3.14 WATER QUALITY

3.14.1 Summary

There may be some direct or indirect negative effects to water quality and watershed health in the analysis area including potential effects to downstream areas and stream reaches that occur within the BWCAW as a result of implementing any of the action alternatives. Potential short term negative effects associated with new temporary roads and stream crossings including point source erosion, run off, and stream flow and flood plain manipulation are expected to be minimal, especially in stream reaches and downstream areas that are not immediately adjacent to or near proposed temporary road and stream crossing sites. These effects are expected to be minimal because all operational standards and guidelines would be followed during project implementation. Alternative 4 would create the most temporary roads followed by Alternative 2 and then 3.

All action alternatives have the potential to directly benefit water quality and watershed health within the analysis area through stream crossing improvements on existing crossings. There are no new stream crossings proposed within one mile of the BWCAW boundary and thus no potential negative effects would occur in the BWCAW related to new stream crossings. The one new temporary stream crossing would follow Forest Plan direction for providing stream simulation through the crossing as well as aquatic organism passage. The three stream crossing improvements would provide benefits to aquatic organism passage and water quality by reducing the potential for passage barriers and impacts to aquatic habitat.

Estimated positive direct effects to aquatic resources include the management of riparian areas for extended rotation, long-lived conifer species, and/or increased basal area. Direct and indirect effects from planting and harvesting in these areas include providing shade and cover for aquatic organisms and increasing in-stream habitat complexity with future large woody debris recruitment. Vegetation management activities in individual watersheds do not result in reaching the 60 percent threshold for open and young forest and therefore would not adversely impact watershed health either inside or outside the BWCAW. The largest increase in open and young forest would occur in the South Kawishiwi River (Upper) watershed; from an existing 11 percent to a proposed 22 percent open and young forest. The largest open and young percentage of any watershed analyzed would be 43 percent (Madden Creek).

3.14.2 Introduction

Aquatic resources and water quality relate to one of the significant issues outlined in Chapter 1: vegetation management and associated roads relative to ecological integrity of the Boundary Waters Canoe Area Wilderness (BWCAW). The main area of potential effects are (1) the construction of new road/stream crossings that could produce barriers to aquatic organism passage or changes on aquatic habitat related to hydrologic alteration and (2) harvest that exceeds a threshold on a watershed level to produce altered hydrologic regimes and results in negative impacts to stream habitat.

3.14.3 Analysis Methods

Three indicators (miles of new road construction, number of new stream crossings, and proportion of upland open and upland young forest within each 6th level watershed) related to water quality and watershed health will be addressed in the analysis of effects of four alternatives associated with the Glacier Project Area. These indicators help to measure the potential direct, indirect, and cumulative

effects to water quality and watershed health at both the site specific and watershed-scale as a result of this project, including potential downstream effects to water quality within the BWCAW. These same indicators were also used to analyze potential effects in the Superior National Forest Land and Resource Management Plan FEIS (pages 3.6-1 – 3.6-60, USDA Forest Service 2004d).

Indicator 1: <u>Miles of new road construction</u>

Indicator 1 assesses the miles of new road construction, including temporary roads that are proposed within the Project Area for each alternative. Additionally, the total miles of new roads within one mile of the BWCAW boundary were analyzed for each alternative to evaluate potential effects to water quality and watershed health within the BWCAW. As a relative comparison among alternatives, this analysis provides a way of evaluating potential effects to water quality and watershed health within the BWCAW because potential effects from roads to perennial, intermittent, and ephemeral streams, wetlands, and other lowland areas that drain into the BWCAW may be observed up to one mile downstream from impacted areas (Verry et al. 2000).

Overall, indicator 1 does a good job of highlighting the differences among alternatives because it is reflective of potential soil disturbances, erosion, and point source sediment input into local streams as well as a measure of potential change to watershed, riparian, stream, and wetland hydrologic functions. If roads are not properly designed and constructed, they may affect watershed, riparian, stream, and wetland hydrologic functions such as reduced soil water infiltration, increased surface runoff, removal of streamside vegetation and riparian habitat, and disruption of natural wetland flow, respectively. A thorough description of potential geomorphic, hydrologic, aquatic habitat, and soil displacement effects from roads and trails is contained in the Superior National Forest Land and Resource Management Plan FEIS, pages 3.6-11-12 (USDA Forest Service 2004d). By following required guidelines, project design features and mitigation measures necessary to protect water quality and watershed health, these effects would be eliminated or substantially minimized.

Indicator 2: <u>Number of new stream crossings</u>

Indicator 2 assesses the number of new stream crossings resulting from building new temporary roads that are proposed within the project area for each alternative. Additionally, the number of new stream crossings within one mile of the BWCAW on streams that flow into the BWCAW and the total miles of stream channel that could potentially be affected by these stream crossings was evaluated for each alternative to determine potential effects to water quality and watershed health within the BWCAW. This additional analysis acknowledges that effects to water quality from new stream crossings, including inputs of sand and other fine sediments may be observed up to one mile downstream from new stream crossing sites (Verry et. al. 2000).

Overall, this indicator does a good job of highlighting differences among alternatives because it represents the potential effects to instream and riparian habitat, potential erosion and point source sediment input at stream crossing sites, as well as potential effects to stream flow, flood flow capacity, and sediment transport. Potential effects to watershed and stream flow conditions include unnaturally confined stream channels with increased flows, reduced stream flood flow capacity, and reduced floodplain function during high flow events. Additionally, this indicator is very useful for determining potential effects to aquatic organism passage and stream connectivity. Potential effects to aquatic organisms include reduced egg and juvenile survival resulting from point source sedimentation, degraded instream and riparian habitat, fish migration barriers, and loss of stream connectivity. These potential effects would potentially be observable at impacted sites as well as in

downstream areas, if proposed new temporary stream crossing construction activities were not properly designed and constructed. By following required guidelines, project design features and mitigation measures necessary to protect water quality and watershed health, these effects would be eliminated or substantially minimized.

Indicator 3: Proportion of upland open and upland young forest within each 6th level watershed

Indicator 3 assesses the proportion of upland open and upland young forest within each 6th level watershed that occurs within or intersects the Glacier Project Area. This includes portions of those watersheds that occur within the BWCAW. The indicator was chosen for the analysis because potential effects associated with vegetation management and other activities associated with each alternative should be evident at the watershed scale. A proportion of upland open and upland young forest (<16 years old) of less than 60% of a 6th level watershed is considered acceptable to protect water quality and watershed health (see Forest Plan p. 2-13, S-WS-1). This indicator can assess direct and indirect effects from vegetation management proposed in the Glacier Project as well as cumulative effects when other vegetation management projects are considered. Indicator 3 assesses all ownerships.

This indicator and current condition information were also used during the 2004 Forest Plan revision and analysis process (USDA Forest Service 2004d, USDA Forest Service 2004b). The proportion of upland open and upland young forest within 6th level watersheds influences the hydrologic function of watersheds in several ways. In recently harvested or open areas, transpiration and evaporation losses are low because of low leaf area and soils are wet thus there is more water available for streamflow and in groundwater that has the potential to contribute to increased water yield and peak flows; in addition, changes in forest vegetation cover from a mature forested area to young forest or open areas can cause snow to melt faster and rainfall to reach streams faster (Verry et al. 2000).

Table 3.14-1 displays the amount of upland open and upland young forest for the portion of each watershed within the Glacier Project Area. Results from the analysis of effects for 6th level watersheds that occur predominantly within the project area may be more reliable than those results for watersheds that occur predominantly outside of the project area.

A conservative assumption of calculating the amount of upland open and upland young forest was made as if the Glacier project and projects considered under cumulative effects were fully implemented by 2014. In fact, implementation would take place over a longer period and thus effects would be less than what are disclosed in this analysis.

Data Sources

Upland Areas

The estimation of upland area was based upon a combination of sources. Available stand data was used for Superior National Forest owned land outside of the BWCAW and where available for State and County land. A thematic mapper (interpretation from aerial photos developed for the State of Minnesota) was used for land within the BWCA, private land, and other land where stand coverage was not available.

Open Areas

'Open areas' were determined using the thematic mapper (TM) as classified for the State of Minnesota in 1995. This coverage includes classifications such as 'agriculture, roads, etc. that were considered open areas. Open areas were not 'aged' and were considered to remain open once identified.

Upland Young

The estimation of upland area was based upon a combination of available sources. Stand data was used for NFS land outside of the BWCAW and where available for State and County land. Information from the 1999 blowdown area and areas of severe fires were also used. In addition, photo interpretation was used to supplement existing stand data to estimate the age of stands. Data was aged accordingly to 2008 to estimate existing conditions.

The compilation of available data sets described above provides the most current and reliable information available for the Glacier Indicator 3 analysis.

3.14.4 Analysis Area

Indicator 1: Miles of new road

The analysis area for direct, indirect and cumulative effects includes the new system and temporary roads within the project area and includes the area within one mile of the new roads. The analysis area can extend up to 1 mile outside the project area if roads are built within one mile of the project area boundary. A map of the analysis area is available in the project record. This analysis area was chosen because effects to water quality and watershed health from routes are evident and relevant within 1 mile or less of the route (Verry et. al. 2000).

Indicator 2: New stream crossings

The analysis area for direct, indirect and cumulative effects for indicator 2 includes one mile downstream of the new stream crossing within the project area. This includes stream reaches within the project area and outside the project area. No new stream crossings are proposed within one mile of the BWCAW and therefore, new stream crossings will not have any impact on water quality in the wilderness. This analysis area was chosen because effects to water quality from stream crossings, including inputs of fine sediments, may be observed up to one mile downstream from stream crossing sites (Verry et. al. 2000).

Indicator 3: Proportion of upland open and upland young forest within each watershed

The analysis area for direct, indirect and cumulative effects for Indicator 3 includes all 6th level watersheds that occur within or intersect the Glacier Project Area, including those watersheds that extend into the BWCAW. The analysis area was chosen because potential effects from vegetation management and other activities associated with each alternative should be evident at the watershed scale.

The analysis area and general flow patterns for the HUC5 and HUC6 order watersheds are shown in Figures 3.14-1 and 3.14-2, respectively.

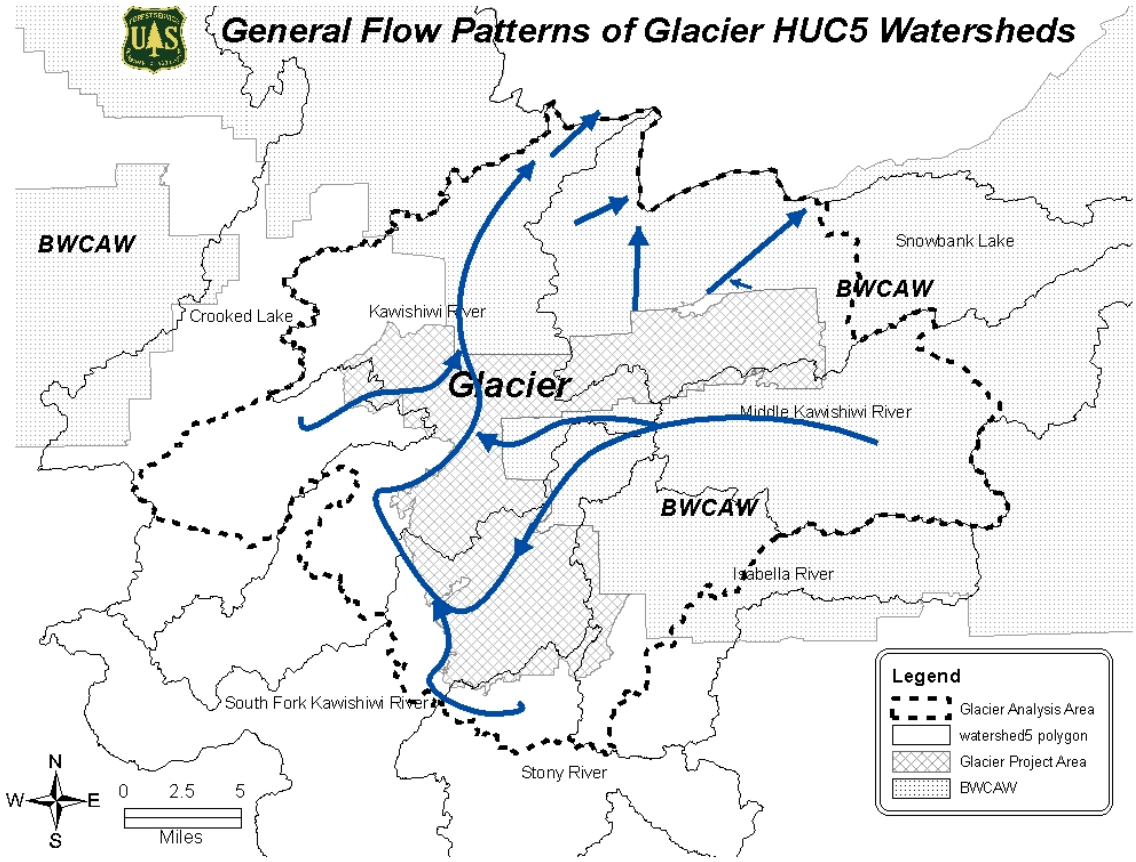

Figure 3.14-1 General Flow Pattern of Glacier HUC5 Watersheds

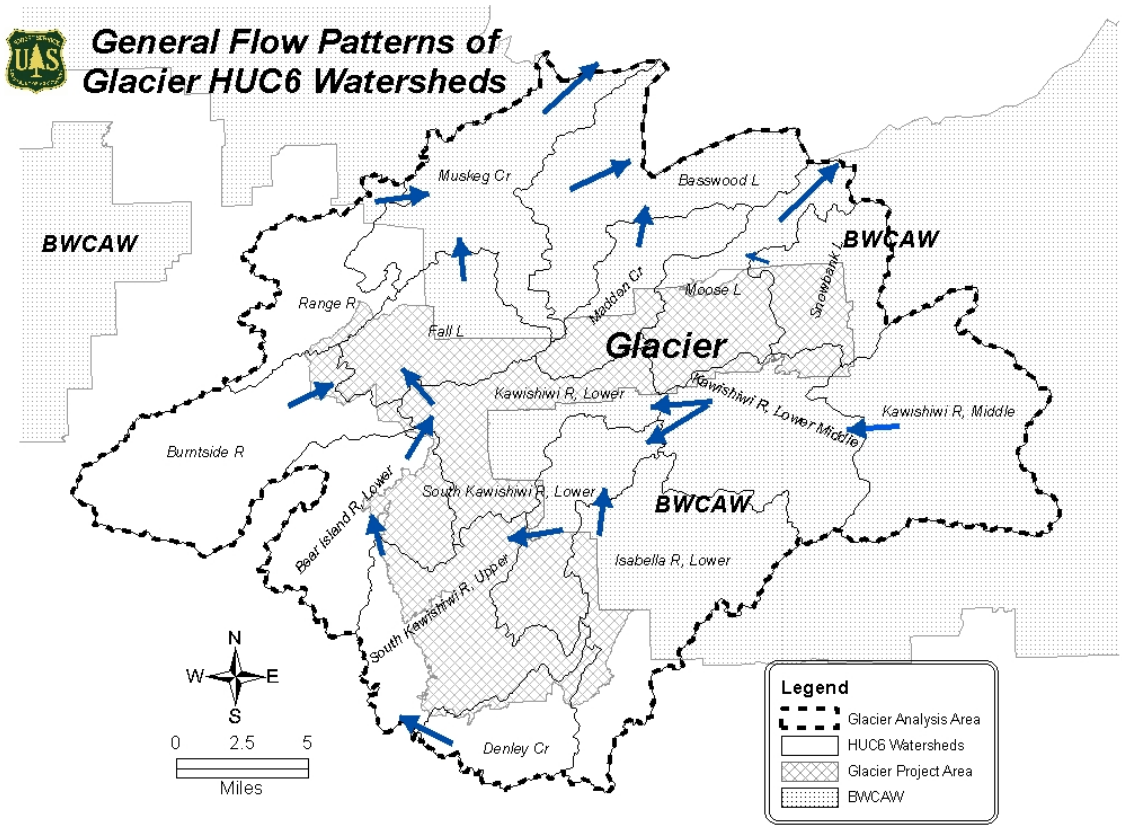

Figure 3.14-2 General Flow Pattern of Glacier HUC6 Watersheds

The timescale selected for the direct, indirect and cumulative effects for all three indicators is 20 years because effects from road construction, stream crossings, and vegetative management may be observable for many years following the initial impact of a particular activity. In the Superior National Forest Land and Resource Management Plan FEIS, page 3.6-6, a timescale of 10-20 years was selected for the same indicators (USDA Forest Service 2004d). Note that for Indicator 3, a conservative analysis point of 2014 is used as explained in the analysis methods section.

3.14.5 Affected Environment

A watershed is defined as the area from which all surface water drains to a common point, commonly thought of as the area that drains water into a given lake or stream (Forest Plan Glossary-30). The mapping system for watersheds consists of multiple levels. These levels are described in detail in the Forest Plan FEIS pages 3.6-1 -3.6-2.

There is one 4th order watershed that drains the Glacier Project Area, the Rainy River drains to the north and east into Lake of the Woods. Within this larger 4th level watershed, there are 16 6th level sub-watersheds that intersect the project area.

The Glacier Project Area (outside of the BWCAW) has been historically subject to road building and decommissioning, timber harvest, prescribed fire, and developments (such as campgrounds, resorts,

businesses, and private dwellings). These activities are anticipated to continue in the future. Nonetheless, water quality and watershed health are considered high (see Indicator 3 below) and the area is a forested environment with some development and roads.

Inside the BWCAW, timber harvest, road construction and use of wheeled motor vehicles have been prohibited since the BWCA Wilderness Act of 1978. Vegetative cover and an absence of mechanized disturbance to land contribute to high water quality and watershed health in the BWCAW. The waters in the BWCAW are classified as Outstanding Resource Value Waters by the State of Minnesota (BWCAW Fuel Treatment FEIS page 3.6-8).

Indicator 1: Miles of new road construction

There are currently 305 miles of existing classified roads, temporary roads, non-jurisdictional roads, unclassified roads, and special use roads within the Glacier Project Area. Of the 305 miles of existing roads that occur within the project area, 44 miles of system, non-jurisdictional, and temporary roads occur within 1 mile of the BWCAW boundary. Existing roads and routes have been and are currently maintained at various levels for different uses and transportation needs as a result of historical or more recent road management decisions.

Indicator 2: Number of stream crossings

There are currently 79 stream crossings within the Glacier Project Area. Of these crossings, two occur within one mile of the BWCAW and are on streams that flow into the BWCAW. One stream crossing is for a special use road and the other is a winter use road. Neither is open for public use nor would they be used to implement any actions in the Glacier Project. Stream crossings occur on different types of roads including classified all season, seasonal, and winter roads, non-jurisdictional drivable roads, and system trails. Winter road and snowmobile trail crossings of smaller streams typically do not include the installation of roadfill or a culvert as vehicles simply cross on the ice without damage to the resource. Winter roads and roads closed to public motorized use are not likely to have road erosion issues since they are used in frozen soil conditions and used very infrequently for administrative purposes. Beginning in 2002, the Superior National Forest has surveyed the condition of stream crossings on 975 sites in all major project areas within the Forest (including 42 crossing surveys in the Glacier Project Area in 2006). This work has focused on crossings of larger streams and on larger / more heavily traveled roads because of the larger potential for impact to water resources. Based upon this work, it was found that approximately 80% do not have erosion issues and 84% do not pose aquatic organism passage issues. Based on the surveys of road crossings within the Glacier Project Area, a prioritized list was recommended for rehabilitation, three of which are considered high priority and are included in this project proposal. All replaced crossings are installed to be consistent with Forest Plan standards and guidelines.

Indicator 3: Proportion of upland open and upland young forest within each watershed

In 2007, a preliminary Watershed Analysis and Resource Report was completed for the project area. The resource report concluded that the existing condition of all 6th level watersheds that intersected the project area was well within Forest Plan desired conditions and in particular S-WS-1 (Forest Plan page 2-13) for vegetative cover and age at the watershed scale (Table 3.14-1; Glacier Watershed Resource Report, 2007, project file). All or parts of sixteen watersheds intersect the Glacier Project Area. The area drains into one major drainage, the Rainy River Watershed. The Glacier Project Area represents less than ten percent of the total area of six of these watersheds; as a result the

assessment is focused on the remaining ten watersheds, which together comprise ninety-four percent of the Glacier Project Area.

The watersheds in the analysis area are largely headwater lake and stream environments for the Rainy River Basin. As such, they are dominated by lakes and wetlands. The sixty percent threshold for combined upland open and upland young forest is relevant as a cumulative effects indicator only for watersheds that contain less than forty percent of the area in wetland (wetland+lowland+water landtype). Out of the remaining ten watersheds mentioned above, three have forty percent or more wetland landtype and are excluded from further analysis. Similarly, a number of watersheds are partly inside the BWCAW; of these, nine are excluded on the basis of the portion of watershed being greater than forty percent wilderness (i.e., since no management would take place in the wilderness to convert to a young and open state, the remaining portion of watershed outside the wilderness cannot exceed the sixty percent threshold). The existing condition of the five remaining watersheds (those not eliminated above) is well within acceptable limits as defined by the sixty percent threshold for combined upland open plus upland young forest. The portion of each watershed in this condition ranges from a high of twenty-one percent (Lower Bear Island River Watershed) to a low of six percent (Lower Kawishiwi River Watershed).

3.14.6 Environmental Consequences

This section evaluates the potential impacts to water quality and watershed health based on proposed actions. It is important to emphasize that potential direct and indirect effects to water quality and watershed health are expected to be minimal if not completely avoided by following all required guidelines, project design features, and mitigation measures during and after project implementation. This expectation is supported by monitoring data gathered by the Superior NF and partners (see Design Features and Mitigation Measures as well as Monitoring and Compliance below).

Design Features and Mitigation Measures

During development of the Glacier Project, the interdisciplinary team, including watershed and fisheries specialists, cooperated in developing design features and mitigation measures that were necessary to avoid or minimize adverse effects to water quality and watershed health during project implementation. All alternatives would follow applicable Minnesota Forest Resources Council (MFRC) Voluntary Site-Level Forest Management Guidelines (MFRC 2005) as well as required Operational Standards and Guidelines contained in the Appendices B and E of the EIS. All applicable Forest-wide desired conditions, objectives, standards and guidelines contained in the Superior National Forest Land and Resource Management Plan would be followed during project implementation. Applicable Forest Plan desired conditions, objectives, standards and guidelines include, but are not limited to those established for: 1) Watershed Health, Riparian Areas, and Soil Resources, 2) Terrestrial and Aquatic Wildlife; and 3) Transportation System (USDA Forest Service 2004b; see especially pp. 2-10 to 2-18 and pp. 2-47 to 2-50).

Monitoring and Compliance

Based upon recent Forest Plan monitoring information collected by the Superior National Forest (2004-2006) and the Minnesota Forest Resource Council (2000-2002 vs. 2004-2006), there is evidence that MFRC Voluntary Site Level Forest Management Guidelines, Forest Plan Standards and Guidelines, project area design features and mitigation measures have been successfully

implemented to help protect water quality and watershed health. Furthermore, there is evidence that these mitigation measures are effective at reducing impacts to water quality and watershed health. This is not only occurring on the Superior National Forest but also across the State of Minnesota.

Timber Sales

In 2005, the results from cooperative MFRC/SNF compliance monitoring at five sites on the Superior National Forest indicated that Fiscal Year 2004 and 2005 timber sales demonstrated consistent and effective use of appropriate best management practices (BMPs) (Fiscal Year 2005 Monitoring and Evaluation Report, p. 25, USDA Forest Service February 2007). The results from the 2005 Monitoring Report are summarized below:

1. Exposed soil over more than five percent of the area, erosion, and rutting deeper than 6 inches in filter strips did not occur at any site;
2. Wetland skid trail crossing impacts did not occur at three of five sites; at two sites a skid trail crossed a wetland during unfrozen ground conditions, resulting in some rutting but no erosion;
3. At four of five sites post operation skid trail re-vegetation exceeded 50 percent, there was not rutting deeper than six inches, and no erosion; at one site a small amount of skid trail erosion was observed in one wetland;
4. Water diversions on roads and skid trails were not needed at four of five sites;
5. No evidence of petroleum-based spillage at four of five sites, one small spot of oil observed at one site, no logging trash was observed at any of the five sites;
6. Four of five landing sites were exclusively upland; one landing was partially located in a wetland and a filter strip;
7. No erosion or repeated rutting deeper than six inches was observed at any of the landings or over the harvest sites in general.

In 2006, MFRC monitoring of Fiscal Year 2006 timber sales on the Superior National Forest also indicated good use of appropriate BMPs (Fiscal Year 2006 Superior National Forest Monitoring and Evaluation Report, page 11, USDA Forest Service 2008). The findings indicated a continuation of high level of compliance and effectiveness for reducing impacts as documented in audit results from previous years. The results from monitoring at four sites on the Forest were as follows:

1. Water quality evaluations were performed for projects near or including a total of 22 wetlands/water bodies.
2. Rutting was either not evident in or impacted less than two to five percent of wetland areas for all sites monitored.
3. No bare soil, erosion, or rutting was observed in any filter strips.
4. The main skid trails were all more than 50 percent vegetated.
5. Erosion was only reaching one (a non-open water system) of 22 wetlands monitored in 2006.

6. There was no evidence of equipment fueling and maintenance or spills at any of the sites.
7. Between two to five logs per acre of coarse woody debris was left on all sites.
8. Slash was present in non-open water wetlands at two of the four sites.

Overall, statewide implementation and effectiveness of Voluntary Site Level Forest Management Guidelines in Minnesota has been very good although there is still a need for County, State, Federal, and private forest land managers to improve some erosion control practices (Richard Dahlman, Minnesota Department of Natural Resources, pers. com; Minnesota Department of Natural Resources 2008, Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Minnesota, Monitoring for Implementation, 2004, 2005, 2006 Results Compared to Baseline Monitoring Report). Highlights from the 2008 MNDNR Report which compared monitoring results for 2004-2006 to 2000-2002 (years before MFRC guidelines were implemented) are summarized below:

1. Landowners and logger followed filter strip guidelines very well.
2. Compliance with riparian management zone guidelines decreased slightly between the two periods.
3. Rutting was evident in non-open water wetlands but did not disrupt hydrology.
4. Some road and skid trail stream and wetland crossings lacked adequate erosion control measures. There was a need identified to improve training for loggers, natural resource professionals, and private land owners.
5. Landings were generally in good condition and were located away from filter strips, riparian management zones, and wetlands.
6. Most road and skid trail locations were within slope recommendations.
7. Although there was an increase in skid trail erosion, there was no corresponding increase in sediment reaching wetlands or other water bodies.

Road Decommissioning and Stream Crossings

Monitoring and evaluation of road decommissioning and stream crossing improvements on the Forest has shown successful implementation of appropriate BMPs and design features to improve water quality, watershed health and aquatic organism passage. Long term monitoring of road decommissioning projects on the Kawishiwi Ranger District indicates that removal of drainage structures, ruts and berms, reshaping and re-contouring, seeding and mulching, drainage control, and road blockage have been successful (2005 Monitoring and Evaluation Report, USDA Forest Service 2007). Monitoring and evaluation surveys conducted at seven stream crossing sites on six streams in 2006, indicated the stream crossing improvement projects completed in 2004 and 2005 were successfully improving water quality, watershed health and aquatic organism passage (2006 Monitoring and Evaluation Report, USDA Forest Service 2008; Ken Gebhardt, Fisheries Biologist, personal communication). Furthermore, in 2008, electrofish surveys occurred at seven stream crossing improvement sites on the Forest to document movement of fish through newly constructed stream crossings. Brook trout had successfully swam through two stream crossing structures on the

Kadunce River (Ken Gebhardt, Fisheries Biologist, personal communication). Successful movement of all fish species is expected to occur with stream simulation culvert designs that would be planned and implemented.

New stream crossings that would be completed for the Glacier Project would meet the design standards of the stream crossing improvements discussed above.

Picture 1. Example of stream crossing meeting current design standards. Inga Creek, Superior NF

Conclusion on Monitoring and Compliance

The above monitoring shows that mitigation measures on National Forest, state, county and private land have been consistently applied and are effective at reducing impacts to water quality and watershed health. This is further supported by auditing of Minnesota BMPs on federal, state, county and private land that have shown the BMPs to be effective at protecting water quality in 99 percent of situations when correctly applied (US EPA 1994). Mitigation measures derived from the 2004 Forest Plan as well as State of Minnesota BMPs have been updated based upon additional technical information and monitoring results since this study occurred (personal communication, Marty Rye, Forest Hydrologist).

Possible Effects with Mitigation Measures

While effects would be greatly reduced, it is still possible that there would be minimal effects after the application of mitigation measures discussed above. These effects could include:

1. Minor sediment input may occur at stream crossing construction sites during initial site preparation. These impacts would occur at a very small scale.
2. Grubbing and clearing activities near road stream crossing construction sites may inadvertently contribute fine sediment and other debris into local stream channels.
3. The use of temporary winter roads on “frozen ground” conditions may compact wetland and riparian vegetation near lakes, streams, and wetlands. This could potentially affect stream, lake and wetland shoreline habitats.
4. The use of temporary winter roads during “frozen ground” conditions may contribute to minor sediment input at stream crossing sites when machinery crosses with dirty tracks, treads, or wheels. Minor sediment input into local stream channels may occur as a result.

5. The use of temporary winter roads on "frozen ground" conditions across wetlands may temporarily affect surface flow of water in wetlands due to ice and snow compaction.

3.14.6.1 Direct and Indirect Effects

This effects analysis is based on assumptions that the project follows applicable Minnesota Forest Resource Council (MFRC) site level guidelines, Forest Plan direction (specifically listed in the Glacier Water Resource Report), as well as required design features and mitigation measures contained within the Glacier Project.

Alternative 1 (No-action)

Indicator 1: Miles of new road construction

Alternative 1 would maintain the existing road transportation system within the Glacier Project Area. No new system or temporary roads would be constructed. As a result, there would be no increased potential for negative effects to water quality or watershed health (Table 3.14-2).

Effects to BWCAW

Alternative 1 would also maintain the existing road transportation system within one mile of the BWCAW boundary. No new system or temporary roads would be constructed. As a result, there would be no increased potential for negative effects to water quality or watershed health within the BWCAW (Table 3.14-3).

Indicator 2: Number of new stream crossings

Alternative 1 would maintain all existing stream crossings within the Glacier Project Area; no new stream crossings would be constructed (Table 3.14-4). As a result, there would be no increased potential for sediment input at new stream crossing construction sites that could potentially affect water quality and watershed health.

Alternative 1 would not contribute to improvement of existing conditions including erosion and sediment input and aquatic organism passage issues at stream crossing sites because no stream crossing improvements would occur (Table 3.14-4). Adequate fish and other aquatic organism passage and connectivity would continue to be a concern at some crossing sites. For Indicator 2, potential negative effects to water quality and watershed health conditions would continue across the entire analysis area because no stream crossing improvements would occur.

Effects to BWCAW

Alternative 1 would also maintain the existing number of stream crossings within one mile of the BWCAW on those streams that flow into the BWCAW. As a result, there would be no increased potential for negative effects to water quality and watershed health within the BWCAW as a result of implementing this alternative. The existing 2 crossings within one mile of the BWCAW would potentially continue to affect 1.58 miles of stream channel and habitat within the BWCAW.

Indicator 3: Proportion of upland open and upland young forest within each 6th level watershed

As displayed in Table 3.14-1 and Figure 3.14-3, all watersheds are under the 60 percent benchmark in the existing condition. Under the no action alternative, there would be no additional young forest created *by vegetation management*. Some existing young stands would grow out of the young age class by 2014. The results of this analysis presented in Table 3.14-1. includes considerations for activities by the USFS (including Echo Trail, Tomahawk, and Dunka projects), the State of Minnesota, and the Counties. Water quality and watershed health, as measured by Indicator 3, is high under the existing condition and these effects apply to both the BWCAW and the rest of the analysis area (see section 3.14.4).

Table 3.14-1: Results of Indicator 3 - Percent Watershed Young and Open Upland

Watershed Identification		General Watershed Data					Existing Condition (2008)		Alternative No. 1 (2014)		Alternative No. 2 (2014)		Alternative No. 3 (2014)		Alternative No. 4 (2014)	
Watershed ID Code (HUC6)	Watershed Name	Total Watershed Area (acres)	Portion of Watershed Within BWCAW (acres)	*Percentage* of Watershed Within BWCAW	Portion of Watershed Area Considered Upland (acres)	*Percentage* of Watershed that is Upland (%)	Portion of Upland Area that is Young and Open in 2008 (acres)	Percentage of Watershed that is Young and Open Upland in 2008 (%)	Upland Young and Open (Acres)	Upland Young and Open (%)	Upland Young and Open (Acres)	Upland Young and Open (%)	Upland Young and Open (Acres)	Upland Young and Open (%)	Upland Young and Open (Acres)	Upland Young and Open (%)
090300011002	Basswood L	25,268	25,260	100%	12,919	51%	8,102	32%	8,077	32%	8,077	32%	8,077	32%	8,077	32%
090300010903	Bear Island R, Lower	21,645	0	0%	13,272	61%	4,667	22%	4,579	21%	4,988	23%	4,998	23%	4,988	23%
090300011004	Burntside R	29,880	0	0%	21,206	71%	6,065	20%	5,371	18%	5,371	18%	5,371	18%	5,386	18%
090300010407	Denley Cr	11,413	0	0%	8,409	74%	1,550	14%	1,821	16%	2,250	20%	2,181	19%	2,250	20%
090300011005	Fall L	17,538	6,432	37%	11,332	65%	3,375	19%	3,206	18%	3,530	20%	3,318	19%	3,754	21%
090300010705	Isabella R, Lower	34,348	23,102	67%	22,379	65%	2,071	6%	2,418	7%	3,508	10%	3,389	10%	3,508	10%
090300010904	Kawishiwi R, Lower	21,594	6,613	31%	14,129	65%	2,919	14%	2,677	12%	3,066	14%	2,961	14%	3,091	14%
090300010508	Kawishiwi R, Lower Middle	25,290	22,902	91%	16,331	65%	1,154	5%	1,126	4%	1,148	5%	1,148	5%	1,174	5%
090300010507	Kawishiwi R, Middle	34,890	34,733	100%	24,786	71%	1,551	4%	1,546	4%	1,546	4%	1,546	4%	1,546	4%
090300011001	Madden Cr	13,300	8,166	61%	8,812	66%	5,190	39%	5,167	39%	5,587	42%	5,440	41%	5,771	43%
090300010304	Moose L	17,364	6,939	40%	11,204	65%	4,824	28%	4,737	27%	5,078	29%	5,385	31%	5,526	32%
090300011007	Muskeg Cr	26,323	22,968	87%	15,198	58%	4,478	17%	4,466	17%	4,926	19%	4,926	19%	4,942	19%
090300011006	Range R	15,494	1,312	8%	11,676	75%	3,049	20%	3,013	19%	3,870	25%	3,870	25%	3,870	25%
090300010303	Snowbank L	14,691	8,480	58%	7,922	54%	3,900	27%	3,953	27%	3,996	27%	4,065	28%	4,175	28%
090300010804	South Kawishiwi R, Lower	15,528	8,197	53%	10,618	68%	678	4%	834	5%	1,469	9%	1,265	8%	1,469	9%
090300010805	South Kawishiwi R, Upper	25,605	0	0%	18,289	71%	2,799	11%	3,148	12%	5,586	22%	4,562	18%	5,586	22%

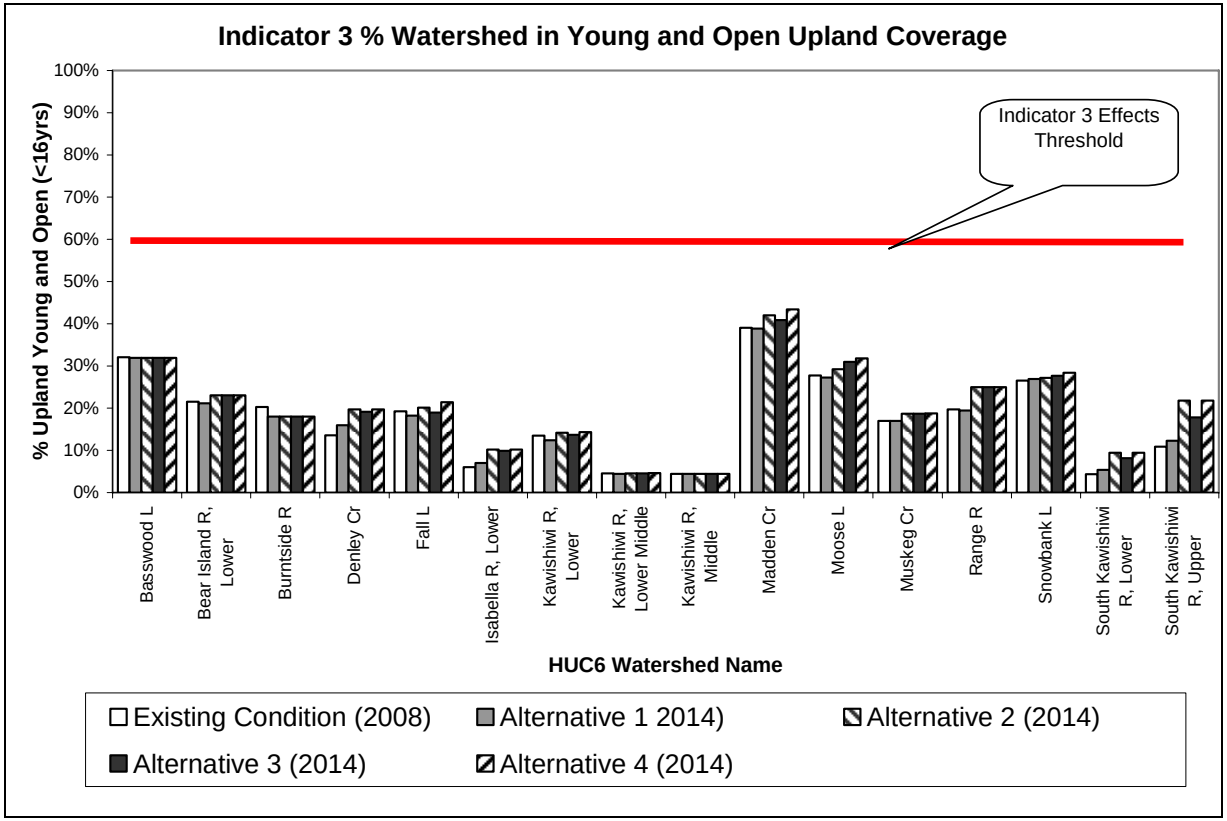

Figure 3.14-3: Indicator 3 – Percent Watershed in Young and Open Upland Coverage

Direct and Indirect Effects Common to All Action Alternatives (Alternatives 2, 3, and 4)

<u>Indicator 1: Miles of new road</u>

Alternatives 2, 3, and 4 each propose new system and temporary road miles within the project area (Table 3.14-2). This is also evident when looking specifically at areas within one mile of the BWCAW (Table 3.14-3). Depending upon the alternative and miles of new temporary road, the construction and use of these roads has the potential to increase short-term soil disturbances, soil erosion, and point source sediment inputs into local streams in the analysis area, including stream reaches one half to one mile downstream in the BWCAW. However, by following required guidelines, project design features, and mitigation measures, effects are expected to be minimal. Under all alternatives, newly constructed temporary roads would be decommissioned after all use is completed (USDA Forest Service 2004d p. F-9).

As discussed and evidenced above, there would be few, if any anticipated negative effects to water quality and watershed health within the analysis area, including the relevant portion of the BWCAW, from proposed new temporary winter roads because they would be designed, constructed, and used following appropriate design criteria and mitigation measures. Typically, these roads are specifically designed to reduce impacts to soils, streams, and wetlands by providing over-the-snow or ice travel for logging equipment during the winter. The use of winter roads provides for greater protection to water quality and watershed health than roads that allow use outside of "frozen" conditions since travel over ice or snow has far less chance to create erosion or contribute sediment to receiving water bodies. A substantial majority of the proposed new roads under the action alternatives are temporary winter roads. There may be some short-term disturbances to riparian vegetation within project area sites that are not protected by snow. Negative impacts to water quality and watershed conditions within the analysis area from the use of temporary winter roads, including downstream reaches within the BWCAW, are not anticipated since that use is restricted to "frozen" conditions.

While effects would be minor, the greatest degree of effects from new roads to water quality and watershed health would occur under Alternative 4, followed by Alternative 2 and finally Alternative 3 when considered across the entire Analysis Area (Table 3.14-2).

Table 3.14-2. Miles of New Road by Alternative.

Road Type	**Alt. 1** (no action)	**Alt. 2**	**Alt. 3**	**Alt. 4**
New System Roads[1]	0	1.0	1.0	1.0
Add existing road to the system	0	0.6	0.6	0.6
Total New Roads		**1.6**	**1.6**	**1.6**
New Temporary Roads	0	16	11	16
Previously Used Temporary Roads	0	28	22	29
Total Temporary Roads	**0**	**44**	**33**	**45**

1 The project proposes to construct 0.2 miles of new road to access Smitty's Resport. The existing 0.2 miles of road would be decommissioned. The decrease in miles is not represented in the table. And 0.8 miles of new winter road would be added to give access to State of Minnesota lands.

Effects to BWCAW

Table 3.14-3 shows there would be temporary roads within one mile of the wilderness boundary. Alternative 4 would have the greatest degree of potential effects from temporary roads to water quality and watershed health, followed by Alternative 2, and then Alternative 3. Note that no treatments are proposed inside the BWCAW and potential effects to the BWCAW are indirect effects produced by actions outside the BWCAW. Potential effects on aquatic organisms within the BWCAW would also be indirect in nature. Since aquatic organisms can respond to changes in watershed health, there may be effects to aquatic organisms within the BWCAW; however, those effects would be minor and not unlike a response to a natural disturbance such as a large rain event or beaver dam failure. Similar to findings in the Biological Evaluation for the Glacier Project, these disturbances may impact individuals but would not cause a loss of species or population viability.

Table 3.14-3. New Roads Within 1 Mile of the BWCAW Boundary By Alternative.

Road Type	**Alt. 1** (no action)	**Alt. 2**	**Alt. 3**	**Alt. 4**
Previously used Temporary Roads	0	5.6	3.4	7.7
New Temporary Roads	0.0	2.7	0.4	2.7
Total Temporary Roads		**8.3**	**3.8**	**10.4**

Indicator 2: New stream crossings

Table 3.14-4 shows there would be one new temporary road stream crossing under Alternatives 2, 3, and 4. The stream crossing would be on Madden Creek and would provide access to units northwest of Greenstone Lake. Under Alternatives 2 and 4, the harvest would occur in winter. Under all alternatives, temporary roads and associated stream crossings would be decommissioned after all use is completed (USDA Forest Service 2004d p. F-9). There may be some short-term negative effects to both local and downstream reaches, resulting from point source erosion, sediment input, and stream flow manipulation. However, stream crossings would be designed and constructed properly following required guidelines, project design features, and mitigation measures and effects would be minimal, if any. Possible effects after mitigation measures are applied include minor contributions of sediment to streams during initial site preparation.

There would be few, if any anticipated negative effects to water quality and watershed health in the analysis area, including relevant portions of the BWCAW, from proposed new temporary winter road stream crossings because they would be designed, constructed, and used following appropriate design criteria and mitigation measures. Typically, new temporary winter roads and associated crossings are specifically designed to reduce impacts to soils, streams, and wetlands by providing over-the-snow or ice travel for logging equipment during the winter. There may be some short-term disturbances to riparian vegetation within the project area that is not protected by snow. Negative impacts to water quality and watershed conditions at both the site specific and watershed scale are not anticipated because use would be restricted to “frozen” conditions.

Alternatives 2, 3, and 4 also propose to improve 3 road stream crossings within the project. This activity has the potential to improve water quality and watershed conditions within the analysis area as well as improve aquatic organism passage. Potential water quality improvements include reduced

point source erosion and sediment input at existing stream crossing sites. Improvements to watershed conditions include improving natural stream flow conditions, flood flow capacity, and floodplain function as well as sediment transport. Benefits to aquatic organisms include improved egg and juvenile survival, aquatic organism passage, and stream connectivity. Alternatives 2, 3, and 4 would improve the same number of road stream crossings and thus have the same benefit to water quality and watershed health in this regard.

Table 3.14-4. New Stream Crossings and Stream Crossing Improvements.

	Alt. 1 (no action)	Alt. 2	Alt. 3	Alt. 4
New Stream Crossings on Existing Temporary Roads	0	1	1	1
Stream Crossing Improvements	0	3	3	3

Effects to BWCAW

There are no new stream crossings proposed for any action alternative within one mile of the BWCAW and therefore, the project would not have any affect on water quality in the wilderness resulting from new stream crossings.

Indicator 3: Proportion of upland open and upland young forest within each 6th level watershed

There are 16 6th level watersheds occurring within or intersecting the Glacier Project Area that comprise the analysis area for Indicator 3 (Tables 3.14-1 and 3.14-5). These watersheds range in size from 11,408 to 34,348 acres and are composed of between 25 and 46 percent wetland, lowland, and water (Table 3.14-1). Seven of these watersheds have greater than 40 percent of their area within the BWCAW where no management activities occur (Table 3.14-1). Six of the 16 watersheds have more than 10 percent of their area inside the Glacier Project Area boundary (Table 3.14-5).

Based on a review and analysis of existing conditions, which reflects all past vegetative management activities within the project area, as well as those conditions that would result from full implementation of Alternatives 2, 3, and 4; there are no watersheds within or intersecting the Glacier Project Area that currently or would potentially exceed the 60 percent threshold (Table 3.14-5). This includes watersheds in the Analysis Area that have some acreage in the BWCAW. Although upland open and upland young values for individual watersheds differ slightly among alternatives, no value was found to exceed the 60 percent threshold (Table 3.14-1.), including those watersheds that have some acreage in the BWCAW. Thus, the action alternatives would not produce substantial negative effects to water quality and watershed health as measured by Indicator 3 and the effects would not vary by a notable degree among alternatives.

Furthermore, vegetation management activities for the action alternatives would follow required design features and mitigation measures contained in the FEIS, applicable standards and guidelines in the 2004 Forest Plan (USDA Forest Service 2004b), and applicable MFRC Voluntary Site-Level Forest Management Guidelines (MFRC 2005). Design features and mitigation measures as well as Forest Plan standards and guidelines have been developed to maintain or restore riparian ecological function within near-bank and remainder riparian zones. Under these design criteria, no harvest of

trees would occur within 100 feet of flowing streams except for the purpose of maintaining or restoring riparian ecological function. Remainder riparian management zones would also be established adjacent to near-bank zones depending upon floodplain and shoreline slope conditions where vegetative management would favor extended rotation of site appropriate tree species. These criteria would together serve to protect and enhance both riparian and within stream channel habitat conditions as well as water quality and watershed health in the Analysis Area, including downstream reaches which may occur within the BWCAW. There would be localized effects to riparian ecological function and watershed health in instances where these criteria were not followed. However, monitoring has shown that timber harvest within near bank riparian zones was completed with good compliance with relevant standards and guidelines (2006 Superior NF Monitoring Report p. 12). These design criteria and mitigation measures, Forest Plan standards and guidelines, and applicable MFRC guidelines have been effective in the past and would continue to protect water quality and watershed health in the future. Note that no treatments are proposed inside the BWCAW and potential effects to the BWCAW are indirect effects produced by actions outside the BWCAW.

Table 3.14-5: Watersheds Within the Glacier Project Analysis Area

HUC6 NAME	Percentage of Watershed in Glacier *Project* Area (1)	Less than 10% of the Watershed is within the Glacier Project Area (1)	Percentage of Watershed in Lowland (wetlands, lakes, streams)	More than 40% of the watershed is in Lowland (2)
Snowbank L	42%		45%	X
Moose L	60%		34%	
Denley Cr	19%		26%	
Kawishiwi R, Middle	0%	X	28%	
Kawishiwi R, Lower Middle	9%		35%	
Isabella R, Lower	11%		33%	
South Kawishiwi R, Lower	47%		30%	
South Kawishiwi R, Upper	70%		28%	
Bear Island R, Lower	28%		39%	
Kawishiwi R, Lower	69%		35%	
Madden Cr	39%		31%	
Basswood L	0%	X	46%	X
Burntside R	7%	X	31%	
Fall L	58%		35%	
Range R	6%	X	25%	
Muskeg Cr	0%	X	41%	X

(1) If less than 10% of the watershed is within the Project Area – it is unlikely to effect the overall % upland young and open

(2) If more than 40% of the watershed is in lowland, then the 60% upland young and open threshold cannot be exceeded.

Conclusion – Direct and Indirect Effects

There may be some direct or indirect negative effects to water quality and watershed health in the analysis area including potential effects to downstream areas and stream reaches that occur within the BWCAW as a result of implementing any of the action alternatives. Potential short term negative effects associated with new temporary roads and stream crossings including point source erosion, run off, and stream flow and flood plain manipulation are expected to be minimal, especially in stream reaches and downstream areas that are not immediately adjacent to or near proposed temporary road and stream crossing sites. These effects are expected to be minimal because all required project design features and mitigation measures referred to previously would be followed during project implementation. For example, Forest Plan standards, guidelines and objectives require that road and trail crossings of streams, wetlands, and riparian areas adjacent to lakes and streams be minimized, that hydrologic and riparian functions be maintained or improved when roads or trails are constructed across wetlands, that temporary roads and stream crossings be stabilized and effectively closed to motorized traffic following all use, and that vegetation is established on these roads within 10 years after termination of all contracts, leases, or permits (USDA Forest Service 2004b pp. 2-47 to 2-50).

All action alternatives have the potential to directly benefit water quality and watershed health within the analysis area through stream crossing improvements on existing crossings. There are no new stream crossings proposed within one mile of the BWCAW boundary and thus no potential negative effects would occur in the BWCAW related to new stream crossings.

Based upon the above analysis, Alternative 3 has the greatest potential to benefit water quality and watershed health when the entire analysis area is considered, followed by Alternative 2 and 4. Alternative 3 has the greatest potential to benefit water quality and watershed health because it proposes to improve 3 existing stream crossings, has slightly fewer proposed road miles, and adds no new stream crossings. The greatest number of existing road miles within one mile of the BWCAW boundary is Alternative 1, followed by Alternative 3, Alternative 2, and Alternative 4.

Estimated positive direct effects to aquatic resources include the management of riparian areas for extended rotation, long-lived conifer species, and/or increased basal area. Direct and indirect effects from planting and harvesting in these areas include providing shade and cover for aquatic organisms and increasing in-stream habitat complexity with future large woody debris recruitment. Vegetation management activities in individual watersheds do not significantly contribute to reaching the sixty percent threshold for open and young forest and will not have any direct or indirect effects on watershed health, both inside and outside the BWCAW. The largest increase in open and young forest occurs in the South Kawishiwi River (Upper) watershed; from an existing eleven percent to a proposed 22 percent open and young forest for Alternatives 2 and 4. The largest existing (2008) open and young percentage of any watershed analyzed is 39 percent (Madden Creek) with a proposed young and open forest coverage of 43 percent for Alternative 4. As displayed on Figure 3.14-3, no watershed exceeds the 60% threshold for Indicator 3.

Positive effects to aquatic resources are anticipated regarding the number of road crossings within the project area; this is based on the proposed improvements to three existing crossings offsetting the addition of two new road crossings. The new road crossings will follow Forest Plan direction for providing stream simulation through the crossing as well as aquatic organism passage. The three stream crossing improvements will provide benefits to aquatic organism passage and water quality by reducing the potential for passage barriers and impacts to aquatic habitat.

3.14.6.2 Cumulative Effects

See Section 3.14.3, Analysis Area, for the temporal and spatial boundaries for the cumulative effects analysis. The past, present and reasonably foreseeable future projects considered for cumulative effects are identified in Appendix C.

Indicators 1 and 2

Non-federal roads and stream crossings

Past, present, and reasonably foreseeable future actions of other land owners that could potentially contribute to negative cumulative effects associated with new road construction and stream crossings include state, county, and private road construction projects associated with timber harvest, private development, and special use permits, as well as routine road maintenance activities.

The Analysis Area has mixed ownership with roads crossing frequently from one landowner to the next.

The known potential future harvest on state, county, and Potlatch land was provided by those landowners. The associated road access needs were addressed through the proposal to add one mile of system road.

Mitigations on State and Private Land

MFRC Voluntary Site-Level Forest Management Guidelines (MFRC 2005), State of Minnesota best management practices (BMPs), Shoreland Rules (Minnesota Department of Natural Resources; MNDNR, 1989), as well as other Minnesota Public Water Works rules and state wetland regulations should also contribute to minimizing negative cumulative effects from State, county, and private landowners in the analysis area, including the relevant portion of the BWCAW. The success and effectiveness of implementing MFRC Guidelines on a statewide basis was discussed in Section 3.13.5.

Furthermore, the Superior National Forest will continue to improve the existing road transportation system and associated stream crossings on the forest. It is also very likely that road transportation systems and associated stream crossings managed by other state, county, local, and private entities have similar improvement needs. The USFS and State of Minnesota have also made significant improvements in the design and correct placement of stream crossings that maintain fish passage and sediment transport. Accordingly, it is very likely that future actions contributing to cumulative effects will be further minimized and/or mitigated.

Other federal roads and stream crossings: Forest-wide Travel Management Project

During development of the Glacier Project, decisions on some unclassified roads were deferred. Those deferred roads were included in the Forest-wide Travel Management Project analysis.

Accordingly, the Travel Management Project would contribute a net beneficial effect to water quality and watershed health in the Glacier Analysis Area. Information on the Forest-wide Travel Management Project can be found on the Forest web site (www.fs.fed.us/r9/superior) under Projects and Plans. The Forest-wide Travel Management Project proposals were also coordinated with the State OHV planning.

Summary for Indicators 1 and 2

Potential short-term negative cumulative effects from building roads and stream crossings may include point source erosion, surface run-off, and sediment input into local streams, lakes, and wetlands. Other negative cumulative effects include reduced flood flow capacity and floodplain function as well as sediment transport, movement of large woody debris, and restricted aquatic organism passage. The sum of past, present and reasonably foreseeable future construction of new roads and stream crossings in the Glacier Project Analysis Area would contribute to minimal long-term negative cumulative effects to water quality and watershed health, including downstream reaches and areas that occur within the BWCAW, given that required Forest Plan standards and guidelines (USDA Forest Service 2004b) for federal projects would be followed, and MFRC and other state mitigation measures for state and private projects are followed during project implementation and construction activities.

Indicator 3

While projecting the amount of harvest activity that may take place on private ownership is nearly impossible, it can be assumed that some very minimal level of harvest may take place. Those harvests would add a minimal amount of acres to the young age class based on harvest activity from the recent past and studies that have shown that timber production is a low priority for private forest landowners (Baughman & Updegraff, 2001). In any case, most logging on private land is not reasonably foreseeable due to the fact that proposals for management activities from multiple private landowners on small parcels are not available. Projects that are reasonably foreseeable for cumulative effects analysis are discussed in Appendix C.

The analysis described for Indicator 3 in the Section 3.13.6.1 Direct and Indirect Effects applies to past actions from federal, state and private parties since the proportion of upland open and upland young forest within each watershed was calculated for all ownerships in the analysis area. Present and reasonably foreseeable future projects were also included in the analysis.

The analyses for this project (that include all proposals to date) show that the proportion of upland open and upland young forest does not exceed the 60 percent threshold in any 6th order watershed in the Analysis. Therefore, there would not be substantial cumulative effects either within the BWCAW or the rest of the analysis area as measured by Indicator 3.

Conclusion-Cumulative Effects

The effects from past, present, and reasonably foreseeable future projects, when added to the effects of the Glacier Project, are expected to be minimal given the nature of these activities as described above and the application of design features, mitigations, standards, and guidelines (including MFRC guidelines that apply to state, county and private ownerships). This is the case both within the BWCAW and in the rest of the analysis area. Cumulative effects would vary by a minor degree between alternatives since direct and indirect effects vary to a minor degree between alternatives and other federal, state and private actions would likely be the same among alternatives.

3.14.6.3 Conclusion-Direct, Indirect and Cumulative Effects

Potential short-term negative effects both overall and within the relevant portion of the BWCAW identified by the Analysis Area are expected to be minimal with the application of mitigation measures. Positive long-term effects would occur from the action alternatives due to existing stream crossing improvements and potential decommissioning temporary roads.

On a net basis across the entire analysis area, Alternative 3 has the greatest potential to benefit water quality and watershed health, followed by Alternative 2, Alternative 4 and Alternative 1. On a net basis within the BWCAW, Alternative 3 has the greatest potential to benefit water quality and watershed health, followed by Alternative 2, Alternative 4 and Alternative 1.