

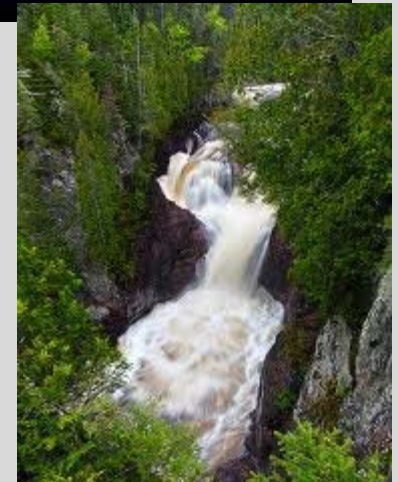


A Review of Landscape and Riparian Disturbances to Stream Ecosystems – with emphasis on the North Shore of Lake Superior

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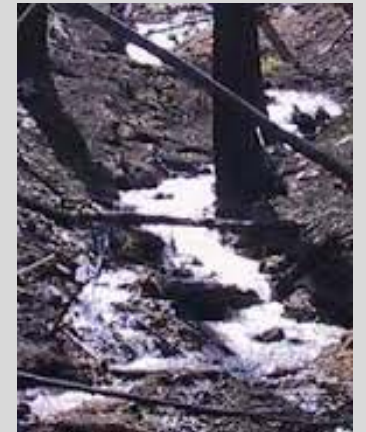
Review

- What are the threats?
- Evolution of Riparian Forest Guidelines
- What is the Riparian Management Zone (RMZ)?
- Benefits of Landscapes and RMZs to stream ecosystems
- Impact vs. Recovery
- Summary



What are landscape and riparian threats to the quality of North Shore Streams?

- Development
 - Residential
 - Commercial
 - Industrial
- Forestry practices
- Natural disturbances
 - Forest Fire
 - Wind
- Climate change

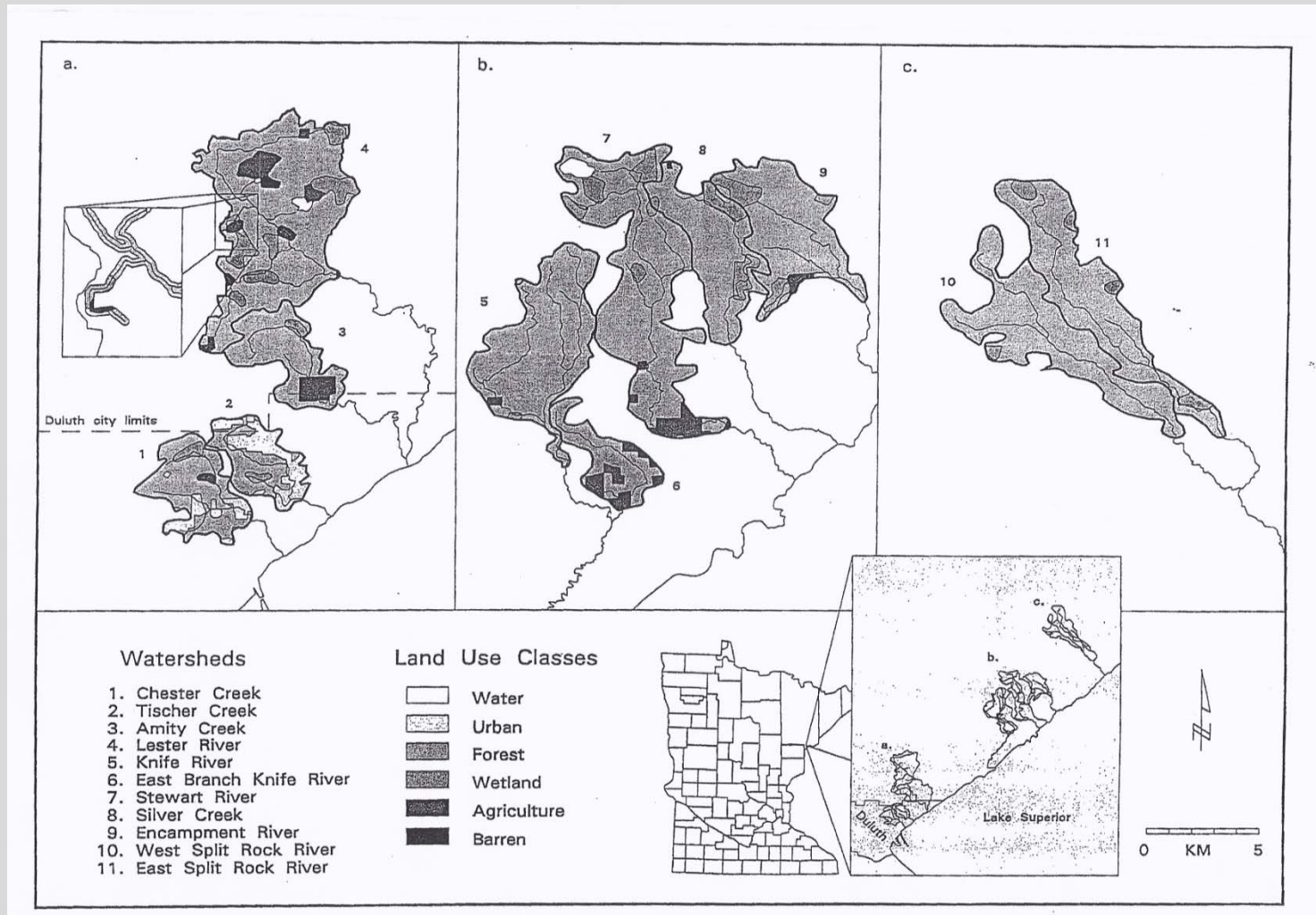


Town of Duluth Township Zoning Ordinance

Table 5.2 Shoreland Overlay (SLO) Dimensional Requirements

<i>Type of Water Body</i>	<i>Shoreland Overlay Area (SLO) (from OHWL or vegetation line, whichever is greater)</i>	<i>Minimum Setback from Water Body (from OHWL or vegetation line, whichever is greater)</i>	<i>Maximum Lot Coverage</i>	<i>Minimum Road Setback</i>
Trout streams	300 feet	200 feet	(1)	200 feet
Tributaries of trout streams	300 feet	100 feet	(1)	100 feet
Other public watercourses	300 feet	100 feet	(1)	100 feet
Unclassified, established watercourses with defined bottom	50 feet	50 feet	(1)	50 feet
Lake Superior shoreland (For Lake Superior shoreland erosion hazard areas see requirements in Article VI, Section 3 . See Article VI, Section 6 for water oriented structures.)	<i>Lake Superior to Highway 61, Expressway</i>	100 feet	(2)	100 feet



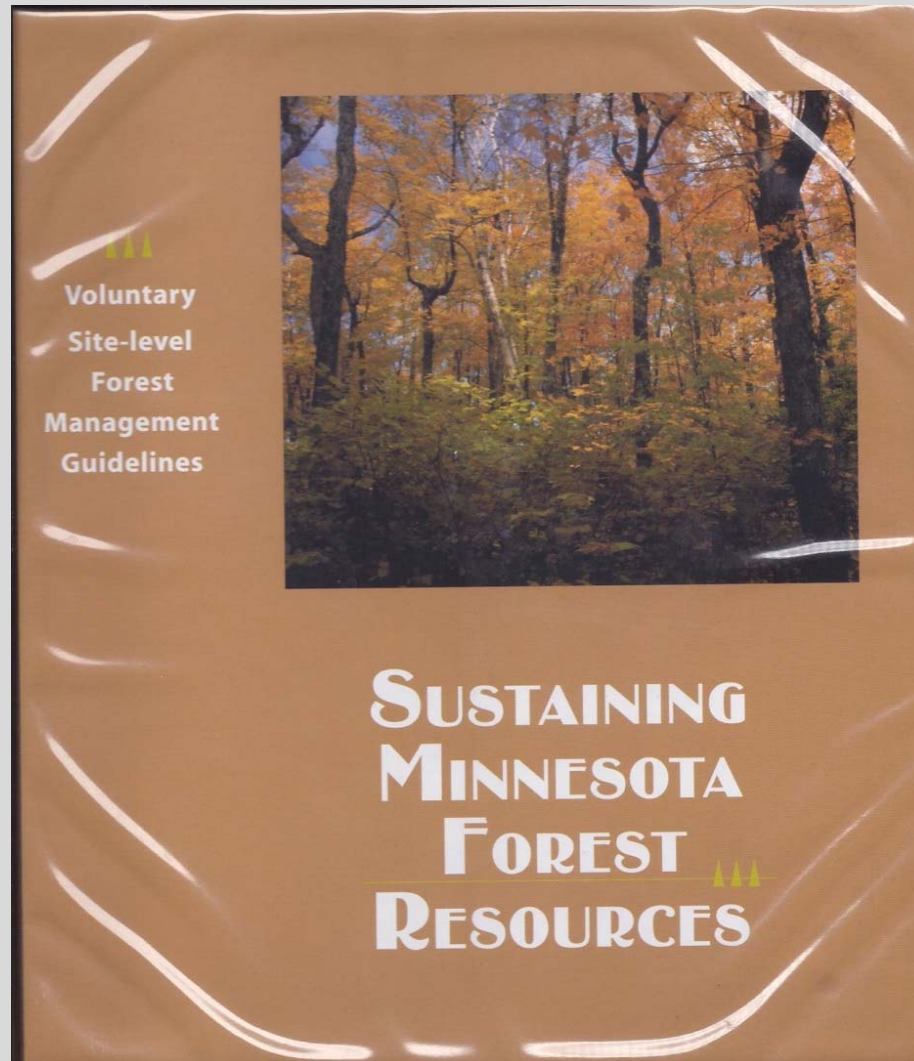


Landscape contrasts in urban to forested watersheds from land use/land cover (16 ha resolution) had measurable effects on North Shore stream water quality and macroinvertebrates
 (from Richards and Host, 1994, Water Resources Bulletin 30:729-738)

Evolution of Riparian Issues and Forestry in Minnesota

- 1989–initiation of a dozen studies to examine the cumulative effects of increased forest harvesting and management in MN
- 1994 - Final **Generic Environmental Impact Study (the GEIS)** statement study on timber harvesting and forest management in Minnesota
- 1993- 1995 - **GEIS** Implementation Roundtable, appointed by MN DNR and EQB Commissioners, consensus process
- 1995 - MN Sustainable Forest Resources Act and MN Forest Resources Council
- 1995 – **Riparian issues were a major concern of the GEIS**
- 1995 - **“At the Water’s Edge: The Science of Riparian Forestry.”** Duluth Conference, Edited by S. Laursen of MN Extension Service, 160 pp.

Ultimately this “voluntary” document in 2005



From – Sustaining MN Forest Resources – Voluntary Site-Level Forest Management Guidelines. MFRC. 2005. p. 4 in Riparian Section.

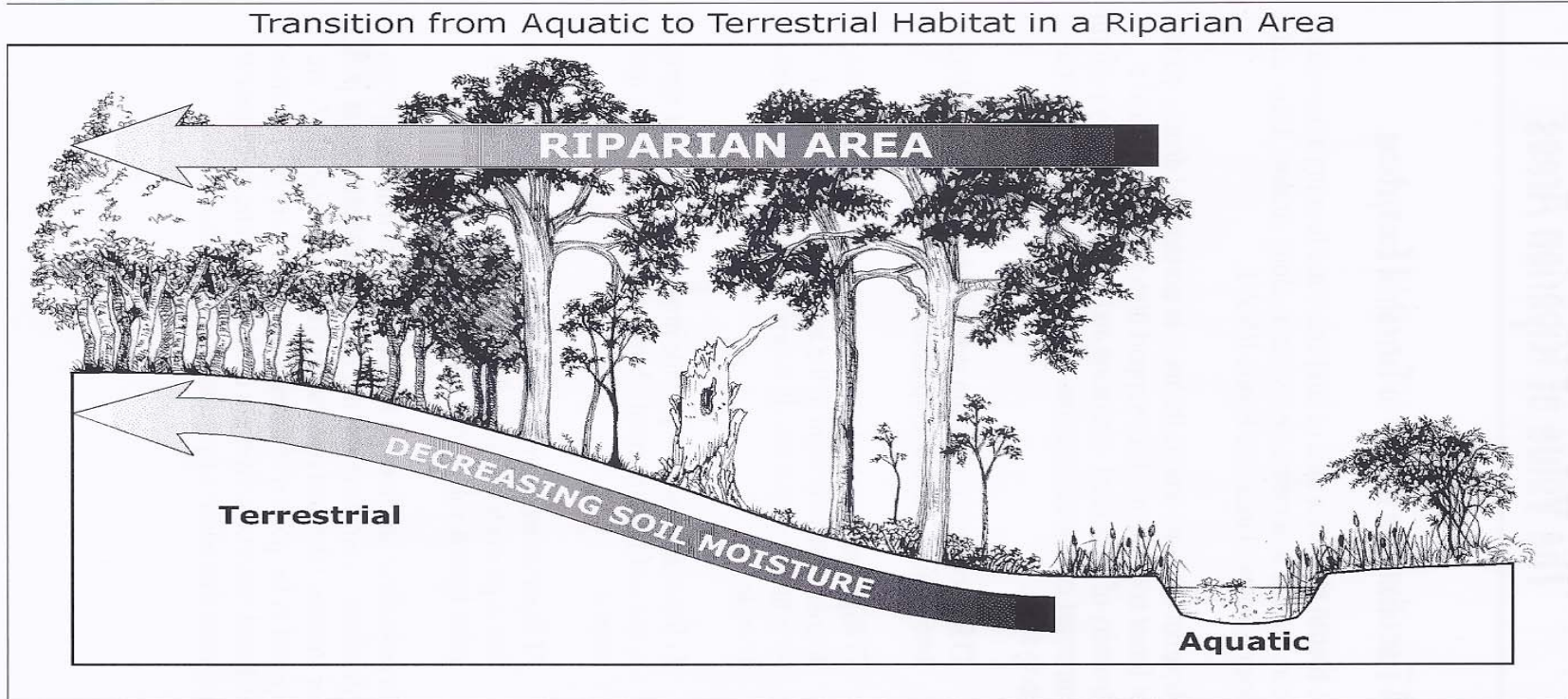


Figure RMZ-1

“The probability of a forest serving a riparian function decreases as the distance from the water’s edge increases.”

Extent of the Riparian Management Zone

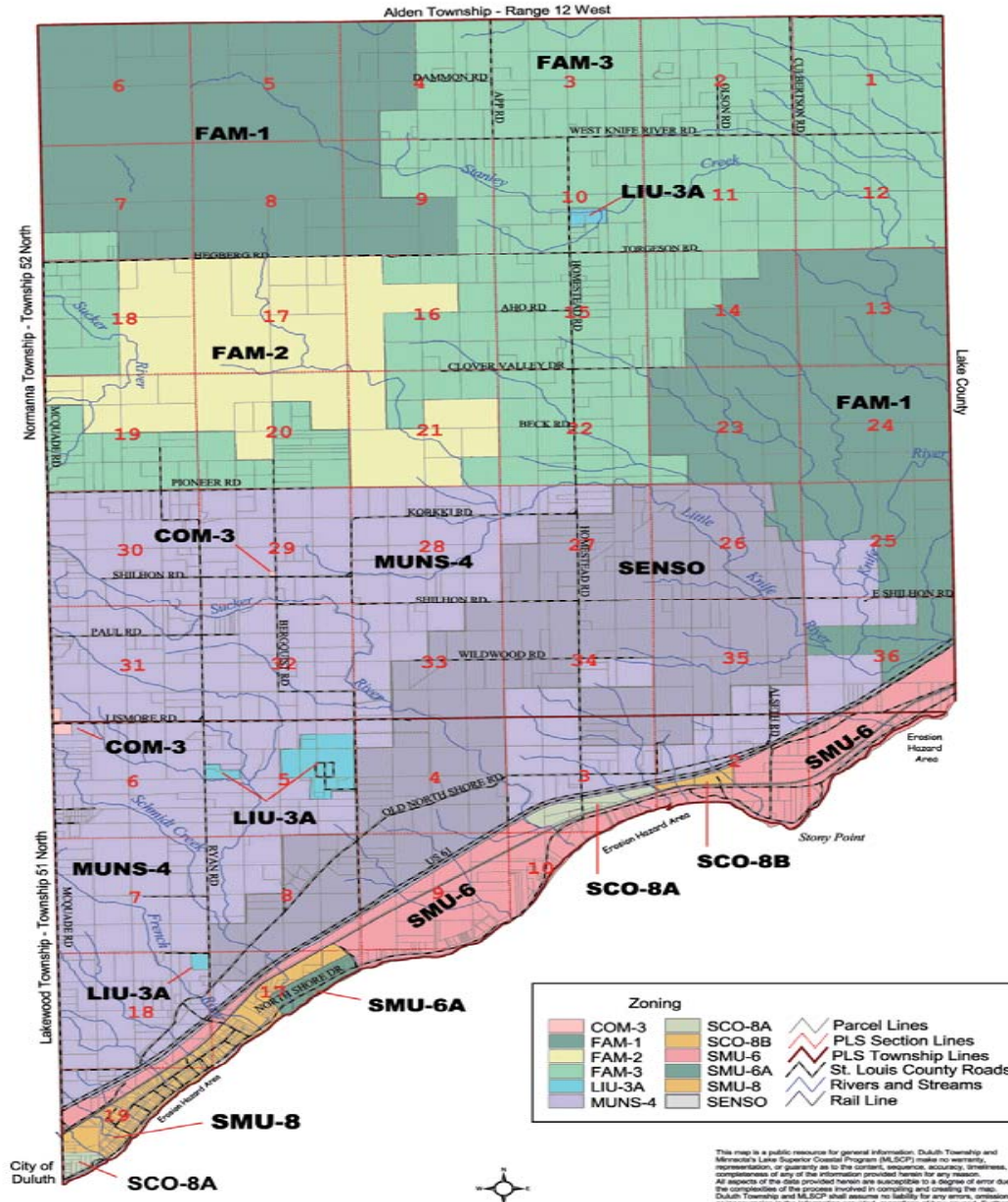
From - Hanowski, J. et al. 2002. *J. of the American Water Resources Association* 38: 633-639.

- Examination of 100 x 100 km area using 28.5 m (94 feet) and 57 m (187 feet) buffer widths within riparian areas (non-forested wetlands, intermittent and or perennial streams, and lakes)
- 18 % of the forest area was within a 28.5 m wide buffer
- 34 % of the forest area was within a 57 m wide buffer

Landsat Scene



Zoning Map - Duluth Township St. Louis County, MN



Richardson, J., R. Naiman, P. Bisson. 2012. How did fixed-width buffers become standard practice for protecting freshwaters and their riparian areas from forest harvest practices. *Freshwater Science* 31: 232-238.

- **Fixed-width buffers are administratively simple to implement and assess, and have come to be the norm for streamside protection from forestry.**
- **Few experiments have been done to test the efficacy of buffers of a particular width or of site- or landscape specific modifications.**

Gunderson, P. et al. 2010. Environmental services provided from riparian forests in the Nordic countries. *Ambio* 39:555-556.

- **Riparian forests growing along streams, rivers, and lakes comprise > 2 % of the forest area in the Nordic countries [with a 10 m (33 ft) buffer].**
- **Forest buffers are effective in protecting water quality and aquatic life, and have positive effects on terrestrial biodiversity, particularly when broader than 40 m (131 ft)**

Lee, P., Smyth, C., Boutin, S. 2004. Quantitative review of riparian buffer width guidelines from Canada and the United States. *Journal of Environmental Management* 70: 165–180.

From – Sustaining MN Forest Resources – Voluntary Site-Level Forest Management Guidelines. MN Forest Resource Council. 2005. p. 9 in Riparian Section.

Relationship of Riparian Function and Distance from Water's Edge

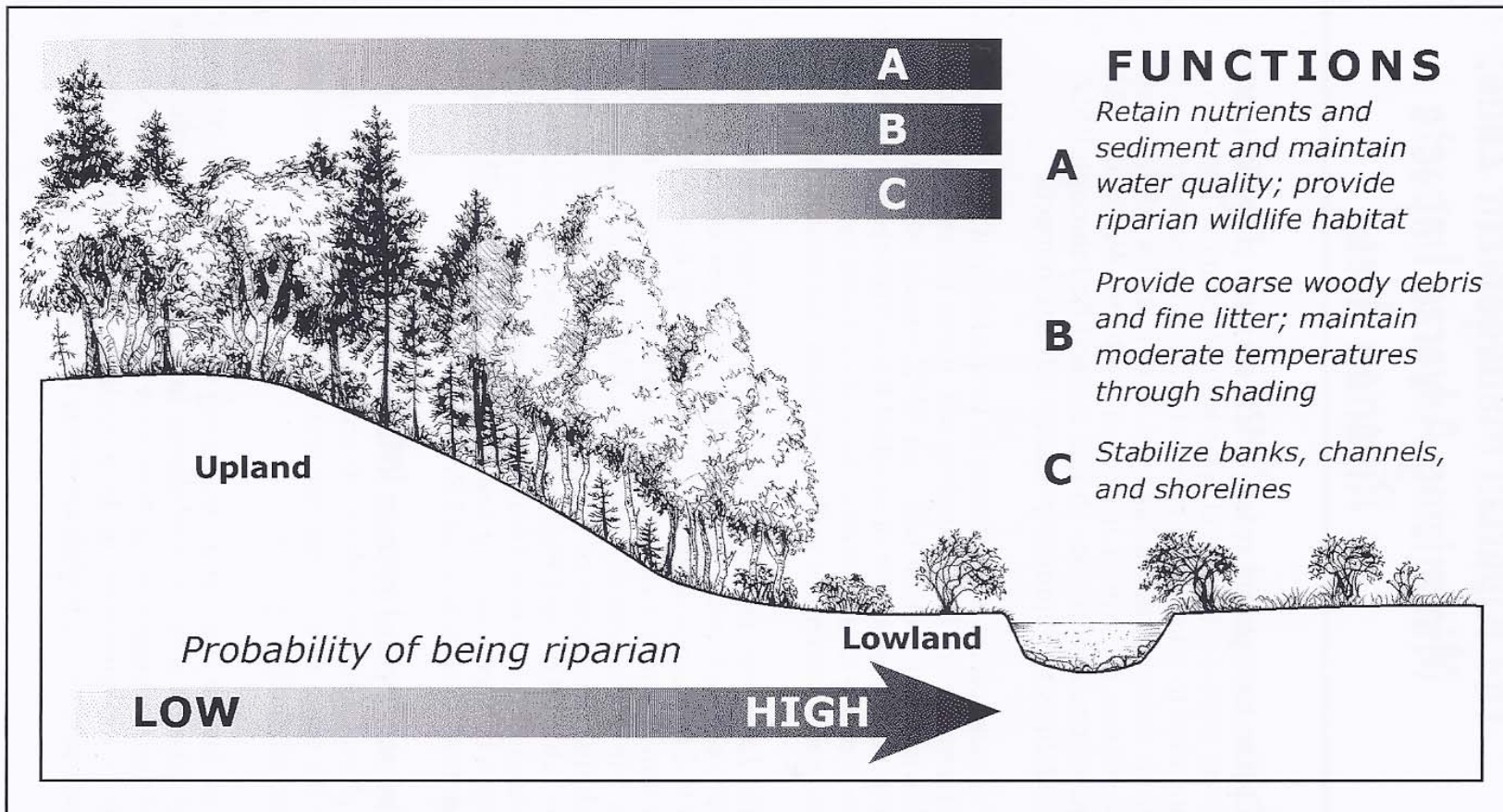
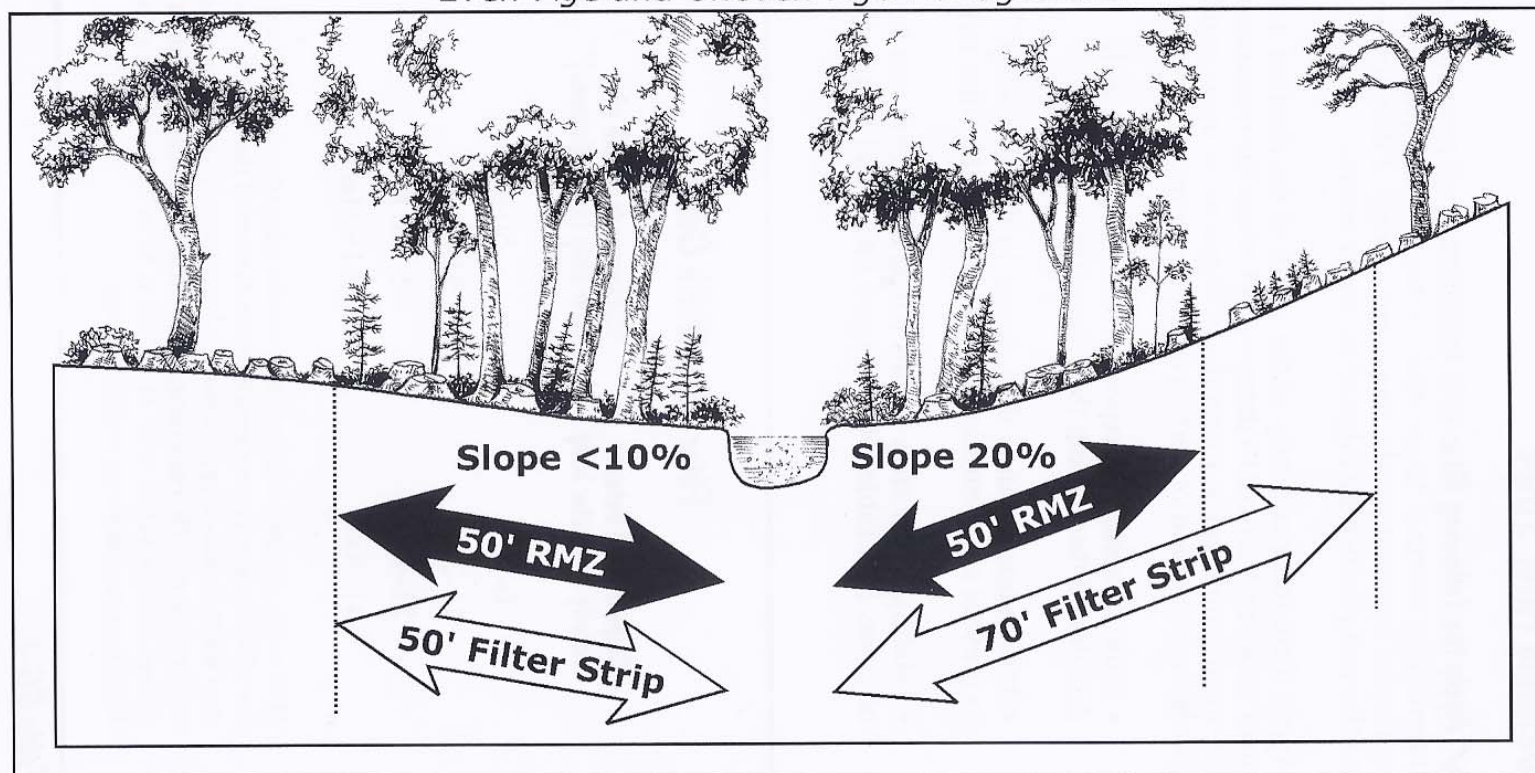


Figure RMZ-2

Figure GG-4

Filter Strips and RMZ for Non-Trout Perennial Streams < 3 Feet Wide
of Varying Slopes in High Bank and Upland Forests:
Even-Age and Uneven-Age Management



Filter strips - areas adjacent to water bodies that help minimize the runoff of sediment, debris, nutrients, pesticides, and water.

Filter Strip Width Guide

Slope of land between activity and water body	Recommended width of filter strip (slope distance) *
0-10%	50 feet
11-20%	51-70 feet
21-40%	71-110 feet
41-70%	111-150 feet

*For roads, distance is measured from the edge of soil disturbance. For fills, distance is measured from the bottom of the fill slope. Filter strip width increases approximately 2 feet for each percent increase in slope above 10%. For example, the filter strip recommendation for a range in slope values from 11 to 20% is 51 to 70 feet. If the slope is 18%, then the filter strip width is 66 feet.

Table GG-1

“On average, the recommended Riparian Management Zone width is 200 ft and can be straight or irregular in character.”

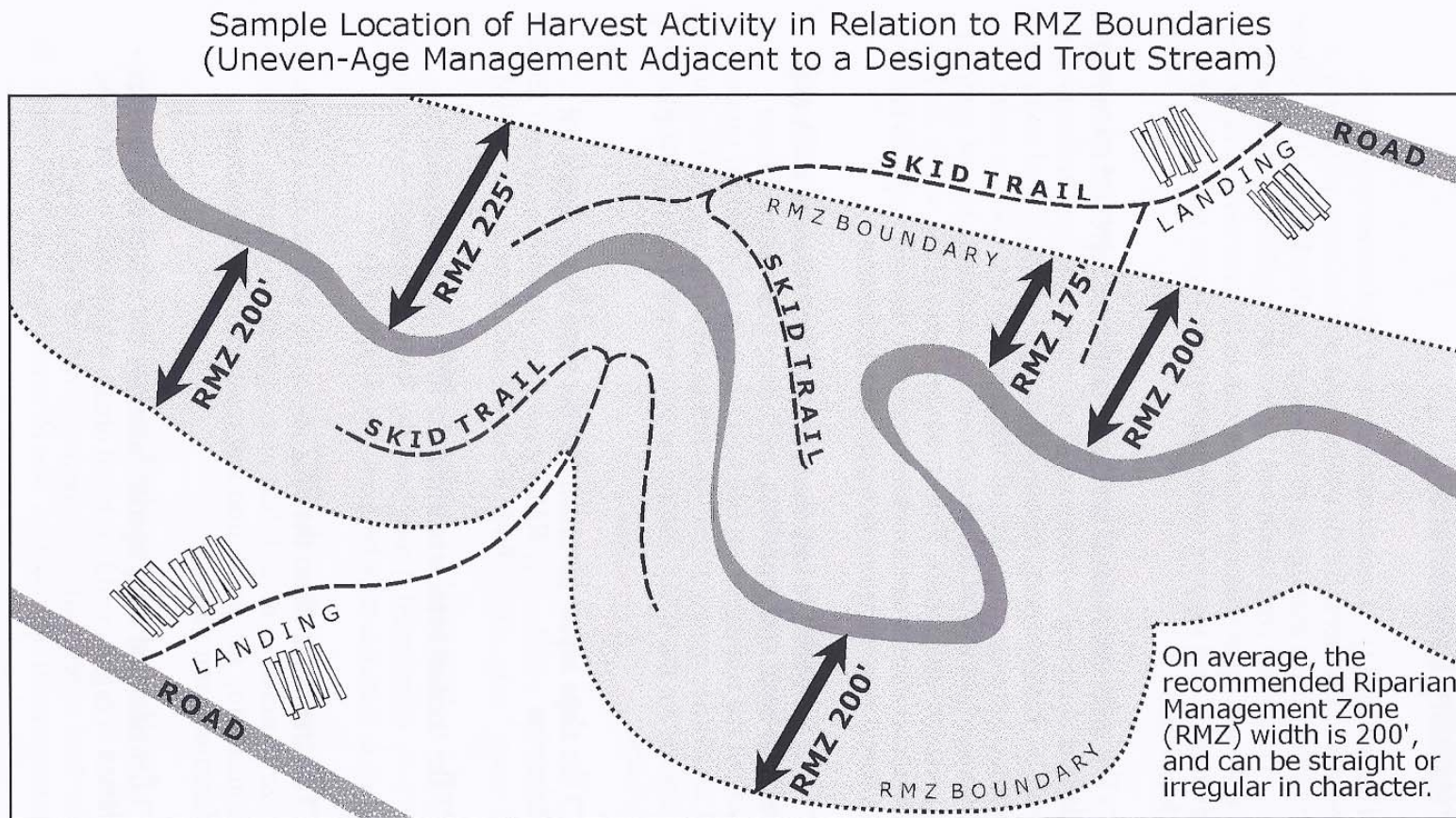


Figure GG-6

Summary of Landscape and Riparian Benefits to Stream Ecosystems

- 1. Retain nutrients and sediment to maintain water quality** (Cooper et al. 1986, Johnston et al. 1990, Richards and Host 1994, Blinn and Kilgore 2001, Merten et al. 2010, Weller 2011)
- 2. Retain and slow water movement across the landscape** (Verry et al. 1983, Naiman and Decamps 1997)
- 3. Provide coarse woody debris and fine litter** (Richards and Host 1994, Merten et al. 2010, 2011; Kreuzweiser et al. 2010, Moore and Richardson 2012, Vaz et al. 2011, 2013)
- 4. Maintain moderate temperatures through shading** (Naiman et al. 2010, Bowler et al. 2012)
- 5. Stabilize bank, channels, and shorelines** (Verry 2001, Riedel et al. 2001)
- 6. Provide riparian wildlife habitat** (Hemstad et al. 2008, Chizinski et al. 2010, Braithwaite and Mallik 2012)
- 7. Reduction of alien plant invasions in riparian zones – by maintaining the native plant community** (Planty-Tabacchi et al. 1996)

Disturbance → “Impact?” → Resistant or Resilient

Macroinvertebrate “fish food” recovery

Disturbance	N	Biomass - years	Density - years	Richness - years
Logging	16	> 5	> 5	< 5
Channelization	11	> 5 to > 50	> 5 to >50	> 5 to > 50
Rotenone	9	.08 to 1.00	.017 to 1.0	1.0 to 1.2
Flooding	8	0.17 to 1.0	> .33 to 1.0	0.17 to 1.0
Drought	7	< 1.0	0.21 to 1.0	0.27 to 1.20

From Niemi et al. 1990. *Environmental Management* 14:571-587.
and Yount et al. 1990. *Environmental Management* 14: 547-570.

Long recovery times were associated with physical alterations to the existing habitat, if residual pollutants remained in the system, or area was isolated and recolonization was suppressed.

But – there are many exceptions

For example – Mertens et al. (2010) report recovery of > 10 years following logging plus an enabling event (high storm flows) for recovery of fine sediments

Summary

1. “Voluntary guidelines” - compliance? — are they working?
2. Impact vs recovery? – what are the most severe disturbances over the long-term
3. Common sense in application of the guidelines
 - a. Use best professional judgment
 - b. Seek additional comments or expertise
 - c. Special conditions may apply to some areas
4. On-going need for more information and experimental approaches

Acknowledgments

- Organizers of this conference
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Reference List – contact me – gniemi@umn.edu