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Executive Summary

Riparian buffers (land bordering streams) are important zones for maintaining water quality and providing critical habitat. Rappahannock County has a rural landscape that presents the opportunity to record baseline conditions of riparian buffers. This study involved analyzing a small drainage area in the Upper Thornton River watershed to offer guidance on targeting riparian buffer restoration.

Aerial imagery from the Virginia Base Mapping Program (VGIN, 2002) was used to create a digital data layer containing land uses and 100 ft. buffers around the streams. Buffer cover in the riparian buffers was identified as all forested, partially forested or no forest. A brief field assessment was conducted to verify the digital product. Results indicate that in the study area 51% of the riparian lands potentially need some restoration.

Recommendations for riparian buffer restoration include:

- Use digital data layer to identify buffers for restoration and conduct field surveys to assess buffer condition.
- Target areas without fully forested riparian buffers for restoration first.
- Plant native species when reforesting buffers.
- Correct detrimental activities in riparian buffers, such as allowing cattle direct access to streams, and unconfined dumpsites.
- Encourage private property owners to restore their riparian buffers through public education and information on incentive programs.
- Protect and restore the riparian buffers and streams located in the Commercial Area delineated in the Rappahannock County Comprehensive Plan.

Acknowledgements

Funding was provided by the U.S. Army Corps of Engineers (Project number W26GLG-5265-5855). Thank you to Mark Mansfield, John McCarthy, Candy Wroth, Juan Arevalo, Bev Hunter, Christina Loock, and the landowners who graciously allowed us access to their properties.
Introduction

Proactive management of riparian lands is an optimal approach to maintaining water quality and habitat, identifying critical natural resources and services for protection, and reducing future expenditures for restoration efforts. Riparian means ‘of the river bank’ and refers to the land bordering river and stream banks. These areas are commonly called riparian buffers because they have the potential to improve stream water quality by intercepting runoff, sediments and nutrients.

The optimal width of a riparian buffer depends upon its intended function. Several stream assessments (SICAM, 2006; SAAM, 2005; SVAP, 1998) as well as the Chesapeake Bay Program (CBP, 2006a) and Virginia Department of Conservation and Recreation prefer a 100 foot riparian buffer. A 100-foot wide strip of forest and grass can reduce sediment by 97 percent, nitrogen by 80 percent and phosphorus by 77 percent (DCR, 2006).

Rappahannock County provides the opportunity to record baseline conditions in a largely rural landscape comprised of forested lands, agriculture, villages and scattered development. The importance of documenting baseline conditions allows for future assessment of the effects of land use modifications on environmental conditions. Land use conversions from forested and agricultural to developed is occurring at an increasing rate in the Chesapeake Bay watershed (CBP, 2006b). The study area is 2.1 mi$^2$ (5.4 km$^2$) located in the central part of the county (Fig. 1). Additional information about the county is available in the Comprehensive Plan found at http://www.eoffice.com/offices/_540/675/5330/my_webserver/files/newsite/page3/page3.html

This project involved analyzing a small drainage area in Rappahannock County to provide guidance on targeting riparian buffer restoration and assess the effects of limited new construction (Virginia Department of Transportation (VDoT) Area Headquarters) on the nearby stream environment. The study area is in the Upper Thornton River watershed (Covington and Lower Rush River subwatersheds) (RappFLOW, 2006). A geographic information system (GIS) and aerial imagery was used to delineate riparian buffers and create a digital database. A brief field survey was conducted to collect qualitative field observations and verify findings from the aerial photographs. Some resources on sampling protocols for water quality monitoring also are included.

Methods and Results

Digital Data

Land use was delineated using a GIS and the Virginia Base Mapping Program (VBMP) aerial photography with a resolution of 1 inch = 400 ft. (VGIN, 2002). Land use was
digitized at the Virginia Institute of Marine Science (VIMS) and categorized into forest, agriculture, and developed (Fig. 1).

These groups were chosen based on differing risks to water quality. Agriculture includes pasture and cropland (e.g. orchards) and developed includes residential and commercial areas. The land use areas are shown in Table 1.

Table 1: Land use acres in study area.

<table>
<thead>
<tr>
<th>Land use in study area</th>
<th>Acres</th>
<th>% of total area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>623.9</td>
<td>47</td>
</tr>
<tr>
<td>Developed</td>
<td>199.8</td>
<td>15</td>
</tr>
<tr>
<td>Forest</td>
<td>496.9</td>
<td>37</td>
</tr>
<tr>
<td>Water</td>
<td>14.1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1334.7</td>
<td>100</td>
</tr>
</tbody>
</table>

The stream network for the aerial photographs was developed by the Virginia Geographic Information Network (VGIN, 2002). A 100 ft. buffer was created on each side of the stream using the GIS. The buffer layer was overlain onto the land use layer (Fig. 2) to calculate the land use areas in the buffers (Table 2).

Table 2: Land use acres in riparian buffer.

<table>
<thead>
<tr>
<th>Land use in buffer</th>
<th>Acres</th>
<th>% of total area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>50.5</td>
<td>25</td>
</tr>
<tr>
<td>Developed</td>
<td>13.2</td>
<td>7</td>
</tr>
<tr>
<td>Forest</td>
<td>139.0</td>
<td>69</td>
</tr>
<tr>
<td>Total</td>
<td>202.7</td>
<td>100</td>
</tr>
</tbody>
</table>

A comparison of the land use in the entire study area to the land use in the riparian buffers (Tables 1 and 2) shows that while the buffers are not completely forested, they have substantially more forest (69%) than the study area as a whole (37%).

The buffers were divided into three types: those that are completely forested; those with some forest; and those with no forest (Figure 3, Table 3). Although 69% of the buffers contain forest (Table 2), only 49% of the buffers are completely forested (Table 3). This means that in the study area 51% of the riparian lands potentially need some restoration.

Table 3. Buffer cover

<table>
<thead>
<tr>
<th>Buffer status</th>
<th>Acres</th>
<th>% of total area</th>
</tr>
</thead>
<tbody>
<tr>
<td>All forest</td>
<td>102.3</td>
<td>49</td>
</tr>
<tr>
<td>Some forest</td>
<td>77.1</td>
<td>37</td>
</tr>
<tr>
<td>No forest</td>
<td>28.8</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>208.3</td>
<td>100</td>
</tr>
</tbody>
</table>
There are some problems inherent in using aerial photographs to delineate land use. There is distortion away from the centers of the photographs, as well as shadows and
There are some problems inherent in using aerial photographs to delineate land use. There is distortion away from the centers of the photographs, as well as shadows and views obscured by the tree canopy (even in leaf-off conditions). Characterization below the forested canopy (presence or absence of small trees, shrubs, and grasses) is impossible to identify from aerial imagery. In addition, some areas of the stream network delineated by VGIN and the true locations identified in the field do not match, making buffers appear to be forested when they are not.

Field Work

Several stream assessments were reviewed and three (SICAM, 2006; SAAM, 2005; SVAP, 1998) were used to created a simple, qualitative field protocol to evaluate riparian buffers. The parameters in the protocol are important, easily observed elements common to the stream assessments. The observations included:

- buffer type (trees, grass, etc);
- buffer cover (approximate vegetation cover);
- condition of bank (eroding, stable);
- condition of stream bed;
- verification of land use beyond buffer using GIS base map; and
- signs of buffer effectiveness.

Field work was conducted at four stream segments in the study area on May 8, 2006. One stream segment was adjacent to recent construction activity (VDoT Area Headquarters). The other three stream segments were chosen to encompass the different buffer covers (all forest, some forest, no forest). The stream segments were walked and assessed. Field observations were compared to the digital imagery in the field and subsequently at VIMS.

Construction of the VDoT Area Headquarters has been completed (Fig. 4 is from 2002). Field observation indicates that the detention pond and distance of construction from the stream have left the stream in an unaltered condition.
Riparian buffer condition varied with the different buffer covers. Some stream segments have completely forested riparian buffers (Fig. 5) and the buffer condition was optimal.

Figure 5. Field photograph of stream with completely forested buffer. Site was located in eastern end of study area.
Generally the degraded banks occurred where land use in the buffer was agriculture or developed. Buffers with only partial forest or fully grassed show some signs of increased bank erosion (Fig. 6).

Figure 6. Field photograph of with grassy buffer and increased bank erosion. Site was located in central part of study area.
Those buffers with no forest cover, where cows have direct access to streams (Fig. 7), or where construction directly impacts the stream have the most degraded banks. Even forested buffers identified by aerial photographs may not have understories, and may therefore have degraded streams, especially if there is cow access.

Figure 7. Field photograph of stream with increased bank erosion due to direct cattle access. Site was located in central part of study area.

Recommendations

From the results of the digital data analysis and field work, several recommendations are offered.

- Use riparian buffer cover data in Figure 3 to target areas for restoration or enhancement of stream buffers. Because of the issues with aerial photographs discussed earlier, after targeting buffers for restoration on the digital imagery, field surveys should be conducted to verify and assess the riparian buffer condition.

- Areas without fully forested riparian buffers should be targeted for restoration first. Forests are the optimal land use in riparian buffers (SICAM, 2006). The effectiveness of a riparian buffer is affected by its cover and the adjacent land use.
Those streams without any forested buffers are most vulnerable to increased bank erosion. Allowing pasture or cropland too close to streams definitely increased the occurrence of stream bank slumping, gullying or additional sedimentation in stream channels. At a minimum, naturalized grass buffers are more preferable than buffers with grazing, mowing, or crops.

- To reforest buffers, it is recommended to plant native species, rather than just allowing buffers to revegetate with invasive or undesirable species. Native species generally are more suited to the environmental and climatological conditions, and are ‘recognizable’ habitat for fauna and other native flora.

- Certain activities in buffers or near streams are detrimental and should be avoided. In the study area, two observed activities of concern are allowing cows direct access to streams, and unconfined dumpsites near streams. Stream segments where these activities occur are a high priority for restoration. One stream restoration option to exclude cattle is streamside fencing. Excluding cattle from direct access to streams can have many benefits to the streams including decreased sediment, nutrient and fecal coliform inputs, as well as potentially improving pasture utilization and cattle health (Burns, 2001). Unconfined dumpsites enable contaminated runoff to reach streams. Dumpsites should be properly constructed and located.

- Private property owners should be encouraged to restore their riparian buffers. Public education seminars on the importance of riparian buffers and information on incentive programs, such as the Conservation Reserve Enhancement Program (CREP), may help. “CREP is a voluntary program for agricultural landowners. Unique state and federal partnerships allow you to receive incentive payments for installing specific conservation practices. Through the CREP, farmers can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible land.” (USDA, 2006)

- Rappahannock County should make every effort to protect the headwaters and riparian buffers of streams located in the Commercial Area delineated in the Comprehensive Plan


Figure 8 shows that most of the riparian buffers within the Commercial Area boundaries are not forested or somewhat forested, so they are particularly at risk from development.
Sampling Protocols

There are several resources available that have developed sampling protocols for physical, chemical and biological parameters for citizen monitoring programs. The type and complexity of monitoring performed depends upon the level of commitment by the participants. In some cases, these agencies will set up training sessions for their monitoring protocols. The websites listed below have more details as well as contact information.

Physical/Chemical Parameters

Alliance for the Chesapeake Bay Citizen Monitoring Program
http://www.acb-online.org/project.cfm?vid=87

Virginia Save Our Streams
http://www.sosva.com/

Virginia Department of Environmental Quality
http://www.deq.state.va.us/cmonitor/guidance.html

Biological Parameters

Virginia Save Our Streams
http://www.sosva.com/

Virginia Department of Environmental Quality
http://www.deq.state.va.us/cmonitor/guidance.html

Future Work

The work discussed in this report fulfills the requirements of the Scope of Work.

There is the potential for future work when new source data is available. The GIS analysis in this report was based on aerial photographs from 2002. The state is being reflown in 2006 (http://www.vgin.virginia.gov/news/vagisnews.html). After the new imagery is processed, land use changes in the study area and riparian buffers can be compared.

The Federal government is under no obligation to provide any funding for future work efforts. Such work efforts, if desired by Rappahannock County, would be requested of the Corps of Engineers under its normal budgetary process.
References


