Buffer/Filter Strips

Updated September, 1997

Description

A buffer/filter strip is a vegetated area adjacent to a waterbody (i.e. river, stream, wetland, lake). The buffer/filter area may be natural, undeveloped land where the existing vegetation is left intact, or it may be land planted with vegetation. Its purpose is to protect streams and lakes from pollutants such as sediment, nutrients and organic matter, prevent erosion, provide shade, leaf litter, and woody debris. Buffer/filter strips often provide several benefits to wildlife, such as travel corridors, nesting sites and food sources.

For the purposes of this BMP, a buffer/filter strip is a combination of 1) a *buffer* of vegetation between human land use and a stream, and 2) a *filter*, to trap sediment and absorb sheet flow. The buffer is usually comprised of trees, the buffer provides shade, leaf litter, woody debris, erosion protection, and often serves as wildlife habitat. The filter strip is an area of dense grass at least 20 feet wide designed specifically to remove pollutants from stormwater runoff from sheet flow off adjacent land, through filtering and infiltration. Although vegetative filters designed as specified in this BMP can be expected to provide significant pollutant removal, overall water quality will not be protected if a filter stirp is not used in conjunciton with a buffer along the stream corridor.

To protect water quality, a buffer/filter at least 100 feet wide should be preserved or created around all waterbodies and wetlands, with strip widths increasing with increasing slope. Research shows that when the buffer is less than 100 feet, stream quality begins to diminish. If a 100-foot buffer/filter strip is not feasible, or if wildlife habitat is of interest, refer to the specifications section of this BMP for additional information.

Special Considerations: Natural or Wild and Scenic Rivers may have special buffer/filter strip restrictions, depending on their designation (see Exhibit 1). Contact the MDNR, Forest Management Division, Natural Rivers Program staff for further information.

Other Terms Used to Describe

Vegetative Filter

Pollutants Controlled and Impacts

Several researchers have measured >90% reductions in sediment and nitrate concentrations; buffer/filter strips do a reasonably good job of removing phosphorus attached to sediment, but are relatively ineffective in removing dissolved phosphorus (Gilliam, 1994).

Application

Land Use

Applicable to all land uses adjacent to waterbodies.

Soil/Topography/Climate

This practice is especially important on and adjacent to steep slopes. Natural buffer strips are essential in maintaining the shade and stream temperatures of coldwater streams.

When to Apply
Natural buffer/filter strips should be identified and protected before any development occurs on a site. At the watershed level, buffer/filter strips could be identified during community land use planning (i.e. during master plan development, development of parks, or greenways, etc.) or as part of efforts to identify and protect specific land uses, such as prime farm land. At the site level, buffer/filter strips should be incorporated into the overall plan for the site, and protected during construction.

Where to Apply
Adjacent to all watercourses and wetlands.

Relationship With Other BMPs

Natural buffer/filter strips should be identified prior to any Land Clearing operations.

BMPs may be needed upslope of a buffer/filter strip if: 1) runoff directed to the buffer/filter cannot enter as sheet flow, or 2) protection of the buffer from excess sediment is needed to maintain the integrity of the buffer.

Specifications

Planning Considerations to Preserve Buffer/Filter Strips:
Buffer/filter strips which are able to remain as undisturbed native vegetation should be delineated on preliminary and final site plans. *To protect water quality*, preserve natural buffer areas a total *minimum width of 100 feet* along all water courses and wetlands, with widths increasing with increasing slope. This is recommended to maintain shade, uptake pollutants and absorb sheet flow (i.e. stormwater that is not concentrated at a single point and causes erosion). While the 100-foot width is consistent with stream research studies (see Exhibit 6) and is the policy of most forest managers as a means to protect water quality, if wildlife habitat is of particular interest, see the Exhibit 1 for information on buffer/filters which protect water quality and wildlife habitat.

Management of the Buffer: The Three-Buffer Zone System
Scheuler (1995) promotes the use of a buffer/filter system made up of three zones, each of which has a different width, function and management scheme. The total minimum width of the three zones is 100 feet and includes the floodplain.

- The *streamside zone* is usually made up of mature trees which provide shade, leaf litter, and woody debris to the stream, as well as erosion protection. The minimum width of this zone is 25 feet. Land uses allowed in this zone are limited to footpaths, and well-designed watercourse crossings (for utilities, roads, etc.). See the Watercourse Crossings BMP to help in designing sound watercourse crossings.
- The *middle zone* extends from the outer edge of the streamside zone and protects the stream's ecosystem by providing a larger protective area between the stream and upland development. Ideally, this zone will also be made of mature trees and will be a minimum of 50 feet, with widths increasing to ensure the 100-year floodplain, adjacent steep slopes and protected wetlands are included. The width of this zone may also increase as the stream order increases. Uses allowed in this zone include bike paths and other low-impact recreational uses and stormwater BMPs.
- The *outer zone* is the zone between the middle zone and the nearest permanent structure (e.g. house or building). This is the filter part of the buffer/filter system. In residential areas, this

zone is usually a grassy backyard. The zone is a minimum of 20 feet in width, with widths increasing with increasing slopes and with the amount of sediment and/or nutrients the filter is expected to treat. Septic systems and permanent structures are restricted in this zone. In urban areas or areas directly adjacent to pavement, this area should be a managed filter strip to maximize pollutant removal.

Incorporating Stormwater BMPs in the Buffer/Filter:
Buffer/filter strips are not capable of treating all stormwater generated in a watershed. (Schueler states that a buffer/filter system can treat runoff from less than 10% of the contributing watershed). Therefore, stormwater BMPs must be used to protect the streamside buffer zone and the stream itself.

The designer should evaluate all the possible paths of flow into the buffer/filter strip. If any flow paths are expected to exceed sheetflow or otherwise cause erosion, then BMPs are needed upslope. If land is limited, the BMPs may need to be installed in the upper or middle zones.

Example problem: A designer determined that stormwater would enter the buffer/filter strip from a new development at three points: 1) a parking lot curb cut draining half of a parking lot, 2) parking lot overland flow draining the other half of a parking lot; and 3) building roof drains. The designer determined that the water leaving the parking lot would do so as sheet flow and cause no erosion in the buffer/filter strip.

Example Solution: Since the parking lot curb cut would cause concentrated flow into the buffer/filter strip, the designer added two more curb cuts to the design to break up the flow. He designed the parking lot so that the buffer/filter would be located 3 to 6 inches lower than the pavement to prevent sediment deposits from blocking inflow to the filter strip. He also included installing a layer of stone at the outlets of the curb cuts to slow the water. To address the concentrated flow from the building roof drains, he included a rock-lined splash apron below the drains, and below it, some dense vegetation. Due to limitations in the land available, these BMPs were installed in the outer zone of the buffer/filter strip.

Planning Considerations for Creating Buffer/Filter Strips:
Re-establishment of buffer/filter strips is possible if urban land is being reclaimed, if sites of environmental contamination are being cleaned up, or if greenways are being established as part of a greenways program or recreation enhancement program. Under these and other re-establishment conditions:

1. Conduct a site evaluation to determine:
   - the drainage characteristics. Depending on drainage, it may be necessary to use other BMPs. Note that concentrated flows can be minimized by limiting the drainage area to less than 5 acres.
   - percentage slope and length of slope.
   - type of soil and soil stability. Sloughing soils, will require additional BMPs to ensure stability of the slope.

2. Determine all of the possible uses of the newly developed buffer strip and incorporate those uses into the design. For wildlife considerations, see Exhibit 1.

3. Select vegetation based on the site characteristics determined uses and the three-zone

concept. For vegetative mixtures for the outer zone, see Exhibit 2.

4. **Buffer/filter strips are not effective methods for treating concentrated flow.** Determine flow patterns onto the buffer/filter strip and incorporate BMPs to ensure stormwater enters the buffer/filter strip as **sheet flow**.

Installing Buffer/Filter Strips:

1. Install any BMPs needed upland.

2. Prepare the site. If it is necessary to clear and grade land, follow specifications in the Land Clearing and Grading Practices BMPs. *Never grade to the edge of a watercourse without using filter fencing or other BMPs to protect the watercourse.* Any use of soil amendments such as fertilizer should be based on soil tests and follow the Soil Management specifications.

3. Refer to the Seeding, Sodding, Mulching and Trees, Shrubs and Ground Covers BMPs, as appropriate to the vegetation selected.

4. Maintain any temporary upland BMPs until vegetation "takes." Grass should be a minimum height of 4 inches and 90 percent ground cover before temporary upland BMPs are removed (i.e. the site should be stable).

5. Consider using mulch between trees and shrubs to keep soil on site.

6. Avoid spraying the buffer strip with pesticides; consider alternatives in the Integrated Pest Management BMP.

7. Protect the buffer/filter from damage by equipment and traffic. Do not use the buffer/filter strip as a roadway.

Maintenance

All Zones:

Periodic inspections should be done to ensure that concentrated flows have not developed, and to make sure the vegetative cover is maintaining its effectiveness. If the integrity of the buffer/filter strip is jeopardized by upland erosion, or if concentrated flows are creating rills or gullies up-slope of the strip, additional BMPs may need to be installed. If the buffer strip is being jeopardized by stream bank erosion, then the cause of the bank erosion needs to be investigated and actions taken to address the causes. Damaged strips should be repaired as soon as possible. Strips damaged due to construction upslope of the buffer/filter should be replanted, as necessary, after the cause of the damage is assessed and any other BMPs needed are implemented.

In buffer/filter strips used by wildlife—but especially in the streamside zone—avoid using herbicides to control weeds. Refer to the Pesticide Management BMP for other options.

Streamside Zone and Middle Zone:

Natural woody buffer/filter strips should be left undisturbed, except for the uses listed in the management section of this BMP (pages 2 and 3). Do not use heavy equipment in this area.

To replace or repair damaged trees, refer to the Tree Protection and Trees, Shrubs and Ground Covers BMP.

The Outer Zone:

- If sediment enters the filter strip in amounts which cannot be removed by hand, or in amounts which damage the filter strip, additional upland BMPs will likely need to be installed.
- Remove sediment in this zone when sediment begins to build up. Reseed if necessary.
- If the filter was designed for nutrient removal, remove any harvested vegetation (grass clippings, leaves, etc.) and dispose of outside the buffer/filter strip.
- If grass fails to grow in newly established filter strips, determine the reasons for failure before reseeding. The Lawn Maintenance BMP includes information on unhealthy turf. Spot seed applications when only small areas are affected. If insects are damaging the filter strip, explore integrated pest management techniques in the Pesticide Management BMP to protect any wildlife using the filter strip.
- Mowing should be done to help control weed growth, prevent the growth of woody plants, and help the filter maintain its effectiveness. Mow no lower than six inches to allow vegetation to provide filtering of sediment, organic matter, nutrients, and pesticides. If the strips are used by nesting birds, do not mow until after July 15. To maintain winter cover for wildlife, do not mow after September 1.
- *During the establishment year,* clip to control undesirable plants such as Canadian thistle and milkweed. Clip high (6 inches) to prevent damage to the permanent seeding. Clip between July 15 and August 15. If needed, clip twice during the summer. Use chemical controls only after all non-chemical methods have been considered.
- *After the establishment year*, only spot clipping (or spot chemical treatment, if necessary) should be done, rather than clipping or otherwise treating the entire strip. If noxious weeds develop, clip in the spring to prevent weed seeds from dispersing. Otherwise, clip between July 15 and August 15 to protect any nesting wildlife.

Exhibits

Exhibit 1: 1997 Literature Review of Buffer/Filter Strips for Wildlife and Water Quality. MDEQ, Surface Water Quality Division.

Exhibit 2: Vegetative Widths for the Outer Zone. USDA Soil Conservation Service Technical Guide.

Exhibit 3: Vegetative Mixtures for the Outer Zone. USDA Soil Conservation Service Technical Guide.

Exhibit 4: 1993 Literature Review on Buffer/Filter Strip Widths. MDEQ, Surface Water Quality Division.

Exhibit 5: References used in developing the BMP.

Exhibit 6: Michigan's Natural Rivers System. List of rivers designated or proposed under the Natural Rivers program.

Exhibit 1

For Wildlife Corridors That Also Protect Water Quality

For wildlife corridors that also protect water quality, consider the following:

- Rudolf and Dickenson (1990) found that reptiles and amphibians were more abundant in buffers 99-313 feet than 0-82 feet.

- Dicken and Huntly (1987) found abundant signs of squirrels in buffers greater than 165 feet, but virtually none in zones narrow than 99 feet.

- Dicken and William (1988) found small mammals to be more abundant in narrower streamside areas with well developed herbaceous vegetation compared to wider zones with sparse vegetation.

- Burk et al (1990) found that turkeys were significantly less when buffers were less than 150 feet.

- Premo (1995) found that a 50-foot zone of intact vegetation is too narrow to support most breeding species of birds. He also found that in hardwood riparian buffers/filters, mammal use was heaviest closest to the river and decreased out to 400 feet and leveled off; in conifer riparian buffer/filters, mammal use was fairly high near the river but peaked at 400 feet, and therefore, sections of 400-foot buffer/filter may be needed in coniferous riparian zones to optimize use by mammals.

Exhibit 2

The Outer Zone: Grass/Sod Filter Widths

Length of Slope	Percent Slope															
	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0
	Width - Feet															
100	20	20	20	20	20	20	20	20	30	40	50	50	50	60	60	60
200	20	20	20	20	20	20	20	30	40	40	50	50	60	60	60	60
300	20	20	20	20	20	20	30	40	40	50	50	60	60	60	60	60
400	20	20	20	20	20	20	30	40	50	50	50	60	60	60	60	60
500	20	20	20	20	20	20	30	40	50	50	60	60	60	60	60	60
600	20	20	20	20	20	20	30	40	50	50	60	60	60	60	60	60
700	20	20	20	20	20	20	30	40	50	50	60	60	60	60	60	60
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1400	20	20	20	20	20	30	40	50	50	60	60	60	60	60	60	60
1500	20	20	20	20	20	30	40	50	50	60	60	60	60	60	60	60
1600	20	20	20	20	20	30	40	50	60	60	60	60	60	60	60	60
1700	20	20	20	20	20	30	40	50	60	60	60	60	60	60	60	60
2000	20	20	20	20	20	30	40	50	60	60	60	60	60	60	60	60

Source: USDA Soil Conservation Service Technical Guide, #326.

Exhibit 3

Vegetative Mixtures for the Outer Zone

Soils: Well and moderately well drained sand and loamy sand (coarse textured soils)

Seeding Mixtures	Rates Lbs./Acre	Suitability Sediment Filter Wind	Water
Red Fescue Ryegrass	20 5		X
Smooth Brome	15		X
Switchgrass	8	X	
Switchgrass Tall or Intermediate Wheatgrass	4 8	X	
Tall or Intermediate Wheatgrass	15	X	

Soils: Well and moderately well drained, moderately coarse to moderately fine textured soils (sandy loam, loam, silt loam, and clay loam)

Seeding Mixtures	Rates Lbs./Acre	Suitability Sediment Filter Wind	Water
Reed Canarygrass	6		
Reed Canarygrass Tall Fescue	4 8		X
Smooth Brome	15	X	X
Smooth Brome Tall Fescue	8 12	X	X
Switchgrass	8	X	
Switchgrass Tall or Intermediate Wheatgrass	4 8	X	
Tall Fescue	20	X	X
Tall or Intermediate Wheatgrass	15	X	

1/ Double seeding rates.

(continued)

Exhibit 3 (Continued)

Vegetative Mixtures for the Outer Zone

Soils - Well and moderately well drained clay and silty clay (fine textured soils)

Seeding Mixtures	Rates Lbs./Acre	Suitability Sediment Filter Wind	Water
Reed Canarygrass	6	X	X
Reed Canarygrass Tall Fescue	4 8	X	X
Smooth Brome	15	X	X
Smooth Brome Tall Fescue	8 12	X	X
Switch Grass	8	X	
Tall Fescue	20	X	X
Tall or Intermediate Wheatgrass	15	X	X

Soils - Somewhat poorly drained or poorly drained soils without artificial drainage.

Seeding Mixtures	Rates Lbs./Acre	Suitability Sediment Filter Wind	Water
Reed Canarygrass	6	X	X
Switchgrass 2/	8	X	
Tall Fescue	20	X	X

* The following legumes may be added to the grass mixtures: 6#-8# alfalfa or 3#-4# of birdsfoot trefoil and/or 2# of sweet cover.

1/ Double seeding rates.

2/ Use species tolerant of wetter soils.

Source: USDA Soil Conservation Service Technical Guide #393

Exhibit 4

1993 Literature Review of Buffer/Filter Widths

SOURCE	FACTORS REVIEWED	FINDINGS/RECOMMENDATIONS
Aubertin West Virginia	turbidity, nutrients	Used 10-20M (32.8 feet - 65.6 feet) buffers in study. Both turbidity & nutrients increased during and after logging.
Brazier Oregon	temperature	80' Buffer was necessary to maintain temperature and 55' was necessary for 90% of that temperature or angular canopy density
Erman California	stream invertebrates	Streams with a buffer strip less than 30M (98.4') showed same response as stream logged without buffers. Changes were caused by decreased canopy density, increased primary production, increased stream flows, increased temperature and increased sediment.
Graynoth New Zealand	stream invertebrates	Streams with buffer strip less than 30M showed same response as stream logged without buffers. Changes were caused by decreased canopy density, increased primary production, increased stream flows, increased temperature and increased sediment.
Corbett Pennsylvania	turbidity, sedimentation	1978 Report recommended 23-30M (75.4'-98.4') Buffers 1981 Report recommended 30M (98.4') Buffers 1990 Report recommended 100 feet or 1 1/2 times the average tree length
Farrish Louisiana	soil erosion	**Buffers did not stop gully erosion** that was initiated upslope of buffer. All 1,584 sites reviewed had developed gullies.
Verry 1986 Minnesota	stream flow	Clearcutting hardwoods increased annual stream flow 9 to 20 cm (a 30 to 80 percent increase). It took 12 to 15 years to return to preharvest levels
Verry 1992 Minnesota	large woody debris, temperature, water depth, cover, stream flow	Recommend 2 tree lengths, typically 150 feet, as a leave zone beginning at the top of the bank. Cut only 25% of basal area in second tree length.
Oklahoma State University	Habitat	
-Rudolph & Dickenson, 1990	reptiles/amphibians	More abundant in buffer 99 - 313' than 0-82 feet.
-Dicken & William 1988	small mammals	More abundant in narrower streamside areas with well developed herbaceous vegetation compared to wider zones with spare vegetation
-Dicken & Huntly 1987	squirrels	Abundant signs of squirrel in buffers wider than 165' but virtually none in zone narrower than 99'
-Burk et. al. 1990	turkeys	Turkeys were significantly less when buffers were less than 150'
Hesser Pennsylvania	trout production, sedimentation, temperature	A recommendation of one and one-half chains (100') on both sides of river was made from a literature review. Increased zones may be necessary for sensitive areas.

Exhibit 5

References

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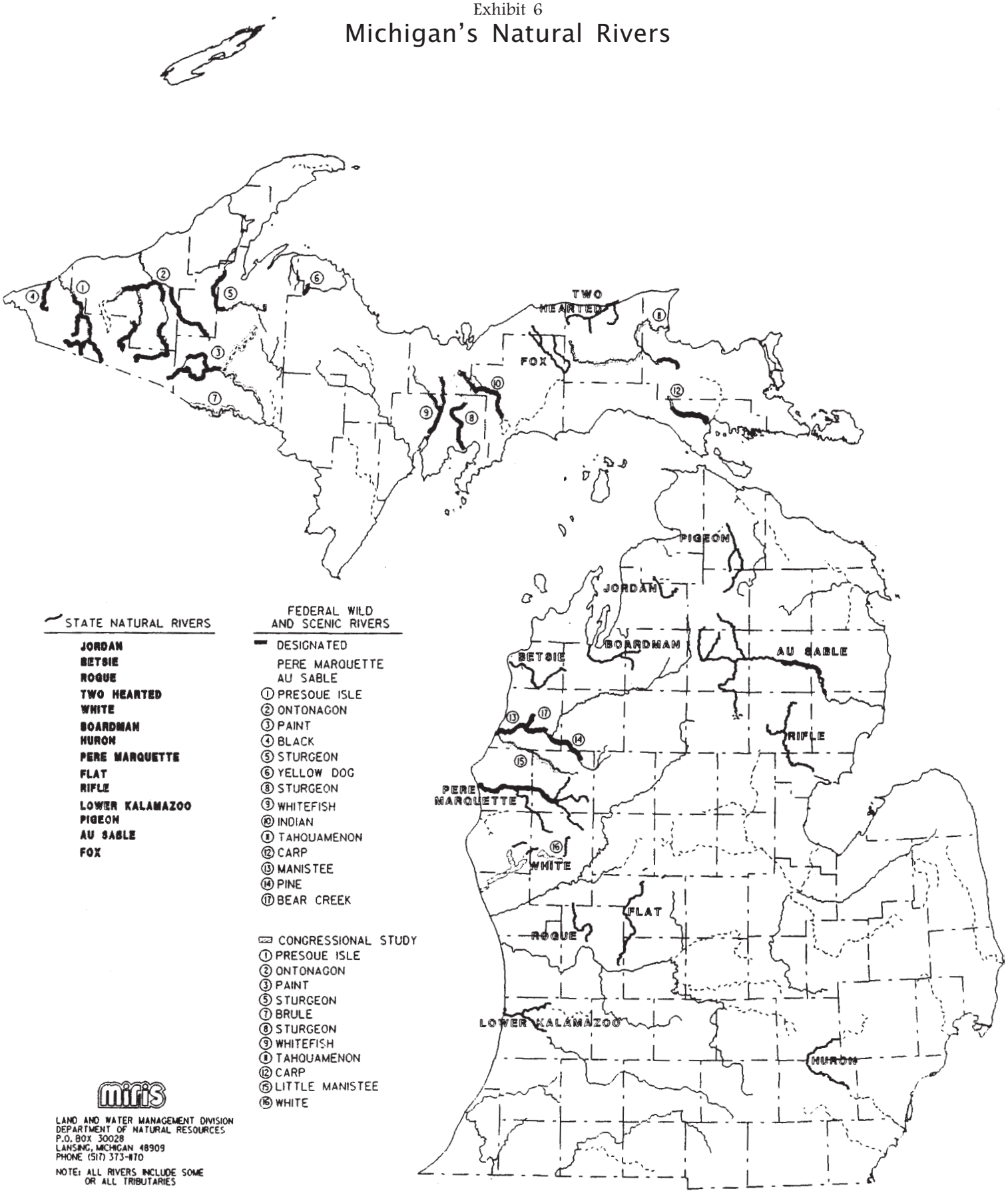
Exhibit 6

Michigan's Natural Rivers



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