Chapter 3

Affected Environment and Environmental Consequences for Alternatives 1-9 and the Selected Alternative

Chapter 3

Chapter 3

Chapter 3

Affected Environment and Environmental Consequences

Introduction

Chapter 3 combines two chapters often published separately in environmental impact statements—The Affected Environment and Environmental Consequences. The purpose of this chapter is to describe the physical, biological, and social environments of the Chequamegon-Nicolet National Forests and to describe how each of the alternatives will affect these environments. These two chapters have been combined to provide a clearer understanding of how each forest resource may be affected by alternatives developed to guide future management of the forests.

Chapter 3 frames this understanding by reviewing the background science and analysis used to predict how each alternative will affect forest resources. Forest resources include not only ecosystem components such as soils, vegetation, and wildlife, but also human uses and values such as producing timber products, recreation experiences, and recreation access. Each resource subject area is evaluated separately. They are organized by topic area, each of which corresponds to a revision topic identified during the forest plan revision process.

Under each resource area, current conditions of each resource area (affected environment) as well as relevant scientific information are reviewed in the “Current Condition” section. Direction included in the 1986 Forest Plans is summarized in the “Current Management Direction” section.

For Aquatic, Riparian, and Wetland Ecosystems, and for Terrestrial Ecosystem Components, we compare the current situation to the estimated historic range of variability in the sections called “Comparison of Present Conditions to Estimates of Natural Variation (Range of Natural Variability). Range of Natural Variability is a term used to reference the variation of physical and biological conditions within an area due to climatic fluctuations and disturbances of wind, fire, and flooding. In the United States, it has been defined as the variability in composition, structure, and dynamics of ecosystems before Euro-American influence (Swanson et al. 1994). This range is determined by studying the ecological history of the area in question. Appendix D includes documentation of such a study for the Northern Wisconsin area. The study area includes the Laurentian Mixed Forest Province (212) of the National Hierarchical Framework of Ecological Units. The study provides a description of historical conditions to be used as a baseline for comparison with current conditions to assess the degree of change that has occurred, and to predict the amount of additional change that may occur under different management options.

Comparison to estimates of the range of natural variability can help identify ecosystem factors and communities that are now reduced in number, size, or extent. Restoring some lands to resemble RNV and including some structural or compositional components of those conditions within actively managed lands may help conserve elements of biodiversity. Assumptions for use of this range of natural variability as a comparison include the following:

1. Species are adapted to certain environmental conditions and can tolerate or may even require a range of disturbances similar to those that existed during their evolutionary period. Loucks (1970) noted that genetic differentiation within major forest genera occurred between 30 million and 2 million years ago, and it was at this time that one or more species in each genus adapted as "opportunists" capitalizing on different kinds of disturbances and on conditions of deep shade in closed canopy forest systems.
2. Most species will generally be adapted to those disturbance regimes that have historically dominated in an area (Alverson et al. 1994).
3. If conditions approaching or within the Range of Natural Variability are achieved in some areas, there may be a higher likelihood of maintaining viable populations of species.

These assumptions have been used as a hypothesis during development of Alternatives 2-9 and the Selected Alternative. Monitoring of the selected alternative will be done to indicate the validity of the hypothesis and adapt future management activities to respond to viability concerns.

Changes proposed for topic areas during the forest plan revision process vary in intensity across alternatives and are outlined in the section called "Proposed Changes and Range of Changes." Direct and Indirect Effects of proposed changes within each resource area are then displayed, and finally, Cumulative Effects are described for each resource area.

The first topic, Biological Diversity and Ecosystems serves as a framework for understanding the natural resources of the Chequamegon-Nicolet National Forests. It is subdivided by Problem Statements that were previously developed and displayed in Chapter 1. An exception is Special Land Allocations and Old Growth. Those two areas are addressed together under Biological Diversity and Ecosystems, rather than a separate section for the Special Land Allocation Topic.

Further sections of the chapter address remaining revision topics—Access and Recreation Opportunities and Timber-related Products. In addition, this chapter includes a discussion of fire management and of the social and economic setting. These subjects were not identified as separate revision topics but are important considerations in forest planning.

Supporting information concerning the affected environment and environmental consequences can be found in Appendices A through P in the FEIS Appendix document.

The discussion of environmental consequences focuses on the direct, indirect and cumulative effects on the environment that are likely to result from activities and resource output levels of each alternative.

Direct environmental effects are those that occur at the same time and place as the initial cause or action. Indirect effects are those that occur later or in another location. Cumulative effects result from actions taken to achieve the goals of each alternative along with past, present, and reasonably foreseeable future activity undertaken by the Forest Service or other entities, public or private.

Federal laws require us to ensure long-term productivity of the lands we manage. The Forest Service established specific regulations and policies to implement these laws. Additionally, a set of Forestwide Standards and Guidelines were established to protect the environment from extreme or undesirable consequences. These apply to all the management activities and desired future conditions in the respective alternatives regardless of the alternative selected for implementation.

In the FEIS, the rank order of how alternatives affect the environment is generally not dependent on forest budget levels. Unless otherwise indicated, we report the likely environmental effects for the full funding level.

Mitigation Measures

Mitigation measures, as defined by 40 CFR 1508.20 include:

- Avoiding the impact altogether by declining to take an action or part of an action;
- Minimizing impacts by limiting the degree or magnitude of an action or its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; and/or
- Compensating for the impact by replacing or providing substitute resources or environments.

At a programmatic level, Forestwide and Management Area Standards and Guidelines should provide the appropriate mitigation measures for all alternatives. While not listed specifically, this also includes administrative guidance including all the laws, regulations, and Forest Service manual or other policies (See Appendix AA of the Proposed Plan for more detail).

At the site-specific project level, analysis may indicate the need for additional mitigation measures to resolve site-specific issues. Monitoring efforts will determine the effectiveness of mitigation measures (See Chapter 4 of the Forest Plan for the Monitoring Strategy).

Relationship between Programmatic and Site-Specific Analysis

The 2004 Forest Plan and FEIS are programmatic documents. The FEIS discusses environmental effects on a broad scale. Over the lifetime of the Forest Plan, the Selected Alternative and the accompanying Forestwide Standards and Guidelines will set Forest management direction by establishing and affirming rules and policies for use of natural resources.

Because this document contains a forestwide level of analysis, it does not predict what will happen when Forestwide Standards and Guidelines are implemented on individual, site-specific projects. Nor does it convey the long-term environmental consequences of any site-specific project. These actual effects will depend on the extent of each project, environmental conditions at the site (which vary across the forests), site-specific mitigation measures, and their effectiveness.

In preparing this document we focused on consequences most likely to occur and why. By combining this broad assessment with site-specific information, a reader can make a reasonable prediction about the kinds of environmental effects that would result from a specific project.

We do not describe every environmental process or condition on the Chequamegon-Nicolet National Forests in this document because that would be impractical, given the complexity of natural systems. The purpose of the FEIS is to provide a survey of the broader environmental and social factors that are relevant to the programmatic planning process.

Biological Diversity and Ecosystem Components

Aquatic, Riparian and Wetland Ecosystems

Introduction

The existing Chequamegon and Nicolet Forest Plans do not adequately address many key issues associated with aquatic, riparian, and wetland ecosystems. Goals, Objectives, Standards and Guidelines were developed that apply across all revision alternatives (2-9 and the Selected Alternative) and provide direction to help the Forests reach conditions described in the desired future condition for Watersheds and Aquatic Resources, found in Chapter 3 of the Forest Plan. This section describes the existing situation of watersheds and aquatic ecosystems, as well as effects of all proposals in Alternatives. The biological aspects of the aquatic systems, such as fish passage in cold water streams, non-native invasive aquatic species, or vegetation within wetlands and riparian areas, are addressed in this section as well as the physical aspects such as stream sediment, channel morphology, or hydrologic connections.

Current Condition

Watersheds

The Unified Federal Policy for Ensuring a Watershed Approach to Federal Land and Resource Management requires federal agencies to develop a common watershed assessment approach for federal lands, a watershed management approach when protecting and restoring watersheds, and collaboration among federal agencies and others when managing watersheds. The Chequamegon-Nicolet National Forests (CNNF) are located within 41 different 5th level watersheds nested within 16 different 4th level sub-basins (Figure 3-1). The 5th level watersheds average 235 square miles (150,000 acres) with a range of 57 to 390 square miles (36,000-250,000 acres). The watersheds fall within two major hydrologic regions with 19 watersheds draining through the Great Lakes to the Atlantic and 22 draining through the Upper Mississippi to the Gulf of Mexico.

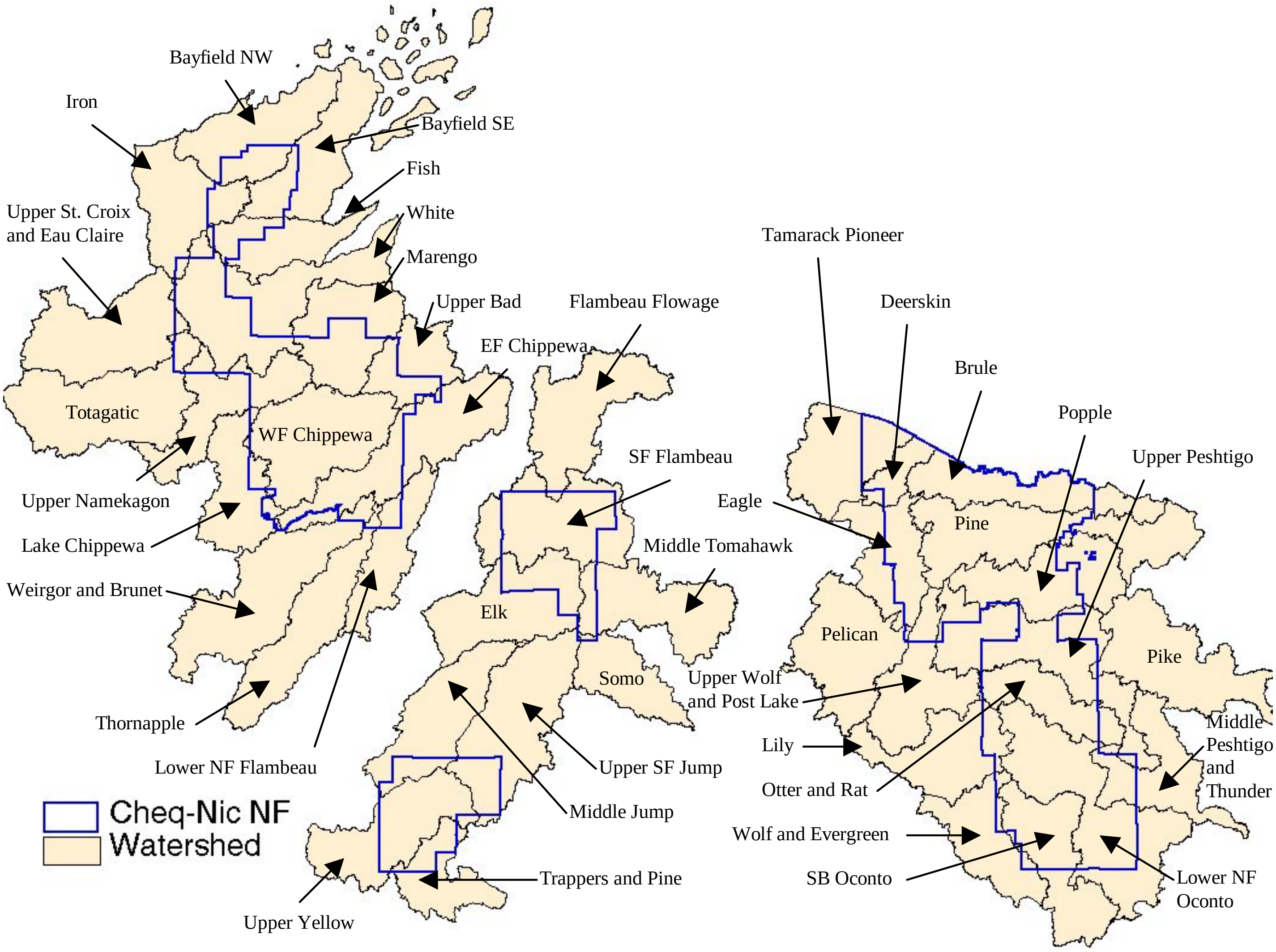

Figure 3-1. 5th Level Watersheds Overlapping the Chequamegon-Nicolet National Forest.

National Forest ownership is important because it determines the degree of influence the CNNF will have in any particular watershed. The Forests can have the greatest influence on those watersheds with a high percentage of National Forest (NF) land. In addition, as part of the Unified Federal Policy for Watershed Management, federal agencies will be required to conduct watershed assessments for all 5th level watersheds with at least 25% federal ownership.

NF ownership within the 41 5th level watersheds ranges from 0.59% to 79.4 %. There are 17 watersheds with more than 25% NF ownership and 10 of these have more than 40% NF ownership. The Forests could have a significant influence on the condition of these 17 watersheds through direct management and collaboration. It is also likely the Forest Service would be the lead federal agency responsible for conducting these watershed assessments. Six watersheds have 15% to 25% NF ownership. In these watersheds the Forests could have an important influence through collaboration with other agencies and citizen groups, particularly in key sub-watersheds with significant NF ownership. In the 11 watersheds with 5% to 15% NF ownership, the CNNF would affect conditions through collaboration with other agencies that take the lead role in assessment and management. Seven watersheds have less than 5% NF ownership. The CNNF have very limited opportunities to affect or influence watershed conditions and would likely focus on any 6th or 7th level sub-watersheds with significant NF ownership.

Impaired Waters

Section 303(d) of the federal Clean Water Act requires each state to periodically submit to the Environmental Protection Agency (EPA) for approval a list of impaired waters. Impaired waters do not meet state water quality standards. States are required to prioritize impaired waters for treatment and develop a plan for each impaired water to achieve water quality standards, including identification of total maximum daily loads (TMDLs) for each pollutant causing impairment.

The Wisconsin Department of Natural Resources last submitted an updated list to EPA in October 2002. EPA approved the list of impaired waters in September 2003. All waterbodies on the 303(d) list within the National Forest are lakes with fish consumption advisories for mercury. These include 39 lakes that cover 14,741 acres within the National Forest boundary. Wisconsin considers these fish consumption advisories to be the result of atmospheric deposition of mercury. Since traditional TMDLs are not practical for impairments caused by atmospheric deposition, states and EPA are discussing a national strategy to reduce atmospheric deposition of mercury.

Groundwater

Groundwater is socially and ecologically important. All drinking water at Forest developed recreation sites is from groundwater. Groundwater also has a significant effect on the ecology of streams, lakes and wetlands. It tends to be high in dissolved minerals that, in turn, affect the chemistry and productivity of water bodies fed by groundwater. The best trout streams (i.e., cold water communities) on the Forests receive a substantial groundwater flow that maintains cold-water temperatures and stable base flows.

The Forests occur within two major groundwater units: the Lake Superior District and Northern Drift – Precambrian District (Zaporozec and Cotter 1985). A majority of the Forests are located in the Northern Drift-Precambrian District that generally consists of thick, productive water-bearing glacial deposits of sand and gravel on top of relatively nonproductive igneous and metamorphic rocks. Water yields from the sand and gravel aquifer are variable but generally yield 10-100 gallons per minute in the western part of the district containing the Chequamegon portion of the Forests and 100-500 gallons per minute in the eastern part containing the Nicolet portion of the Forests. The surface material has a wide range of permeability but much of it allows good recharge. Most ground-water flow systems are small and shallow and flow towards nearby lakes and streams.

The Lake Superior District contains water-bearing sandstone underneath clay deposits adjacent to Lake Superior or sand deposits inland. The Chequamegon Forest portion in this unit includes nearly the entire Washburn Ranger District and thick deposits of medium and coarse sands with high permeability. Because of this high permeability and the thickness of the deposits, there are very few streams and much of the area serves as a regional groundwater recharge area. This groundwater recharge area is located in the headwaters of Bayfield NE, Bayfield SW, Iron, Fish, White, and Upper St. Croix-Eau Claire 5th level watersheds. Groundwater flow is generally northwest to northeast into Lake Superior or its tributaries or southwest toward the upper St. Croix.

Riparian Ecosystems

Riparian ecosystems play a critical role in the health of aquatic ecosystems (streams, lakes, and ponds). Along streams they provide shade to maintain cold or cool water temperatures. They provide the primary food source for headwater streams in leaf litter and detritus. They provide storage for floodwaters. Along both lakes and streams, riparian ecosystems act as filter strips to remove non-point water pollutants. They produce large woody debris that enhances aquatic habitat and, when occupied by healthy vegetation, stabilize stream-banks and shorelines. Riparian ecosystems are also important wildlife habitats and recreation sites.

Large woody debris is an extremely important habitat component for aquatic organisms in lakes and streams. It serves as a substrate for aquatic invertebrates, particularly in streams and rivers with a shifting sand bed. In lakes and rivers it provides cover for both large and small fish. In rivers it helps create scour pools and complex habitat. Woody nesting cover also improves bass reproduction in lakes. While all large (greater than 12 inches diameter) wood is generally beneficial to aquatic ecosystems, tall, large diameter, decay resistant trees with strong branches that hold the bole off the bottom tend to provide the best aquatic habitat. Tall trees are more likely to enter a lake or stream when they fall and reach out into deeper water and remain stable over time. Large diameter trees provide better overhead cover and are more stable over time. Strong branches hold the bole of the tree off the bottom to create excellent overhead cover and branches provide good cover for a variety of aquatic organisms. Desirable species for large woody debris, particularly adjacent to lakes and wide rivers, include white pine, red pine, hemlock, northern white cedar, and to a lesser extent white spruce, red oak, sugar maple, and red maple.

Most large woody debris in aquatic ecosystems originates from the riparian ecosystem. Historical log drives removed large quantities of wood from streams and lakes both for the wood itself and to make rivers suitable for log drives. Logging activities from the 1800s to 1980s also removed future sources of large woody debris by harvesting trees from riparian ecosystems. As a result, aquatic habitat in many CNNF lakes and streams was affected because of a lack of large woody debris.

Wisconsin’s Forestry Best Management Practices for Water Quality define riparian management zones as areas next to lakes and streams where management practices are modified to protect water quality, fish and other aquatic resources (WDNR 1995a). The riparian management zone extends a minimum of 100 feet landward from the ordinary high water mark of perennial lakes and streams and 35 feet from intermittent streams. While these set distances do not precisely delineate the riparian ecosystem, whose distance varies depending on the above factors, they provide a reasonable estimate of the portion of the riparian ecosystem that directly affects aquatic ecosystems (by providing shade, large woody debris, leaf litter, detritus, filter strip, etc.) and are directly addressed by Forest Plan Standards and Guidelines. The primary exception is that 100 feet frequently will not represent the entire flood-prone width in wetlands next to streams. Recognizing this limitation, the riparian management zone is used in this analysis to evaluate the effects of the alternatives on riparian conditions.

Within CNNF boundaries there are an estimated 151,132 acres (7.6%) within riparian management zones when water is also included (Table 3-1). Excluding water and islands, there are about 77,000 acres (3.9%) within 100 feet of perennial water bodies and 35 feet of intermittent streams. About three-fourths of this area is in National Forest ownership.

Table 3-1. Riparian/BMP Areas Within Chequamegon-Nicolet NF Boundary.

Riparian/BMP Areas	Area (acres) Cheq	Nic	Total	Percent of Area Within NF Boundary
RMZ Intermittent (35 ft buffer)	1,867	1,368	3,235	0.2
RMZ Perennial (100 ft buffer)	36,908	37,325	74,233	3.7
RMZ Total	38,775	38,693	77,468	3.9
Islands	896	223	1,119	0.1
Water - Streams and Rivers	2,450	2,096	4,546	0.2
Water - Reservoirs and Flowages	6,071	1,520	7,591	0.4
Water - Lakes and Ponds	26,284	34,124	60,408	3.0
Water Total (including islands)	35,702	37,963	73,665	3.7
Total	74,476	76,656	151,132	7.6

Note: RMZ = Riparian Management Zone as defined in Wisconsin's Forestry Best Management Practices for Water Quality (WDNR 1995).
RMZ area includes upland and wetland within 100 feet of perennial water bodies and 35 feet of intermittent water bodies plus some small interior polygons.

Sixty-four percent of the riparian management zone in National Forest ownership is wetland. This area has a variety of wetland vegetation with open and shrub swamp (including shrub swamp, sedge meadow, open bog, shallow marsh and deep marsh) the most common, followed by swamp conifer and lowland hardwood (Table 3-2)**.** Many resource management and recreation activities do not occur in these areas because wet soils predominate. Beaver activity frequently influences vegetation in wetland adjoining streams. Beaver-caused flooding kills trees and shrubs. When beaver ponds are later abandoned and drained, they typically revert to sedge meadow then gradually succeed to shrub swamp and occasionally forested wetlands. Beaver activity in the last four decades is responsible for large existing proportions of open and shrub swamp.

Table 3-2. RMZ Vegetation on Chequamegon-Nicolet NF Lands

Land Type	Forest Longevity Class	Forest Group Type	Area (acres) Cheq	Nic	Total	% Total Area
Upland	Short-Lived	Hardwood	4,895	3,446	8,341	14.4
		Conifer	706	1,158	1,864	3.2
	Long-Lived	Hardwood	4,506	2,699	7,205	12.4
		Conifer	1,130	1,431	2,561	4.4
		Open	468	344	812	1.4
Wetland		Hardwood	1,493	1,634	3,127	5.4
		Conifer	1,985	4,581	6,567	11.3
		Open/Brush	16,759	10,798	27,557	47.5
Total			31,942	26,093	58,035	100.0

Approximately 36% of the riparian management zone in National Forest ownership is upland, with about half in long-lived species and half in short-lived species. The most common forest types are short-lived hardwoods (aspen, paper birch), long-lived hardwoods (northern hardwoods, oak), long-lived conifer (red pine, white pine, hemlock, white spruce) and short-lived conifer (balsam fir, jack pine) (Table 3-2). These upland portions of the riparian management zone tend to be among the most sensitive Forest areas with impacts to aquatic resources. They are immediately adjacent to water and, when compared to wetlands, are more likely to: (1) experience resource management and recreation activities; (2) have existing roads and trails; (3) provide locations for new road, trail and skid trail crossings of streams; and (4) contain steeper slopes. These upland portions of riparian management zones also provide opportunities for managing vegetation to achieve desired conditions in species composition, sizes and restoration of large woody debris.

Streams: General Characteristics

The CNNF contain 2,140 miles of perennial streams and rivers and 380 miles of intermittent streams. The Forests use a variety of classification systems to manage streams. These include trout classes, beneficial uses and outstanding/exceptional resource waters developed by the Wisconsin Department of Natural Resources (WDNR) and ecological classification units developed by the Forests.

The WDNR has three trout stream classes: Class I, high quality trout waters with natural trout reproduction at or near carrying capacity; Class II, natural trout reproduction but not sufficient to utilize available food and space so that stocking is sometimes required to maintain a sport fishery; and Class III, marginal trout habitat with no natural reproduction (WDNR 1980). The CNNF contain 1,072 miles of Class I and II trout streams or 13.8% of Wisconsin trout streams.

Two WDNR classifications used for water quality protection and management are the following: (1) beneficial uses with five classes for fish and other aquatic life, and (2) designation of outstanding or exceptional resource waters for anti-degradation of water quality. While these classes are used primarily for regulating point source water pollution, they provide a useful perspective for establishing goals or objectives with regard to non-point source water pollution. Fish and aquatic life classes include: cold water communities, warm water sport fish communities, warm water forage fish communities, limited forage fish communities and limited aquatic life. These classes are correlated with ecological stream segment types described in Table 3-3.

Table 3-3. Summary of Stream Segment Types for Chequamegon-Nicolet National Forest.

Stream Segment Type[1]	Number of Segments Sampled	Mean Bankfull Width (ft)	Mean Annual Max Water Temp (deg C)	Mean Daily Range Water Temp (deg C)	Mean Alkalinity (mg/l)	Mean Lab pH	Mean Color (pt-co)	Mean Number of Fish Species per Sampled Segment	Mean Number of Mussel Species Per Sampled Segment	Probable WDNR Beneficial Use Class for Fish and Other Aquatic Life	Estimated Length of Perennial Stream (%)
NAC	5	8.8	20.2	2.3	-2.5	4.4	342	1.2	0.0	Limited Forage Fish	0.8
NSC	7	7.4	19.6	2.4	12.5	6.0	224	3.4	0.0	Limited Forage Fish	0.6
NSO	4	9.7	24.3	4.8	15.7	6.1	213	4.8	0.3	Limited Forage Fish	0.5
NSW	7	9.0	26.9	5.0	12.7	6.0	283	7.3	0.0	Warm Water Forage Fish	7.2
NLCg	19	10.3	19.6	3.3	72.0	7.5	71	4.2	0.0	Cold Water	12.4
NLOg	10	12.2	24.2	4.9	51.6	7.0	95	7.0	0.5	Cold Water	10.5
NLO	15	12.0	25.1	4.4	61.7	7.2	117	7.1	0.1	Warm Water Forage Fish	5.7
NLW	25	12.5	27.5	5.5	61.2	7.3	109	8.0	0.6	Warm Water Forage Fish	26.3
MSW	6	36.9	27.4	3.9	13.5	6.3	236	9.0	1.0	Warm Water Forage Fish	2.0
MLCg	6	26.9	20.9	4.0	72.3	7.7	42	10.3	0.0	Cold Water	2.9
MLOg	12	30.8	24.8	4.2	72.6	7.6	76	10.6	1.4	Cold Water	3.3
MLW	14	32.6	27.6	4.6	78.2	7.6	110	14.0	1.5	Warm Water Sport Fish	11.0
WLO	9	85.5	25.2	3.5	77.4	7.6	87	11.0	2.2	Warm Water Sport Fish	5.0
WLW	18	81.3	27.1	3.6	49.7	7.1	117	14.3	3.7	Warm Water Sport Fish	11.8

[1]First letter indicates bankfull width class with N=Narrow (<20 ft), M=Medium (20-50 ft) and W=Wide (>50 ft)

Second letter indicates water chemistry class with A=Acid (alkalinity <5 mg/l), S=Soft (alkalinity 5-20 mg/l) and L=Alkaline (alkalinity >20 mg/l)

Third letter indicates temperature class for mean of annual max temperatures where: C=Cold (<23°C), O=Cool (23-26°C) and W=Warm (>26°C)

The small g indicates there is likely to be a moderate to high amount of local groundwater inflow to the segment.

Outstanding resource waters designated by Wisconsin may not be lowered in quality by point sources (NR 102) and exceptional resource waters may only be lowered under very specific conditions (NR 207). Within the CNNF boundaries there are 26 lakes totaling 17,174 acres and 322 miles of streams designated as outstanding resource waters (NR 102). There are also over 319 miles (not including unlisted Class I trout streams) of streams designated exceptional resource waters (NR 102).

Streams: Segments

The Forests also developed hierarchically structured ecological classification units for streams (Maxwell et al. 1995). Classification units were tentatively developed for stream segment and stream reach levels in the hierarchy. Segments are long sections of stream relatively homogeneous in size, temperature, chemistry, and aquatic community. They are subdivided into reaches with homogeneous geomorphic characteristics. Fourteen stream segment units were identified based on abundance of fish and mussel species and the following characteristics: stream size (bankfull width: <20 ft, **N**arrow; 20-50 ft, **M**edium; >50 ft, **W**ide), baseflow water chemistry (mean alkalinity: <5 mg/l, **A**cid; 5-20 mg/l, **S**oft; >20 mg/l, Alkaline-(**L**)), and water temperature (average annual maximum: <23^{o}C, **C**old; 23-26^{o}C, Cool (**O**); >26^{o}C, **W**arm).

The NAC, NSC, NSO, and NSW types are small, dark stained streams fed primarily by surface runoff and expansive wetlands (Table 3-3). These streams have low alkalinity and pH, widely fluctuating flows, 1-5 fish species (central mudminnow, brook stickleback, northern redbelly dace, pearl dace) and no mussels. Species increase from NAC to NSW. MSW segments are similar to NSW but have more white sucker and other species.

The NLCg and MLCg types are the best Forest trout streams and are generally designated Class I trout streams. They receive a substantial groundwater flow that maintains a high baseflow of clear, cold, alkaline water. Maximum water temperatures remain below 23^{o}C and brook trout, mottled sculpin, and brown trout dominate the aquatic community. Mussels do not occur in these types. NLCg typically has four fish species while the wider MLCg type has greater diversity with an average of 10 species including white sucker, blacknose dace and creek chub. These segments receive the heaviest trout fishing pressure, particularly the MLCg types. NLOg and MLOg segments have maximum temperatures in the cool range but sufficient local groundwater inflow to support some trout. Other primary species include blacknose dace, creek chub, and white sucker. These types are generally designated as Class I or II trout streams.

Creek chubs dominate the NLO type which lacks sufficient local groundwater inflow to support substantial trout numbers. NLW segments have maximum temperatures above 26^{o}C. They are similar to NLO segments except warmer and tend to have more species. MLWs have temperatures and chemistry similar to NLW but greater diversity of fish species including hornyhead chubs, common shiners, longnose dace, and some mussels.

WLO and WLW are wide streams or rivers (>50 feet) with moderate to high alkalinity, lightly stained water and maximum water temperatures in the upper cool or warm ranges. They typically have 11-14 fish species and 2-4 mussel species. Dominant fish species include common shiners, hornyhead chubs and longnose dace, white suckers and Johnny darters. Several species of redhorse and darters are also common; rock bass, smallmouth bass and other game fish species can be present. These rivers are frequently used for canoeing, fishing and other recreation activities. While large woody debris is an important habitat component in all stream types, it is most valuable in wide streams and alkaline-coldwater types (NLCg, NLOg, MLCg and MLOg).

Streams: Reaches

Stream segments are subdivided into reaches and classified according to physical form (Rosgen 1995; Rosgen 1994). Two primary considerations are aquatic habitat quality provided by stream channel and sedimentation effects on that habitat. Only a small fraction of stream reaches are mapped so far, but a Forest-wide study conducted in the 1990s provides an index of current range and condition of streams (Savery et al. 2001).

Most of the 121 stream reaches studied had broad flood-prone areas (entrenchment >2.2), low-moderate sinuosity (<1.6), low-moderate width/depth ratios (<23), low slope (<0.30%) and sand or gravel channel materials. Sixty-one percent were in wetlands and 39% in uplands. Upland reaches have steeper slopes, coarser channel materials and lower entrenchments than wetland reaches (B, C, E and F types). All wetland reaches are slightly entrenched (C, DA and E types). C types are most common (51.2%) followed by E (34.7%), B (8.3%), F (5.0%) and DA (0.8%). E channels are concentrated in headwaters with drainage areas less than 14 square miles. These channel conditions are the result of natural landscape-climate interactions and human activities that have directly modified stream channels and the landscape.

Streams: Sediment and Channel Morphology

Stable stream channels in equilibrium with natural watersheds are a desired condition that provides good aquatic habitat. Narrow and deep streams (i.e., E types or C types with low width/depth ratios in the range of 12-15) provide the best fish habitat while clean gravel or cobble channel materials provide optimum habitat for many aquatic invertebrates and spawning habitat for many fishes. These desirable channel characteristics can and have been affected by human activities including direct alteration, indirect effects, and sedimentation.

Direct and indirect stream channel alterations occurred in the late 1800s and early 1900s as a result of log drives and logging dam construction and operation. Streams and rivers were cleared of large woody debris and boulders that could impede log movement and some sections were straightened to make log drives possible. The flush of water created extreme floods that scoured some stream banks and channels. Logging dam remnants still pond water for up to a mile causing wide, shallow, sand, and silt-bottomed channels. These activities make channels wider, shallower, and less complex.

Roads and beaver also cause direct and indirect effects on stream channel characteristics. Direct road effects occur when culverts are set too high causing the channel to aggrade upstream or from frequent failures resulting in heavy sediment loads immediately downstream that have the same effect. Roads also affect channel morphology and aquatic habitat through sedimentation as described below. Beaver can cause stream channels to become wider and shallower, particularly above old dams.

Fine sediments (i.e., sand, silt and clay) can be a serious water quality problem. They affect fish by reducing reproductive success, over-winter habitat, and carrying capacity. They also affect aquatic invertebrates by reducing available habitat for ephemeroptera, plecoptera and trichoptera, the preferred food group for fish, and causing a shift to chironomids and oligochaetes that are less available to fish.

Sources of Forest stream sediment include historic logging activities and fires, roads, trails, all-terrain vehicle use, beaver dam removal, boat landings, eroding stream banks, construction activities and other ground disturbances adjacent to water bodies. The Forest does not have a comprehensive survey of all historic and existing sediment sources and riverine segments impacted by sediment but there is clear evidence of many streams being impacted by sedimentation. Most impacts are from historic activities and roads. The Forests reduced erosion and sedimentation through reconstructing road-stream crossings and restoring stream channels.

Streams: Coldwater-Trout

The Chequamegon-Nicolet National Forests contain 1,072 miles of Class I and II trout streams or 13.8% of Wisconsin trout streams. These streams are valuable aquatic and recreational resources. Maintaining or improving this resource requires consideration of water temperatures, in-stream habitat, effects of beaver, historical activities, and current management activities.

Maximum summer water temperatures less than 23^{o}C provide optimum temperatures for brook trout while those less than 26^{o}C provide tolerable temperatures for brook and brown trout, particularly where there is local groundwater inflow. A sample of annual maximum water temperatures from 170 sites on Class I and II trout streams on the Forests indicated 24% were below 23°C, 36% were between 23°C and 26°C, 32% were above 26°C, and 8% do not have the potential to support trout or cold-water temperatures (USDA Forest Service 2002 Aquatic Assessment). Class I and II trout streams on the Forests with maximum water temperatures above 23°C are candidates for watershed assessment to determine the reasons water temperatures are above the desired range, whether restoration practices would reduce temperatures or whether trout management objectives should be revised.

Beaver may be a partial cause of warm water temperatures in Class I and II trout streams. Beaver can adversely affect trout habitat by blocking migration, reducing shade through flooding, increasing water temperature, causing sedimentation of spawning areas, and altering habitat that causes increased competition from other fish species. Aspen is a preferred food of beaver. Beaver do most of their foraging within 300 feet of water but will forage out to 600 feet. Canal construction and beaver impoundment flooding improves access and shortens foraging distance to aspen. Reducing aspen next to streams is a long-term management activity to reduce these beaver conflicts. The Forest has approximately 12,340, 19,870 and 27,400 acres of aspen within 300, 450 and 600 feet, respectively, of Class I and II trout stream systems.

Lakes: General Characteristics

There are 609 CNNF lakes larger than 10 acres. These lakes are classified according to size, fishery, ownership, shoreline development, and public access.

A majority of CNNF lakes (62.6%) are small (i.e., less than 50 acres) while 22.7% are medium (i.e., 50-150 acres) and 14.8% are large (i.e., greater than 150 acres). Small, medium and large lakes account for 10.1%, 13.8% and 76.1% of lake areas, respectively.

Just over half of CNNF lakes (51.1%) have a bass-northern pike-panfish (BNP) fishery, 23.8% a forage (FOR) fishery, 21.7% a walleye-muskie-bass-northern pike-panfish (WMBNP) fishery and 3.4% a trout (TR) fishery. When considering lake acreage, WMBNP, BNP, FOR and TR account for 71.0%, 23.2%, 5.2% and 0.7% of the lake area, respectively. Game fish occur in about three-fourths of the lakes and 95% of the lake area. The average sizes of WMBNP, BNP, FOR and TR lakes are 455, 63, 30, and 27 acres, respectively.

The 609 CNNF lakes are almost equally split regarding shoreline ownership patterns. About one-third of the lakes have no federal ownership, mixed ownership and complete federal ownership, respectively. When considering the acreage of lakes rather then number, 27.3% have no federal ownership, 63.8% have mixed ownership and 9.0% have complete federal ownership. Average lake sizes for 0, <75, >75 and 100 percent National Forest ownership are 120, 294, 125 and 37 acres, respectively.

Slightly over half (307 of 609) of CNNF lakes have undeveloped shoreline while 7.4% have minor shoreline development and 42.2% have moderate development. When considering lake acreage, 13.2% have no development, 28.5% minor development and 58.2% moderate development. The average size for lakes with development is 242 acres, and 37 acres for lakes with no development.

Of the 609 CNNF lakes: 22.2% have no public access, 39.7% have vehicle access and 38.1% have carry-in access. These percentages change dramatically when considering lake area rather than lake numbers; approximately 84% of the lake area has vehicle access. This large percentage reflects that most medium and large lakes, which constitute a majority of the lake area, have vehicle access.

Lakes: Access and Development

Access and recreation opportunities are a major Forest Plan Revision topic (USDA Forest Service 1996). Since lakes are a major focal point for Forest recreation use, the types of access and their degree of development and remoteness are important considerations. The most common lake-associated recreation activities are fishing, boating, camping, swimming, water skiing, canoeing and waterfowl hunting. Some users prefer vehicle access and motorized boats for these activities. These people are either less concerned about the degree of lake development or prefer development because of the conveniences often associated with development. Some recreationists want vehicle access and motorized boat use but on lakes with little or no development. Others prefer more difficult access where small boats, motors or canoes must be portaged a short distance to lakes with minimal or no development. Some people prefer a remote experience that requires a portage of a ¼ mile or more to an undeveloped lake in a non-motorized setting.

Additionally, shoreline development has become a significant issue in northern Wisconsin in the last 10 years. The WDNR's "Northern Initiatives" project identified the rapid rate of shoreline development as a major concern for lake resources (WDNR 1996a). As a consequence, a major theme of the Northern Initiatives Lake and Shorelands report is to preserve as many existing wild lakes as possible (WDNR 1996a). Wild lakes are defined as lakes with no artificial structures or other forms of cultural disturbance on their shores.

The types of public access to the 609 CNNF lakes in order of frequency are as follows: undeveloped (22.8%), boat ramp (22.7%) and no acccess (22.2%), Roadside (12.6%), Walk-in trail (8.0%), navigable water (4.4%), remote, walk-in trail (4.3%) and remote, undeveloped (3.0%). When considering lake area, boat ramp access accounts for the vast majority of lake acreage (70.4%), followed by navigable water (7.8%), no access (6.9%), roadside (5.4%), undeveloped (5.4%), walk-in trail (2.4%), remote, walk-in trail (1.3%), and remote, undeveloped (0.5%). Definitions for the access types are provided in Table 3-4.

Table 3-4. Description of Lake Access Types and Codes.

Access Code	Type of Access	Description of Access Type
BR	Boat Ramp	Sites with a defined public boat launching facility with or without parking.
NW	Navigable Water	Navigable access is provided by the presence of an inlet or outlet stream that furnishes adequate boat access to the lake. A small stream that is not large enough to float a boat does not provide effective navigable access.
RO	Roadside	These sites do not include any access developments. Public roads with a marked right-of-way extending to the water provide a limited degree of access.
WT	Walk in Trail	These access sites are partially developed, excluding a boat ramp, and are entirely within public lands.
UN	Undeveloped	Public lands adjoin the water with a public road that is over 200 feet from the water. There is no defined trail to the water. (Note: This is the same definition used by the WDNR for the access type described as "Wilderness in Public Ownership" in the 1978 version. In 1991 version, the WDNR uses the same term, "Wilderness in Public Ownership", but provides a definition that is different from the 1978 version.)
RT	Remote, Walk in Trail	Same as WT except with 100 percent National Forest ownership and >0.25 miles from the nearest road that is open to the public for driving.
RU	Remote, Undeveloped	Same as UN except with 100 percent National Forest ownership and >0.25 miles from the nearest road that is open to the public for driving.
NO	None	There is no public access in the form of a defined public access facility or public land that adjoins the lake with a public road.

There are 4,019 lakes north of Highway 29 and 75% are developed. Of the 1,024 undeveloped lakes, just over half are in public ownership. Twenty percent of undeveloped lakes are located within the Chequamegon-Nicolet National Forests. Of the 204 lakes in the Chequamegon-Nicolet that are undeveloped and in public ownership, 60 have vehicular access, 100 have carry-in access and 44 have remote access. The 160 lakes with vehicular and carry-in access are similar to the WDNR's wild lakes except motorized use may occur at many of these lakes and those with vehicular access may have a boat ramp. Those lakes with remote access are similar to the WDNR's wilderness lakes.

Lakes: Winterkill

Winterkill occurs when dissolved oxygen consumption under lake ice exceeds the rate of production to such an extent that levels drop below the lethal limit to fish. Fish species vary in their sensitivity to low dissolved oxygen levels. Salmonids and trout are the most sensitive followed by bass, walleye, musky, northern pike, sunfish, and crappie. Yellow perch, bullheads and minnows are the most tolerant of low oxygen levels. Shallow, dark stained lakes with an abundance of aquatic vegetation tend to be most susceptible to winterkill. Depending on these characteristics, winterkill can occur frequently (most years) or occasionally and it can be complete (all fish sensitive to low dissolved oxygen are killed) or partial. Lakes with frequent and complete winterkills have a forage fishery while those with occasional winterkills may have a bass-northern pike-panfish fishery or may alternate between that and a forage fishery. Extreme weather conditions such as early ice cover, heavy snow cover, low inflows and extended winters can cause periodic or partial winterkill on several types of lakes.

On the Chequamegon Forest, 38.9% of the lakes representing 17% of the lake acreage experience some level of winterkill. The Nicolet Forest has a lower incidence with 9.9% of the lakes or 2.6% of total lake acreage experiencing some degree of winterkill. Winterkill limits opportunities for quality recreational fishing, particularly on the Chequamegon Forest. To mitigate winterkill, the Forest operates aeration systems on eight lakes totaling 1,432 acres.

Lakes: Mercury in Fish

Since 1997 over 900 Wisconsin water bodies have been sampled for mercury contamination in fish. At that time there were over 321 (35.7%) water bodies on the mercury consumption advisory list (WDNR 1997a). Air pollution is the primary source of additional mercury in Wisconsin waters. Burning fossil fuels, mainly coal, releases mercury into the air and is deposited in surface waters through precipitation or dry deposition. Inorganic mercury is not readily taken up by fish or other organisms and typically ends up in the sediments where microorganisms transform it into methylmercury that is readily available to fish and other organisms. Fish absorb methylmercury directly from water passing over their gills or by ingesting other contaminated organisms. The highest mercury concentrations tend to be in older, bigger fish in Wisconsin's inland lakes (WDNR 1997a). The bioconcentration factor for methyl-mercury can increase threefold for each level in the food chain of fish (Watras et al. 1992).

Fish from over 94 bodies of water in the Chequamegon-Nicolet National Forests have been tested for mercury and 39 (41.5%) of these are on the mercury advisory list. Approximately 34 lakes and 2 rivers were sampled on the Nicolet. Nine (25.0%) are on the advisory list and three (8.3%) have at least one fish species with a Group 4 advisory.

The Chequamegon had 57 lakes and one river sampled for mercury concentrations in fish; 30 lakes (52.6%) are on the advisory list and 10 of these (17.5%) have a Group 4 rating. The Group 4 lakes appear to be concentrated on the Great Divide and Washburn Ranger Districts (9 of 10 lakes).

Studies in Wisconsin indicate mercury concentrations in fish, particularly walleye, tend to increase in clear water lakes as pH and alkalinity decrease. Another study found similar results in fish but also that mercury concentrations increased in fish as dissolved organic carbon or color increased. For the Chequamegon-Nicolet lakes, color seemed to be more strongly correlated with fish consumption advisories for mercury than alkalinity. Consumption advisories exist for 29%, 55%, and 63% of the clear, stained, and dark brown lakes, respectively.

Wetlands

The Chequamegon-Nicolet National Forests contain approximately 347,000 wetland acres that amount to 23% of the Forests. Forested types account for 55% of the wetland followed by 18.5% shrub swamp, 4.7% open bog, 4.5% shallow and deep marsh, 3.4% sedge meadow and 0.9% open water with the remainder undifferentiated. In addition, the Forests contain many small (less than one acre), isolated wetlands referred to as woodland ponds or vernal pools.

Forest Service policy regarding wetlands is based primarily on legal requirements in the Clean Water Act, particularly Sections 401 and 404, and Executive Order 11990 for the Protection of Wetlands. This policy includes but is not limited to minimizing adverse impacts to wetlands, preserving and restoring the beneficial uses of wetlands, avoiding wetlands whenever there is a practicable alternative and providing for early public review for all actions affecting wetlands.

Some wetland management issues include constructing and managing low head impoundments for waterfowl and other wildlife, vegetation management adjacent to woodland ponds and minimizing adverse wetland impacts from existing and proposed road and trail crossings.

Aquatic Non-Native Invasive Species (NNIS)

"Invasive species" are defined as: (1) non-native (or alien) to the ecosystem under consideration, and (2) species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112).

Numerous aquatic NNIS species were introduced intentionally or accidentally into Wisconsin waters. Also called "exotic" or "non-indigenous" species, these newcomers cause trouble by changing the ecological balance of aquatic ecosystems and sometimes crowd out native species. Some non-native species are ecologically harmless or even beneficial. However, most cause great harm. Harmful NNIS include ruffe, goby, sea lamprey, zebra mussel, and rusty crayfish. There are several aquatic plants and one crayfish on the Forests considered to be NNIS. Although brown trout and rainbow trout are non-native species they are not considered NNIS by the State. Boats and trailers commonly transfer aquatic NNIS to new waters. Larger lakes with shoreline development, good fisheries, and boat landings are most susceptible because recreational boating and fishing traffic is higher on these lakes compared to non-developed lakes.

Rusty crayfish are commonly found in larger more developed lakes supporting native crayfish. This species is more prevalent on Nicolet lakes where it was probably introduced by anglers transporting it in bait buckets. Rusty crayfish reduce vegetation by feeding aggressively on aquatic plants. They are very prolific and feed on native crayfish populations. Every year brings new findings of rusty crayfish across the forest.

Zebra mussels have yet to be discovered on the Forests. However, in 2001 the species was found outside the Nicolet boundary in Forest County and likely will be found on the forest in the future. Zebra mussels are filter feeders, taking plankton for food that young native fish rely on. They also out-compete native mussels, are highly prolific, and can cause major changes to aquatic ecosystems.

Additional aquatic NNIS, such as rainbow smelt, will likely invade the forest in the future.

Current Management Direction

Current management direction for aquatic resources is summarized below. Additional details are available from the Analysis of the Management Situation for Aquatic Resources on the Chequamegon-Nicolet National Forests (USDA Forest Service 1999b) and the Land and Resource Management Plans for the Chequamegon and Nicolet National Forests (1986a and b). The current plans provide limited direction regarding aquatic resources, particularly desired future conditions. The Chequamegon NF plan provides goals to (1) cooperate with other resource agencies in a unified resource protection effort, (2) design activities to minimize adverse impacts on water quality and other riparian resources, and (3) to cooperate with the WDNR on fisheries improvement projects. The Nicolet NF plan provides no goals regarding aquatic resources. A summary of aquatic resource management objectives and accomplishments for the first decade of plan implementation is provided in Table 3-5.

Table 3-5. Summary Planned Objectives and Accomplishments for Aquatic Resources.

	Planned Objectives			Ten Year Accomplishments		
Activity	**Cheq**	**Nicolet**	**Total**	**Cheq**	**Nicolet**	**Total**
Watershed Improvement (ac)	100	None	100	36	40	76
Impoundment, construction (ac)[1]	280	730	1,010	223	345	568
Impoundment, reconstruction (ac)				181	881	1,062
Stream Improvement (mi)[2]		190			360	
Lake Structures (#)	800	439		900	1,304	2,204
Lakes Improved (#)		65		41	43	84
Lakes Improved (ac)	5,490			9,314		

[1] *Chequamegon had 8 impoundments, assuming an average size of 35 acres results in an objective of 280 acres.*

[2] *Chequamegon had 125 acres of stream brushing and 393 acres of stream rebrushing.*

One or both plans contain some Standards and Guidelines regarding erosion, riparian areas, water quality and fisheries management. Both contain Standards restricting aspen regeneration along Class I and II trout streams to reduce beaver and their potential negative impacts on trout habitat, over time. The Chequamegon Standard is 300-feet and the Nicolet is 200-feet.

The current Land Management Plans (LMP) offer no aquatic NNIS direction. The Forests worked cooperatively with other agencies to inventory and help stop the spread of NNIS. The Forests are working to eradicate purple loosestrife through the use of biological control.

Proposed Changes and Range of Changes

The current LRMPs fail to provide adequate goals, objectives, and direction for all areas of water resource management. Key points include lack of direction for Desired Future Conditions (DFC) for riparian areas, aquatic resources, watershed assessments, watershed restoration and improvement, habitat restoration and improvement and the impacts of recreational activities.

A significant change includes a Watershed and Aquatic Resources Desired Condition (Chapter 3 of the Forest Plan). The prescription provides Forest-wide direction for managing watersheds, riparian areas and aquatic resources. Additional changes may include more guidance for aquatic resource management through forest plan Standards and Guidelines, goals, objectives and Management Area prescriptions. No changes in Standards and Guidelines are proposed regarding impaired waters on the state 303(d) list since all are the result of atmospheric mercury deposition rather than land management activities.

There is no range of changes for aquatic resources. All changes are incorporated into Forest-wide Standards and Guidelines, goals, objectives, and Aquatic Prescription. These changes do not vary by alternative.

Comparison of Current Conditions to Estimates of Natural Variation (Range of Natural Variability)

Current conditions are described in detail beginning on page 3-4. A brief comparison of current condition to Range of Natural Variability (RNV) is provided here for large woody debris in aquatic ecosystems, stream channel morphology, stream temperature, fish passage, beaver, and aquatic Non-Native Invasive Species (NNIS).

Historically there were large quantities of large woody debris in lakes, rivers and some streams. Much of this wood was removed during turn of the century logging drives. Potential replacement wood was logged in riparian areas at the time and throughout the 1900s until a few decades ago. Tree drops and fish crib construction have been used in the last few decades to restore wood in lakes and rivers but the current condition is well below the natural range.

Streams naturally have a high range of variability in channel characteristics including width/depth ratio and bed materials. Bed materials range from silt and sand to boulders and bedrock although sand and gravel are the most common natural materials on the Forests. Evidence indicates some streams have a higher incidence of sand bedload because of historical impacts caused by log drives, roads and other land management activities. Current conditions indicate some streams may have higher width/depth ratios than historically because of log drives, remnant logging dams, roads and other land management activities. Below some old logging dams and culverts there are pools that may not have existed naturally or may be larger or deeper than existed. These widely scattered pools provide fish habitat.

Streams naturally have a high range of variability in water temperature. This range includes cold-water streams with maximum water temperatures below 23^{o}C, cool waters with maximum temperatures of 23-26^{o}C and warm waters with maximum temperatures from 26-32^{o}C. These ranges still occur but evidence indicates historical timber harvesting and high beaver populations in recent decades increased water temperatures in some cold and cool water streams.

Aside from a few waterfalls, upstream fish passage occurred in all streams. Current fish passage is below the natural range of variability because dams and some culverts prevent upstream movement of fish and other aquatic organisms.

The introduction of aquatic NNIS such as rusty crayfish and several aquatic plants resulted in aquatic species composition outside the natural range of variability. An increase in aspen along riparian areas in the past century and limited trapping has resulted in a high beaver population. The number of beaver may be near or above their RNV.

Direct and Indirect Effects

Effects on Aquatic Resources from Transportation System

Roads and trails can affect hydrology, water quality, stream channel morphology, fish movement, and wetlands. While road and trail-derived pollutants can affect the fish and other aquatic life, sediment is the primary pollutant associated with Forest roads and trails.

Hydrology and Hydrologic Connections

Generally, roads and trails tend to increase the drainage efficiency of a watershed by intercepting, concentrating, and diverting flows from their natural flow paths. These changes can result in increased peak flows if surface and subsurface flows are intercepted and routed directly to streams. Where roads and trails intercept and store water, or route water away from streams, they can have the opposite effect.

Road and trail segments are hydrologically connected to streams wherever runoff from their surfaces and ditches flow directly into streams. This direct connection can increase peak flow rates and deliver pollutants to streams. Within the Chequamegon-Nicolet National Forests, hydrologic connections occur primarily at stream crossings and typically extend up to the first slope break. These connections are best estimated through field surveys rather than topographic maps. Without such surveys, stream crossings and length of road or trail in Riparian Management Zones (RMZ) can be used as an index of hydrologic connections.

A Geographic Information Systems (GIS) analysis of Level 3, 4 and 5 roads indicated that within Chequamegon-Nicolet boundaries these roads have 1,059 stream crossings and 80 miles within RMZs (Table 3-6). About half the RMZ road miles are associated with stream crossings while the other half represent road segments parallel to streams or lakes. These RMZ road miles represent about 2.2% of the total length (3,630 miles) of Level 3, 4 and 5 roads.

Table 3-6. Roads and Motorized Trails in Riparian Management Zones (RMZs) and Wetlands.

Type of Road[1] or Trail	Total Length (miles)	Stream Crossings (#)	Stream Crossings (#/mile)	Length in RMZ[4] (miles)	Length in RMZ[4] (%)	Length in Wetland (miles)	Length in Wetland (%)
5	1,290	427	0.33	34.4	2.7	92.6	7.2
4	1,396	462	0.33	33.1	2.4	108.8	7.8
3	947	170	0.18	12.5	1.3	35.1	3.7
1 and 2[2]	6,700	670	0.10	50.0	0.7	135.0	2.0
Road Total	10,333	1,729	0.17	130.0	1.3	371.5	3.6
Snowmobile	659	162	0.25	11.6	1.8	42.2	6.4
Snowmobile/ATV[3]	271	57	0.21	4.0	1.5	16.3	6.0
ATV[3]	13	3	0.22	0.2	1.8	0.8	6.0
Motorized Trail Total	943	222	0.24	15.8	1.7	59.3	6.3

[1]Numbers are road maintenance level.

[2]Level 1 and 2 stream, RMZ and wetland values estimated from trends for 3, 4 and 5 roads.

[3]ATV = All Terrain Vehicle

[4]RMZ includes all areas within 100 feet of perennial water and 35 feet of intermittent streams.

The Forest also contains 6,700 miles of level 1 and 2 roads. Most stream crossings are not inventoried so their potential impacts must be evaluated more generally. Because level 1 and 2 roads are short, mostly dead-end timber access roads, they generally have fewer stream crossings per mile of road and a lower percentage of total road miles in RMZs compared to higher maintenance level roads. The Level 3, 4 and 5 roads have 0.18, 0.33 and 0.33 crossing per mile and 1.3%, 2.4% and 2.7% of their length in RMZs, respectively, as displayed in Table 3-6. Based on these proportions, it is estimated that 0.75% or about 50 miles of the Level 1 and 2 roads are in RMZs and they may contain up to 0.1 stream crossings per mile or 670 stream crossings.

The Forests contain 943 miles of motorized trail including 659 miles of snowmobile trail, 271 miles of dual-use snowmobile/All-Terrain Vehicle (ATV) trail and 13 miles of ATV trail based on a GIS analysis (Table 3-6). Overall, these trails have 1.7% of their length in RMZs and a stream-crossing rate of 0.24 crossings per mile. These rates are higher than Level 3 roads. This probably occurs because motorized trails are similar to Level 3 and 4 roads in that they attempt to connect from one location to another and therefore must cross more streams than Level 1 and 2 roads which provide local access and frequently have dead-ends. Snowmobile trails are of less concern with regard to effects on hydrology and sedimentation because they are normally used when the ground is frozen and there is snow cover. They are generally well vegetated during the off-season and therefore much less likely to produce surface runoff and sedimentation. ATV trails have a greater impact to hydrology and sedimentation because they are used year-round resulting in bare, compacted trail surfaces. All existing ATV trails are on the Chequamegon Forest. ATV trails have 60 (mapped perennial and intermittent) stream crossings and 4.2 miles of trail within RMZs.

Road and trail-caused hydrologic effects and hydrologic connections occur throughout the Forest but are more common in areas with high drainage density, heavier soils and steeper slopes where surface and shallow subsurface runoff is greatest. These areas include the Penokee/Gogebic Iron Range in portions of the White, Marengo and Upper Bad Watersheds; the Flambeau Silt Capped Drumlins in the Thornapple, Log Creek, Elk, Scott, and Willow Sub-Watersheds; the steeper portions of the Perkinstown Moraine in the Upper Yellow and Trappers-Pine Watersheds; the steeper portions of the silty Iron River/Argonne Drumlins in the headwaters of the Brule Watershed; and the silty Wabeno Drumlins over bedrock and loamy Mountain Moraines in the upper Peshtigo and Oconto Sub-Basins.

While some hydrologic effects occur, particularly in the areas described above, roads and trails generally have a small effect on hydrology across the Forest. This is particularly true regarding increasing peak flows because the hydrologic connections are not extensive and most watersheds have large floodwater storage areas in lakes, wetlands and broad flood prone areas. The estimated length of hydrologic connections for roads and ATV trails is about 135 miles which represent 1.3% of total road and ATV trail length and 5.4% of total stream miles. These proportions are relatively small compared to areas with steeper terrain. Therefore, the hydrologic connections are considered more of an effect on water quality through delivery of sediment to streams, lakes and wetlands than on hydrology.

Surface Erosion and Sedimentation

Roads and trails affect water quality primarily through erosion and sedimentation. Surface erosion and sedimentation occur when rainfall or snowmelt detaches soil particles (erosion) and runoff carries these particles into streams (sedimentation). Sediment is recognized as the most important water pollutant in the United States in terms of total quantity, miles of stream affected, and adverse effects on aquatic communities (Waters 1995). Fine sediment (i.e., sand, silt and clay) is a particular water quality problem in streams because it reduces available habitat by filling pools; reduces survival of fish eggs and fry; and reduces survival, composition and abundance of aquatic invertebrates.

Poorly designed, located, constructed, or maintained roads and trails can be significant sources of stream sediment. Roads and trails with undersized culverts that fail frequently are considered the largest sources of sediment in streams on the Forest because each failure typically produces several tons of sediment and the entire volume is delivered to the stream. Most failed culverts were originally installed many years ago without adequate design. When these sites fail, fill is often replaced over the same culvert to make the road or trail passable but the problem is perpetuated.

Sediment can also originate from "hydrologically connected" roads and trails with native surface material, inadequate gravel surface, poorly vegetated slopes or ditches, inadequate ditch armor and inadequate drainage. The potential for this erosion and sedimentation also increases as the slope of the road increases. This occurs because water moves at higher velocities as slope increases and water volume accumulates as slope length increases. Thus both slope steepness and length contribute to greater rill and gully erosion. Roads and trails that are paved or have at least 6 inches of crushed gravel and are regularly graded to maintain a crowned surface; have ditches and slopes that are protected by good vegetative ground cover; have good cross-drainage and low hydrologic connection can be minimal sources of sediment.

Areas with the greatest risk for road and trail surface erosion (steep slopes) and sedimentation (high runoff potential, high drainage density, greater hydrologic connection) include the Penokee/Gogebic Range in portions of the Marengo, White and Upper Bad Watersheds; the steeper portions of the Perkinstown Moraine in the Upper Yellow and Trappers-Pine Watersheds; the steeper portions of the silty Iron River/Argonne Drumlins in the headwaters of the Brule Watershed; and the silty Wabeno Drumlins over bedrock and loamy Mountain Moraines in the upper Peshtigo and Oconto Sub-Basins. These locations have a large proportion of area with slopes over 5% and many slopes over 15%.

A large portion of the Washburn RD has steep slopes (5-15% slopes on about 45% of the area and greater than 30% slopes on about 15% of the area) with high erosion potential which increases construction and maintenance costs. However, sedimentation potential is low because of fewer surface waters. Exceptions are the concentration of lakes and ponds near Bladder and Wanoka Lakes and the headwaters of Fourmile and Lenawee Creeks.

The Forests contain an estimated 1,900 road and motorized trail stream crossings (Table 3-6). From 1998 through 2001, 65 of the worst road stream crossing problems were corrected through the Forest Roads and Trails (10%) program or road maintenance. The majority of these have been on Level 3 and 4 roads. In addition, 11 road stream crossings and 9 motorized trail crossings were eliminated and restored over the same period.

The Level 3, 4 and 5 roads for the Chequamegon-Nicolet National Forests contain 1,059 stream crossings. Of these, over 670 have been inventoried to determine potential water quality and fish passage problems. The inventory included an evaluation of culvert condition; erosion and sedimentation from frequent washouts, road surface, ditches, and embankments; potential fish passage problems; and a severity ranking. The ranking was based primarily on sedimentation problems and was the following: 0-no problem; 1-minor problems; 2-moderate problems; 3-major problems and 4-severe problems.

Despite the corrective work described above, there are still road stream crossings with sedimentation or fish passage problems. Just over 8% of the sites still have major or severe problems, 20% have moderate problems and 33% have minor problems (Table 3-7). While these sites are scattered across the Forests, concentrations of road stream crossings with moderate-severe sedimentation problems occur in the North Branch Oconto, Upper Yellow, Marengo, Trappers and Pine, White and South Branch Oconto Watersheds (Table 3-7).

Table 3-7. Summary of Road-Stream Crossing Inventory Severity Ratings and Fish Passage Concerns.

	# of Sites by Severity Rating from Road-Stream Crossing Inventory						Sites With a Fish Passage Concern
5th Level Watershed	**0**	**1**	**2**	**3**	**4**	**Total**	**Total Number**
Upper Yellow River	30	27	10	5	0	72	10
Lower North Branch Oconto River	17	24	18	7	2	68	16
Marengo River	19	14	13	4	0	50	8
West Fork Chippewa River	17	18	12	3	0	50	7
Upper South Fork Flambeau River	23	11	9	1	0	44	2
South Branch Oconto River	10	21	6	2	1	40	6
Pine River	23	8	1	1	0	33	3
Trappers and Pine Creeks	11	9	5	3	1	29	8
East Fork Chippewa River	6	11	10	1	0	28	5
Upper Peshtigo River	11	8	6	1	1	27	3
Middle Peshtigo and Thunder Rivers	10	9	7	0	0	26	3
Otter Creek and Rat River	14	7	5	0	0	26	1
Upper South Fork Jump River	9	9	6	1	0	25	0
Popple River	15	4	2	1	0	22	2
Brule River	13	3	1	3	0	20	4
Upper Bad River	7	9	1	1	1	19	0
White River	4	4	3	5	0	16	4
Elk River	6	6	2	0	0	14	0
Upper Namekagon River	2	6	5	0	0	13	5
Eagle River	6	2	2	1	0	11	0
Middle Jump River	4	2	1	1	0	8	0
Deerskin River	1	3	2	1	0	7	3
Upper Wolf River and Post Lake	3	0	2	1	0	6	0
Weirgor Creek and Brunet River	1	1	2	1	0	5	2
Middle Tomahawk River	3	0	0	1	0	4	0
Lily River	1	1	0	1	0	3	0
Lower North Fork Flambeau River	0	2	1	0	0	3	1
Bayfield Peninsula Southeast	0	0	0	0	2	2	0
Tamarack Pioneer River	0	1	1	0	0	2	0
Thornapple River	0	0	2	0	0	2	1
Bayfield Peninsula Northwest	0	0	0	1	0	1	0
Somo River	0	0	1	0	0	1	0
Wolf River/Langlade and Evergreen Rivers	0	1	0	0	0	1	0
Total (#)	266	221	136	47	8	678	94
Total (%)	39.2	32.6	20.1	6.9	1.2	100.0	13.9

Assuming stream crossings on Maintenance Level 1 and 2 roads and motorized trails have conditions similar to Level 3, 4 and 5 roads, the Forests could still have over 75 crossings with major sedimentation problems and 180 with moderate problems. This estimate does not include the Level 3, 4 and 5 stream crossings not inventoried since many of them may have a lower incidence of problems.

Mass Wasting

Road-related mass wasting (landslide) typically occurs in steep terrain. Because of the relatively gentle relief throughout the Chequamegon-Nicolet, road-related mass wasting is extremely rare and generally not a problem. Work in California indicated an increase in mass wasting road failures when slopes exceeded 40% and 50% (USDA Forest Service 1999a). Only 0.5% of the areas within Chequamegon-Nicolet boundaries have slopes exceeding 30%.

Water Temperature

Roads and trails paralleling streams that have permanently removed a substantial portion of riparian vegetation providing stream surface shade can increase the temperature of cold and cool water streams. This is a rare occurrence on the Chequamegon-Nicolet because few roads or trails parallel streams for any length and where they do, there frequently is a sufficient strip of vegetation between the road and stream to shade the stream and maintain water temperatures. Alder or other shrubs and trees usually provide this shade.

Stream Channel Morphology

Roads and trails also affect the shape or morphology of stream channels both above and below crossings. These effects occur where culverts are set too high or constrict the channel too much, where culverts wash out regularly or where there is heavy sedimentation from the road surface, slopes and ditches.

Culverts set too high at the inlet or that constrict the stream too much cause sediment to deposit in the upstream channel. In low gradient streams, deposits extend upstream several hundred feet and consist of sand, silt and muck. On steep streams that transport gravel bedload at high flows, deposits consist of gravel and cobble. On these streams, the width of the culvert or bridge should be about as wide as the bankfull width of the channel to maintain natural bed load transport through the crossing.

Some stream crossings have undersized culverts that wash out frequently as described above. This causes the downstream channel to fill with sediment. In low gradient streams this can back water upstream, causing the channel to accumulate sand, silt and muck similar to a culvert that is set too high.

Heavy sediment loads from frequent washouts or erosion of road surfaces can also affect the downstream channel by causing it to become wider and shallower. Wide, shallow channels with a predominantly sand bed tend to provide poor habitat for fish and aquatic invertebrates.

Most of these effects can be minimized by properly sizing and installing culverts (usually to pass the 100-year flood), preventing sedimentation from roads and matching the culvert width to the bankfull width, particularly on streams with a mobile gravel bed.

The estimated number and condition of road and trail stream crossings are described above under Erosion and Sedimentation. Most sites with major problems and some with moderate problems are likely to also affect channel morphology.

Fish passage

Roads and trails can act as barriers to the upstream movement of aquatic organisms, particularly at stream crossings. Fish are most commonly affected but roads and trails can affect movement of a variety of species including salamanders, turtles, and mussels. The Forest has over 50 species of fish including brook trout, walleye, smallmouth bass, largemouth bass; various species of redhorse, dace, darters; and many minnow-type species. The smaller fish generally have limited swimming and jumping abilities. In fact none of the fish species found on the Forest have the jumping ability of many of the western salmonids.

Generally the type, size, and placement of culverts will determine if fish movement is blocked. Common problems associated with passage include: culverts placed too high resulting in a drop at the outlet; culverts placed at too steep a slope resulting in water velocities that are too high or water depths that are too shallow; culverts that are too small resulting in water velocities that are too high; and culverts that are too long resulting in swimming distances through high velocity water that are too long for fish. All these conditions, either alone or acting together can block fish movement.

The Forest objective is to provide fish passage at all road and trail stream crossing sites unless it is deemed unnecessary by the fisheries specialists. The main exceptions would be to stop the spread of exotic species or crossings located in headwaters where fish passage would not normally occur.

A road-stream crossing inventory was conducted on the Chequamegon-Nicolet National Forests from 1997 to 1999 with periodic updates afterwards. Over 670 sites on mostly Maintenance Level 3, 4 and 5 (more highly developed) roads were inventoried to determine potential water quality and fish passage problems. The inventory is briefly described above in the sub-section on Surface Erosion and Sedimentation. Probable fish passage problems were noted for culverts that appeared to be too steep (high velocity and/or too shallow water) or had a drop at the outlet. Any drop at an outlet was usually measured to the nearest 0.1 foot. If upstream fish passage was questionable for any of the species and their life stages, the site was rated as a probable fish passage barrier (See Table 3-7).

Fourteen percent (94) of the crossings were identified as fish passage concerns. While these sites need more detailed field survey and evaluation, it is likely that most of these sites restrict the upstream movement of some life stages of some species of fish during some time of the year. Therefore, culvert replacement at most of these sites would benefit these fish and the stream ecology. If the Level 1 and 2 roads and motorized trails have a similar rate of fish passage concerns, there may be an additional 125 crossing that are potential fish barriers.

Non-Native Invasive Species (NNIS)

The road system contributes to the introduction of NNIS aquatic species by providing access to lakes and streams. Boats and trailers are a major component of the introduction of non-native species into lakes and rivers. This is particularly true for aquatic plant species such as Eurasian water milfoil as well as zebra mussels and baitfish. Road-stream crossings provide angler access and may increase the likelihood of the introduction of NNIS fish species.

Wetlands

Road and trail systems can affect wetlands in two primary ways: (1) direct loss through filling or heavy sedimentation, and (2) alteration of wetland type through changes in water levels and flow rates. There are 434,000 acres of wetland within the boundaries of the Chequamegon-Nicolet. This amounts to 23% of the area. Because of their abundance, it is not feasible to completely avoid crossing wetlands with roads or trails in many areas of the Forests even though such crossings tend to be more difficult and expensive to construct. A geographic information systems analysis indicates there are 237 miles of level 3, 4 and 5 roads located in wetlands (Table 3-6). This amounts to 6.5% of the total road miles. Assuming an average width of 40 feet, this length would occupy 1,149 acres or 0.26% of wetland within the Chequamegon-Nicolet boundaries. Since most of these high maintenance level roads are open to traffic throughout the year, they represent permanent filling of wetlands. The fact that 23% of the Forests are occupied by wetland while only 6.6% of roads are located in wetland is further evidence that wetlands have frequently been avoided during road construction when practicable.

There are approximately 6,700 miles of maintenance level 1 and 2 roads on the Forest. Because they are short, mostly dead-end timber access roads, they have fewer wetland crossings than higher maintenance level roads and when they do cross wetlands, they frequently are winter-only roads not using permanent fill. The Level 3, 4 and 5 roads have 3.7, 7.8 and 7.2% of their length in wetlands, respectively (Table 3-6). Based on these proportions, it is estimated that 2.0% or about 135 miles of the Level 1 and 2 roads are in wetlands. Since these roads cross much less wetland and typically do not contain permanent fill, they have much less potential impact on wetlands than the higher maintenance level roads.

The Forests currently contain 943 miles of motorized trail including 659 miles of snowmobile trail, 271 miles of dual-use snowmobile/ATV trail and 13 miles of ATV trail based on a GIS analysis (Table 3-6). There are 59.3 miles (6.3%) of motorized trail in wetlands. These percentages are higher than Level 3 roads and less than Level 4 and 5 roads. This probably occurs because motorized trails are similar to high maintenance roads in that they attempt to connect from one location to another and therefore must cross more wetland than Level 1 and 2 roads which provide local access and frequently have dead-ends. Snowmobile trails are less of a concern with regard to effects on wetlands because they typically do not use fill and are normally used when there is snow cover and the ground is frozen. ATV trails have a greater wetland impact because they are used when the ground is not frozen causing severe rutting and requiring permanent fill. All existing ATV trails are on the Chequamegon Forest. There are 17.1 miles (6.0%) of ATV trails in wetland.

Accurate measures of the adequacy of cross-drainage and impacts to wetland type are not readily available but are thought to be minor in terms of total area and percent of wetland affected based on general observations. Impacts to wetland type can be mitigated by providing adequate cross-drainage.

Wetlands are numerous throughout the Forests with the exception of the outwash sands on the Washburn RD. Therefore, wetland crossings and potential impacts to wetland type occur throughout most of the Forests.

Alternatives and Overall Effects of Roads and Motorized Trails

All alternatives include continued use of the existing road and motorized trail systems. These systems currently affect aquatic ecosystems through erosion, sedimentation, changes to channel morphology and by preventing upstream fish movement. The effects are described in the preceding subsections and generally occur at approximately 30% of road and trail streams crossings, 1-2% of roads and trails in RMZs and a portion of the 3% of roads in wetlands and the 6% of ATV trails in wetlands. This existing infrastructure and it's continued use is the primary effect of roads and trails on aquatic resources. However, all alternatives include objectives, and Standards and Guidelines to reduce these impacts over time and to avoid impacts from new roads and trails. These include objectives to relocate or reconstruct existing road and trail segments adversely affecting aquatic ecosystems and Standards and Guidelines to prevent adverse impacts from new road or motorized trail construction. Therefore, the adverse effects of the existing road and trail systems will decline over time under all alternatives. A possible exception could be Alternative 1 because it does not provide these objectives and specific Standards and Guidelines. However, work to reduce road and trail effects has begun and is progressing under the existing Forest Plan without this specific direction and would likely continue in the future.

The alternatives differ with regard to the amount of non-motorized area and amount of trail construction (Table 3-8). These differences would affect the extent to which road and motorized trail impacts to aquatic resources would decline in the future. In general, Alternatives 3, 4 and 7 would likely improve aquatic resources at a faster rate and greater extent than Alternatives 5 and 6. Alternatives 2, 9, 1 and the Selected Alternative would probably improve aquatic resources at a somewhat slower rate and to a slightly lesser extent than the other Alternatives.

Table 3-8. Comparison of Alternatives Regarding Roads and Trails.

	Alternative								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**SA**
Non-Motorized Area (1000's of ac)	120.6*	150.9	286.5	342.2	199.9	252.1	277.7	233.5	170.5
Projected Total Road Density in 30-50 years (mi/sq mi)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
New ATV Trails and/or Connectors (mi)	0	290	40	0	135	135	100	290	185

**Includes MAs 5,6, and Wilson Flowage*

Effects on Aquatic Resources from Timber Management

All alternatives apply Wisconsin's Forestry Best Management Practices (BMPs) for Water Quality (WDNR 1995a) in riparian areas. BMPs include a Riparian Management Zone (RMZ) of 100 feet adjacent to all perennial water bodies and 35 feet adjacent to all intermittent streams. The purpose of the RMZ is to filter sediment and nutrients from runoff, allow surface runoff to infiltrate, stabilize stream banks and lakeshores, shade streams to maintain cold or cool water temperatures and provide food and habitat for aquatic organisms in the form of detritus and large woody debris. Selective timber harvest is allowed within the RMZ provided at least 60 square feet of basal area per acre is left in trees five inches DBH (diameter breast height) and larger that are evenly distributed. Along perennial streams and lakes, harvesting equipment may not operate within 50 feet of the ordinary high-water mark to ensure there is an undisturbed filter strip adjacent to the water.

Riparian Vegetation

About 65% of the RMZ areas on the Forests are wetland occupied by sedge meadow, shrub swamp, lowland conifers, and lowland hardwoods. These wetlands are considered unsuitable for timber management and receive no commercial timber harvest treatment under any of the alternatives. Some of the lowland hardwoods and swamp conifer will increase in age and tree diameter but will not change appreciably, particularly in the next decade. Some of the forested area may convert to open water, sedge meadow or shrub swamp as a result of beaver activity.

The upland portion of the RMZ area includes both suitable and unsuitable areas with regard to timber management. In all alternatives, suitable upland ranges from 20% to 23% of the total RMZ while unsuitable upland ranges from 12% to 15%. The suitable portion could be commercially treated according to the timber management prescription for the Management Area provided it included the BMPs. Unsuitable areas would change over time through natural growth and succession. The effects of each alternative on riparian vegetation in upland portions of the RMZ, including both timber harvest and natural succession, were modeled using SPECTRUM. Desired future conditions for riparian forests include tall, large diameter, long-lived trees that provide shade, bank stability, large woody debris, leaf litter, and nesting trees for riparian wildlife such as eagle, osprey, wood ducks, and mergansers. Desired long-lived conifers include red pine, white pine, white spruce, and hemlock. Aspen is a desired species where it is important to maintain or enhance beaver habitat. The alternatives were evaluated to determine changes in long-lived conifer (including age 70+) and hardwood (age not considered since most northern hardwood stands in riparian management zones would be managed for an uneven-aged structure) over time.

The primary difference among the alternatives is in the proportion of long-lived conifer and hardwood in the future. All alternatives are similar after the first decade for all vegetation types and with regard to open, short-lived conifer (balsam fir, jack pine) and short-lived hardwood (aspen, paper birch) over the long term. Openings occupy 3.1-4.0% of the upland RMZ in years 0 and 10 for all alternatives and decline to 1.1-1.2% in 100 years. Short-lived conifers range from 6.8-8.1% in years 0 and 10 for all alternatives and decline to 2.9-3.1% in 100 years. Short-lived hardwoods occupy 41.0-43.1% in years 0 and 10 and decline to 0.0 in 100 years in all alternatives. Long-lived conifers (red pine, white pine, white spruce, hemlock) occupy 8.7-11.2% of the upland RMZ in years 0 and 10 and increase to 15.2-27.9% in 100 years (Figure 3-2). Alternatives 2 and 6 would provide the largest proportion of long-lived conifers while Alternatives 7 and 4 would provide the least. Long-lived hardwoods (northern hardwood, oak) occupy 35.7-38.4% of the upland RMZ in years 0 and 10 but would increase to 68.0-80.6% in 100 years. Alternatives 7 and 4 provide the largest proportion of long-lived hardwoods and Alternatives 2 and 6 the least. For long-lived conifer greater than 70 years old, all alternatives are similar after 10 years with just over 6% of the upland RMZ occupied by trees over 70 years old. In 100 years, this area increases to 14.6% in Alternative 2, 12.7% in the Selected Alternative, and 11.0% in Alternatives 6 and 9.

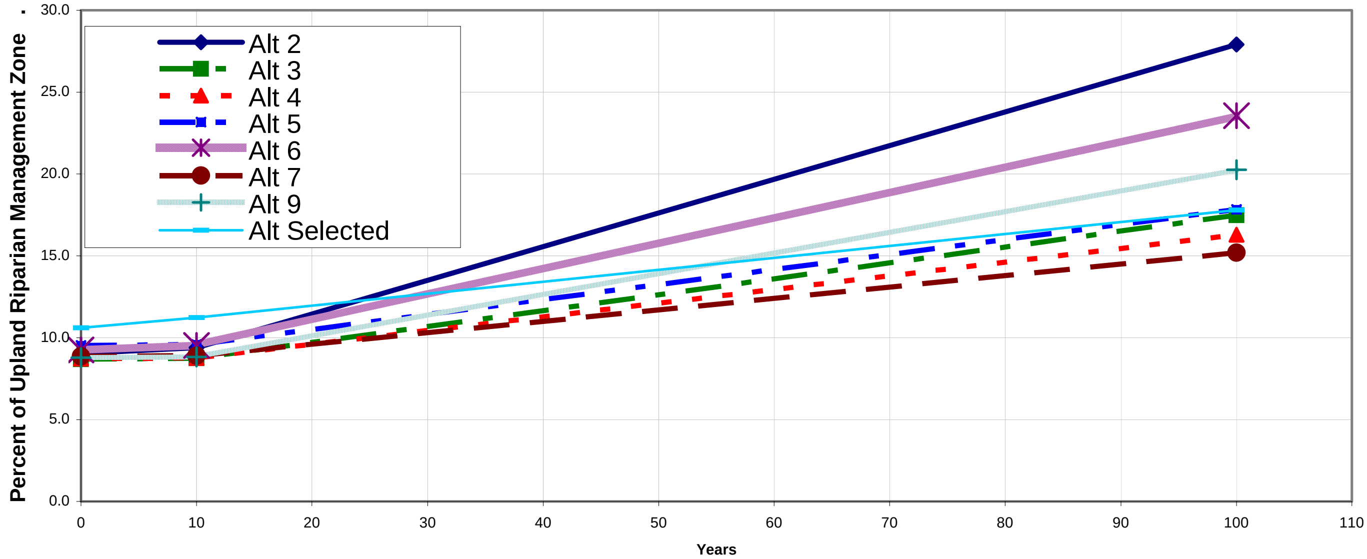

Figure 3-2. Long-Lived Conifer in Riparian Management Zones by Alternative (red pine, white pine, white spruce, hemlock)

All alternatives would have minimal effects on riparian forest in the first decade but would increase the proportion of long-lived trees in the upland portion of the RMZ over the long-term (i.e., 100 years)(Figure 3-2). Overall, Alternatives 2 and 6 would provide the best mix of long-lived conifer and hardwood.

Aspen Adjacent to Trout Streams

All alternatives include standards that prevent the regeneration of aspen patches along trout streams for the purpose of reducing beaver and trout conflicts over time. Alternative 1 restricts aspen regeneration within 200 and 300 feet of Class I and II trout streams on the Chequamegon and Nicolet Forests, respectively. Alternatives 2-9 and the Selected Alternative prohibit the regeneration of aspen patches with 450 feet of selected trout streams and their tributaries and within 300 feet of all other Class I and II trout streams and their tributaries. SPECTRUM modeling indicates that aspen stands within these zones will increase in age over the next 10 years in all alternatives, then convert to other species—mainly northern hardwoods and some conifers—within 100 years. All alternatives will have a minimal effect on beaver-trout interactions over the first decade but will significantly reduce beaver food adjacent to trout streams in the long run.

Erosion and Sedimentation

All alternatives include the use of Wisconsin's BMPs minimizing erosion and sedimentation near water bodies. The greatest risk for sedimentation occurs where skid trails and haul roads must cross streams or in steep terrain with high drainage densities and heavy soils. These risks can generally be minimized by limiting harvesting and hauling to periods when the ground is frozen and by using good erosion control practices such as water bars and re-vegetation. During Forest Plan implementation, site-specific environmental analyses will be conducted to determine where these mitigation measures are needed.

Water Temperature

Timber harvesting will have no direct effects on water temperature in any of the alternatives because BMPs will maintain stream surface shade where it exists and should lead to increased stream surface shade over time where it is inadequate adjacent to cool and cold-water streams. Not regenerating aspen adjacent to trout streams could indirectly improve water temperatures by reducing beaver colonization of those streams over time.

Effects on Riparian Vegetation resulting from Restoration Goals

Management Areas (MAs) 2B, 3B, 4B, and 4C were specifically developed to accomplish "ecosystem restoration" goals. The direction for the management of aquatics within these MAs is similar to other MAs. Forest wide Standards and Guidelines for riparian area management, roads, trails, and fish would be followed. Aquatic ecosystems within these areas could benefit from the increased emphasis on larger older tree species. Since timber harvest activities on northern hardwood sites in MA2B are restricted to periods when there are frozen ground conditions, there would be less potential for physical damage to vegetation near woodland ponds in those areas. Alternatives vary in allocation of MA2B from 454,000 acres in Alternative 3 to 23,000 acres in Alternative 2. MA2B and its restoration emphasis was not a part of the 1986 Forest Plans. The Selected Alternative allocated 209,000 acres of MA2B.

Effects on Aquatic Resources from Recommended Wilderness Study Areas and Semi-Primitive Non-Motorized (SPNM) areas

Wilderness and SPNM designations affect the type of recreational fishing opportunity available on the Forests. Lakes and streams within wilderness and SPNM areas offer a more remote fishing experience as well as carry-in type access. The most remote experiences would be found in the Wilderness (MA 5), Potential Wilderness (MA 5B) and SPNM low disturbance (MA 6A) areas where limited management activities occur.

People that prefer vehicle access to lakes would have fewer opportunities under all alternatives except Alternative 1. Those looking for a more remote fishing experience would have increased opportunities under Alternatives 2-9 and the Selected Alternative. Table 3-9 shows the range across the alternatives for the acres of lakes ≥ 10 acres and miles of perennial stream within MAs 5, 5B, 6A, 6B and within Non-Motorized Areas with Full Vegetation Management (sometimes called XX.0).

Table 3-9. Acres of lakes (>10 acres) and miles of perennial stream within Non-Motorized Areas.

Alternative	Lakes > 10 Acres (acres)	Perennial Stream (miles)
1	1,698	Approx. 100
2	3,937	128.2
3	5,252	272.2
4	6,064	273.5
5	4,633	144.1
6	5,366	149.5
7	5,545	180.9
9	5,011	185.8
SA	4,280	120.0

There would be limited opportunities for fisheries restoration or enhancement work in the Management Areas 5 and 5B. Only natural processes would occur. Opportunities to restore or enhance recreational fishing may be slightly affected particularly in the 6A, as the bodies of water may be more difficult to access. Fisheries management within the 6B and Non-motorized areas with full vegetation management would be similar to those activities found in other areas of the forests.

The effects of these designations on aquatic systems are minimal. Only natural processes are allowed to occur within MA 5 so there would be no effects from any management activities.

Management is allowed in varying degrees within MA 6B and Non-motorized with full vegetation management (XX.0) areas. Forest wide Standards and Guidelines would be followed for any management activities. Aquatic resources could benefit from the non-motorized designation particularly in the absence of motorized trails and a lower road density.

Effects on Aquatic Resources from Mineral Exploration and Development

The management of mineral resources does not vary by alternative. Forestwide Standards and Guidelines addressing the protection of aquatic resources would be followed for any mineral exploration or development. There is potential for effects on aquatic resources during leasable mineral development but site-specific environmental analyses will be conducted to determine where specific mitigation measures are needed.

Cumulative Effects

The cumulative effects analysis for aquatic resources will focus on the issues discussed under Direct and Indirect Effects. The cumulative effects area for this analysis covers the 41 different 5^{th} level watersheds that contain all or a portion of National Forest System lands administered by the Chequamegon-Nicolet National Forests. The Forests can have the greatest influence on those watersheds with a high percentage of National Forest land. National Forest (NF) ownership within the 41, 5^{th} level watersheds range from 0.59% to 79.4%. There are 17 watersheds with more than 25% NF ownership, 6 with 15-25% NF ownership, 11 with 5-15% and 7 with less than 5% ownership. The Forests could have significant influence on the conditions of the watersheds through direct management and collaboration within the 17 watersheds with greater than 25% National Forest ownership. Although 39 lakes that cover 14,741 acres within the National Forest boundary have been identified as impaired waters by the Wisconsin Department of Natural Resources, atmospheric deposition is considered the cause of impairment. Since traditional total maximum daily load allocations are not practical for impairments caused by atmospheric deposition, states and EPA are discussing a national strategy to reduce atmospheric deposition of mercury

Historical Context

Logging/Log Drives.

Some primary historical factors affecting area aquatic resources resulted from turn of the century logging practices. Some activities included massive deforestation, log drives, and fires. Large mature or old growth communities dominated pre-European settlement forests. Aquatic systems flowing through these areas were rich in large-woody debris and complex habitat. To move wood down the waterways, streams, and rivers were cleared of large woody debris and boulders that could impede the movement of logs and some sections were straightened to further facilitate log drives. The flush of water created extreme floods that scoured some stream banks and channels. These activities all tended to make channels wider, shallow, and less complex. The vegetation found within the riparian area changed dramatically during this period. Riparian areas were some of the first to be cut because of their proximity to water. Subsequent harvesting techniques up to the early 1980s continued to harvest next to many lakes, rivers, ponds, and streams. This resulted in most riparian areas dominated by younger forested systems. Because of these past activities many aquatic systems are more than 50 years behind in the recruitment of large woody debris.

Beaver also had significant influence on streams. Early logging greatly changed the relative dominance of early successional species. The aspen-birch type occupied a much smaller portion of the landscape than it does today. Aspen is a favorite food item of the beaver. In the early 1900s beaver populations were still recovering from the earlier fur trade. The combination of increased amounts of aspen and restrictive trapping regulations resulted in a massive beaver population growth during the 1960s, 1970s and 1980's. Beaver colonized many streams not recovered from the effects of log drives. Beaver activity helped to stagnate or even set back channel recovery in many stream systems. This was particularly evident in the headwaters of the coldwater systems.

Roads/Motorized Trails

Many of the roads within the area have been in place since the early logging era. Over the years, road mileage has increased, but often road systems are still based on roads located during the early logging era. Because of this, many roads are poorly located, have drainage problems, lack properly sized culverts, and result in significant impacts to aquatic resources. Some road/stream crossings that have been in place for over 20 years are now known to have washed out on an almost annual basis. As such, the road system has contributed to changes in drainage patterns, increased sediment load, fish passage problems, and loss of riparian habitat.

In addition to roads, motorized trails increased significantly over the last 20 years. Lands throughout northern Wisconsin, both within and outside National Forests, have seen large increases in recreational off-road vehicle use. These trails impact the same aquatic systems.

Development

Development played an important role in shaping aquatic shorelines since the turn of the century. Northwoods recreation is heavily dependant on water resources. The WDNR "Northern Initiatives" project identified the rapid rate of shoreline development as a major concern for lake resources (WDNR, 1996). Over the past 20 years in particular there has been a boom in shoreline development and loss of access to lakes for the public. Because undeveloped shoreline is becoming such a premium, lots are becoming smaller resulting in a higher density of homes per mile compared to 40 years ago. National Forests are more desirable for water-based activities because of an increase in developed shoreline.

Future Trends

A cumulative effects analysis requires that proposed actions be analyzed together with past actions and potential future activities both in the project area and outside the project area. Potential future activities for the watershed portion outside the Chequamegon-Nicolet National Forests are difficult to predict due to the geographic area and various ownerships. Some predictions can be made based on recent and current trends. It is highly likely that recreational use will continue to increase, including motorized off-road vehicles, and other recreational activities that occur within the riparian area. Non-federal ownership will continue to be fragmented into vacation properties. Most industrial forestlands will probably continue in forest management. Some private agricultural lands have been converted to other uses in recent years including parceling into vacation or hunting properties. Because of this increase in development, roads will continue to be built, particularly where land has been subdivided. Management of other agency lands such as county, state, and tribal, probably will not change much of what is presently occurring. It is likely that these areas will continue to be managed in ways similar to previous and current management.

Alternative 1 would represent the least amount of change in the management of aquatic resources. Despite this there would be some movement forward toward the restoration of aquatic resources. Forestry BMPs are not included in 1986 plans, therefore, water quality protection and riparian structure, function and composition restoration could not be assured. Aspen would continue to be discouraged along Class I and Class II trout streams, although the buffers would be smaller (200 and 300ft). Alternative 1 does not provide specific direction for addressing the adverse impacts from new and or existing road or motorized trail construction. Work has begun to reduce these effects, but without more specific plan direction, emphasis could not be assured.

This alternative offers no change over current conditions in terms of recreational emphasis. Motorized recreational vehicle use would continue to increase on the Chequamegon, including cross-country use. There would be no additional areas proposed for non-motorized recreational emphasis. Management under this alternative would probably be similar to management outside the Forests, and therefore would not offer much compensating management in terms of many aquatic concerns.

Alternatives 2-9 and the Selected Alternative would result in more change in the management of aquatic resources compared to the existing condition. An Aquatic Desired Condition would be in place, which would set the direction for aquatic resources. Forestwide Standards and Guidelines across the alternatives would set direction for protecting and enhancing water resources. Forestry BMPs would be used to protect water quality and help protect/restore/enhance riparian systems.

Sedimentation in aquatic systems would be reduced through the removal and/or repair of road/stream crossings, relocation of trails/roads, better road/trail design and the elimination of ATV cross-country use. This could be particularly important as areas outside the Forests continue to be developed and fragmented by roads.

Alternatives 2-9 and the Selected Alternative would designate substantially more acreage for non-motorized recreation emphasis, including proposed Wilderness. This in turn would increase the acreage of lakes and miles of stream available to the non-motorized user. The Forests already offer most of this type of management in the state. As lakes and streams come under increasing levels of development, these additional water bodies in a non-motorized setting could offer important recreational opportunities not available outside Forest boundaries. These areas could also offer refuge for aquatic dependent species potentially affected by high disturbance levels.

Alternatives 2-9 and the Selected Alternative would help find a solution to the aspen/beaver/trout conflict by increasing the width of area with no aspen regeneration next to selected class I and II trout streams. Although the amount of aspen within these areas would not change significantly within the first decade of planning, it sets the course for long-term recovery and maintenance of free-flowing streams.

Alternatives 2-9 and the Selected Alternative would have the most cumulative beneficial impact on those 5th level watersheds where NF ownership is greater than 25%, particularly the 10 that are greater than 40%. Urbanization near and adjacent to the forests can contribute significantly to cumulative watershed impacts. Those watersheds with less than 25% FS ownership could be at higher risk for degradation as a result of development occurring on private lands. Increased development has the potential to affect aquatic and riparian resources through increased runoff and pollutants from roads, driveways, and fertilized yards. Increased recreation can lead to increased trail density, trampling of riparian areas, and other activities threatening watershed health. These activities may limit management options in watersheds of mixed ownership where aquatic and riparian health is of concern.