A Riparian Canopy Assessment of the Clackamas River Watershed using Aerial Imagery

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Abstract:

The canopy is one part of a system of shade and cover that promotes bank stability and along with vegetation helps to filter sediments, enhance physical channels, provides wood recruitment, intercepts upland runoff (Harris, Kocher, & J.M. Gerstein, 2005) and filters pesticides and other residues, promotes stream temperature reduction and contributes to improved water quality and the riparian ecosystem as a whole. In order to assess the nature and health of the canopy and cover of the riparian ecosystem of the Clackamas River Watershed, it is appropriate to use Geographic Information Systems to determine the spatial distribution of canopy in order to calculate the need for restoration, rehabilitation and management within the watershed.

The Clackamas River Watershed encompasses approximately 940 square miles with the upper half of the area containing the Mount Hood National Forest and the lower half comprised of urban and rural areas. LiDAR coverage is not available at this time for the entire watershed, so aerial photogrammetry is the method chosen to calculate the canopy and vegetation coverage in the riparian area. Fixed-width buffer areas have been shown to be inadequate as they "have no functional relationship to the naturally varying watercourse". (Abood, Maclean, & Mason, 2012) In order to define the riparian area, the Riparian Buffer Delineation Model (RBDM) developed by Abood, Maclean and Mason was used in order to create the variable-width riparian boundary.

Keywords: Riparian, Buffer, Aerial, Photogrammetry, Watershed

Introduction/Objective:

Climate change and increasing population are only two reasons to plan for future water needs and water providers are becoming more interested in ways to improve water quality and are stewards of best management practices, to include understanding the riparian canopy and vegetation cover. The Clackamas River Water Providers are exploring the necessity of and the possibilities of implementing a similar type of program in order to address the riparian areas of the Clackamas River Watershed that are not covered by the Mount Hood National Forest.

LiDAR data is only available for a very small portion of the north end of the watershed at this time, so the only way to spatially model the canopy and vegetative cover in the watershed is with the use of aerial photogrammetry. The objective of this research is to characterize the canopy and vegetative cover by modeling a variable width riparian buffer using the Riparian Buffer Delineation Model then combining the buffer in combination with aerial photogrammetry in order to define riparian areas and the canopy and vegetative cover present. The resulting Riparian Canopy Assessment will enable all interested parties to better understand the canopy coverage along streams within the watershed and point out areas in need of rehabilitation, mitigation or further enhancement in order to improve the quality of the drinking water in the Clackamas River Watershed.

Materials and Methods:

The majority of the Clackamas River Watershed is located in Clackamas County, Oregon with some upper portions located in northeast Marion County, and provides drinking water to approximately 300,000 people. The assessment was conducted using ESRI's ArcGIS Desktop 10.3, the Riparian Buffer Delineation Model (RBDM), and a 50-year flood height layer that was previously created by the author using the HAZUS flood model by FEMA. "This approach better characterizes the watercourse and its associated floodplain". (Abood, Maclean, & Mason, 2012)

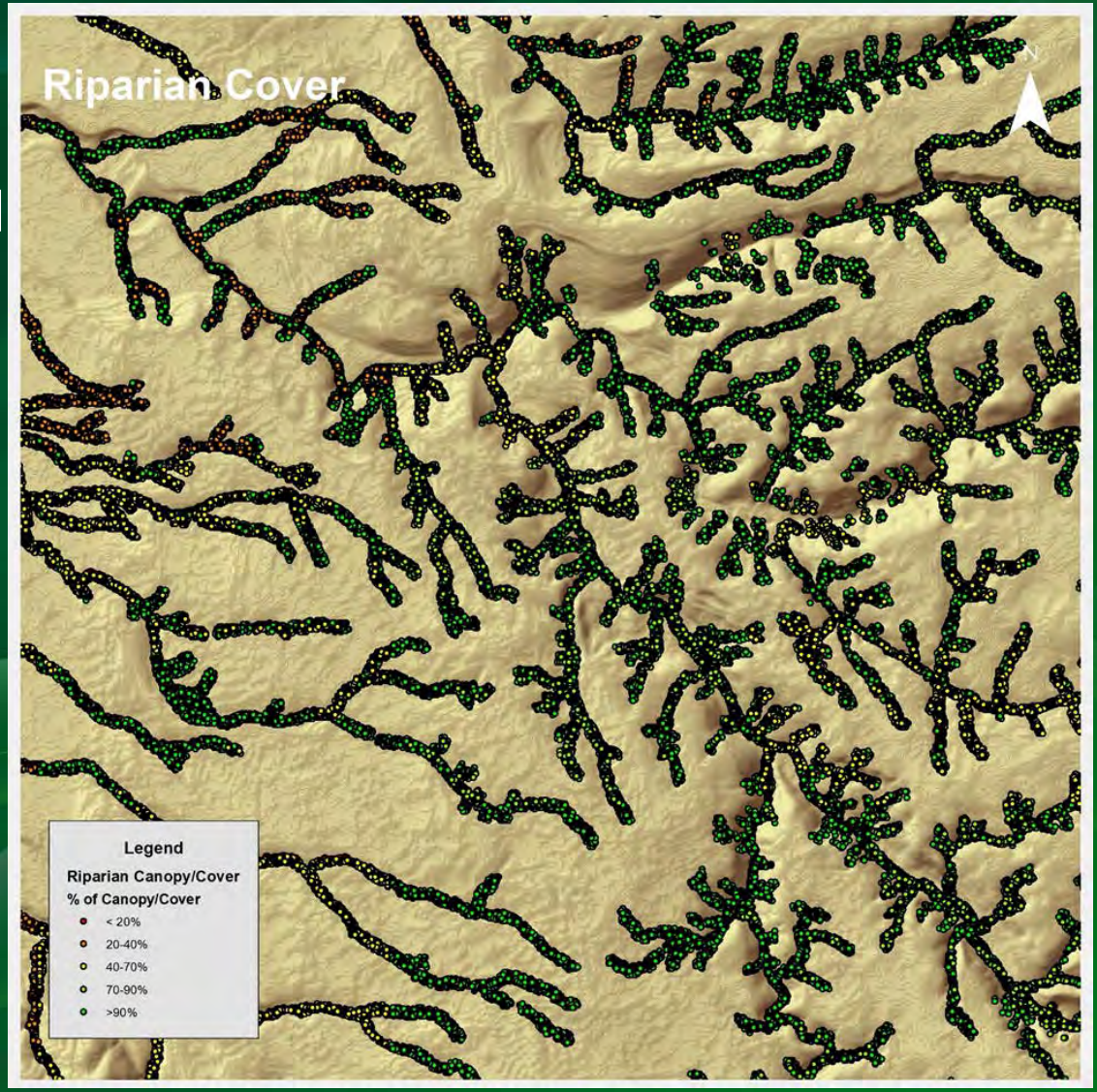
Other datasets used in this assessment were: USGS 10-meter digital elevation model (DEM) 2014, USGS NHD Hydrology 2014, the HUC8 watershed boundary, and the USDA NAIP Imagery 2014. The RBDM model comes as an ArcMap toolbox and requires some preprocessing of the hydrological dataset. The NHD Flowline VAA text file must be joined to the NHD flowline layer in order to access the reach codes and the stream level and the attribute name header for the StreamLevel is too long and must be changed to StreamLeve. The datasets for both the flowline and waterbodies were examined prior to running the RBDM model and unnecessary data (i.e. estuaries) were extracted before beginning the model. The RBDM model requires several base inputs, yet is quite robust and can incorporate other layers for consideration such as Wetlands, Soils and Landcover data although these were not used for this assessment.

Results:

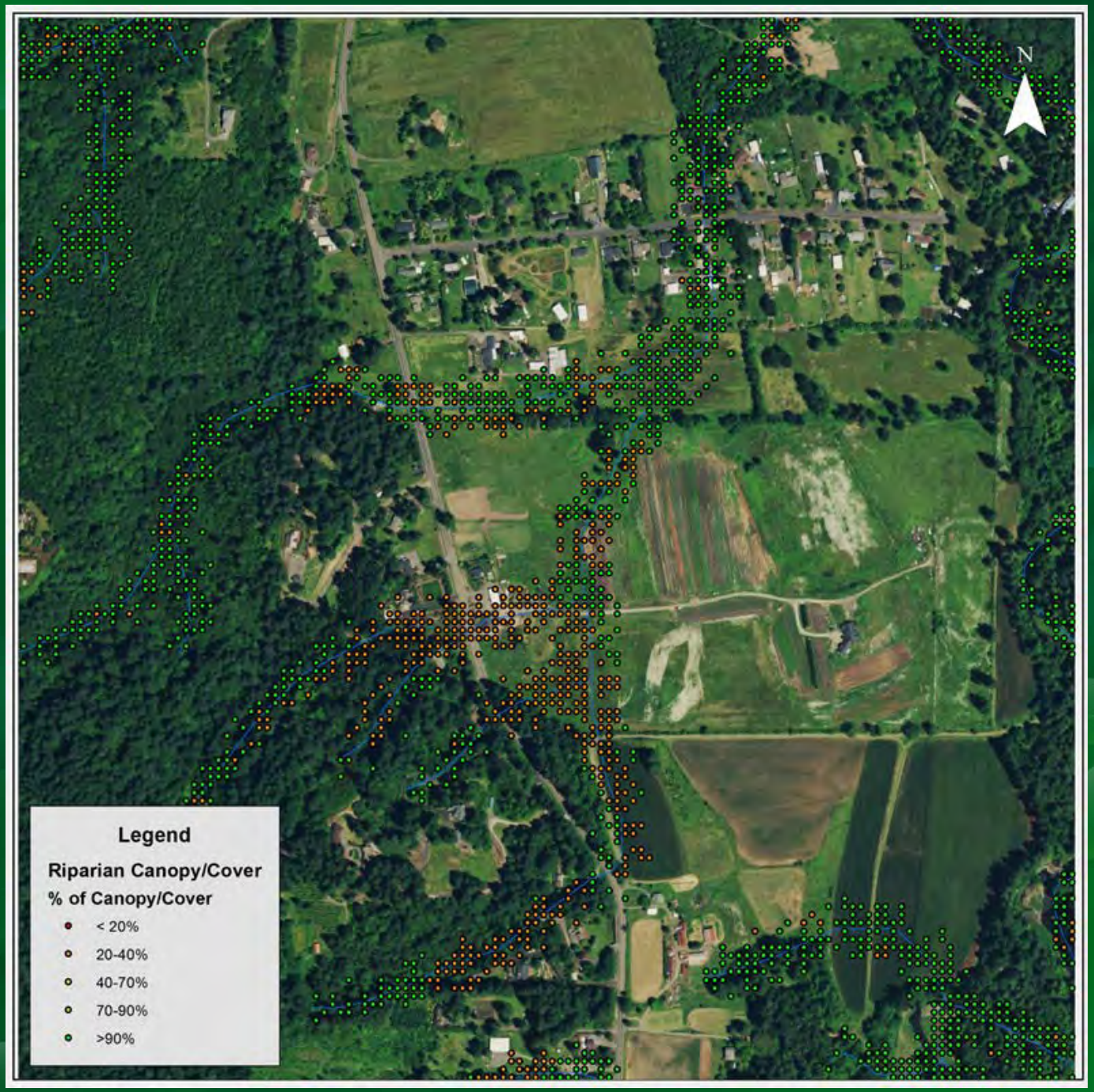
The RBDM produces a final raster layer incorporating the changes in elevation and the 50-year flood height for the streams and rivers, and a final raster layer for the waterbodies with the 100-foot buffer.

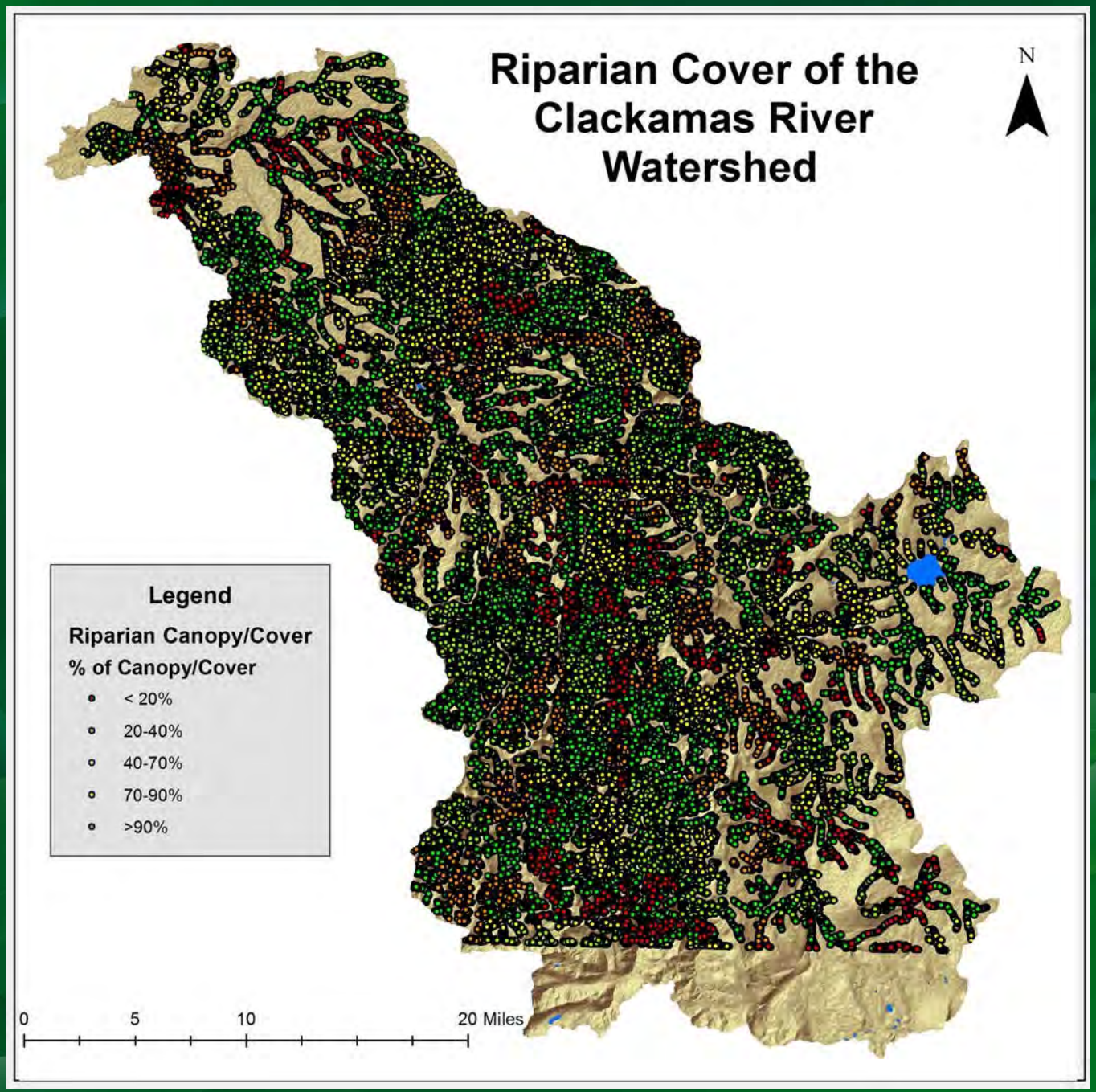
This layer was then converted to polygons using the Raster to Polygon tool in order to create a layer for both the streams and lake buffers in order to extract the NAIP Imagery to the buffer areas.

The resulting Imagery Clip layer (raster) was then converted to points using the Extract Values to Points tool in ArcGis using interpolation of the values of the points (one point per pixel of 10 meters within the buffer area). The resulting multipoint layer contained values from 21 to 5000, denoting the density of canopy and/or vegetative cover at that point. These values were classified into 5 classes: less than 20%, 20 to 40%, 40 to 70%, 70 to 90%, and more than 90%.



When combined with the full NAIP imagery, the canopy and vegetative cover becomes more clear. The riparian buffer is variable according to the stream level and reach codes when combined with the 50-year flood height. In converting the RBDM raster layer to points we are able to overlay this layer on the NAIP Imagery and use this as a tool in order to better understand the different areas of the watershed that have a robust riparian corridor versus those that do not. It should be noted that the RBDM calculated the riparian buffer for all streams, perennial and intermittent, NAIP Imagery was not supplied for that portion of Marion County, and that ground-truthing is necessary to verify to voracity of this model.


N
Legend
Riparian Canopy/Cover
% of Canopy/Cover
< 20%
20-40%
40-70%
70-90%
>90%


Riparian Cover of the Clackamas River Watershed
N
Legend
Riparian Canopy/Cover
% of Canopy/Cover
< 20%
20-40%
40-70%
70-90%
>90%
0
5
10
20 Miles

Conclusions:

The RBDM is one of several models available, however the author has chosen this model to work with because being able to convert the raster layer supplied by the RBDM from values to points allows for variability in the buffer according to the actual value at the specified point.

The Riparian Canopy Assessment is a tool that can be used to start identifying those areas in the Clackamas River Watershed that are in need of streamside vegetation rehabilitation, restoration or enhancement and can be used to create new methods in best management practices when planning for additional programs.

References:

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50 Year Flood Zone modeling via HAZUS Model FEMA

Hydrography USGS NHD 2014

USGS DEM 10 meter 2014

Imagery by USDA NAIP 2014

Analyzed and Created by Laura Zanolli