster and Outlier Lot Analysis

The Cluster and Outlier Analysis tool provided a tool for expediting the district creation process. Since this tool could determine hot spots (clusters) and cold spots (outliers) based on a weighted quantity, the lot sizes offered a way to geographically reference clusters of residential uses within the Agricultural (A) District. On the assumption that small, non-conforming lots (lots less than 20 acres) in the current A District were likely created for residential use, clusters of these lots would suggest higher densities of residential use. The weights for lot sizes are as follows: "1" for lots less than 20 acres; "2" for lots greater than or equal to 20 acres but less than 40 acres; "3" for lots greater than or equal to 40 acres but less than 160 acres; "4" for lots greater than or equal to 160 acres. The high-high cluster and low-low cluster represent a regional similarity of lot sizes, larger or small, respectively. high-low and low-high outliers represent regional dissimilarity of lot sizes, large among small and small among large, respectively. The result of the analysis suggested that grouping the geographies with low-low clusters together with high-low outliers would produce a buffered residential area. This geography provided the basis for the Mixed Use - 20 (MU-20) District and the remainder provided the basis for the Mixed Use - 40 (MU-40) District.

Cluster-Outlier Analysis
- Null Hypothesis
- High-High Cluster
- High-Low Outlier
- Low-High Outlier
- Low-Low Cluster

Roadway
- Asphalt
- Other
- Gravel
- Paved

Sources: MSDI Montana Cadastral (2018), MSDI Transportation Framework (2018), MSDI County Boundary (2018)

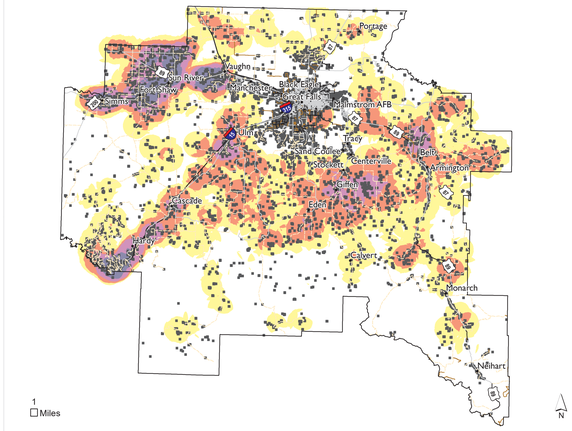


Geography 2
Structure Density Analysis

Structures from the Microsoft Building Footprints dataset were used to perform a structure density analysis. This analysis involved producing a raster with cell values populated with a structure per square mile density value. The resulting analysis shows the natural breaks classification of the resulting values into five classes. The dense clustering of structures closely parallels clusters of small lots portrayed in Geography 1 (G1). Contrary to that trend, the areas around Eden, Giffen, and Stockett show a high density of structures but the predominance of large lots portrayed in G1 suggests that these areas consist of large lots with several structures located on a single lot. This analysis provides insight into the geography of structures within the Agricultural District, but it provides little help in understanding use.

Structure Density Structures/Square Mile	Roadway Surface
0 - 1.8	Asphalt
1.9 - 5.1	Other
5.2 - 10	Gravel
11 - 18	Paved
19 - 38	* Structure

Sources: USGS DEM (2018), Microsoft US Building Footprints (2018), MSDI Transportation Framework (2018)



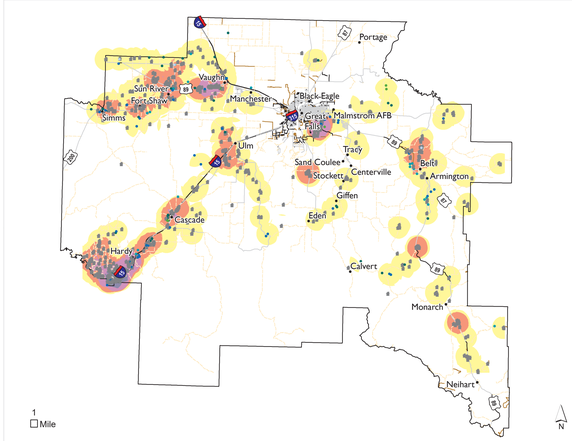
Geography 3
Permit Density Analysis

Permits from the Planning Division's database were georeferenced using geocode with cadastral parcels and then converted to points. The resulting permit points were used to produce a permit density analysis. Like the analysis in Geography 2 (G2), this was produced through a magnitude by area value population of raster cell values and displayed in a five class natural breaks classification. The permit points are overlaid the resulting raster with the use type classified. The resulting analysis shows that Geography 3 (G3) and G2 complement the land use pattern assumed in G1. The three analyses combined provide support for using the results of G1 as a basis for splitting the Agricultural (A) District into two districts with the aim to buffer those residences against the higher intensity uses allowed within the A District.

Use Type
- Agricultural
- Commercial
- Educational; Worship Facility
- Infrastructure; Sanitation
- Manufacturing; Mining
- Residential

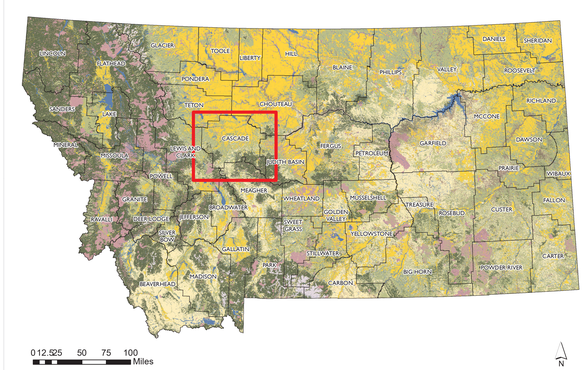
Roadway Surface	Permits Permit/Square Mile
Asphalt	0 - 0.21
Other	0.22 - 1.1
Gravel	1.2 - 2.8
Paved	2.9 - 5.8
	5.9 - 11

Sources: USGS DEM, Cascade County Planning Division Permits, MSDI Transportation Framework



Vicinity Map
Montana Counties and Land Cover

Cascade County is situated east of the Continental Divide and serves the communities of central and northcentral Montana as a regional hub. The county has a mix of pasturelands, croplands, and wildlands outside of urban development. The communities in the county have environmental and development legacies in mining, forestry, agriculture, industrial smeltering and refinement.

- Alpine Systems
- Forest and Woodland Systems
- Grassland Systems
- Human Land Use
- Open Water / Wetland and Riparian Systems
- Recently Disturbed or Modified
- Shrubland, Steppe and Savanna Systems
- Sparse and Barren Systems

Sources: MSDI County Boundaries (2018), MSDI Landcover Framework (2017)