Comparing Riparian Management Zones to Riparian Areas in Minnesota (Pilot Study)

A mid-term follow-up action in response to the riparian peer reviews from the Minnesota Forest Resources Council

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Introduction

In 1999 the Minnesota State Legislature directed the Minnesota Forest Resources Council (MFRC) to conduct a scientific peer review of the riparian recommendations made in its Voluntary Site-Level Forest Management Guidelines (MFRC 1999; hereinafter referred to as "Guidelines"). One response the MFRC had to this review was to examine "existing pilot projects along various river/streams" with a goal to "understand the linkages between applying site-level forest management practices in forested riparian areas and cumulative effects of these practices across larger forest landscapes." The expected product was to include "maps and analysis describing vegetative and physical conditions, riparian management zones, and management practices along discrete segments of selected streams or rivers" (MFRC 2000).

This pilot project was initiated to partially address this goal. This report looks at one pilot study area along a quarter of a mile section of a stream in northern Minnesota. The study's objective was to develop and test a method to compare the boundaries of the riparian management zone as recommended by the Guidelines (MFRC 1999) to the boundary of the riparian area as dictated by geomorphological features (Ilhardt et al. 2000). It is important to note that the intent of this study is not to support any conclusion regarding the relative positions of the two boundaries. Rather, it reports on a test of a method for addressing this comparison.

In this study, the terms "Riparian Management Zone" and "Riparian Area" are defined as follows:

Riparian Management Zone (RMZ): The portion of the riparian area where site conditions and landowner objectives are used to determine management activities that address riparian resource needs. It is the area where riparian guidelines apply (MFRC 1999).

Riparian Area (RA): A general description for RA from the Guidelines (1999) states: The area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes and open water wetlands.

More specifically RA is defined by Ilhardt, et al. (2000) as: Riparian areas are three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems, that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at a variable width.

Methods

Several steps were involved in the comparison of RMZ and RA. First, a study area adjacent to a forested stream segment was selected using geographic information system (GIS) data. The pilot study area chosen was in the Savanna State Forest in eastern Aitkin County along the Prairie River. Next, forest management information was collected for the area. The study area was field visited and a global positioning system (GPS) unit was used to delineate the RA based on the criteria described below. Integrating the characteristics of the site and the landowner objectives, the authors consulted the Guidelines to determine an appropriate RMZ boundary. Lastly, the RA was compared to the RMZ boundary by looking at average distances from the stream and forest cover.

Pilot site selection

The study area was selected based on ownership, general topography, and relation to riparian features (streams/rivers). The study area selection was limited to the northern-forested part of the state. The Minnesota Department of Natural Resources (DNR) forestland was the primary area used to select the study area because the DNR had forest inventory information that was readily accessible. DNR forestland data was compared to stream GIS data to find forestland along streams where RAs and RMZs could be compared. The stream data used throughout this study originated from 1:24,000 scale streams captured from USGS seven and one-half minute quadrangle maps. DNR forestland was selected if it was within one fourth of a mile (1,320 feet) of a stream. The selected forestland was then visually compared to the stream data in a GIS. Only contiguous areas of DNR forestland that contained a minimum of 2-3 miles of a stream were selected. This produced 15 possible study areas.

From these 15 possible study areas, 4 were selected that had a range of topography from steep to gentle slopes, as determined from general GIS topographic data. Of these, one study area was chosen for its central location in the state. This study area was field visited in July 2001. The study area was along the Prairie River in Township 50, Range 22 West, Section 23, in eastern Aitkin County (Figure 1).

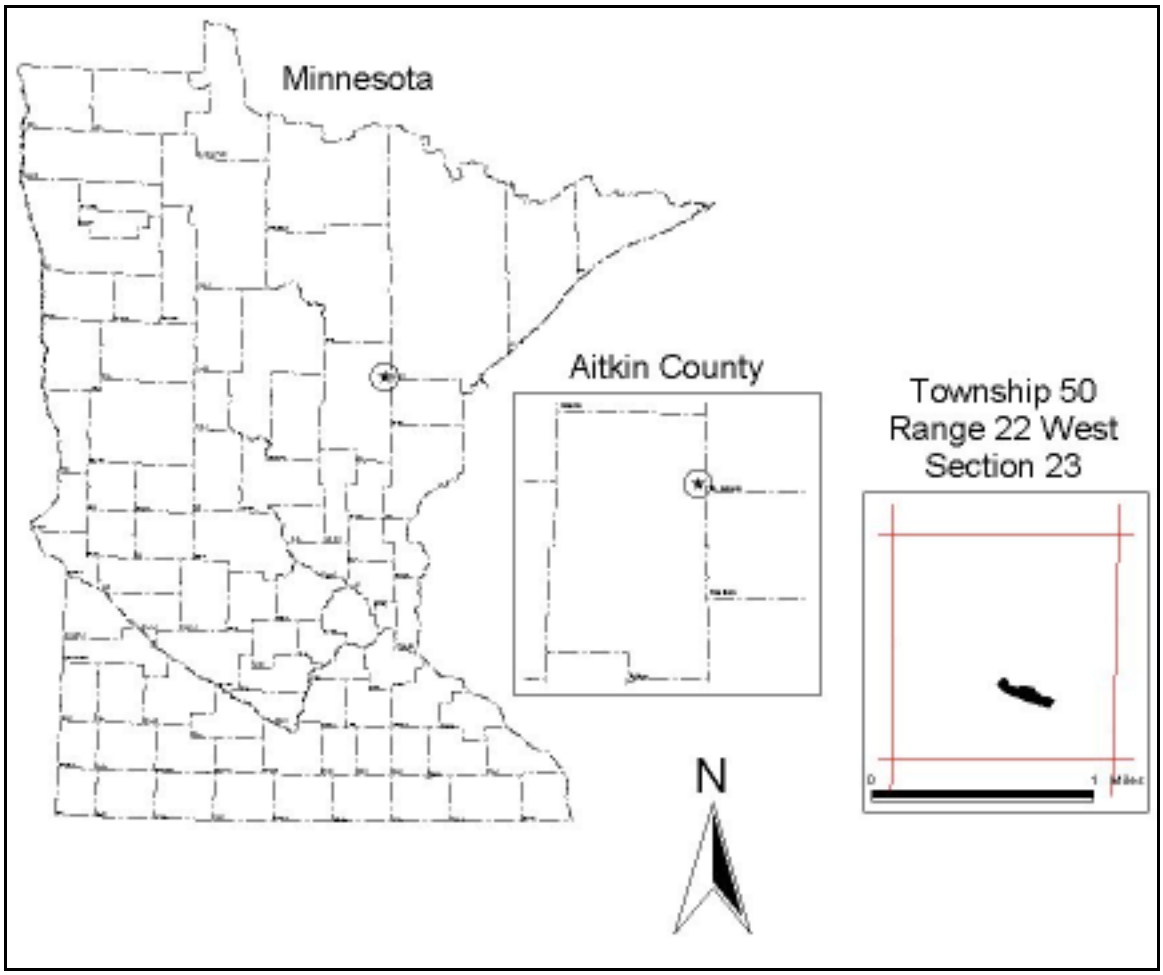

Figure 1. Location of study area.

Gathering forest management data

A request of all DNR timber sale appraisals for the study area from 1996 to 2001 was sent to the local DNR office. The request specifically asked for any appraisals on forest stands within a quarter mile from the stream. This information was used to determine whether the management occurring in the area was even-aged or uneven-aged. This management information was used along with information collected during the field visit to determine the RMZ from the Guidelines.

Collecting riparian area data

To collect information on the RA the study area was field visited. The authors walked along the edge of the high bank, or flood plain (Ilhardt, et al. 2000). Accurate identification of the high bank boundary was determined by field consultation with Sandy Verry. One person, with the GPS unit, walked the high bank boundary, while the other person walked ahead guiding the GPS person. During the field visit the authors also visually estimated the width of the stream and average height of the codominant trees.

Data entry and analysis

Estimation of the RMZ was based on the Guideline recommendations for the size and type of water body (MFRC 1999). Information from the study area, including: width of the stream; whether the stream was classified as a trout stream or not; upland or lowland nature of the adjacent forest; along with the management information (even- or uneven-aged) was used to set the RMZ width (Tables GG-2, GG-4, and GG-6 from the Guidelines). A fixed distance RMZ was spatially created in the GIS by buffering the RMZ distance from the stream. This buffered distance was analyzed to calculate the average distance between the stream and the upland edge of the RMZ, and the area of the RMZ in a GIS.

The GPS data collected in the field were converted into a GIS format. The data collected represented the high bank point, not the RA. Ilhardt et al. (2000) found that the RA extends upland of the high bank point a distance of approximately one tree length to include trees that provide nutrients to the floodplain. From the high bank line the average height of the codominant trees in the area was buffered away from the stream. This buffered line constituted the upland edge of the RA. A GIS was then used to analyze the average distance of this edge to the stream. Lines were drawn from the two ends of this edge to their nearest point on the stream to delineate the RA. A GIS then calculated the area of the RA.

One final analysis was done comparing the forest cover that fell within the RA and RMZ. This was done using DNR forest inventory GIS data (Cooperative Stand Assessment – CSA). The forest cover type was summarized for both the RA and RMZ.

Results

RMZ width: In the study area the width of the stream was estimated to be greater than 10 feet, it was not classified as a trout stream, and the management was even-aged. Putting this information into the Guidelines, Table GG-4 (MFRC 1999), we used a RMZ width of 100 feet.

RA width: The average height of the co-dominant trees on the study site was about 90 feet. Ninety feet was buffered from the GPS high bank line. About one mile of data were collected, but only a quarter of a mile of data were analyzed. This was because part of the data fell along a wetland area with a boundary that diverged greatly from the stream bank. Data along this portion of the study area were excluded from analysis because the scope of this study is restricted to stream, not wetland, RAs.

Figure 2 is a map depicting the study area while Figure 3 gives a summary of the RA and RMZ. The RA edge was the longest of the three edges at 1,506 feet. The stream and RMZ edge lengths were nearly identical at 1,404 and 1,391 feet, respectively. The RA edge on average was almost 2.5 times farther from the stream than the RMZ edge and

varied from 179 to 340 feet from the stream while the RMZ varied 99 to 101 feet from the stream.

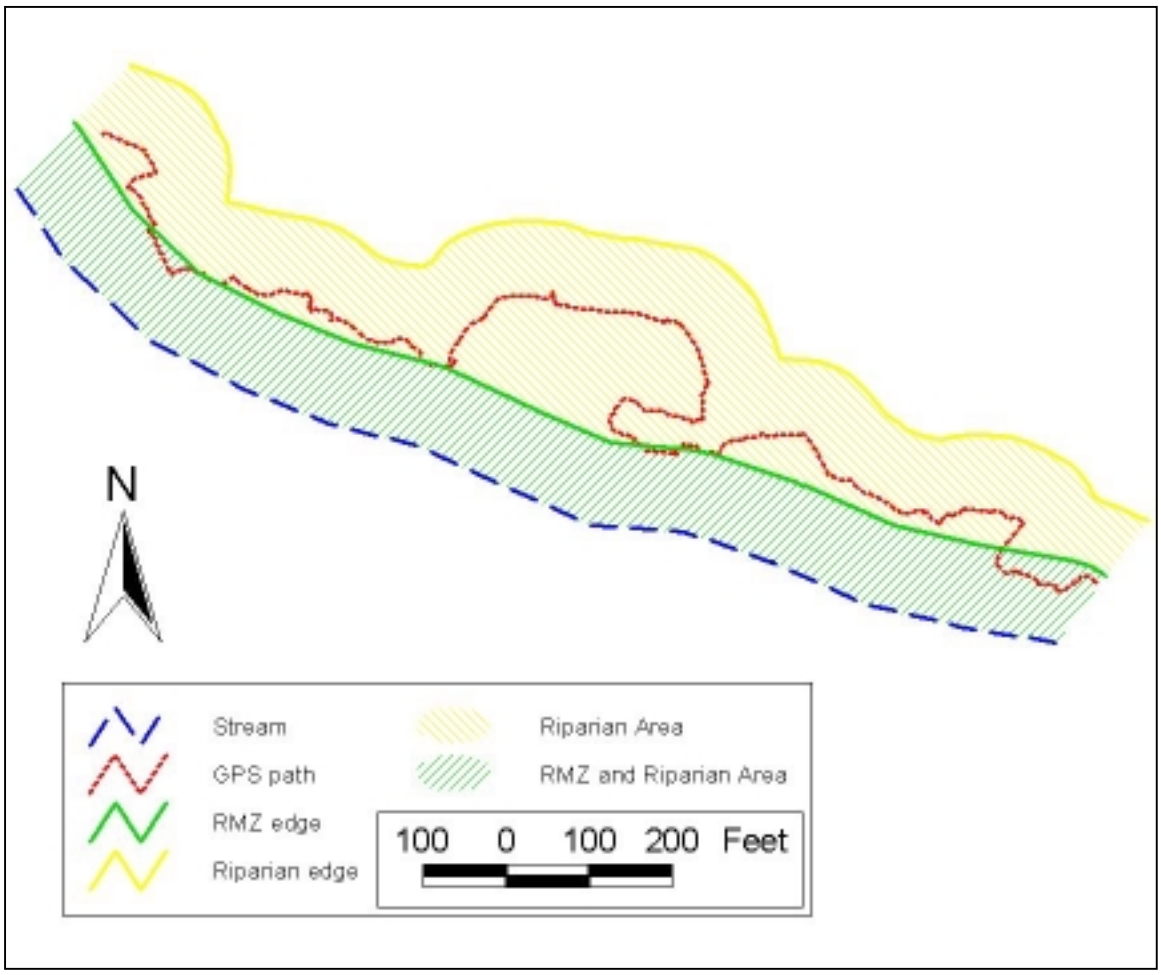

Figure 2. Map of study area showing GPS path, RA boundary and area, and RMZ boundary and area.

Length of Stream – 1,404 feet

Riparian Area

Length of Edge – 1,506 feet

Distance of Edge from Stream

Mean: 242 feet
Maximum: 340 feet
Minimum: 179 feet

Area – 7.82 acres

RMZ

Length of Edge – 1,391 feet

Distance of Edge from Stream

Mean: 100 feet
Maximum: 101 feet
Minimum: 99 feet

Area – 3.20 acres

Figure 3. Results from GIS analysis of the stream, RA, and RMZ.

Forest cover types within the RMZ and RA differed (Table 1). The main difference was the abundance of hardwoods (Ash and Northern Harwood forest types) within the RA that are not present in the RMZ. Both areas have a forest type of "permanent water", which is one of many of the non-forest cover types used when collecting CSA data.

Table 1. Comparison of forest cover type acres within the RMZ and RA.

Forest Type	RMZ acres	RA acres
Ash	0.04	3.35
Aspen	2.77	3.17
Northern Hardwood	0.02	0.91
Permanent Water	0.37	0.39
Total	*3.20*	*7.82*

Discussion

This study is not intended to evaluate the generalized difference in the boundaries of the RA and the RMZ. In order to do so, it would be necessary to sample numerous sites for greater distances than were covered in this analysis. However, it can be informative to consider some of our findings with respect to the RA and RMZ boundaries in the context of an evaluation of the method used.

The difference in the lengths in the three edges can be explained by how the data was created. Since the RMZ width data was established in a GIS by buffering (drawing a line at a fixed distance) from the stream data it makes sense that this length and the stream length are similar. Since the riparian edge was created from data collected hiking in the field, it makes sense that this data is more convoluted and thus longer.

In this study area the RA is larger than the RMZ. This may not be the case in other areas with different geomorphology, vegetation, and management practices.

It is evident from Figure 2 that in this case the RMZ approximates the edge of the high bank (GPS data). The only exception occurs for a section of the stream towards the middle of the study area where a wetland adjacent to the stream channel extended away from the main bank of the stream.

Conclusion

The result from this pilot study suggests that a fixed width RMZ established from the Guidelines, in some cases, will be narrower than the true RA. However, it is unclear what the outcomes would be on areas that have geomorphologic, vegetative, and management practices different from this one.

Overall the methods developed in the pilot study seemed to provide useful information to compare the RMZ and RA. In the study area, the high bank line was readily visible. Both authors felt confident in their ability to identify this line after on-site consultation with Sandy Verry, one of the developers of the definition of the RA that was used (Ilhardt et al. 2000). Once this method was developed it took about 4 hours to collect 1 mile of field data, and another 8 hours to complete the GIS analysis.

It appears the method tested here would provide reliable results on sites that are geomorphologically similar to this one. In areas with different geomorphic conditions it is uncertain how well the results would be. These differences could include less steep banks, different soil types, different vegetation patterns, different watershed positions, different flood frequency or intensity, or other factors.

Ultimately, the determination of the RMZ boundary is a decision based on numerous and complex factors including the management objectives of the landowner, the type of management occurring in the main (upland) harvest zone, the characteristics of the stream, the topography, dominant vegetation, soil types, and other factors. The type and intensity of management within the RMZ will also depend on these factors, some of which cannot be informed by the method tested here. However, the method on collecting and comparing RMZ and RA data appears to be useful on the study area tested and it would be worthwhile to expand its application to a variety of site types. The results of an expanded study might provide valuable and useful information to help landowners and natural resources professionals to make better-informed decisions in the forests of Minnesota.

Recommendations for future work

This method holds promise for use in future studies of the relationship between RMZ recommendations and the location of the RA. If the MFRC determines that this type of investigation is a priority, we recommend expanded use of this method, in consultation with the developers of the geomorphological definition scheme for RAs (Ilhardt et al., 2000).

Minnesota's forested ecosystems are very diverse. The forests in the North Superior Uplands, the Drift and Lake Plains Area, and the Driftless Zone are very different biophysical systems. In order to adequately understand the nature of RAs in forested regions throughout Minnesota, this method would need to be applied in numerous locations representing each ecosystem type. This would be a major descriptive and analytical study, likely requiring the commitment of at least one masters or Ph.D. student or similar resources.

Acronyms

CSA – Cooperative Stand Assessment (forest inventory)
GIS – Geographic Information System
GPS – Global Positioning System
MFRC – Minnesota Forest Resources Council
DNR – Department of Natural Resources
RA – Riparian Area
RMZ – Riparian Management Zone

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