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Forest Assessment: A Model for Prioritizing Needs

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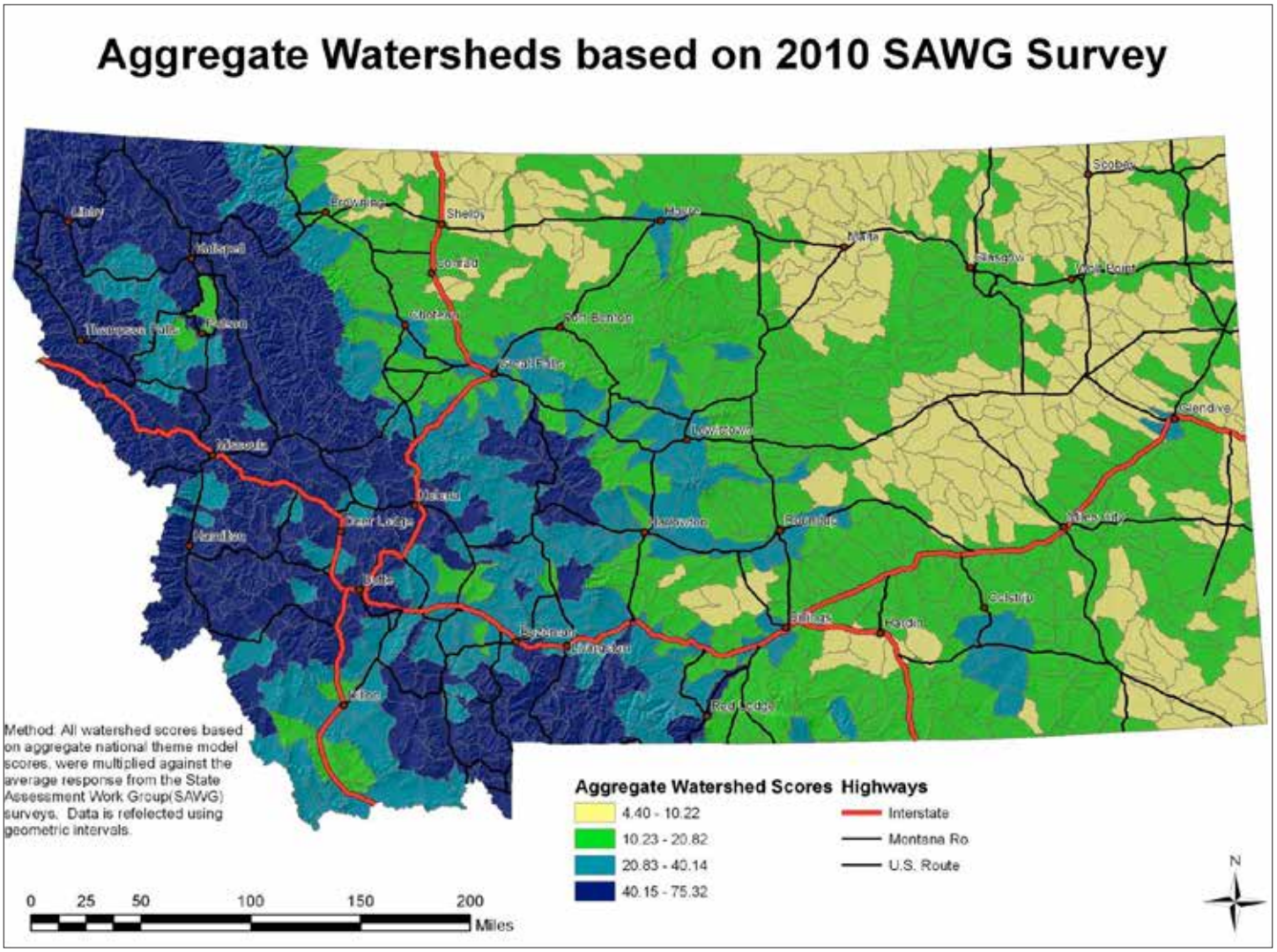
Forest managers need to perform forest assessments for certification, funding application, policy recommendations, regulatory compliance, and value assessments. To receive federal funding provided by the US Forest Service's 2008 Farm Bill, state forest services must complete assessments of their forest landscapes and create strategies for forest resources statewide. Assessments need to show an analysis of forest conditions and trends, prioritize needs for rural and urban forest



↑ A suitability model rates 1,000 watersheds in Montana and prioritizes resource planning needs.

landscapes, and outline a long-term plan for how Farm Bill funding will be used. Furthermore, the Farm Bill asks that multiple partners be involved in the forest assessment process.

The Montana Department of Natural Resources and Conservation (DNRC) addressed these requirements through a program called the Statewide Forest Resource Assessment and Forest Action Plan. The program is designed to meet 11 US Forest Service objectives, categorized into three national themes: conserving working forest landscapes, protecting forests from harm, and enhancing public benefits from trees and forests.

DNRC invited more than 40 stakeholders to participate in the Statewide Assessment Working Group (SAWG) and help shape the forest assessment and action plan. This group of experts combined its knowledge and used geographic information system (GIS) outputs to assign value rates to forest resources and prioritize needs.

↑ Montana is a trove of natural resources.

↑ The assessment tool cited wildfire as a priority issue.

↑ Logging is considered in the forest assessment process.

The first step was to obtain the data necessary for understanding, defining, and analyzing forest needs. The Department of Revenue was a valuable resource. It had completed its 2009 statewide forest productivity database, which reappraised private forest lands for taxation purposes. The database included data for nearly four million acres of commercial forestland, including potential forest productivity and yield, ownership, and commercial quantities of wood products.

Another data resource was the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soil database, which includes four soil elements that are determinants of forestland productivity. The USDA data also provided National Agriculture Imagery Program

(NAIP) digital orthographic imagery from 2005 at 1-meter resolution. Used to delineate forest and nonforest areas, this database includes progressive classes of potential forest productivity. In addition, the University of Montana contributed climatological data for the state.

The second step was to create a suitability model. Because DNRC was already using Esri's ArcGIS software, managers knew that it could save them a lot of money, time, and effort. Therefore, they asked the local GIS consultant, Geodata Services, Inc., to create a forest suitability model tool for ArcGIS. This team, headed by Ken Wall, used the ArcGIS software extension CommunityViz to create and run the model. CommunityViz performs weighted sum calculations and prioritizations and provides tools for easy analysis by users who know little or nothing about GIS. Eventually, Geodata Services would build the GIS data layers, create model layers for each resource, and configure the suitability model for other natural resources.

DNRC staff developed Montana's statewide assessment by creating 11 different submodel layers based on the Forest Plan's National Guidance Objectives. Three weighting calculations were applied to each layer to rate levels of relative importance, geographic scale, and quality of source data. Between three and nine GIS analysis layers formed the basis for each objective.

DNRC also designed a suitability model to assess watersheds. SAWG experts and resource specialists provided insight for building the model layers, model components, and default layer weightings. They collaborated via WebEx conference calls, an enterprise wiki, ArcGIS Online, and an intranet to discuss data and weighted averages. Because SAWG members needed to compare disparate data layers as equally as possible, the GIS team normalized data source layers and adjusted data to account for differences in watershed size and shape.

In his article "Montana's State Assessment of Forest Resources: Base Findings and GIS Methodology," Montana DNRC project manager Dan Rogers wrote, "To compare and aggregate data while minimizing bias, the team decided to limit the upper end of the weighting range of some layers, such as the generalized county GIS data, in order to make it comparable. It may be an important layer from a values perspective, but mapping inequalities required that it be reduced in importance simply because of its resolution and quality. The potential mathematical bias of using multiple layers was handled by normalizing all GIS analysis to actual counts or percent of watershed. This also neutralized slight differences in the size and shape of the watersheds."

The data model was used to prioritize 1,000 watersheds within the state. SAWG weighted each data layer in each submodel based on the group's consensus on the value of importance.

"In both instances, (1) the aggregate snapshot of the SAWG, or 'popular vote,' and (2) the weighting of GIS layers making up each objective, we asked each participant to assign 100 points among each

component," noted Rogers. "A weighted average score from this weighting exercise was then calculated. Participants were allowed to allocate points freely and could spread them out more or less equally, or they assigned more points to some components and no points to others, as long as they summed to 100."

The process of weighting GIS layers for each objective requires subjective input by the area expert. In most GIS analyses, weighting the importance of one GIS layer is complicated, so it is usually done within the GIS modeling environment by a GIS analyst. However, using the CommunityViz suitability tool, forest managers were able to bypass the technology analyst and apply statistical weights to data layers within ArcGIS themselves, making adjustments based on their expert insight.

Once the watershed model was completed and approved, DNRC and Geodata Services began working to complete the remaining forest decision support tools. DNRC developed 120 GIS layers from existing and newly collected GIS data. It converted these into 53 unique layers of natural resource categories. Using the same analysis process applied to the watershed theme, GIS calculated the zonal mean, categorized outcomes within a range, and applied the SAWG weights for these other natural resource themes. The forest productivity tool evaluates biomass potential and site productivity; the forest industry infrastructure tool evaluates existing or planned mills and other forestry infrastructure; and the forest economic characteristics tool evaluates federal, state, and private landownership as well as Montana legacy data for public landownership.

In each case, Geodata Services combined some or all of the natural resource data layers into one composite map layer. CommunityViz tools, such as slider bars, are intuitive and allow anyone to easily combine layers, see relationships, and understand adjusted values for prioritized objectives.

The assessment model displays results from several perspectives and resolutions. The user can see critical landscapes and drill into data to see risks and opportunities. The model shows the priority of landscapes for the three national themes: conserving working forest lands, protecting forests from harm, and enhancing public benefit from trees and forests. In addition, it can produce a final aggregate of the data.

Montana's Statewide Forest Resource Assessment was adopted by the Montana State Forester in 2010 and submitted to the US Department of Agriculture. The assessment data models provided key resource materials for the Montana Statewide Assessment of Forest Resources and the Montana Statewide Forest Resource Strategy. Both works were submitted to and approved by USDA.

The assessment tool helped DNRC identify five priority issues for the forests of Montana: forest biodiversity and resilience, wildfire and public safety, forest product and biomass utilization, sustainable urban forest landscapes, and changing forest ownership patterns. The assessment model gave decision makers insight about where to direct specific outreach and what types of outcomes to expect.

Although the GIS assessment model was not the sole criterion of the scoring matrix, it was a valuable tool in defining it. Meanwhile, the forest assessment and the strategy analysis were being used for other related projects such as assessing watershed evaluations, marketing biomass feasibility, scoring grant applications, and comparing prioritization models with other land management agencies.

"The future intent is to allow forest managers to use the model to assess potential responses to funding programs," concluded Rogers. "This will effectively move resource management analysis from the back office to the front desk, saving time and steps."

The GIS forest assessment model helped DNRC

- Show state project priority scores.
- Create a living document that can be continuously used, updated, and applied.
- Streamline analysis.
- Generalize data in a dynamic way.
- Interpret multiple data layers easily at one time.
- Interact easily with a massive volume of data via slider bars.
- Adjust and update analysis tools.
- Update and add more data layers as needed.
- Support professional collaboration and community engagement with easy-to-use tools.
- Adapt the model to other types of projects.

Learn about the statewide forest assessment model and CommunityViz by contacting Ken Wall of Geodata Services, Inc., at KWall@geodataservicesinc.com.

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