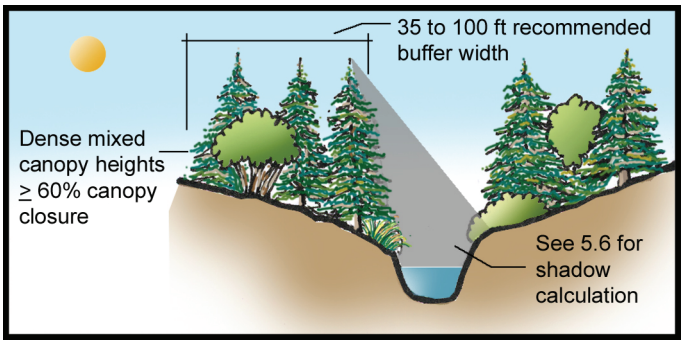


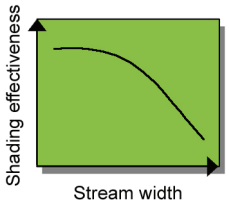
2.12 Stream temperature and buffers

Buffers can help maintain cooler water temperatures in small streams if the vegetation provides adequate shade on the water surface. This can be beneficial for coldwater aquatic species and for water quality.

Stream shade is comprised of topographic shade provided by nearby hills, bank shade, and vegetative shade. Streams with vegetation removed usually have undesirable summer temperature increases from 5 to 11°C. Aspect, channel morphology, and groundwater input may affect temperatures more than buffers.

Key Design Considerations

- Incorporate topography and bank shade in the design.
- Trees and shrubs provide the most shade but unmowed or ungrazed grass buffers can provide shade on streams less than 8 feet in width.
- Buffer shading effectiveness decreases as stream width increases.
- Windthrow may be common in buffers retained after timber harvest and wider buffers may be necessary.
- Buffers may need to be wider (150 to 1000 ft) to maintain other microclimatic factors (e.g., soil temperature, humidity).



2.12 References

Anbumozhi, V.; Radhakrishnan, J.; Yamaji, E. 2005. Impact of riparian buffer zones on water quality and associated management considerations. Ecological Engineering. 24: 517-523.

Barton, D.R.; Taylor, W.D.; Biette, R.M. 1985. Dimensions of riparian buffer strips required to maintain trout habitat in southern Ontario streams. North American Journal of Fisheries Management. 5: 364-378.

Beschta, R.L. 1997. Riparian shade and stream temperature: an alternative perspective. Rangelands. 19: 25-28.

Blann, K.; Nerbonne, J.F.; Vondracek, B. 2002. Relationships of riparian buffer type to water temperature in the Driftless area ecoregion of Minnesota. North American Journal of Fisheries Management. 22: 441-451.

Brosofske, K.D.; Chen, J.; Naiman, R.J.; Franklin, J.F. 1997. Harvesting effects on microclimatic gradients from small streams to uplands in western Washington. Ecological Applications. 7: 1188-1200.

Brown, G.W. 1969. Predicting temperatures of small streams. Water Resources Research. 5: 68-75.

Brown, G.W.; Krygier, J.T. 1970. Effects of clear-cutting on stream temperatures. Water Resources Research. 6: 1133-1139.

Caissie, D. 2006. The thermal regime of rivers: a review. Freshwater Biology. 51: 1389-1406.

Chen, J.; Saunders, S.C.; Crow, T.R. [and others]. 1999. Microclimate in forest ecosystem and landscape ecology. BioScience. 49: 299-297.

Davies-Colley, R.J.; Payne, G.W.; van Elswijk, M. 2000. Microclimate gradients across a forest edge. New Zealand Journal of Ecology. 24: 111-121.

Davies, P.; Cook, D.; Rutherford, K.; Walshe, T. 2004. Managing high in-stream temperatures using riparian vegetation. River and Riparian Land Management Technical Guideline No. 5. Canberra, Australia: Land and Water Australia. 24 p.

Dignan, P.; Bren. L. 2003. Modelling light penetration edge effects for stream buffer design in mountain ash forest in southeastern Australia. Forest Ecology and Management. 179: 95-106.

Feller, M.C. 1981. Effects of clearcutting and slashburning on stream temperature in southwestern British Columbia. Water Resources Bulletin. 17: 863-867.

Greene, G.E. 1950. Land use and trout streams. Journal of Soil and Water Conservation. 5: 125-126.

Hewlett, J.D.; Fortson, J.C. 1982. Stream temperature under an inadequate buffer strip in the southeast piedmont. Water Resources Bulletin. 18: 983-988.

Johnson, S.L.; Jones, J.A. 2000. Stream temperature responses to forest harvest and debris flows in western Cascades, Oregon. Canadian Journal of Fisheries and Aquatic Sciences. 57 (supplement 2): 30-39.

Karr, J.R.; Schlosser, I.J. 1978. Water resources and the land-water interface. Science. 201: 229-234.

Larson, L.L.; Larson, S.L. 1996. Riparian shade and stream temperature: a perspective. Rangelands. 18: 149-152.

Macdonald, J.S.; MacIsaac, E.A.; Herunter, H.E. 2003. The effect of variable-retention riparian buffer zones on water temperatures in small headwater streams in sub-boreal forest ecosystems of British Columbia. Canadian Journal of Forest Research. 33: 1371-1382.

Mitchell, S. 1999. A simple model for estimating mean monthly stream temperatures after riparian canopy removal. Environmental Management. 24: 77-83.

Moore, R.D.; Spittlehouse, D.L.; Story, A. 2005. Riparian microclimate and stream temperature response to forest harvesting: a review. Journal of the American Water Resources Association. 41: 813-834.

O'Laughlin, J.; Belt, G.H. 1995. Functional approaches to riparian buffer strip design. Journal of Forestry. 93: 29-32.

Osborne, L.L.; Kovacic, D.A. 1993. Riparian vegetated buffer strips in water-quality restoration and stream management. Freshwater Biology. 29: 243-258.

Parkyn, S.M.; Davies-Colley, R.J.; Halliday, N.J. [and others]. 2003. Planted riparian buffer zones in New Zealand: do they live up to expectations? Restoration Ecology. 11: 436-447.

Quigley, T.M. 1981. Estimating contribution of overstory vegetation to stream surface shade. Wildlife Society Bulletin. 9: 22-27.

Rishel, G.B.; Lynch, J.A.; Corbett, E.S. 1982. Seasonal stream temperature changes following forest harvesting. Journal of Environmental Quality. 11: 112-116.

Saunders, S.C.; Chen, J.; Crow, T.R.; Brosofske, K.D. 1998. Hierarchical relationships between landscape structure and temperature in a managed forest landscape. Landscape Ecology. 13: 381-395.

Sridhar, V.; Sansone, A.L.; LaMarche, J. [and others]. 2004. Prediction of stream temperature in forested watersheds. Journal of American Water Resources Association. 40: 197-213.

Webb, B.W.; Crisp. D.T. 2006. Afforestation and stream temperature in a temperate maritime environment. Hydrological Processes. 20: 51-66.

Wilkerson, E.; Hagan, J.M.; Siegel, D.; Whitman, A.A. 2006. The effectiveness of different buffer widths for protecting headwater stream temperatures in Maine. Forest Science. 52: 221-231.

Zwieniecki, M.A.; Newton, M. 1999. Influence of streamside cover and stream features on temperature trends in forested streams of western Oregon. Western Journal of Applied Forestry. 14: 106-113.