5. RIPARIAN MANAGEMENT ZONES (RMZs)

Riparian Management Zones (RMZs) are sometimes called buffer strips, filter strips, or streamside management areas or zones (see Figure 2). An RMZ occurs on both sides of perennial or intermittent streams and around the perimeter of bodies of open water (e.g. open water wetlands or lakes) where **extra precaution** is used in carrying out forest management practices including timber harvesting activities.

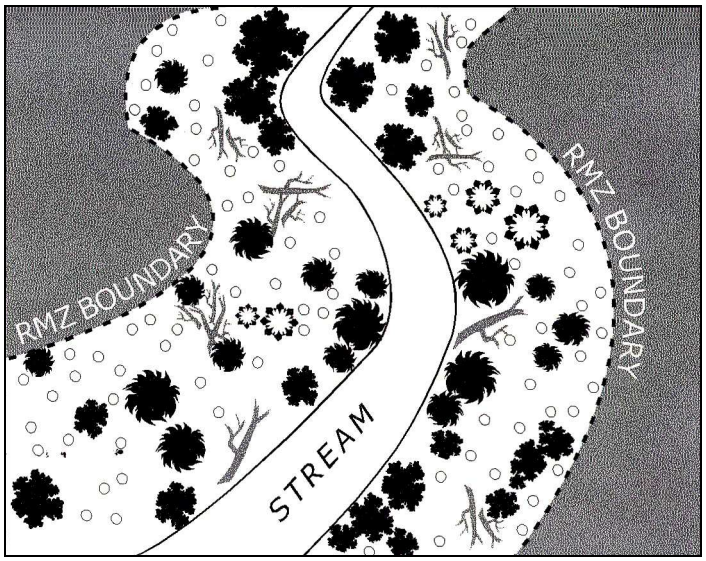

Figure 2. Example of a Riparian Management Zone

One of the purposes of a management zone is for water quality protection to provide an area of vegetation to interrupt water flow and to trap and filter out suspended sediments, nutrients, chemicals, and other polluting agents before they reach the body of water. An RMZ also provides shade to small streams, thus reducing thermal pollution.

The part of the zone nearest the stream bank can also provide an important contribution to the aquatic food chain. As trees die within the RMZ, all or portions of them may fall over into the adjacent stream. This dead material provides aquatic habitat known as large woody structure (LWS). Naturally occurring LWS in lakes and streams provides essential areas of shaded cover for fish, amphibians and aquatic insects and can provide important isolated platforms for reptiles and small mammals. In developing a management plan for the RMZ, consider leaving some late successional trees (both coniferous and deciduous) within the RMZ that have the potential to provide LWS to a lake or stream.

Forest Management Activities within the Riparian Management Zone

Michigan's BMPs do allow for forest management activities within the RMZ. These include equipment operation and timber harvesting. The key is ensuring the water quality protection function of the RMZ is maintained (see Section "RMZ Water Quality Function Factors") throughout and after the harvesting operation.

The RMZs should be maintained along all perennial and intermittent streams, lakes or ponds where nearby management activities result in surface/soil disturbance, earth changes and where erosion and sediment transport occur during rain events. An example of this is a newly constructed forest road where the base consists entirely of compacted soil and the road begins eroding after a rain event.

The RMZs are critical to watersheds, wildlife, fish, trees, and people for many different reasons. Adequate vegetation in a RMZ helps filter and trap pollutants such as sediment, excess nutrients, and other contaminants before they reach surface waters. Excessive disturbance of the forest floor within the RMZ minimizes its ability to prevent nonpoint source pollutants from reaching a stream or other water body. In fact, such disturbance might lead to the transport of sediment directly from the RMZ to the water body adjacent to it.

Site Specific Factors to Consider

Landowners considering forest practices in or near a RMZ must plan carefully to assure that the water quality functions of the RMZ are maintained. Those unsure of the water quality impacts of a planned activity should either seek the advice and assistance of foresters or other natural resource professionals familiar with RMZ functions, or leave the RMZ undisturbed. The following are site-specific factors to consider prior to harvesting or conducting other management activities in the RMZ:

- Water body characteristics.
  - DNR designated trout stream
    - Greater than 50 feet in width (typical beaver dam building activity not a concern on these streams).
    - Less than 50 feet in width (typical beaver dam building activity is a concern on these streams and aspen regeneration within 300 feet of the stream may be a concern).
- Legally Designated Natural River (There are specific rules and regulations for each designated Natural River system).
- Slope
- Soils
- Aesthetics
- Existing vegetation
- Shade requirements to maintain water temperature
- Time of year activity is scheduled to occur
- Availability of large woody structure for the adjacent water body
- Recent precipitation
- Extent of soil saturation

Riparian Management Zone Water Quality Function Factors

The water quality function of RMZs can be maintained by using the following specifications:

- When setting up a timber sale, make sure the forester or logger establishes a minimum RMZ. Michigan's standard RMZ minimum width is 100 feet or 30 meters measured from the top of the bank of the lake or stream or the ordinary high water mark. The RMZ width should be increased as slope percentages increase above ten percent (see Table 1).

- Zone width may have to be increased along State designated "Natural Rivers" and federally designated "Wild and Scenic Rivers" as designated in their management plans.

- Minimize disturbance of the forest floor in the RMZ (a recommended goal is to have less than 10% of the soil disturbed).

- Harvesting/cutting specifications should be modified to retain a sufficient number of trees (60-80 basal area is often used as a benchmark) to maintain shading of streams and to

leave a relatively stable and undisturbed forest floor (less than 10 percent bare soil exposure).

- Trees growing along the stream bank should not be cut.

- Do not leave felled trees, limbs or tops in streams and open water wetlands; spread them on the ground, unless corrective action would create more damage to the site or stream. This biomass is considered a source of "unnatural" organic debris that impacts aquatic habitat, for example, by lowering levels of dissolved oxygen required to maintain healthy coldwater fisheries.

- Limbs and tops from trees that are cut within the RMZ should be left on the ground in the RMZ.

- Felled trees, limbs and tops harvested outside the RMZ should not be placed within the RMZ.

- Locate haul roads outside of RMZs. Where a road must cross a stream, it should do so at right angles. A permit from DEQ to construct a stream crossing is required.

- Locate equipment storage and maintenance sites and landings outside all RMZs.

- Harvesting activities in the RMZ should minimize scarification and soil compaction. Skidding or dragging logs in the RMZ should be avoided. Skidders should not be operated in RMZs when soils are saturated, as the soil easily compacts and runoff is not easily absorbed by the soils in the RMZ. If cutting must occur in the RMZ, every effort should be used to remove timber from the zone with techniques such as tracked equipment with knuckleboom cranes (see Figure 3) to ensure equipment is not negatively impacting the RMZ's soil base. Even if the soil is not scarified, compaction will decrease the ability of the soil to absorb runoff.

- All roads, cuts and fills in the RMZ must be stabilized. Use appropriate seeding and mulching procedures (see Appendix E). Energy dissipaters (e.g. rock ranging from 3-12 inches in diameter) should be installed at inlets and outlets of cross-drainage culverts located underneath roads approaching a stream.

- Drainage structures such as culverts, diversion ditches, conveyor belt water bars, and broad-based dips should be installed according to BMP specifications (see section 7) prior to roads and primary skid trails entering the boundary of a RMZ.

Figure 3. An Example of a Knuckleboom Harvester.

(Note the boom allows for removal of timber from a RMZ with little soil disturbance.)

Riparian Management Zone Widths

Michigan's standard RMZ minimum width is 100 feet or 30 meters measured from the top of the bank or the ordinary high water mark of a lake or each side of a stream. This is the zone in which extra precaution should be used in harvesting timber or for other forest management activities. It is generally the minimum distance needed to protect water and aquatic habitat quality when conducting forest management activities adjacent to a water body, especially if the activity provides a source of sediment (e.g. a dirt-based forest road). A wide range of riparian management zone widths (from less than 50 feet to over 500 feet) has been proposed in water quality research. If management objectives include protecting wildlife habitat or controlling beaver activity on smaller streams, widths larger than 100 feet may be appropriate. Activity within the RMZ is acceptable where there is little chance of significant soil disturbance, no chance of water sedimentation, and only select trees are being removed.

Table 1 illustrates the minimum recommended widths for RMZs based on slope. Note that these widths are for overland sheet flows only. Nonpoint source pollutants transported via concentrated flows into a RMZ will usually require additional measures such as using nonwoven geotextile fabric overlain by riprap or large sized rock, ranging from 3-12 inches in diameter, for a width of 3 feet and a length of 5 feet (Michigan Department of Transportation, 2003).

When measuring for a proper width of a RMZ, take into account the natural variablility of the landscape and widen the RMZ accordingly. Slope can be estimated ocularly or calculated by several methods, including using a string and line level or through the services of a professional surveyor. Remember that it takes years for deposited sediment to be cleansed from a stream, so the landowner or the land manager should err on the side of caution when establishing the width of a RMZ.

Table 1. Minimum Riparian Management Zone Width Adjusted for Slope.

Slope of Land Above Water Body or Stream (%)	Minimum Width of Riparian Management Zone (Feet)
0-10	100
10-20	115
20-30	135
30-40	155
40-50	175
50 +	Timber removal is not advised due to the high potential for erosion and sediment transport.

The RMZ width shown in Table 1 may need to be increased where domestic water supply could be impacted.

In addition to slope influencing sedimentation, different soils or soil textures have differing amounts of susceptibility to erosion. Table 2 displays the susceptibility of different soil textures at the soil surface to erosion. When developing an effective RMZ, consider the soils near the lake or stream.

Table 2. Soil Erosion Susceptibility.

Surface Soil Texture	Susceptibility to Erosion *(1=highest)*
Silt, silt loam, loam, very fine sandy loam	1
Sandy clay loam, silty clay loam, clay loam	2
Clay, silty clay, sandy clay, very fine loamy sand	3
Sandy loams, loamy sands, sands	4

(Re-printed courtesy of the Minnesota Forest Resources Council.)

Designated Trout Streams and Management Within the Riparian Management Zone

Certain streams are designated by the DNR as “Trout Streams”. For these designated streams, the DNR has the authority to require only lures or baits for fishing and may prescribe the size and number of fish that may be taken (Per Act 451, MCL Section 324.48701). The DNR Director’s Order FO-210 lists all designated trout streams, and is available upon request (43 pages) from the DNR Fisheries Division (517-373-1280), or online at www.michigan.gov/dnr.

Excess erosion of sand sediment into streams is broadly regarded as a serious threat to the viability of trout streams. Research has demonstrated that relatively small increases in sand erosion into streams can greatly reduce spawning habitat and habitat for the food supply (e.g. caddis fly or mayfly larva). When topography is relatively flat, sediment can stay in a stream for several decades. A functional RMZ should be maintained to prevent sediment from reaching trout streams.

The Sustainable Soil and Water Quality Practices on Forest Land recommends generally using the DNR designated trout streams as a guide for additional protection with respect to RMZs. Trout are sensitive to changes in habitat requirements and require a clean gravel bed, along with large woody structure and cool water temperatures to sustain their population. Because of these narrow population sustaining requirements, forest management activities may be different in a trout stream RMZ than what is "typical" practice for a non-designated trout stream RMZ. This may be tempered by considerations of other factors, such as management for species of greatest conservation need as identified in the DNR's Wildlife Action Plan.

Designated Trout Stream Width and RMZ Management

In the section "Site Specific Factors to Consider**",** a distinction is made between DNR-designated trout streams greater or less than 50 feet in width. The reason for this distinction is that beaver do not generally build beaver dams on streams greater than 50 feet in width. In contrast, designated trout streams smaller than 50 feet in width have a higher occurrence of beaver dam construction when a beaver population's food and construction supply (e.g. aspen) is within 300 feet of the stream. Beaver dams are considered a serious source of damage to these trout streams. Beaver dams will increase stream temperatures and prevent free passage of trout and anadromous fish species. Consequently, the dammed up stream will not support a viable population of trout or other coldwater fish species.

If the objective is to minimize beaver impacts on designated trout streams smaller than 50 feet in width, forest managers or landowners are encouraged to consider widening the RMZ beyond the standard 100 feet and manage this RMZ to discourage aspen regeneration within it. By widening the RMZ to 300 feet, beaver habitat will be reduced and related stream impacts can be minimimized, but this needs to be evaluated on a case-by-case basis as other site conditions and values may come in to play; for example, riparian zones are key habitats for terrestrial species of concern such as woodcock. Possible management options within an RMZ that favor trout and associated coldwater aquatic habitat are: 1) leaving large super-canopy trees within 50 feet of the stream bank as a source of shade and large woody structure (wood that is four inches or greater in diameter), 2) managing to promote the health and vigor of longer-lived coniferous (e.g. white pine and hemlock) and deciduous (e.g. sugar maple) species, and 3) only harvesting trees that are 50 feet away from the stream and that can be transported out of the RMZ without disturbing the soil (see Figure 3 as an example of a piece of harvesting equipment that might be employed).

For designated trout streams greater than 50 feet in width, implement the RMZ widths (e.g. starting with a minimum width of 100 feet) as stated in table 1 and design an RMZ management plan which considers site specific factors as well as water quality (pages 13, 14 and 15).

Management for Shade Intolerant Species within the RMZ

In general, landowners, loggers and land managers should consider if the amount of timber harvest removal is compatible with the ecology of the stream (e.g. warmwater or coldwater), and if the DNR has the adjacent stream listed as a designated trout stream. For streams that are not designated for trout, landowners may consider that managing for shade intolerant species, such as aspen, within an RMZ may be desirable to meet wildlife management goals.

Warmwater rivers or streams may be appropriate for this type of management. With the help of a forester, creative silvicultural and harvesting methods can be employed to allow for multiple goals. While large scale clearcuts should be avoided in the RMZ, it is possible to regenerate species like aspen using other harvesting methods. For example, small clearcuts ¼ to ½ acre in size, spaced appropriately throughout the RMZ, may be an option. Cuts like these mimic natural disturbances such as blowdowns.

Another example is to leave a higher residual basal area (BA) in the RMZ than what would occur outside the RMZ. In contrast to traditional clearcuts outside of the RMZ, leaving 20 to 25 BA would still provide enough sunlight to promote regeneration of aspen or other shade intolerant species. Also consider leaving a higher basal area (e.g. 60-80 BA) or clusters of mature longer-lived trees within 25 to 50 feet of the stream bank for shade, soil and bank stabilization and a source of large woody structure. Refer to Appendix A-Glossary for the definition of basal area.

Natural River Regulations

There are currently 16 legally designated Natural River Systems in Michigan. Part 305, Natural Rivers, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), *provides the DNR with the legal authority for managing these river systems and regulating all land management or construction activities occurring on these river systems*. Note that in all the management plans, the term "vegetative buffer strip" is used instead of the term Riparian Management Zone. However, for the purposes of this document, the term "RMZ" will be used to avoid confusing the reader.

All forest management activities within a legally designated Natural River RMZ are regulated. A permit is required before any activities can take place. A Natural River management plan has been developed for each designated river. Each plan includes use and development standards for private and public lands. The State is required to manage its lands and programs in accordance with the approved Natural River plan. Each state designated Natural River has it own standards regarding RMZs (buffer widths) for both private and public ownerships (see Appendices F and G).

The minimum RMZ for each Natural River is codified in its approved plan and promulgated rules. In general, the RMZ requirements are wider for public lands than private lands. For example, the Au Sable Natural River Management Plan has a 150-foot RMZ for both mainstreams and tributaries. On private lands, the management plan has a minimum 75-foot RMZ on the mainstream and 50-foot RMZ on tributaries.

In general, as the Natural Rivers designation program progressed through the years, more and more research indicated that wider RMZs were better for the health of the stream. On public lands, RMZs may range from 50 feet (the Flat River in the southern lower peninsula) to 200 feet wide (on the Fox River) on each side of the river or tributary. Private land RMZs also vary, but are statutorily limited to a width of no more than 100 feet on each side of the river. Dead, diseased, unsafe and fallen trees, as well as noxious plants, can be removed within the RMZ.

For more detailed information and the listing and location of all 16 Natural Rivers, visit the DNR Natural Rivers website at www.michigan.gov/dnrnaturalrivers.

In addition, all public agencies must comply with the Rules for Utilities and Publicly Provided Facilities, adopted as mandated by Part 305. These rules include standards related to road/stream crossings, erosion control, management of vegetation in utility corridors and others.

Natural River plans typically include standards related to public access site development, campgrounds, land and stream alteration, motorized vehicle use and vegetative buffer requirements. Thirteen of the 16 rivers also have State zoning rules based on the plans that contain private land development standards for residential development and limited commercial activity such as campgrounds, canoe liveries and rental cabins. Most rivers also have local zoning ordinances in effect based on Natural River plans.

The RMZs are maintained to provide fisheries and wildlife habitat, filter runoff, provide shade to maintain cool water temperatures, prevent streambank erosion and sedimentation of the Natural River system, screen new developments, and maintain the aesthetic qualities of the Natural River system. Under a permit issued by the DNR, trees and shrubs may be selectively pruned or thinned for timber harvest, habitat improvement or to maintain public utility facilities. Clearcutting is not usually permitted within the RMZ.

Other development standards for public land are designed to maintain the natural character of the river corridor, limit the impacts of recreational use and help prevent resource damage. New campgrounds have development standards such as setbacks for campsites and associated structures. New access site standards may restrict sites to "walk-in" only and include setbacks for parking areas. Within 400 feet of the river, motorized vehicle use is usually restricted to designated public roads and access roads to permitted areas. Land alteration is prohibited in areas of high groundwater.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act, (Pub. L. 90-542 as amended; 16 U.S.C. 1271-1287) is legislation enacted by Congress and establishes federal protection for designated free-flowing rivers throughout the country. They are designated as "Wild and Scenic Rivers." This designation regulates the management and control of development on these river systems. In Michigan, there are 16 Wild and Scenic River systems. The management and regulations for these river systems occur strictly within the administrative boundaries of Michigan's three National Forests. Each component of the Wild and Scenic rivers system is administered to protect and enhance a variety of values, and certain uses of a designated river are limited. Emphasis is given to protecting its aesthetic, scenic, historic, archaeological, and scientific features and values.

For more information, such as the listing and location of those river systems within Michigan, visit the website: http://www.nps.gov/ncrc/portals/rivers/index.htm.

Vernal Pools, Seeps, and Intermittent Streams

Vernal pools are small (usually less than an acre), temporary bodies of water in depressions that lack perennial inlet or outlet streams and have no permanent fish populations. They appear after snow melt and gradually dry up as the summer progresses. During the wettest seasons of the year, vernal pools are small bodies of water, while in dry seasons they may only be recognizable as an isolated depression on the forest floor. This unique forest feature provides habitat for a variety of aquatic invertebrates, a breeding and feeding site for many amphibians and reptiles, an attractive feeding and resting spot for songbirds, a source of food and water for many mammals, and unique microhabitats for plants.

Some animals will live their entire life cycle in a vernal pool. Fairy shrimp and clam shrimp are suited to a watery environment that varies widely in temperature and dries up annually. They produce thick shelled eggs that survive in the dried up pool until the next spring's thaw when they hatch in the newly hydrated pool. Therefore, when harvesting occurs, there should be no disturbance to the vernal pool depression. All equipment, trees and tops should be kept out of this area. Within 100 feet or at least one tree length of the pool, it is especially important to avoid deep ruts which can interfere with the movement of salamanders to and from the pools. Equipment should generally only be used when the soil is in a dry or frozen condition to keep rutting to a minimum in this area. Timber harvesting can occur in the area, but the canopy closure should not be reduced to less than 70% to minimize the affect of sun and wind.

A seep, also called a spring seep or just a spring, is a permanent or intermittent discharge of water that emerges from the ground and flows across the soil surface without defined bed and banks. The limits of the seep are demarked by the extent of surface water, water-stained leaves, or other signs of hydrology. Avoid soil and leaf litter disturbance within the known area of the surface water. Limit harvest activity to dry or frozen conditions, when possible.

Intermittent streams have definable beds and banks, but water does not flow through the channel all of the time. Crossing an intermittent stream requires a permit. In contrast, ephemeral streams only occasionally have water flowing and do not typically have defined beds and banks. Use of motorized equipment should be limited near the streams and forest floor disturbance should be minimized. Avoid these areas when laying out skid trails and remove felled tree tops. It is strongly encouraged that skid trails, roads, site-preparation, and other soil-disturbing activities be minimized in the ephemeral streams to avoid erosion and sedimentation of stormwater runoff that will flow downstream into streams or other water bodies.

Fens and Bogs

Fens are wetlands that receive much of their water and nutrients from groundwater rich calcium and magnesium carbonates. They accumulate peat and have relatively high pH and nutrient levels. As a result, fens support a high diversity of grasses, wildflowers, and insects. The high water table, in combination with periodic disturbances such as beavers and seasonal fire, discourages growth of trees and shrubs within fens.

In contrast to fens, bogs are acidic, nutrient poor wetlands that receive most or all of their water from precipitation. They often contain rare, threatened or endangered plants or animals. They also do not tend to contain much in the way of commercially desirable trees.

Harvest activity immediately adjacent to fens or bogs may encounter weak soils that are highly susceptible to rutting. When timber harvesting occurs near fens or bogs, ground disturbance within the wetland area should be avoided. To prevent sedimentation or excessive nutrient delivery into a fen or bog, timber harvests should be avoided along slopes immediately above and leading into a fen or bog.

6. FOREST ROADS

Forest roads are that part of a forest land road system, either temporary or permanent, designed and maintained for the transportation of timber products and often maintained and used for access for resource protection and recreation activities. They are usually minimum standard roads, i.e., single lane with turnouts, surfaced with locally available materials or just the underlying bare soil that is compacted and graded after the vegetative cover is removed. Commercially processed gravel underlain by geotextile is good for use in critical erosion areas. Properly laid, constructed and maintained forest roads provide safe operations over longer periods at desirable vehicle speed. Operating and maintenance costs, as well as sedimentation runoff, are reduced because of proper construction (this includes installation of BMPs), placement and regular maintenance.

Planning and Forest Road Placement

Use of Soil Surveys