2020-2024 Statewide Regional Report

Forest Management Guideline implementation rate and compliance report for all watersheds surveyed across Minnesota

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A report by the Minnesota Department of Natural Resources
Forest Management Guideline Monitoring Program,
Respectfully submitted to the Minnesota Forest Resources Council

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1 EXECUTIVE SUMMARY

The 2020-2024 monitoring data collected by the Guideline Monitoring Program (GMP) has been summarized according to the MFRC's Landscape Regions for the first time in this report. While the program will still report biannually during the 5-year data collection period on a watershed basis, the 5-year summary report stands alone in its ability to examine trends and voluntary implementation rates across the regions of the state. Regional summaries align best with the DNR's four main regions (Figure 2), allowing this report to be easily read and used by DNR foresters, regional offices, and administrative officials. Regional reports also provide a stronger connection to private landowners who may be interested in their lands and the trends across neighboring harvests in their area. The MFRC uses regional landscape committees to connect with public and private landowners, providing a public forum for cooperative forest sustainability. The use of regions in this report will allow seamless integration of this data with those regional landscape committees for use in planning and improvements to forest health.

This report is broken up by landscape region, reporting only the data that is specific to that region and summarizing results at the end of each regional section. Readers should skip to their region of interest. GMP visited 404 sites over the 5-year period, averaging 81 sites per year. Some landscape regions show as more highly visited, due to the nature of the watershed distribution across regions. Watersheds are more heavily concentrated in Northern and Northeastern Minnesota, with very few possible sites in regions such as Prairie and Southeastern Minnesota. The most visited region was North Central at 46% of all site visits, followed by Northeast at 27.5% and Northern region with 11% (Table 1).

Table 1. Total sites visited across all regions broken down by ownership.

Region	County	Federal	Industry	NIPF	State	Tribal	Total	Percent of Total
East Central	4	0	0	12	18	0	34	8.4%
North Central	75	14	10	24	59	4	186	46%
Northeast	27	34	6	14	28	2	111	27.5%
Northern	13	0	3	9	19	0	44	10.9%
Prairie	0	0	0	1	5	0	6	1.5%
Southeast	0	0	0	3	7	0	10	2.5%
West Central	0	0	0	7	6	0	13	3.2%
Total	119	48	19	70	142	6	404	100%

For the first time, GMP has accumulated all areas in which a 'compliance rating' is applied in the data, meaning the rate at which a guideline or set of guidelines was implemented correctly in the field. These ratings are typically reported as part of the biannual reports but are conglomerated here for ease of access. While some of these ratings are associated with 'compliance,' it should be noted that all FMGs are voluntary, and compliance serves as a marker for success rate of implementation in the field.

The summary compliance rating percentages are discussed in detail in an accompanying report. These percentages are compiled from the data presented in the remainder of this report, and more detailed information on each area of interest can be found for each region of the state. Statewide results are not displayed here, since the lack of sites in areas such as West Central, Southeast, and Prairie regions with RMZs will skew the statewide results lower if a standard average is taken.

Table 2. Summary compliance ratings for each region and statewide; no RMZs were present in West Central, Southeast, and Prairie regions.

Regions	RMZs	Filter strips	Crossings	Approaches	Rutting	Leave Trees	On-site Infrastructure	Landings	Slash and CWD*	Visual Quality
Northeast	78.8%	78%	22.4%	87.9%	91.3%	93.1%	70.3%	83.4%	100%	64.6%
North Central	82.9%	86%	73.6%	95.4%	82.3%	90.8%	79%	89.4%	100%	69%
Northern	84.9%	77%	86.5%	98.8%	93.8%	91.4%	86.4%	77.3%	100%	61%
East Central	87%	74%	65.8%	94.1%	87.9%	99.4%	91.2%	77.6%	100%	70.8%
West Central	NA	90%	83.3%	100%	68.2%	100%	92.3%	100%	100%	94%
Southeast	NA	94%	100%	100%	97.5%	100%	90%	100%	100%	68.2%
Prairie	NA	77%	95.2%	100%	100%	96.7%	100%	84.6%	100%	75%

Table 2 shows FMG areas with a need for improvement across the most heavily forested areas of the state, including Northeast, North Central, and Northern region, include visual quality, on-site infrastructure, landings, crossings, filter strips, and RMZs. Approaches, rutting, leave tree areas, and slash and coarse woody debris were all compliant above 75-80% for northern regions. The central parts of the state, including East Central, Southeast, and Prairie regions (Table 2) could improve in visual quality, rutting, crossings, and some RMZs, though RMZs are less common in those areas of the state including East and West Central, and Prairie regions. Southeast region overall did very well, with improvements recommended in visual quality. However, very few sites were surveyed in Southeast region, and may not be representative of trends in FMG compliance in that area. A deep dive into summary statistics for all FMG areas will be published in a separate report alongside this 5-year report.

1.1 SUMMARY RESULTS – HARVEST METHODS

In terms of harvest methods, the majority of harvest treatments applied were clearcuts, with 324 observed instances of clearcut harvests, making up 81% of surveyed harvest methods. The remaining methods made up 19% of harvest methods, all falling between 2-5% of methods. Figure 1 shows the breakdown of harvest methods, with clear cut being most favored followed by thinning and all other harvest types.

Table 3. Harvest method across all sites with the percent of each strategy out of the total number of treatments observed; not all sites reported a harvest method.

Observed site harvest method	Count	Percent
Clear Cut (All Strategies Combined)	324	81%
Group Selection	12	3%
Salvage/Sanitation Cut	7	2%
Seed Tree	11	3%
Shelterwood	14	4%

Single Tree Selection	10	3%
Thinning (All Strategies Combined)	21	5%
Total Treatments Observed	399	100%

1.2 LANDINGS BY OWNERSHIP

Landings are a consistent source of erosion, sediment delivery to waterbodies, and reduced regeneration due to soil compaction. Throughout this report, guideline monitoring results are broken up by region. However, different landowners may use various methods for designing sites and placing and using landings. When broken down by ownership, landing guideline results show a clearer picture of planning and possible corrections and training for landowners (Table 4). County and Federal ownerships had a similar percentage of sites with landing in filter strips or wetlands where uplands were available (hovering between 19-21%). Forest industry and non-industrial private forestland managers also had similar percent of sites with landings in wetlands or filter strips where uplands were available (between 27-29%), and educational opportunities should be presented to both groups to decrease lowland riparian landings. State was relatively low at 14.8%, with tribal not far behind at 16.7%. State harvests typically involve extensive planning by trained foresters, while NIPF harvests may be done by local loggers or the landowner themselves, with less focus on harvest planning.

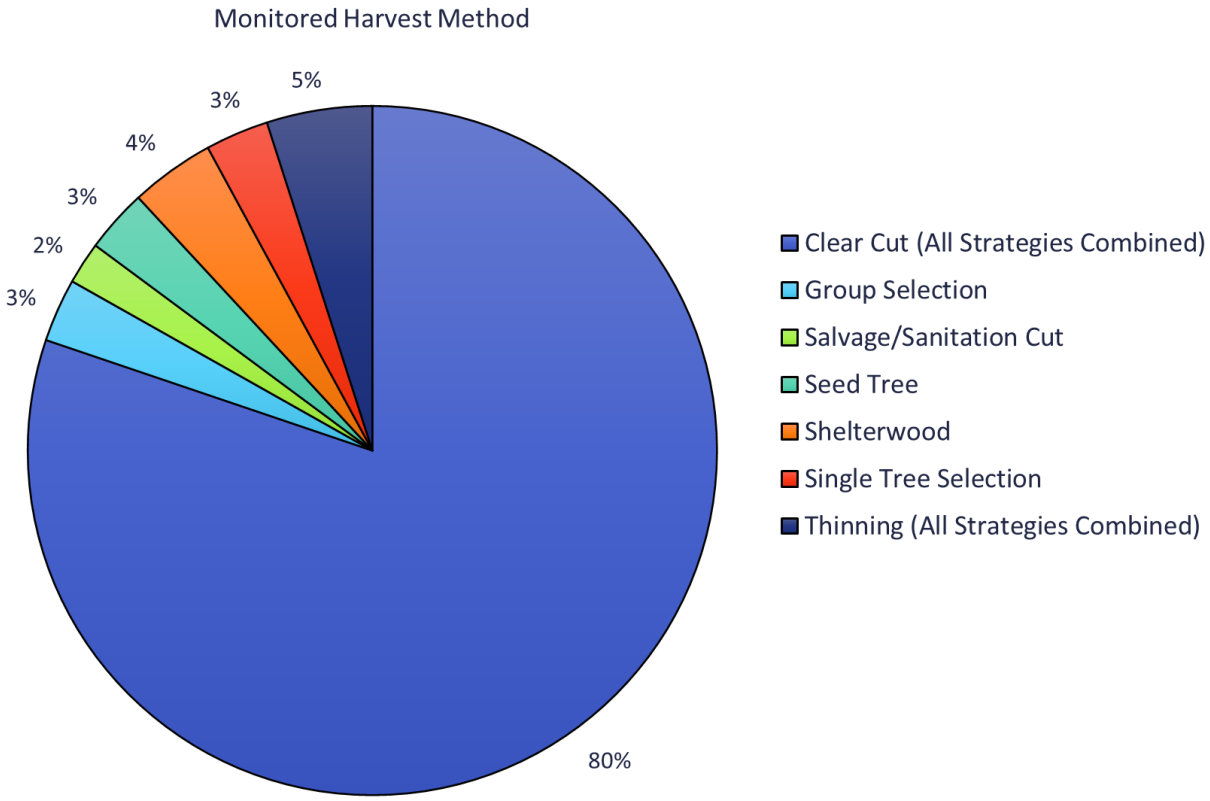

Figure 1. Monitored site harvest method from 5-years of monitoring data (n = 399).

Table 4. Landing location by ownership and monitoring year. Note: one site in Northeast did not have landing data reported, resulting in 403 sites out of the 404 sites surveyed over the 5-year period.

Ownership	Sites	Total Landings	Percent Landings in Wetland or Filter Strip Where Upland Available	Percent Sites w/ Landings in Wetland or Filter Strip Where Upland Available
County	119	223	14.4%	19.3%
Federal	48	119	10.9%	20.8%
Forest Industry	18	38	18.4%	27.8%
Non-Industrial Private Forestland (NIPF)	70	108	25.9%	28.6%
State	142	232	9.5%	14.8%
Tribal	6	9	11.1%	16.7%

1.3 CROSSINGS COMPLIANCE ACROSS REGIONS

Crossings are a major source of potential damage to the forest ecosystem that is avoidable. Across all regions, about one fifth of all crossings were considered avoidable – either an alternative route existed for the harvest, or it was not clear from the field monitoring why the crossing was necessary at the location it was found post-harvest (22.8% avoidable crossings). In total, that is equivalent to 144 crossings over all regions, with the majority falling in wetlands or peatland (601 crossings, or 95% of all crossings). Further education about harvest planning would be a major route for decreasing this number, as would encouraging winter harvests on frozen ground whenever possible to avoid damage to wetlands or peatland. The majority of issues occurred in North Central region (60), followed by Northeast (38) and East Central (27). Focusing educational efforts across Northern Minnesota would be advised.

Table 5. Summary table of regional data for crossings, showing avoidable crossings across all sites in all regions.

Region	Total Sites	Crossings	Stream	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
East Central	34	79	2	74	245.9	27	34.2%
North Central	186	227	5	220	218.3	60	26.4%
Northeast	111	170	12	157	278.1	38	22.4%
Northern	44	126	2	123	439.8	17	13.5%
Prairie	6	21	0	21	685.6	1	4.8%
Southeast	10	2	0	0	24	0	0%
West Central	13	6	0	6	166.8	1	16.7%
Total	**404**	**631**	**21**	**601**	**2,058.5**	**144**	**22.8%**

1.4 INFRASTRUCTURE ACREAGE AND COMPLIANCE RATE ACROSS REGIONS

Infrastructure includes roads and landings, areas where heavy machinery is typically transported or used. Landings tend to expand, or 'creep,' over time. They are typically areas where brush and ground cover has been disturbed and are at risk of producing runoff and delivering sediment to nearby areas.

Riparian areas are at high risk for runoff when landings or roads are placed too close to filter strips, wetlands, streams, or lakes.

The FMGs dictate that for harvest areas less than 20 acres, infrastructure – including landings and roads – should be less than 1 acre in total size. For sites 20-30 acres, infrastructure should total 5% or less of the site's acreage. For sites that are greater than 30 acres, infrastructure should total 3% or less of the site's acreage. The rating for compliance with these voluntary guidelines in the tables in this report are calculated by taking the mean acreage of roads and landings and using those acreages to decide for each site of 'compliant' or 'non-compliant' according to the size and percentage guidelines noted earlier (Table 6). Those compliances are averaged by region to get the compliance rating for the region.

Table 6. Summary table of all regions and infrastructure acreages, average acreage of each infrastructure category, and compliance rating for each region.

Region	Total Sites	Sites w/ Infrastructure	Avg Acres	SD	Total Acres	Avg Infrastructure Acres	Avg Landing Acres	Avg Road Acres	% Compliant
East Central	34	34	78.2	62.3	2,658	1.20	0.80	0.40	91.2%
North Central	186	174	71.8	57.1	13,348	1.42	0.93	0.48	79%
Northeast	111	107	83	71.5	9,216	1.85	1.28	0.57	70.3%
Northern	44	41	89	65.1	3,916	1.91	1.10	0.80	86.4%
Prairie	6	6	97.7	68.7	586	1.90	1.47	0.43	100%
Southeast	10	9	35	20.2	350	0.57	0.57	0.002	90%
West Central	13	9	68.3	43.1	888	0.52	0.26	0.26	92.3%

1.5 COARSE WOODY DEBRIS ACROSS REGIONS

Coarse woody debris (CWD) is defined in the FMGs as requiring a minimum of four pieces of CWD per acre on average when harvesting in RMZs, if logs are not already present. These guidelines apply to dead logs greater than 12 inches in diameter and longer than 6 feet. In areas that are not defined as RMZs, the FMGs only require 2-5 pieces of CWD per acre if not present. All regions demonstrated a high amount of CWD on the landscape, typically anywhere from 434%-1,188% of the required amount. While technically the entire state is meeting the required amount of CWD, exceeding that amount by the ratios shown in Table 7 present concerns around possibly negatively impacting regeneration and ETS. Negative impacts may include diverting water flow from streams to the forest floor, erosion around stream bed and banks, inability for fish to navigate streams due to debris, and possible changes to the pH or water quality of streams (Table 6; Table 7).

Larger amounts of CWD result in higher carbon storage, but present possible negative effects on forest ecosystems including potentially adding to fire severity, preventing regeneration, changing chemistry of forest soils, and possibly impacting seedling establishment, growth, and survival. Loggers

are likely leaving most of their slash distributed around the site, which may reduce the compaction of gathering slash, and reduce carbon released into the atmosphere through burning slash piles, but large amounts of slash may be more detrimental to the next succession of forests. Further analysis of the benefits and detriments of large amounts of slash should be performed to create the best policy for landowners and loggers statewide.

Table 7. Average coarse woody debris (CWD) per acre, ratio compared to highest possible amount in FMGs, and percentage based on ratio. Required amounts in FMGs range from 2-5, 5 was used as the basis for the ratios and subsequent percentages.

Region	Avg Required	Avg CWD/Acre	Compliance Ratio	Compliance Percentage
Northeast	2-5	41.8	8.4	836%
North Central	2-5	34.9	7.0	698%
Northern	2-5	34.8	7.0	696%
East Central	2-5	24.4	4.9	488%
West Central	2-5	21.7	4.3	434%
Southeast	2-5	59.4	11.9	1,188%
Prairie	2-5	43.2	8.6	864%

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5 INTRODUCTION

This report is the culmination of five years of data collection by the Guideline Monitoring Program (GMP) within the Minnesota Department of Natural Resources to understand how well forest landowners and managers adhere to the voluntary Forest Management Guidelines (FMGs) in the state. GMP tracks harvest activity and guideline adherence across ownerships over six regions, including private landowners both industrial and small forest landowners, state, county, and federal managers, and tribal ownerships.

Established as part of the Sustainable Forest Resources Act (SFRA), the MN DNR maintains the GMP to monitor the implementation of FMGs on public and private forestlands. The Minnesota Forest Resources Council (MFRC), also established by the SFRA, is responsible for semi-regular and peer reviewed updates to the FMGs and provides oversight and program direction for the implementation of the GMP. The guidelines have been revised three times since their inception in 1999 (2007, 2012, 2024). The most recent guideline update will go into effect in 2025, and questions will be revised and added to the GMP's data collection process for all future site visits. Some guidelines are still being added to the GMP's data collection process, with an update planned for 2026-2027.

The GMP is not a regulatory program, and while it is housed within the Minnesota Department of Natural Resources Division of Forestry, GMP works alongside the Resource Assessment Program (RAP) to create a change detection model for identifying forest harvest sites and uses numerous experts for analysis and historical database management through RAP. GMP works with logging educators across the state to give trainings, present at Minnesota Logger Education Program conferences, and assist with planning and presenting at University of Minnesota Sustainable Forests Education Cooperative trainings yearly.

5.1 BACKGROUND AND METHODOLOGY

The Guideline Monitoring Program has two full time employees, the Program Consultant and the Program Forester. For this report, contractors were used to collect data at all sites, with quality control performed by the GMP staff. The forester is integral to ensuring site information is acquired from county, state, and federal lands and connects with private landowners for site access. The forester is also responsible for training contractors in data collection yearly, overseeing their work, and quality control alongside other RAP staff.

Forest cover change detection process

Each year of data collection, GMP works with RAP team members, using satellite imagery in the Google Earth Engine platform (Sentinel-2 Multispectral imagery and Sentinel-1 Radar imagery) to create a stack of imagery showing the change in forest cover from one year to the next.

Known harvest areas, acquired from state, county, and federal harvest records shared by stakeholders and areas of fire damage, and forest health damage from insects and disease, are used to train a model and applied to the stack of imagery to map the changes detected across the state. This forest cover change detection process allows GMP to identify areas where trees were harvested and distinguish them from areas where trees were removed due to fire, insects, disease. This model is especially important for identifying private harvests, which are not reported anywhere in any centralized system. County, federal, and state foresters share their harvest polygons with the GMP forester by request annually. For more detailed imagery, RAP staff fly strips of land with plane-mounted cameras to identify harvest boundaries and provide imagery for contractors to use on the ground.

RAP staff reach out to landowners via mail and phone to collect as close to a representative sample of the state's ownership as possible. The categories of ownership are:

- State: all lands owned by the state of Minnesota.
- County: all lands owned or managed by the individual counties.
- Federal: all lands owned or managed by the United States Forest Service.
- Forest Industry: all lands owned or managed by forest industry corporations.
- Non-Industrial Private Forests (NIPF): all privately owned non-industry owned lands, including small forest landowners and tribal landowners and managers.

Landowners are contacted to gain access to their property and request information, including when the harvest was performed and completed, and other information included on the 'pre-site' survey.

5.2 FIELD DATA COLLECTION

For the past five years, GMP has utilized contractors trained by the GMP forester for all data collection. On-site field monitoring is typically conducted between May and September. Methodology generally involves a ground survey of the site with aerial imagery maps for referencing features, delineation of streams, filter strips, wetlands, sample plots, leave tree areas, landings, roads, and skid trails. For quality control checks, the GMP forester visited the contractors during their field collection for a 'hot check' in real time, and both the GMP consultant and forester conducted on-site review of randomly selected sites making up approximately 20% of all sites evaluated each year. Quality control checks involve resurveying each item noted on the site and their appropriate surveys and entering scores into a tracking sheet. If sites fail the score sheet (below 80% accuracy), they must be resurveyed by contractors.

5.3 HOW TO READ THIS REPORT

Reporting for the past five years has focused on a watershed approach, thanks to funding from the Clean Water Council that supports the program. GMP will continue to report watershed-based results through the creation of an online, DNR-hosted dashboard to be deployed in 2026-2027. For this report, GMP published results based on the regions specified by the Minnesota Forest Resources Council Landscape Program. Each region has an associated Landscape Committee, which bring together interests from different areas of the state and is guided by the MFRC's Landscape Advisory Committee and the Landscape Program Administrator. The MFRC regions also relatively neatly coincide with the Minnesota Department of Natural Resources administrative regions (Figure 2). This makes the following report most applicable to DNR foresters, land managers in the state and federal forestry divisions, and private landowners and stakeholders involved in MFRC activities in the landscape regions.

Compliance rates may be mentioned throughout this report. 'Compliance' and 'implementation' rates are interchangeable in this report context, given that the FMGs being assessed are entirely voluntary. Compliance in this report refers to the number of FMGs being followed correctly versus the number of FMGs found to have errors in implementation. The GMP is not a regulatory arm of the DNR, and nor do they monitor effectiveness. GMP simply provides an understanding of how the FMGs are being implemented across ownerships and across the state.

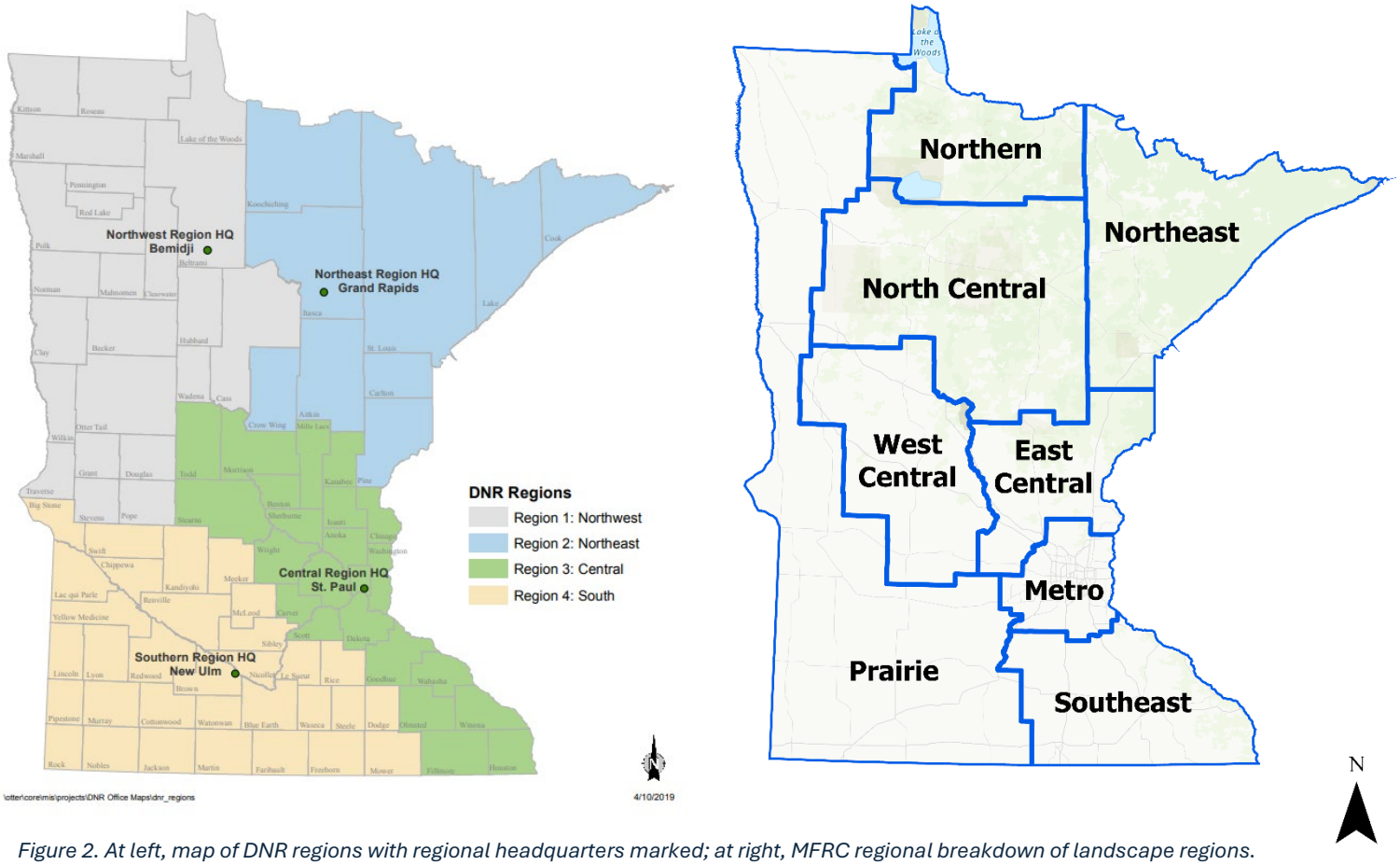


Figure 2. At left, map of DNR regions with regional headquarters marked; at right, MFRC regional breakdown of landscape regions.

Data collected in the field is done in the form of surveys, with a survey for each area of interest under the FMGs. Surveys were designed to address all related FMGs that can be measured in the field during a post-harvest visit. Results from surveys are analyzed using python scripts by RAP and GMP staff, and categorized according to the following areas for reporting:

- Streams, including trout and non-trout streams
- Lakes
- Wetlands, including open water wetlands and non-open water wetlands
- Filter strips
- Crossings and approaches
- Leave tree areas, including dispersed and clumped groupings
- Slash and coarse woody debris (CWD)
- Soil exposure, erosion, sediment delivery to waterbodies
- Landings
- Visual quality and Endangered and Threatened Species (ETS)
- Timing and season of harvest

Tables and figures will identify results according to the surveys filled out in the field. If your area of interest is in only one region, go to the header for that region and it should contain all related sites and their results. Tables and figures have descriptions, but the data can be complicated, so refer to summaries for a wider perspective on the results.

6 MAPS OF REGIONS

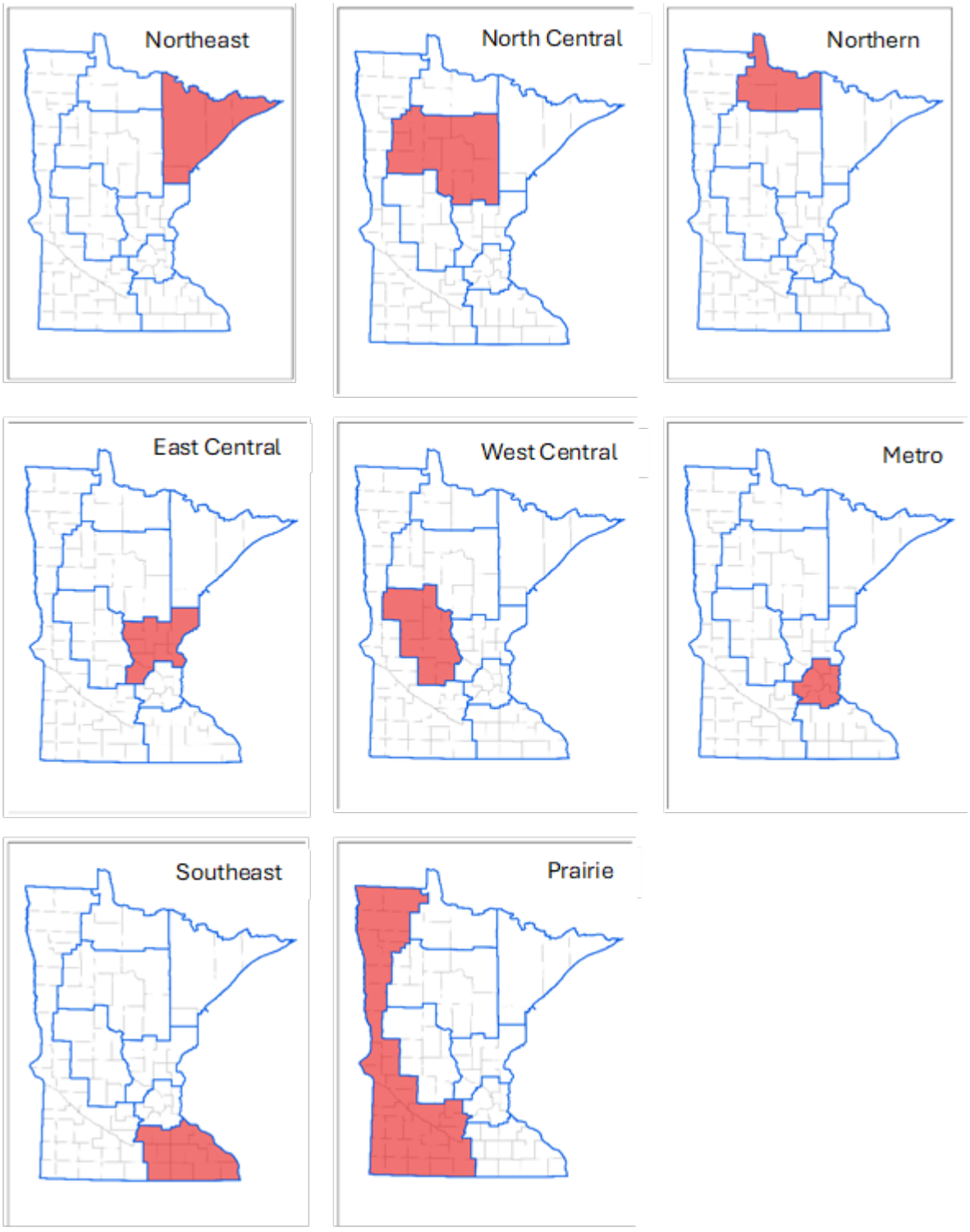


Figure 3. MFRC Regions used for this report from top left: Northeast, North Central, Northern, East Central, West Central, Metro, Southeast, Prairie; for the purposes of this report, Metro is shown but not described further in this report due to no harvests in the area.

7 PRE-SITE QUESTIONNAIRES – HARVEST METHODS AND PLANNING

Questionnaires sent out to all landowners or land managers prior to visiting their land for data collection provide valuable information about the nature of their harvests, the type of equipment and harvest patterns used, and whether they employed a professional planner or used a written plan for harvests. This information can be used to identify the reason for certain patterns left on the landscape, such as rutting patterns or slash and debris patterns. Harvest type has a large influence on possible destruction of the landscape but may be necessary in certain parts of the state with specific types of forests.

Table 8. Skidding methods used in harvests across regions according to pre-site survey.

Region	Forwarder	Full Tree	Other	Short Wood	Tree Length	Unknown	Total
East Central	5	21	0	3	13	0	42
North Central	32	43	1	32	78	1	187
Northeast	11	23	0	21	47	0	102
Northern	1	10	0	7	21	0	39
Prairie	0	4	0	0	4	0	8
Southeast	7	1	0	0	9	0	17
West Central	1	3	0	2	3	0	9
Total	57	105	1	65	175	1	404

The most common skidding methods were tree length skidding, along with full tree and short wood skidding. Full tree skidding tends to be the most destructive to the landscape; it involves possible degradation to the site from dragging entire trees long distances, displacing soil along temporary roadways and damaging nearby ditches or wetlands. However, full tree logging can also spread seeds or cones when performed at the right time of year or self-scarify the landscape and leaving cones on mineral soil in the heat of the summer sun to avoid a prescribed burn. Tree length skidding means to the top of the tree is cut off prior to dragging the remainder to a landing to be loaded onto a truck. This process is less destructive, since the larger top of the tree was removed and the remaining bole creates less impact on the landscape, but there is still always a risk of soil erosion or disruption, especially in wet conditions (Table 9).

Table 9. Type of equipment used in harvests across regions according to pre-site survey.

Region	Cable Skidder	Forwarder	Grapple Skidder	Unknown	Total
East Central	4	7	21	0	32
North Central	10	49	103	0	162
Northeast	14	21	66	1	102
Northern	0	9	26	0	35
Prairie	0	0	6	0	6
Southeast	6	7	3	0	16
West Central	0	2	6	0	8
Total	34	95	231	1	361

Use of grapple skidders was most common across almost all regions surveyed, followed by forwarders and cable skidders. Grapple skidders are efficient, especially for smaller sized trees such as

Aspen. Forwarders are often used to carry logs to a landing and may also be used to carry logs to a roadside landing to avoid placing a landing in the site, or when a site is not suitable for a landing and logging trucks can pick up logs along the road into the site (Table 10).

Table 10. Skidding pattern used in harvests across regions according to pre-site survey.

Region	Distributed	Focused	Not evident	Total
East Central	13	20	1	34
North Central	104	81	1	186
Northeast	38	72	1	111
Northern	39	3	2	44
Prairie	5	1	0	6
Southeast	4	6	0	10
West Central	6	5	2	13
Total	209	188	7	404

Forest management plans are often used by private landowners to plan out harvests, work with loggers to select trees to cut, and ensure an agreed upon price is set for the work. Plans address management for wildlife or certain species and ensure protection of resources (Table 12).

Table 11. Whether a general forest management plan or stewardship plan of any kind was developed for the site, whether an oral agreement, written agreement, or none; was an activity-specific forest management plan or detailed contract prepared, with similar responses.

Was a general forest management plan prepared for the property?			
Ownership	No	Oral	Written
Forest Industry	0	0	1
Non-Industrial Private Forestland (NIPF)	16	7	43
Tribal	0	0	2
Was an activity-specific plan or detailed contract prepared for the property?			
Ownership	No	Oral	Written
Forest Industry	0	0	1
Non-Industrial Private Forestland (NIPF)	15	13	37
Tribal	0	0	2

Management plans are required for state and federal timber harvests, as well as any certified wood harvests, but are not required for private landowners who are not looking to certify their timber by selling to a certified mill. Most counties require plans according to their harvest rules. Many landowners work with registered stewardship plan writers to develop harvest plans to protect certain sensitive sites or riparian areas, fishing access and stream health, or manage for wildlife and hunting species such as deer or pheasants. Monitoring results in the pre-site questionnaire from Forest Industry did not include mention of management plans. Non-industrial private forest landowners tended to use written or oral plans in about half of surveyed landowners.

Use of site maps are highly recommended by the guidelines, especially to understand where sensitive resources such as open water and forested wetlands, streams, lakes, filter strips, and cultural

resources or vistas are located and need protections. Site maps are useful planning tools and give landowners the ability to design harvests to work for their goals while protecting the landscape. By Program standards, policy, or statute, site maps are required for state, federal, and county sites in most cases. Of those who responded to the survey question, about a third of private landowners used a forest plan, a third did not, and a third answered "do not know." Forest industry mainly used a forest plan when responding to the question in the survey (Table 13).

Table 12. Whether a site map was used in harvest planning across ownerships, according to pre-site survey.

Ownership	Do Not Know	No	Yes
County	0	1	117
Federal	1	0	45
Forest Industry	0	0	19
Non-Industrial Private Forestland (NIPF)	21	18	29
State	0	0	142
Tribal	0	0	6

Development of plans was mainly done by a professional, typically this person is a private forester who works alongside the landowner to manage for their objectives. Loggers or landowners may also make the harvest plan, especially those with resource management experience (Table 14).

Table 13. Who developed the harvest plan across ownerships, according to pre-site survey.

Ownership	Landowner	Logger	Other	Professional
Forest Industry	0	0	0	2
Non-Industrial Private Forestland (NIPF)	14	6	1	78
Tribal	0	0	0	4

Skidding and rutting questions were also important indicators of potential impacts to the landscape, and information from the pre-site surveys provides insight into how landowners and land managers view the landscape post-harvest and the quality of the logging (Table 15).

Table 14. Was rutting greater than 6" deep on skid trails (other than approaches or crossings) responses by region according to the pre-site survey.

Region	No	Yes	Total
East Central	30	4	34
North Central	165	21	186
Northeast	96	15	111
Northern	37	7	44
Prairie	6	0	6
Southeast	8	2	10
West Central	11	2	13
Total	353	51	404

Most respondents did not note rutting greater than 6" deep present on skid trails post-harvest. Those

that did note rutting present, the majority was focused in North Central and Northeast regions (Table 15).

Table 15. Skidding pattern used by region according to the pre-site survey.

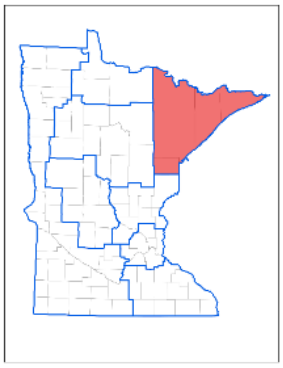
Region	Distributed	Focused	Not evident	Total
East Central	13	20	1	34
North Central	104	81	1	186
Northeast	38	72	1	111
Northern	39	3	2	44
Prairie	5	1	0	6
Southeast	4	6	0	10
West Central	6	5	2	13
Total	209	188	7	404

Skidding patterns are an important guideline, which work to ensure that the compaction of soil is reduced and controls for slash management. Guidelines indicate that skidding patterns should be planned out prior to the harvest (Table 16).

Table 16. Type and purpose of harvest across regions, according to pre-site survey data.

Region	Clear Cut (All Combined)	Group Selection	Salvage Sanitation	Seed Tree	Shelter Wood	Single Tree Selection	Thinning (All Strategies Combined)	Other
East Central	26	2	0	1	1	2	1	1
North Central	141	5	0	6	12	5	13	3
Northeast	99	2	4	1	1	1	3	0
Northern	43	0	1	0	0	0	0	0
Prairie	6	0	0	0	0	0	0	0
Southeast	3	3	0	3	0	1	0	0
West Central	6	0	2	0	0	1	4	0
Total	324	12	7	11	14	10	21	4

Type of harvest was also a major question on pre-site surveys, and the majority of landowners responded and identified the goal of harvest and type of harvest. The majority of harvests are clear cuts, but thinning prescriptions are often used to control for future forests or wildlife management (Table 17).



8 NORTHEAST REGION

8.1 SITES BY OWNERSHIP

A total of 111 sites were visited in the Northeast region across all ownership categories, including 25% of sites from State lands, 31% from Federal lands, 24% from County lands, and 2% from Tribal lands. Private industry made up 18% of sites, split up between 5% industry and 13% non-industrial private forest ownerships. Northeast region represented the second largest number of tribal sites (2) next to North Central region (4) (Table 18).

Table 17. Ownership across Northeast region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
Northeast	27	34	6	14	28	2	111

Over the 111 site visits, a mean site contained 83 acres (with a standard deviation of 71.5 acres). The largest site visited was 415.8 acres, and the smallest was 7.92 acres (Table 19).

Table 18. Acreage across Northeast region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
Northeast	111	7.92	83	415.8	71.5	9,216

8.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services. In the Northeast region, 53 sites had RMZs with a total of 85 overall RMZs. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average acreages of RMZs were 300.6 acres, with a much larger average acreage of lakes at 355.3 acres. Open water wetlands (OWW) were at the lowest acreage of all waterbodies at 2 acres (Table 20).

Table 19. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands.

Region	Northeast
Number sites with RMZ	53
Number RMZs	85
Average residual basal area in RMZ	66.7
Average CWD per acre	19.8
Average Guideline Width of RMZ buffer	300.6
Average width of streams	13.5

Average acreage of lakes	355.3
Average acreage of OWW	2

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report. Northeast region had a 67% compliance rate for trout stream buffer guidelines, though a much higher non-trout stream compliance (80%) and lake compliance (100%). As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For Northeast region, 76% of sites meet all requirements associated with basal area widths on RMZs, and 17% of sites met 78.8% of total basal area width requirements (Table 21).

Table 20. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
Northeast	53	85	67%	80%	100%	76%	17%	78.8%

8.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas. Northeast region had 451 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways. In total, filter strip compliance with FMGs was at 78% for Northeast region, with a wide variety of situations in which erosion was associated with infrastructure such as skid trails or road construction, landings, slash, and rutting. Skid trails were the main contributor of erosion in filter strips and should be avoided in the filter strip buffer as much as possible. Roads were the second highest, both construction and use contribute to sediment delivery to waterbodies and destruction of filter strip buffer systems. Landings should only be placed in filter strips as a last resort, if absolutely no other areas are available including no available upland area (Table 22; Table 23).

Table 21. Filter strips and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in Northeast region.

Region	Filter Strips (FS)	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
Northeast	451	15	27	48	3	5	78%

Table 22. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated =

exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Northeast	Concentrated	451	19	8	0	3
Northeast	Erosion	451	3	3	0	3
Northeast	Greater >5%	451	7	2	0	2
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Northeast	Landing	451	32	0	32	0
Northeast	Road constructed	451	13	0	13	0
Northeast	Rutting	451	12	7	0	1
Northeast	Skid trail	451	50	0	50	2
Northeast	Slash	451	3	1	0	0

8.4 CROSSINGS ON STREAMS, WETLANDS, AND PEATLANDS

Northeast region, across 111 sites, had 170 crossings of riparian areas. Of those 170 crossings, 12 were associated with streams, and 157 with wetlands or peatlands including open water wetlands and non-open water wetlands. The average length of the crossings surveyed was 278.1 feet, with 38 being noted as avoidable, meaning a route that avoided disruption of riparian area or equipment rutting and/or damage was available onsite. In total, 22% of crossings were avoidable (Table 24).

Table 23. Crossings and their associations with types of waterbodies.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
Northeast	111	170	12	157	278.1	38	22.35%

8.5 APPROACHES

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff. Out of 72 sites in the Northeast region with approaches, a total of 298 approaches were found in total by GMP and 12% of which needed erosion control methods. Six percent of all approaches had erosion control but still demonstrated some level of erosion, and 2% of all approaches had erosion with no control methods. Only 1% of all approaches in Northeast region showed delivery of sediment to a waterbody (Table 25).

Table 24. Table showing results from Northeast region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
Northeast	111	72	298	36	17	5	3

8.6 RUTTING

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years. A total of 40 sites contained rutting across the Northeast region, equivalent to 36% of all sites surveyed. The majority of rutting was associated with crossings (37%), non-open water wetlands (23%) and skid trails (15%). Roads made up 8% of all rutted features, and landings made up 3%. The average percent of each feature that was rutted was relatively low, but the large number of rutted features does raise concerns about how the landscape will recover from damage. Rutting is often considered short-term damage, and the USFS has conducted rutting severity studies for many years that may provide more information (Table 26).

Table 25. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across Northeast region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips Rutted	Rutted Features	Avg % of Feature Rutted
Northeast	111	40	0	22	36	3	15	8	12	97	8.7%

8.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands. Northeast region had 98 sites with leave tree retention strategies used, and 97 scattered leave trees per acre on average. A total of 16.8% of leave trees were adjacent to or found in an RMZ, and Northeast had a high compliance rate of FMGs around LTCs at 93.1% (Table 27).

Table 26. Leave Tree Areas or Clumps (LTC) in Northeast region.

Landscape Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree	Percent of Site in	Percent of Site in RMZ	Percent Net Compliance

				count per Acre	Leave Tree Clumps		
Northeast	111	7,865.20	98	97	4.13	16.8	93.1

8.8 On-site infrastructure – roads and landings

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can "creep," or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs. Northeast region had an average acreage across all sites of 83 acres, and an average infrastructure acreage of 2%, well within guidelines. In total Northeast region saw a 70.3% compliance rate for infrastructure impact areas. A total of 16.6% of landings were placed in wetlands, filter strips, or RMZs, and about a quarter of all sites in Northeast had landings placed in these sensitive areas even though alternative upland sites were present on site (Table 28; Table 29).

Table 27. Infrastructure acreage for Northeast region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg Infrastructure acres	Avg Landing acres	Avg Road acres	% Compliant
Northeast	111	107	83	1.845	1.276	0.56938	70.3%

Table 28. Total number of landings in Northeast region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
Northeast	2024	110	229	16.6%	25.5%

8.9 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species. Northeast region had 98 sites with distributed slash, 8% of which used methods of biomass harvest where all slash was removed from the site, and 4% of sites used a fine woody debris (FWD) strategy, retaining a small percentage (greater

than 33%) of tops and limbs. On average, sites had 41.8 logs of CWD per acre, well above guidelines but possibly creeping into non-beneficial territory (Table 30).

Table 29. Coarse Woody Debris (CWD) and slash distribution and strategies for Northeast region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
Northeast	111	98	8	4	41.8	2.8

8.10 Visual quality and Endangered and Threatened Species (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes. Northeast region had 53% of sites with vistas, 41% with less sensitive vistas, 9% with moderately sensitive, and 8% with more sensitive vistas. In total, 32.2% of vistas were considered highly sensitive, and 64.6% were compliant with FMGs protecting harvests from view (Table 31).

Table 30. Visual Quality and Endangered or Threatened species results for Northeast region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
Northeast	111	59	46	10	9	32.2%	64.6%
Region	**Sites**	**Checked For ETS**	**ETS**	**ETS Protected**	**% Sites Checked**	**% of Sites w/ ETS Protected**	**Total % of Sites Protected**
Northeast	111	101	7	5	91%	71.4%	4.5%

Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 31).

8.11 Timing and seasonality of harvest

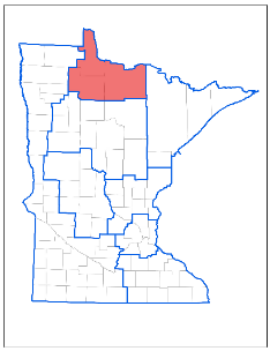
Timing of harvest is incredibly important to preventing long-term damage to an ecosystem, especially with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage, but provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, winters are expected to reach below freezing less often, and more severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often times equipment or

loggers are not available in winter months, or timber prices are more favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be more favorable if the weather is dry, but wetlands and RMZs are still highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills.

Northeast region had the majority of harvesting was done in winter at 57%, with remaining harvests split amongst spring, summer, and fall (Table 32).

Table 31. Timing and season of harvest for Northeast region.

Region	Spring	Summer	Fall	Winter
Northeast	16%	12%	15%	57%



9 NORTH CENTRAL

9.1 SITES BY OWNERSHIP

A total of 186 sites were visited in the North Central region across all ownership categories, including 31.7% of sites from State lands, 7.5% from Federal lands, 40% from County lands, and 2.2% from Tribal lands. Private industry made up 18.4% of sites, split up between 5.4% industry and 13% non-industrial private forest ownerships. North Central region represented the largest number of tribal sites (4) (Table 33).

Table 32. Ownership across North Central region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
North Central	75	14	10	24	59	4	186

Over the 186 site visits, a mean site contained 71.8 acres (with a standard deviation of 57.1 acres). The largest site visited was 504.9 acres, and the smallest was 9.45 acres (Table 34).

Table 33. Acreage across North Central region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
North Central	186	9.45	71.8	504.9	57.1	13,348

9.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services. In the North Central region, 56 sites had 84 overall RMZs. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average acreages of RMZs were 267.2 acres, the highest of all waterbody categories with much smaller average lake acreages (35.8 acres). Open water wetlands (OWW) were lowest at 2.9 acres (Table 35).

Table 34. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands.

Region	North Central
Number sites with RMZ	56
Number RMZs	84
Average residual basal area in RMZ	45.4
Average CWD per acre	13.1
Average Guideline Width of RMZ buffer	267.2
Average width of streams	17.9
Average acreage of lakes	35.8

Average acreage of OWW	2.9

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report. North Central region had an 80% compliance rate for trout stream buffer guidelines, though a slightly lower non-trout stream compliance (74%) and slightly higher lake compliance (85%). As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For North Central region, 74% of sites meet all requirements associated with basal area widths on RMZs, and 18% of sites met 82.9% of total basal area width requirements (Table 36).

Table 35. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
North Central	56	84	80%	74%	85%	74%	18%	82.9%

9.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas. North Central region had 911 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways. In total, filter strip compliance with FMGs was at 86% for North Central region, with a wide variety of situations in which erosion was associated with infrastructure such as skid trails or road construction, landings, slash, and rutting. Skid trails and roads were the main contributor of erosion in filter strips and should be avoided in the filter strip buffer as much as possible. Landings in filter strips were also high and should only be placed in filter strips as a last resort, if absolutely no other areas are available including no available upland area (Table 37; Table 38).

Table 36. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in North Central region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
North Central	911	22	38	93	4	1	86%

Table 37. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated =

exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
North Central	Concentrated	911	6	3	0	0
North Central	Erosion	911	4	1	0	0
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
North Central	Landing	911	42	0	42	0
North Central	Other	911	2	1	0	0
North Central	Road	911	1	0	1	0
North Central	Road Construction	911	29	0	29	0
North Central	Rutting	911	6	1	0	0

9.4 CROSSINGS ON STREAMS, WETLANDS, AND PEATLANDS

North Central region, across 186 sites, had 227 crossings of riparian areas. Of those 227 crossings, 5 were associated with streams, and 220 with wetlands or peatlands including open water wetlands and non-open water wetlands. The average length of the crossings surveyed was 218.3 feet, with 60 being noted as avoidable, meaning a route that avoided disruption of riparian area or equipment rutting and/or damage was available onsite. In total, 26.4% of crossings were avoidable (Table 39).

Table 38. Crossings and their associations with types of waterbodies for North Central.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
North Central	186	227	5	220	218.3	60	26.4%

9.5 APPROACHES

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff. Out of 89 sites in the North Central region with approaches, a total of 417 approaches were found in total by GMP and only 5% of which needed erosion control methods. Less than one percent of all approaches had erosion control but still demonstrated some level of erosion, and 1.2% of all approaches had erosion with no control methods. Less than one percent of all approaches in North Central region showed delivery of sediment to a waterbody (Table 40).

Table 39. Table showing results from North Central region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
North Central	186	89	417	19	4	5	3

9.6 RUTTING

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years. A total of 54 sites contained rutting across the North Central region, equivalent to 29% of all sites surveyed. The majority of rutting was associated with crossings (41%), non-open water wetlands (13%) and skid trails (18%). Roads made up 17% of all rutted features, and landings made up 6%. The average percent of each feature that was rutted was relatively low, but the large number of rutted features does raise concerns about how the landscape will recover from damage. Rutting is often considered short-term damage, and the USFS has conducted rutting severity studies for many years that may provide more information (Table 41).

Table 40. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across North Central region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips Rutted	Rutted Features	Avg % of Feature Rutted
North Central	186	54	1	15	47	7	21	19	5	115	17.7%

9.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands. North Central region had 136 sites with leave tree retention strategies used, and 134 scattered leave trees per acre on average. A total of 5.7% of leave trees were adjacent to or found in an RMZ, and North Central had a high compliance rate of FMGs around LTCs at 90.8% (Table 42).

Table 41. Leave Tree Areas or Clumps (LTC) in North Central region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance

North Central	186	9,535.8	136	134	5.7%	5.7%	90.8%

9.8 ON-SITE INFRASTRUCTURE – ROADS AND LANDINGS

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can "creep," or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs. North Central region had an average acreage across all sites of 71.8 acres, a total of 13,348 acres in total across North Central sites, and only 1.415 average acres of infrastructure across all sites, well within guidelines. In total North Central region saw a 79% compliance rate for infrastructure impact areas. A total of 10.6% of landings were placed in wetlands, filter strips, or RMZs, and 16.1% of sites in North Central had landings placed in these sensitive areas even though alternative upland sites were present on site (Table 43; Table 44).

Table 42. Infrastructure acreage for North Central region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
North Central	186	174	71.8	1.42	0.93	0.48	79%

Table 43. Total number of landings in North Central region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
North Central	2024	186	301	10.6%	16.1%

9.9 SLASH AND COARSE WOODY DEBRIS (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species. North Central region had 169 sites with distributed slash, 19.5% of which used methods of biomass harvest where all slash was removed from the site, and 10% of sites used a fine woody debris (FWD) strategy, retaining a small

percentage of tops and limbs. On average, sites had 34.9 logs of CWD per acre, well above guidelines but possibly creeping into non-beneficial territory (Table 45).

Table 44. Coarse Woody Debris (CWD) and slash distribution and strategies for North Central region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
North Central	186	169	33	17	34.9	3

9.10 VISUAL QUALITY AND ENDANGERED AND THREATENED SPECIES (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes. North Central region had 63% of sites with vistas, 41% with less sensitive vistas, 11% with moderately sensitive, and 13% with more sensitive vistas. In total, 38.1% of vistas were considered highly sensitive, and 69% were compliant with FMGs protecting harvests from view (Table 46).

Table 45. Visual Quality and Endangered or Threatened Species guidelines for North Central region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
North Central	186	118	76	21	24	38.1%	69%
Region	**Sites**	**Checked For ETS**	**ETS**	**ETS Protected**	**% Sites Checked**	**% of Sites w/ ETS Protected**	**Total % of Sites Protected**
North Central	186	169	18	13	90.9%	72.2%	7%

Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 46).

9.11 TIMING AND SEASONALITY OF HARVEST

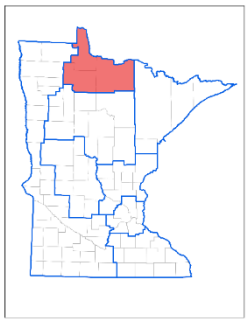
Timing of harvest is incredibly important to preventing long-term damage to an ecosystem, especially with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage, but also provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, winters are expected to reach below freezing less often, and more severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often times equipment or

loggers are not available in winter months, or timber prices are more favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be more favorable if the weather is dry, but wetlands and RMZs are still highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills.

North Central region had about half of sites harvested in winter, with the remaining half split amongst fall, spring, and summer (Table 47).

Table 46. Timing and season of harvest for North Central region.

Region	Spring	Summer	Fall	Winter
North Central	17%	14%	22%	47%



10 NORTHERN

10.1 SITES BY OWNERSHIP

A total of 186 sites were visited in the Northern region across all ownership categories, including 43% of sites from State lands, 30% from County lands, with no Federal or Tribal sites. Private industry made up 26.8% of sites, split up between 6.8% industry and 20% non-industrial private forest ownerships (Table 48).

Table 47. Ownership across Northern region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
Northern	13	0	3	9	19	0	44

Over the 44 site visits, a mean site contained 89 acres (with a standard deviation of 65.1 acres). The largest site visited was 253.4 acres, and the smallest was 12.6 acres (Table 49).

Table 48. Acreage across Northern region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
Northern	44	12.6	89	253.4	65.1	3,916

10.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services. In the Northern region there were a total of 16 overall RMZs over 44 sites. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average basal area was 38.2, even with fewer RMZs and smaller overall sites (Table 50).

Table 49. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands.

Region	North
Number sites with RMZ	44
Number RMZs	16
Average residual basal area in RMZ	38.2
Average CWD per acre	13.1
Average Guideline Width of RMZ buffer	193.1
Average width of streams	53.6
Average acreage of lakes	0
Average acreage of OWW	0

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report. Northern region had an 80% compliance rate for trout stream buffer guidelines, though a complete lack of non-trout stream compliance (0%) out of only 16 overall RMZs, and decent lake compliance (75%). As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For Northern region, 75% of sites meet all requirements associated with basal area widths on RMZs, and 25% of sites met 84.9% of total basal area width requirements (Table 51).

Table 50. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
Northern	11	16	80%	0%	75%	75%	25%	84.9%

10.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas. Northern region had 171 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways. In total, filter strip compliance with FMGs was at 77% for Northern region, with a wide variety of situations in which erosion was associated with infrastructure such as skid trails or road construction, landings, slash, and rutting. Skid trails and landings were the main contributor of erosion in filter strips and should be avoided in the filter strip buffer as much as possible. Landings in filter strips should only be placed in filter strips as a last resort, if absolutely no other areas are available including no available upland area (Table 52; Table 53).

Table 51. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in Northern region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
Northern	171	2	15	23	2	2	77%

Table 52. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated = exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody

Northern	Concentrated	171	2	1	0	1
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Northern	Landing	171	18	0	18	0
Northern	Road Construction	171	10	0	10	1
Northern	Skid Trails	171	12	0	12	0
Northern	Slash	171	4	3	0	0

10.4 Crossings on streams, wetlands, and peatlands

Northern region, across 44 sites, had 126 crossings of riparian areas. Of those 126 crossings, 2 were associated with streams, and 123 with wetlands or peatlands including open water wetlands and non-open water wetlands. The average length of the crossings surveyed was 439.8 feet, with 17 being noted as avoidable, meaning a route that avoided disruption of riparian area or equipment rutting and/or damage was available onsite. In total, 13.5% of crossings were avoidable (Table 54).

Table 53. Crossings and their associations with types of waterbodies.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
North	44	126	2	123	439.8	17	13.5%

10.5 Approaches

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff. Out of 44 sites in the Northern region with approaches, a total of 165 approaches were found in total by GMP and only 1.2% of which needed erosion control methods. Zero approaches had erosion control but still demonstrated some level of erosion, and 1.2% of all approaches had erosion with no control methods. Less than one percent of all approaches in Northern region showed delivery of sediment to a waterbody (Table 55).

Table 54. Table showing results from Northern region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
Northern	44	34	165	2	0	2	1

10.6 RUTTING

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years. A total of 20 sites contained rutting across the Northern region, equivalent to 45% of all sites surveyed. The majority of rutting was associated with crossings (35%), roads (19%), non-open water wetlands (NOWW) (19%), and skid trails (13.5%). Filter strip rutting and landing rutting were very low, and zero rutting occurred in OWW. The average percent of each feature that was rutted was very low (Table 56).

Table 55. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across Northern region

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips rutted	Rutted Features	Avg % of Feature Rutted
Northern	44	20	0	10	18	4	7	10	3	52	6.2%

10.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands. Northern region had 42 sites with leave tree retention strategies and 42 average leave trees per acre. In total, 6.5% of sites used the clump leave tree strategy, 19.3% of which were placed in RMZ areas, with a high compliance of just over 91% (Table 57).

Table 56. Leave Tree Areas or Clumps (LTC) in Northern region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance
Northern	44	3,628.9	42	42	6.5%	19.3%	91.4%

10.8 ON-SITE INFRASTRUCTURE – ROADS AND LANDINGS

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can “creep,” or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs.

Northern region had an average acreage across all sites of 89 acres, and an average of 1.9 acres of infrastructure across all sites, well within guidelines. In total Northern region saw an 86.4% compliance rate for infrastructure impact areas. A total of 17.5% of landings were placed in wetlands, filter strips, or RMZs, and 22.7% of sites in Northern region had landings placed in these sensitive areas even though alternative upland sites were present on site (Table 58; Table 59).

Table 57. Infrastructure acreage for Northern region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
Northern	44	41	90	1.9	1.1	0.80	86.4%

Table 58. Total number of landings in Northern region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
Northern	2024	44	114	17.5%	22.7%

10.9 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species. Northern region had 43 sites out of 44 total with distributed slash, with an average of 34.8 CWD logs per acre, well above guidelines but possibly too high for adequate regeneration. Only 4% of sites used a method to remove slash from the site, and only 4% of sites used retention of smaller tops and limbs. A large amount of slash was left across the majority of sites, possibly due to the type of harvest and timber removed from Northern sites, or due to the type of logging equipment used (Table 60).

Table 59. Coarse Woody Debris (CWD) and slash distribution and strategies for Northern region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
Northern	44	43	2	2	34.8	2.3

10.10 VISUAL QUALITY AND ENDANGERED AND THREATENED SPECIES (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes. Northern region had 41% of sites with vistas, 33% with less sensitive vistas, 7% with moderately sensitive, and 2% with more sensitive vistas. In total, 22.2% of vistas were considered highly sensitive, and 61% were compliant with FMGs protecting harvests (Table 61).

Table 60 Visual Quality and Endangered or Threatened Species guidelines for Northern region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
Northern	42	18	14	3	1	22.2%	61%
Region	Sites	Checked For ETS	ETS	ETS Protected	% Sites Checked	% of Sites w/ ETS Protected	Total % of Sites Protected
Northern	44	37	0	1	84.1%	NA	2.3%

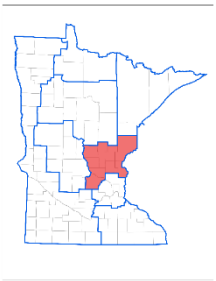
Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 55).

10.11 TIMING AND SEASONALITY OF HARVEST

Timing of harvest is important to preventing long-term damage to an ecosystem, with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage but provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, warm winters and severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often equipment or loggers are not available in winter months, or timber prices are favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be favorable if the weather is dry, but wetlands and RMZs are highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills. Northern region had the majority of harvests in winter at 80%, with 14% in spring and 7% in summer. 10 harvests were started in Fall and likely finished in winter, and a few harvests were started in winter and likely completed in the spring (Table 62).

Table 61. Timing (season) of harvest in Northern region.

Region	Spring	Summer	Fall	Winter
Northern	14%	7%	0%	80%



EAST CENTRAL

10.12 SITES BY OWNERSHIP

A total of 34 sites were visited in the East Central region across all ownership categories, including 53% of sites from State lands, 12% from County lands, with no Federal, Industry, or Tribal sites. Private ownership harvests made up 35% of all sites (Table 63).

Table 62. Ownership across East Central region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
East Central	4	0	0	12	18	0	34

Over the 34 site visits, a mean site contained 78.2 acres (with a standard deviation of 62.3 acres). The largest site visited was 298.9 acres, and the smallest was 11.61 acres (Table 64).

Table 63. Acreage across East Central region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
East Central	34	11.61	78.2	298.9	62.3	2,658

10.13 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services. In the East Central region there were a total of 17 overall RMZs over 34 sites. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average basal area was 54.2 in the RMZ (Table 65).

Table 64. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands.

Region	East Central
Number sites with RMZ	34
Number RMZs	17
Average residual basal area in RMZ	54.2
Average CWD per acre	15
Average Guideline Width of RMZ buffer	292.6
Average width of streams	12.1
Average acreage of lakes	0
Average acreage of OWW	0

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report.

East Central region had an 100% compliance rate for trout stream buffer guidelines, though a lower non-trout stream compliance (67%) out of only 17 overall RMZs. Lake compliance was at zero because no lakes were noted in the region's samples. As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For East Central region, 67% of sites meet all requirements associated with basal area widths on RMZs, and 33% of sites met 87% of total basal area width requirements (Table 66).

Table 65. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes in East Central region.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
East Central	12	17	100%	67%	0%	67%	33%	87%

10.14 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas.

East Central region had 190 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways, a huge number compared to the small number of overall sites in East Central. In total, filter strip compliance with FMGs was at 74% for East Central region, with situations in which erosion was associated with infrastructure. Landings were the main contributor of erosion in filter strips and should be avoided in the filter strip buffer as much as possible. Landings should only be placed in filter strips as a last resort, if absolutely no other areas are available including no available upland area (Table 67; Table 68).

Table 66. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in East Central region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
East Central	190	4	15	31	2	3	74%

Table 67. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated =

exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
East Central	Concentrated	190	2	1	1	1
East Central	Erosion	190	1	1	1	1
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
East Central	Greater >5%	190	1	1	0	1
East Central	Landing	190	17	0	17	2
East Central	Other	190	1	1	0	1
East Central	Road construction	190	9	0	9	0

10.15 Crossings on streams, wetlands, and peatlands

East Central region, across 34 sites, had 79 crossings of riparian areas. Of those 79 crossings, 2 were associated with streams, and 74 with wetlands or peatlands including open water wetlands and non-open water wetlands. The average length of the crossings surveyed was 245.9 feet, with 27 being noted as avoidable, meaning a route that avoided disruption of riparian area or equipment rutting and/or damage was available onsite. In total, over a third (34.2%) of crossings were avoidable (Table 69).

Table 68. Crossings and their associations with types of waterbodies in East Central region.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
East Central	34	79	2	74	245.9	27	34.2%

10.16 Approaches

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff.

Out of 25 sites in the East Central region with approaches, a total of 153 approaches were found in total by GMP and only 5.8% of which needed erosion control methods. Three approaches had erosion control but still demonstrated some level of erosion, and 2% of all approaches had erosion with no control methods. Zero approaches in East Central region showed delivery of sediment to a waterbody (Table 70).

Table 69. Table showing results from East Central region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
East Central	34	25	153	9	3	3	0

10.17 RUTTING

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years.

A total of only 7 sites contained rutting across the East Central region, equivalent to 21% of all sites surveyed. The majority of rutting was associated with skid trails (57%), crossings (43%), and non-open water wetlands, landings, and roads (each 14%). The average percent of each feature that was rutted was very 12%, slightly higher than other northern regions but still at manageable levels (Table 71).

Table 70. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across East Central region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips rutted	Rutted Features	Avg % of Feature Rutted
East Central	34	7	0	1	3	1	4	1	0	10	12.1%

10.18 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands. East Central region had 25 sites with leave tree retention strategies and 25 average leave trees per acre. In total, 5.2% of sites used the clump leave tree strategy, 5.7% of which were placed in RMZ areas, with a very high compliance of just over 99% (Table 72).

Table 71. Leave Tree Areas or Clumps (LTC) in East Central region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance

East Central	34	2,208.20	25	25	5.2%	5.7%	99.4%

10.19 On-site infrastructure – roads and landings

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can "creep," or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs.

East Central region had an average acreage across all sites of 78.2 acres and only an average of 1.2 acres of infrastructure across all sites, well within guidelines. In total East Central region saw a 91.2% compliance rate for infrastructure impact areas. A total of 22.4% of landings were placed in wetlands, filter strips, or RMZs, and 29.4% of sites in East Central had landings placed in these sensitive areas even though alternative upland sites were present on site. This number is relatively high, close to a third of sites had a landing in a wet area where a dry area was potentially available (Table 73; Table 74).

Table 72. Infrastructure acreage for East Central region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
East Central	34	34	78.2	1.2	0.80	0.40	91.2%

Table 73. Total number of landings in East Central region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
East Central	2023	34	49	22.4%	29.4%

10.20 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species.

East Central region had 30 sites out of 34 total with distributed slash, with an average of 24.4 CWD logs per acre, well above guidelines and potentially high for adequate regeneration. Forty percent

of sites with slash used a method to remove slash from the site, and only 3% of sites used retention of smaller tops and limbs (Table 75).

Table 74. Coarse Woody Debris (CWD) and slash distribution and strategies for East Central region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
East Central	34	30	12	1	24.4	2.7

10.21 Visual quality and Endangered and Threatened Species (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes.

East Central region had 56% of sites with vistas, 41% with less sensitive vistas, 12% with moderately sensitive, and 3% with more sensitive vistas. In total, 26.3% of vistas were considered highly sensitive, and 70.8% were compliant with FMGs protecting harvests (Table 76).

Table 75. Visual Quality and Endangered or Threatened Species guidelines for East Central region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
East Central	34	19	14	4	1	26.3%	70.8%
Region	Sites	Checked For ETS	ETS	ETS Protected	% Sites Checked	% of Sites w/ ETS Protected	Total % of Sites Protected
East Central	34	27	7	3	79.4%	42.9%	8.8%

Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 76).

10.22 Timing and seasonality of harvest

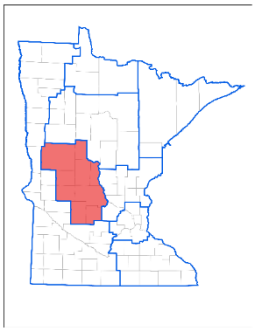
Timing of harvest is important to preventing long-term damage to an ecosystem, with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage but also provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, warmer winters and severe rain events are predicted. Winter is the best season to harvest to prevent damage to regeneration, but often equipment or loggers are not available in winter months, or timber prices are favorable earlier in the

year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be favorable if the weather is dry, but wetlands and RMZs are still susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills.

East Central region had the majority of harvests in winter at 56%, with 13% in spring and 19% in summer. A total of 13% of harvests were completed in Fall. Two harvests did not have timing data for the region (Table 77).

Table 76. Timing (season) of harvest in East Central region.

Region	Spring	Summer	Fall	Winter
East Central	13%	19%	13%	56%



11 WEST CENTRAL

11.1 SITES BY OWNERSHIP

A total of 13 sites were visited in West Central region, with 53% of sites in non-industrial private forest ownership, and the remaining 46% in state ownership (Table 78).

Table 77. Ownership across West Central region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
West Central	0	0	0	7	6	0	13

Over the 13 site visits, a mean site contained 68.3 acres (with a standard deviation of 43.1 acres). The largest site visited was 143.1 acres, and the smallest was 13.07 acres (Table 79).

Table 78. Acreage across West Central region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
West Central	13	13.07	68.3	143.1	43.1	888

11.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services. In the West Central region there were a total of only 4 overall RMZs over 13 sites. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average basal area was 49.2 in the RMZ. Coarse woody debris was relatively low, with only an average of 5.8 logs per acre (Table 80).

Table 79. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands.

Region	West Central
Number sites with RMZ	13
Number RMZs	4
Average residual basal area in RMZ	49.2
Average CWD per acre	5.8
Average Guideline Width of RMZ buffer	249.8
Average width of streams	19
Average acreage of lakes	151
Average acreage of OWW	2

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report.

West Central region had an 0% compliance rate for trout stream buffer guidelines, though a non-trout stream compliance (67%) out of only 4 overall RMZs. Lake compliance was at zero because no lakes were noted in the region's samples. As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For West Central region, 67% of sites meet all requirements associated with basal area widths on RMZs, and 0% of sites met 0% of total basal area width requirements (Table 81).

Table 80. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes in West Central region.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
West Central	3	4	0%	67%	0%	67%	0%	0%

11.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas.

West Central region had 30 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways, a huge number compared to the small number of overall sites in West Central. In total, filter strip compliance with FMGs was at 90% for West Central region, incredibly high considering the number of filter strips surveyed. Road construction, skid trails, and slash were all equally contributing to the erosion in filter strips but overall represented only a few select instances of erosion in a FS (Table 82; Table 83).

Table 81. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in West Central region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
West Central	30	1	0	3	0	0	90%

Table 82. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated =

exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
West Central	No Soil Exposure	30	3	1	3	0
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
West Central	Road Construction	30	1	0	1	0
West Central	Skid trail	30	1	0	1	0
West Central	Slash	30	1	1	0	0

11.4 CROSSINGS ON STREAMS, WETLANDS, AND PEATLANDS

West Central region, across 13 sites, had 6 crossings of riparian areas. Of those 6 crossings, all 6 were associated with wetlands or peatlands including open water wetlands and non-open water wetlands. The average length of the crossings surveyed was 166.8 feet, with only one being noted as avoidable, meaning a route that avoided disruption of riparian area or equipment rutting and/or damage was available onsite. In total, 16.7% of crossings were avoidable (Table 84).

Table 83. Crossings and their associations with types of waterbodies in West Central region.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
West Central	13	6	0	6	166.8	1	16.7%

11.5 APPROACHES

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff.

Out of 25 sites in the West Central region with approaches, a total of 10 approaches were found in total by GMP and none of which needed erosion control methods Zero approaches in Southeast region showed delivery of sediment to a waterbody (Table 85).

Table 84. Table showing results from West Central region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
West Central	13	4	10	0	0	0	0

11.6 RUTTING

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years.

A total of only 3 sites contained rutting across the West Central region, equivalent to 23% of all sites surveyed. The majority of rutting was associated with skid trails (66%) and roads (33%). The average percent of each feature that was rutted was very 31.8%, quite high but only associated with 3 overall sites (Table 86).

Table 85. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across West Central region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips rutted	Rutted Features	Avg % of Feature Rutted
West Central	13	3	0	0	0	0	2	1	0	3	31.8

11.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands.

West Central region had 6 sites with leave tree retention strategies and 5 average leave trees per acre. In total, 3.3% of sites used the clump leave tree strategy, 8.8% of which were placed in RMZ areas, with a very high compliance of 100% (Table 87).

Table 86. Leave Tree Areas or Clumps (LTC) in West Central region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance
West Central	13	417.2	6	5	3.3%	8.8%	100%

11.8 ON-SITE INFRASTRUCTURE – ROADS AND LANDINGS

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can “creep,” or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or

replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs.

West Central region had an average acreage across all sites of 68.3 acres and only an average of 0.52 acres of infrastructure across all sites, well within guidelines. In total West Central region saw a 92.3% compliance rate for infrastructure impact areas. A total of zero landings were placed in wetlands, filter strips, or RMZs, and zero sites in West Central had landings placed in these sensitive areas even though alternative upland sites were present on site. This represents an incredibly successful 13 sites according to guidelines around infrastructure in riparian areas (Table 88; Table 89).

Table 87. Infrastructure acreage for West Central region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
West Central	13	9	68.3	0.52	0.26	0.26	92.3%

Table 88. Total number of landings in West Central region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
West Central	2023	13	15	0%	0%

11.9 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species.

West Central region had 100% of sites with distributed slash, with an average of 21.7 CWD logs per acre, well above guidelines and potentially high for adequate regeneration. None of the surveyed sites with slash used a method to remove slash from the site or a strategy for retention of smaller tops and limbs (Table 90).

Table 89. Coarse Woody Debris (CWD) and slash distribution and strategies for West Central region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
West Central	13	13	0	0	21.7	4.2

11.10 VISUAL QUALITY AND ENDANGERED AND THREATENED SPECIES (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes.

West Central region had 54% of sites with vistas, 38% with less sensitive vistas, 15% with moderately sensitive, and zero with more sensitive vistas. In total, 28.3% of vistas were considered highly sensitive, and 94% were compliant with FMGs protecting harvests (Table 91).

Table 90. Visual Quality and Endangered or Threatened Species guidelines for West Central region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
West Central	13	7	5	2	0	28.6%	94%
Region	Sites	Checked For ETS	ETS	ETS Protected	% Sites Checked	% of Sites w/ ETS Protected	Total % of Sites Protected
West Central	13	6	3	2	46.2%	66.7%	15.4%

Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence of ETS before harvest gives managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 91).

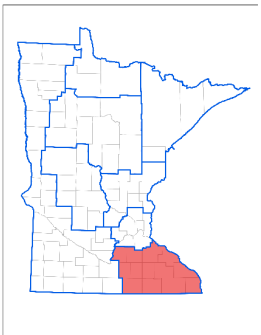
11.11 TIMING AND SEASONALITY OF HARVEST

Timing of harvest is important to preventing long-term damage to an ecosystem, with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage but provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, warm winters and severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often equipment or loggers are not available in winter months, or timber prices are favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be favorable if the weather is dry, but wetlands and RMZs are highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills. West Central region had equal numbers of harvests completed in spring and winter (33%), and 17% in fall and 17% in summer. Only 12 sites were recorded for harvest timing information from the region (Table 92).

Table 91. Timing (season) of harvest in West Central region.

Region	Spring	Summer	Fall	Winter

West Central	33%	17%	17%	33%



12 SOUTHEAST

12.1 SITES BY OWNERSHIP

A total of 10 sites were visited in the Southeast region, with 30% of sites in non-industrial private forest ownership, and the remaining 70% in state ownership (Table 93).

Table 92. Ownership across Southeast region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
Southeast	0	0	0	3	7	0	10

Over the 10 site visits, a mean site contained 35 acres (with a standard deviation of 20.2 acres). The largest site visited was 75.6 acres, and the smallest was 10.78 acres (Table 94).

Table 93. Acreage across Southeast region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
Southeast	10	10.78	35	75.6	20.2	350

12.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services.

In the Southeast region there were a total of 12 overall RMZs over 10 sites. Basal area of RMZs tends to be higher than the rest of a site, unless the harvest is specifically targeting species that grow in riparian areas such as black ash. Average basal area was 84.1 in the RMZ. Coarse woody debris was at 19.2 logs per acre on average (Table 95).

Table 94. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands in Southeast region.

Region	Southeast
Number sites with RMZ	10
Number RMZs	12
Average residual basal area in RMZ	84.1
Average CWD per acre	19.2
Average Guideline Width of RMZ buffer	238.8
Average width of streams	11.3
Average acreage of lakes	0
Average acreage of OWW	0

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report.

Southeast region had an 100% compliance rate for trout stream buffer guidelines, and a non-trout stream compliance at 100%. Lake compliance was at zero because no lakes were noted in the region's samples. As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For Southeast region, no partial compliance was calculated due to 100% compliance rates for trout and non-trout streams (Table 96).

Table 95. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes in Southeast region.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
Southeast	7	12	100%	100%	0%	100%	0%	0%

12.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas.

Southeast region had 16 surveyed filter strips, or buffer areas around lakes, streams, open water wetlands, and other riparian areas that provide stabilization of banks and reduce sediment runoff into waterways. In total, filter strip compliance with FMGs was at 94% for Southeast region. The only association with erosion was with skid trails in both instances of erosion noted in the data for Southeast (Table 97; Table 98).

Table 96. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in Southeast region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
Southeast	16	2	0	2	0	0	94%

Table 97. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated = exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody

Southeast	Concentrated	16	1	0	1	0
Southeast	Greater >5%	16	1	0	1	0
Southeast	No Soil Exposure	16	2	0	3	0
Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Southeast	Skid trail	16	2	0	2	0

12.4 Crossings on streams, wetlands, and peatlands

Southeast region had a total of only 2 crossings, none of which were found in streams or wetland areas. The average length of the crossings was 24 feet, and zero were noted as avoidable (Table 99).

Table 98. Crossings and their associations with types of waterbodies in Southeast region.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
Southeast	10	2	0	0	24	0	0%

12.5 Approaches

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff.

Out of just two sites in the Southeast region with approaches, a total of 4 approaches were found in total by GMP and none needed erosion control methods. Zero approaches in Southeast region showed delivery of sediment to a waterbody (Table 100).

Table 99. Table showing results from Southeast region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
Southeast	10	2	4	0	0	0	0

12.6 Rutting

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years.

A total of only 3 sites contained rutting across the Southeast region with 4 total rutted features, equivalent to 30% of all sites surveyed. The majority of rutting was associated with skid trails (67%) and landings (67%). The average percent of each feature that was rutted was very low at 2.5% (Table 101).

Table 100. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across Southeast region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips rutted	Rutted Features	Avg % of Feature Rutted
Southeast	10	3	0	0	0	2	2	0	0	4	2.5%

12.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands.

Southeast region had 3 sites with leave tree retention strategies and 3 average leave trees per acre. In total, 15% of sites used the clump leave tree strategy, 3.65% of which were placed in RMZ areas, with a very high compliance of 100% (Table 102).

Table 101. Leave Tree Areas or Clumps (LTC) in Southeast region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance
Southeast	10	92.3	3	3	15%	3.65%	100%

12.8 ON-SITE INFRASTRUCTURE – ROADS AND LANDINGS

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can “creep,” or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs.

Southeast region had an average acreage across all sites of 35 acres and only an average of 0.57 acres of infrastructure across sites, well within guidelines. In total Southeast region saw a 90% compliance rate for infrastructure impact areas. A total of zero landings were placed in wetlands, filter strips, or RMZs, and zero sites in Southeast had landings placed in these sensitive areas even though alternative upland sites were present on site. This represents an incredibly successful 10 sites according to guidelines around infrastructure in riparian areas (Table 103; Table 104).

Table 102. Infrastructure acreage for Southeast region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
Southeast	10	9	35	0.57	0.57	0.003	90%

Table 103. Total number of landings in Southeast region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
Southeast	2023	10	10	0	0

12.9 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species.

Southeast region had 10 sites with distributed slash, with an average of 59.4 CWD logs per acre, well above guidelines and potentially high for adequate regeneration, as this is close to recommended basal area in some riparian areas. None of the surveyed sites with slash used a method to remove slash from the site or a strategy for retention of smaller tops and limbs (Table 105).

Table 104. Coarse Woody Debris (CWD) and slash distribution and strategies for West Central region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
Southeast	10	10	0	0	59.4	8.5

12.10 Visual quality and Endangered and Threatened Species (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important

to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes.

Southeast region had 60% of sites with vistas, 30% with less sensitive vistas, zero with moderately sensitive, and 30% with more sensitive vistas. In total, 50% of vistas were considered highly sensitive, and only 68.2% were compliant with FMGs protecting harvests (Table 106).

Table 105. Visual Quality and Endangered or Threatened Species guidelines for Southeast region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
Southeast	10	6	3	0	3	50%	68.2%
Region	Sites	Checked For ETS	ETS Present	ETS Protected	% Sites Checked	% of Sites w/ ETS Protected	Total % of Sites Protected
Southeast	10	7	0	0	70%	NA	NA

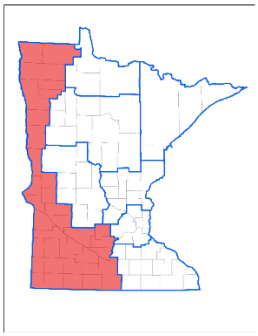
Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 106).

12.11 TIMING AND SEASONALITY OF HARVEST

Timing of harvest is important to preventing long-term damage to an ecosystem, with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage but provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, warm winters and severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often equipment or loggers are not available in winter months, or timber prices are favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be favorable if the weather is dry, but wetlands and RMZs are highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills. Southeast region had relatively similar proportions of harvests completed in each month. Winter was highest at 40% of harvests, with spring following closely behind (30%) (Table 107).

Table 106. Timing (season) of harvest in Southeast region.

Region	Spring	Summer	Fall	Winter
Southeast	30%	10%	20%	40%



13 PRAIRIE

Prairie region represents much of western Minnesota and is generally not forested across much of its acreage. The region is generally not discussed as part of Minnesota's Forest Management Guidelines, and generally very few harvests occur in the area considered to be "Prairie" region; it also does not host its own MFRC Landscape Committee. However, since a few of the sites surveyed during the previous 5-year period by GMP were technically found in the Prairie region, it is discussed here in detail.

13.1 SITES BY OWNERSHIP

A total of 6 sites were visited in Prairie region, with 17% of sites in non-industrial private forest ownership, and the remaining 83% in state ownership (Table 108).

Table 107. Ownership across Prairie region sites.

Region	County	Federal	Industry	NIPF	State	Tribal	Total
Prairie	0	0	0	1	5	0	6

Over the 6 site visits, a mean site contained 97.7 acres (with a standard deviation of 68.7 acres). The largest site visited was 181.4 acres, and the smallest was 12.88 acres (Table 109).

Table 108. Acreage across Prairie region sites.

Region	Total Sites	Min acres	Mean acres	Max acres	Standard deviation	Total acres
Prairie	6	12.88	97.7	181.4	68.7	586

13.2 RIPARIAN MANAGEMENT ZONES (RMZS)

Riparian management zones serve major functions for the landscape, hosting numerous unique native species and play a crucial role in maintaining water quality, preventing erosion, and encouraging healthy regeneration of forests. Managing land use activities to prevent erosion, runoff, and degradation of RMZs ensures protection of these resources and ecosystem services.

Only one RMZ was found in Prairie region. No other information was collected regarding acreages, no streams, wetlands, or lakes were found in the region as part of GMP surveying (Table 110).

Table 109. Breakdown of RMZ sites and acreage of detailed information about waterbodies and wetlands in Prairie region.

Region	Prairie
Number sites with RMZ	6
Number RMZs	1
Average residual basal area in RMZ	0
Average CWD per acre	0
Average Guideline Width of RMZ buffer	0

Average width of streams	0
Average acreage of lakes	0
Average acreage of OWW	0

Included in discussion of RMZs are trout and non-trout streams and lakes. Specific guidelines exist around trout streams, giving them larger disturbance buffers than non-trout streams or lakes. Note that filter strip results are not included in this area of the report.

Southeast region had only one site with two total RMZs, none of which were associated with trout or non-trout streams or lakes, therefore no compliance is reported for these guidelines (Table 111).

Table 110. Regional compliance results for RMZ guidelines, including trout streams, non-trout streams, and lakes in Prairie region.

Region	Sites w/ RMZ	Total RMZ	% trout stream compliance	% non-trout stream compliance	% lake compliance	Total compliance	Partial compliance	Mean compliance
Prairie	1	2	0%	0%	0%	67%	0%	0%

13.3 FILTER STRIPS

Filter strips serve as an important protection for waterbodies, filtering sediment and runoff before it can enter a waterway and work its way downstream or damage the local species. Sediment can be detrimental to the natural ecosystems of rivers and lakes, destroying habitat and changing the chemistry of the water content. Filter strips are the final filtration for preventing sediment delivery to riparian areas.

Prairie region had 22 filter strips, only 2 of which had a landing placed in the filter strip (without soil exposure present). Overall compliance for Prairie region was at 77%. All filter strips with issues were associated with infrastructure, specifically in once instance with road construction (Table 112; Table 113).

Table 111. Filter strips (FS) and their associations with soil exposure, landings, skid trails or roads, and filter strips containing erosion and sediment delivery to a nearby waterbody observed in Prairie region.

Region	Filter Strips	FS w/ Soil Exposure	FS w/ Landing & No Soil Exposure	Road or Skid Trail on FS	FS w/ Erosion	FS w/ Sediment to Waterbody	Percent Compliant
Prairie	22	0	2	0	0	0	77%

Table 112. A breakdown of reasons for monitoring a filter strip (FS), the number of filter strips associated with the monitoring reason and detailed information about associations with soil exposure. Soil exposure categories are as follows; concentrated = exposed mineral soil concentrated in filter strip, erosion = erosion occurring within filter strip, greater >5% = greater than 5% exposed mineral soil distributed through filter strip.

Region	Soil exposure	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Prairie	No Soil Exposure	22	3	0	4	0

Region	Monitoring Reason	FS	FS w/ erosion	FS not associated with infrastructure	FS associated with infrastructure	FS with sediment delivery to waterbody
Prairie	Road construction	22	1	0	1	0

13.4 Crossings on streams, wetlands, and peatlands

Prairie region, across 6 total sites, had 21 crossings, all of which were associated with wetlands or peatlands. One crossing was deemed avoidable, a very small number in comparison to the overall total crossings in the area, and only 4.8% were considered avoidable (Table 114).

Table 113. Crossings and their associations with types of waterbodies in Prairie region.

Region	Total sites	Crossings	Streams	Wetland / Peatland	Average Length (feet)	Avoidable	% Avoidable
Prairie	6	21	0	21	685.6	1	4.8%

13.5 Approaches

Approaches are areas of equipment use in a filter strip immediately before a waterbody that may lead to sedimentation; they may or may not enter a waterbody and can be in the form of a skid trail, road, or landing. Most approaches are associated with crossings. Approaches should be designed in a way that diverts water away from streams and wetlands, controlling runoff into riparian areas and preventing sediment delivery to waterbodies. This also typically includes erosion control methods like water bars or rolling dips to control runoff.

Out of 6 sites in the Prairie region with approaches, a total of 17 approaches were found in total by GMP and zero needed erosion control methods. Zero approaches in Central Region showed delivery of sediment to a waterbody (Table 115).

Table 114. Table showing results from Prairie region on approaches and their needs for erosion control and possible sediment delivery to a waterbody.

Region	Sites	Sites w/ approaches	Approaches	Approaches needing erosion control	Approaches with erosion control	Approaches w/ erosion	Approaches with sediment delivery to waterbody
Prairie	6	6	17	0	0	0	0

13.6 Rutting

Rutting commonly occurs when heavy forestry equipment and machinery conduct harvest activities in wet or muddy areas. Rutting surveyed by GMP typically measures at least 6 inches in depth. Rutting can disrupt native species, create more soil exposure and possible runoff into riparian areas. Rutting can also impact forest regeneration and compaction of soil, leading to lower production in subsequent years.

No rutting was found at any site or feature for Prairie region (Table 116).

Table 115. Rutting in or associated with non-open water wetlands (NOWW), crossings, landings, skid trails, and roads across Prairie region.

Region	Sites	Rutted Sites	OWW rutting	NOWW rutting	Crossing rutting	Landing rutting	Skid trail rutting	Road rutting	Filter Strips rutted	Rutted Features	Avg % of Feature Rutted
Prairie	6	0	0	0	0	0	0	0	0	0	0

13.7 LEAVE TREE AREAS

Leave trees are the trees, either individual trees scattered across the landscape or clumped into groups to protect them from blowdown and stress, that provide regeneration for a stand as a seed source. Landowners typically design leave tree clumps, or LTCs, to be filled with the species they want to naturally reseed their landscape for the forest of tomorrow. Leave tree clumps or dispersed leave trees may also be left for controlling or encouraging certain wildlife, such as deer browse for future hunting stands.

Prairie region had 6 sites with leave tree retention strategies and 6 average leave trees per acre. In total, 15.4% of sites used the clump leave tree strategy, 19.5% of which were placed in RMZ areas, with a very high compliance of 96.7% (Table 117).

Table 116. Leave Tree Areas or Clumps (LTC) in Prairie region.

Region	Sites	Total Acres	Sites w/ Leave Tree Retention	Avg Scattered Leave Tree count per Acre	Percent of Site in Leave Tree Clumps	Percent of Site in RMZ	Percent Net Compliance
Prairie	6	586.2	6	6	15.4%	19.5%	96.7%

13.8 ON-SITE INFRASTRUCTURE – ROADS AND LANDINGS

Infrastructure like roads and landings are vital to timber harvest, and the use of landings is often dictated by the type of machinery used, the type of cut performed, and the nature of the landscape of the site. A major FMG goal is to keep all infrastructure area below 1 acre for sites <20 acres, 5% or less for sites between 20-30 acres, and 3% of less for sites greater than 30 acres. Landings can "creep," or slowly expand over time as erosion and runoff contribute to soil instability if areas are not reseeded or replanted, typically difficult due to the compaction that occurs on landings. Placing landings in wetlands or RMZs creates sediment delivery to waterbodies over time, as creep occurs.

Prairie region had an average acreage across all sites of 97.7 acres and an average of 1.9 acres of infrastructure across all sites, well within guidelines. In total Prairie region saw a 100% compliance rate for infrastructure impact areas. A total of 15.4% of landings were placed in wetlands, making up 33.3% of sites, out of a total of 13 landings across the region (Table 118; Table 119).

Table 117. Infrastructure acreage for Prairie region sites, including landings and roads.

Region	Sites	Sites w/ infrastructure	Mean acres / site	Avg infrastructure acres	Avg landing acres	Avg road acres	% Compliant
Prairie	6	6	97.7	1.9	1.5	0.43	100

Table 118. Total number of landings in Prairie region, including percent of landings located in a wetland, filter strip (FS), or RMZ, and a percent of the total sites with a landing in a wetland FS/RMZ where an alternative upland landing site was available.

Region	Monitoring year	Sites	Landings	% Landings in wetland/FS/RMZs	% Sites with landings in wetland/FS/RMZs where Upland available
Prairie	2022	6	13	15.4%	33.3%

13.9 Slash and Coarse Woody Debris (CWD)

Slash is the accumulation of woody material from a timber harvest, typically the cut ends of logs, the limbs of trees, and brush or chips left on a site. Suggested methods for managing slash include evenly distributing limbs and brush across the site for faster decomposition and nutrient breakdown for regeneration or piling slash and burning it to reduce areas where soil may be negatively impacted. Slash can also be chipped or cut into very small wood chips and used for mulching. Coarse woody debris is another term for slash accumulated on a site and is often measured in log diameter at breast height; in the FMGs, CWD is defined as dead logs >12 inches in diameter (DBH) and longer than 6 feet, or if they do not exist, 6inches in diameter, and it is recommended to have between 2-5 pieces of CWD per acre, and 4 per acre in RMZs (if not already present). Some coarse woody debris is beneficial for woodland species, soil erosion stability, and encouraging old-growth forest characteristics, but too much can start to impact drainage, compaction, and actually be harmful for other species.

Prairie region had 100% of sites with distributed slash, with an average of 43.2 CWD logs per acre, well above guidelines and potentially high for adequate regeneration. None of the surveyed sites with slash used a method to remove slash from the site or a strategy for retention of smaller tops and limbs (Table 120).

Table 119. Coarse Woody Debris (CWD) and slash distribution and strategies for Prairie region.

Region	Sites	Sites w/ Distributed Slash	Sites w/ Biomass Harvest	Biomass Sites w/ FWD Retention Strategy	Average CWD Logs per Acre	Average Snags per Acre
Prairie	6	6	0	0	43.2	4.1

13.10 Visual quality and Endangered and Threatened Species (ETS)

Visual quality in the FMGs is a tool used to reduce the public impact of the visual view of logging practices. In general, the implementation of visual quality guidelines reduces public complaints against logging and logged areas. Visual quality elements may include windbreaks of trees that block visual access to the site or reducing piled slash along roadways. In heavy use areas such as near hiking trails, placing leave trees in access points reduces the public's interaction with logging practices. It is important to note that visual quality guidelines have not been shown to have any impact on regeneration success or ecological processes.

Prairie region had 83% of sites with vistas, 100% with less sensitive vistas. In total, zero vistas were considered highly sensitive, and 75% were compliant with FMGs protecting harvests (Table 121).

Table 120. Visual Quality and Endangered or Threatened Species guidelines for Prairie region.

Region	Sites	Vistas	Less Sensitive	Moderate Sensitivity	More Sensitive	Percent Sensitive	Percent Compliant
Prairie	6	5	5	0	0	0%	75%
Region	Sites	Checked For ETS	ETS Present	ETS Protected	% Sites Checked	% of Sites w/ ETS Protected	Total % of Sites Protected
Prairie	6	5	0	0	83.3	NA	NA

Endangered and Threatened Species (ETS) are present across Minnesota's landscape. Promoting the diversity of species, both plant, animal, and insect, is beneficial to the long-term ecological health of forests. Checking for the presence or possible presence of ETS before harvest gives landowners and managers the ability to alter harvest methods, timing of harvests, and equipment used to reduce impact to these species. Some ETS rely on slash left on site or in riparian areas, others may be active in winter or summer months when harvest would otherwise occur. ETS checks are built into state forest harvest plans but may not be as accessible to private landowners and loggers (Table 121).

13.11 TIMING AND SEASONALITY OF HARVEST

Timing of harvest is important to preventing long-term damage to an ecosystem, with respect to rutting, compaction of soil, avoiding crossings and other RMZ damage. Frozen ground harvests allow heavy machinery to cover large areas without leaving damage but provides opportunities to miss wetlands and seasonal stream protections. With a warming climate, warm winters and severe rain events are predicted to occur. Winter is still the best season to harvest to prevent damage to regeneration, but often equipment or loggers are not available in winter months, or timber prices are favorable earlier in the year. Spring represents a difficult time to harvest, due to rain and soft soils. Summer can be favorable if the weather is dry, but wetlands and RMZs are highly susceptible to damage. Fall is a common harvest period, and dry conditions with colder temperatures are favorable for loggers and transportation of timber to mills. Prairie region was harvested almost entirely in the winter, with a few sites in the fall. This is the highest percentage of winter harvests of the state for the five-year period (Table 122).

Table 121. Timing (season) of harvest in Prairie region.

Region	Spring	Summer	Fall	Winter
Prairie	0%	0%	17%	83%

14 RECOMMENDED AREAS FOR TRAINING & EDUCATION EFFORTS

Based on the results of the past five years, the areas the GMP recommends trainings focus on are listed below by region. A fair amount of overlap occurred between regions, with many needing to cover the same topics in education efforts.

14.1 NORTHEAST, NORTH CENTRAL, AND NORTHERN REGIONS

The northern part of Minnesota and subsequent regions would benefit from trainings in the following areas of the FMGS:

- RMZs – specifically FMGs on buffer sizes necessary to provide adequate shade for trout streams and necessary buffer sizes for non-trout streams
- Filter strips – reducing the number of roads and skid trails in filter strips, especially where upland travel routes are available, and installing erosion control into filter strips to prevent soil delivery to waterbodies
- Crossings – especially in the Northeast region, reducing unnecessary crossings, or installing and using crossings during frozen ground months, reducing wetland crossings especially where avoidable
- Approaches – similar to filter strips, reducing equipment use, installing erosion control such as water bars or broad-based dips to control sediment delivery to area water
- Rutting – reducing rutting on skid trails and filter streps, non-open water wetlands, and crossings
- On-site infrastructure – specifically around overall infrastructure acreage, avoiding placement of landings in wetlands, filter strips, or RMZs
- Visual quality – ensure that adequate protections are in place to block view of sensitive sites to the general public, thereby reducing public concern or complaints

14.2 EAST CENTRAL AND WEST CENTRAL REGIONS

The East and West Central areas of Minnesota would benefit from trainings in the following areas of the FMGS:

- RMZs – specifically around non-trout stream compliance
- Filter strips – specifically reducing roads and skid trail development and placement in filter strips, and placement of landings near or within filter strips
- Crossings – especially in the West Central region (though present in both regions) reducing the high number of avoidable crossings, especially those crossing wetlands
- Rutting – specifically in West Central region, where rutting was high across a variety of infrastructure categories
- Landings – specifically in East Central region, reducing the number of landings placed in wetlands, filter strips, or RMZs
- Visual quality – ensure that adequate protections are in place to block view of sensitive sites to the general public, thereby reducing public concern or complaints

14.3 Southeast and Prairie Regions

The Southeast and Prairie regions of Minnesota would benefit from trainings focused in the following areas of the FMGS:

- Filter strips – specifically in Prairie region, reduce the number of filter strips associated with landings or other infrastructure
- Landings – specifically in Prairie region, reducing the number of landings placed in wetlands, filter strips, or RMZs especially where upland sites were available
- Visual quality – ensure that adequate protections are in place to block view of sensitive sites to the general public, thereby reducing public concern or complaints, especially in sensitive areas

14.4 Other areas for Discussion and conclusion

Seasonality of harvests may be worth mentioning at trainings, but with warming winters and fewer days below freezing, the option to harvest on frozen ground may not be feasible for many loggers depending on location and timing of the lumber markets. Increasing training around rutting, filter strips, and RMZs will be beneficial to ensuring harvests performed above freezing reduce their impact on the landscape and regeneration in subsequent years.

Leave trees had high compliance across all regions, and while Northern and West Central regions struggled with rutting, Southeast and Prairie regions did not demonstrate any rutting in samples. Much of this is due to precipitation and terrain, with dryer conditions in Southern and Prairie regions of the state. Small sample sizes were also to blame for potentially skewed statistics in Southeast region and Prairie region. In the future, Prairie region samples will be moved to the nearest region and analyzed as part of that region to avoid bias in reporting FMG implementation rates. Southeastern Minnesota has less forest cover overall, leading to a lower sample size. Most forest management in SE MN is performed on private landowner harvests leading to difficulties enrolling private landowners in the monitoring program.

Proposed changes that will begin in the 2026 field season for GMP include the updated process of change detection to identify timber harvests over the past year and find contact information for private landowners, hopefully increasing the number of private landowners in sample sizes for the next five-year period. The updated change detection process takes advantage of the most up-to-date satellite imagery and updates the current models being used for harvest detection. This work will be performed by RAP. The process will also take advantage of a public database of landowner contact information to improve private landowner inclusion in the program. Conversion of the data collection software from Collector, an outdated and clunky survey method, to Fieldmaps, a modernized data collection approach, will occur during the 2025-2026 season. This process will include reducing the number of repetitive questions in data collection surveys, removing outdated questions, and creating a stronger future dataset with more guardrails to prevent errors during field data collection. GMP and Resource Assessment Program (RAP) staff will deploy the new data collection method on newly purchased tablets during summer of 2025, and run quality control tests during data collection in 2026.

Finally, GMP aims to pilot the use of RAP and GMP staff to collect data on private and public lands in 2026. Currently, contractor costs are skyrocketing and the lack of contractors with forestry experience has led to numerous errors in data collection, input of data, and even on-site assessments.

The GMP and RAP staff are not associated with the DNR Division of Forestry's Timber Program and therefore do not have the bias of using a forester who cruised for an appraisal or oversaw a timber sale for the Division. The program would also take advantage of the interns who are hired yearly by RAP. The use of internal staff would also allow GMP to hit survey goals of 100 sites per year or more, which is not currently possible due to costs associated with outside contractors. This program will deploy through a pilot program during the 2026 data collection year.

15 APPENDIX - GRAPHS AND CHARTS

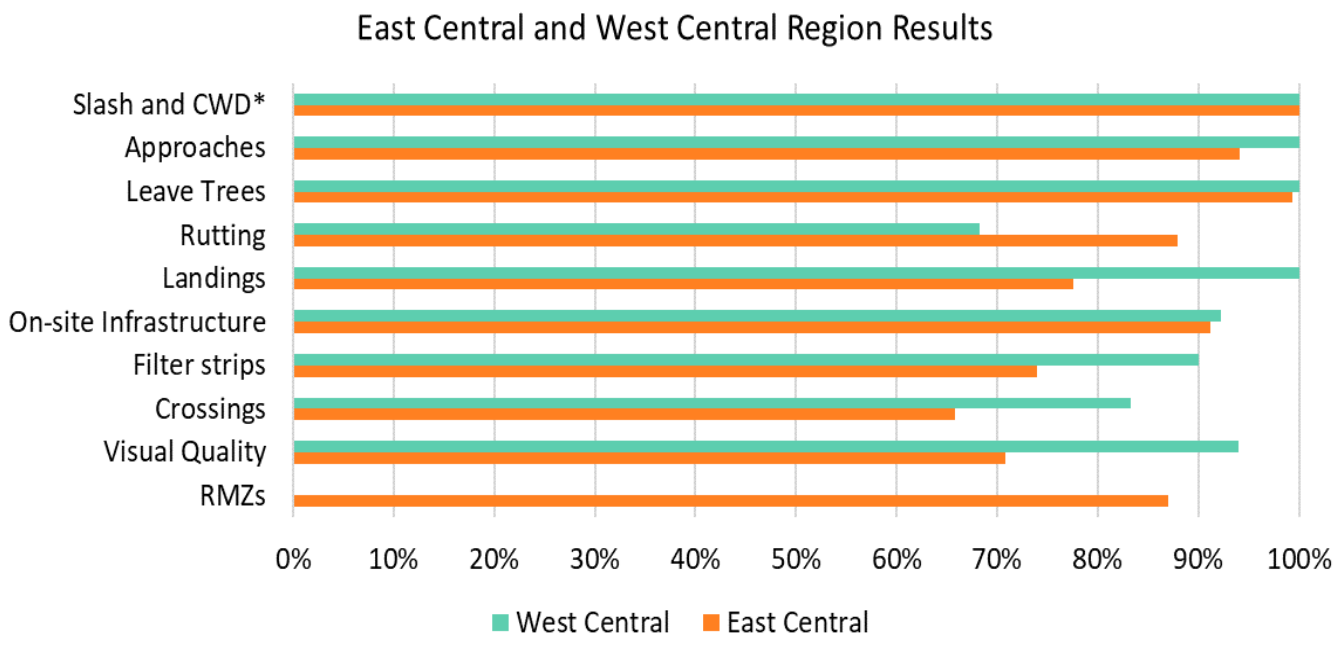


Figure 4. East Central and West Central Region overall compliance across all surveyed areas of FMGs; compliance rates (x-axis) represent summary results as noted in the report.

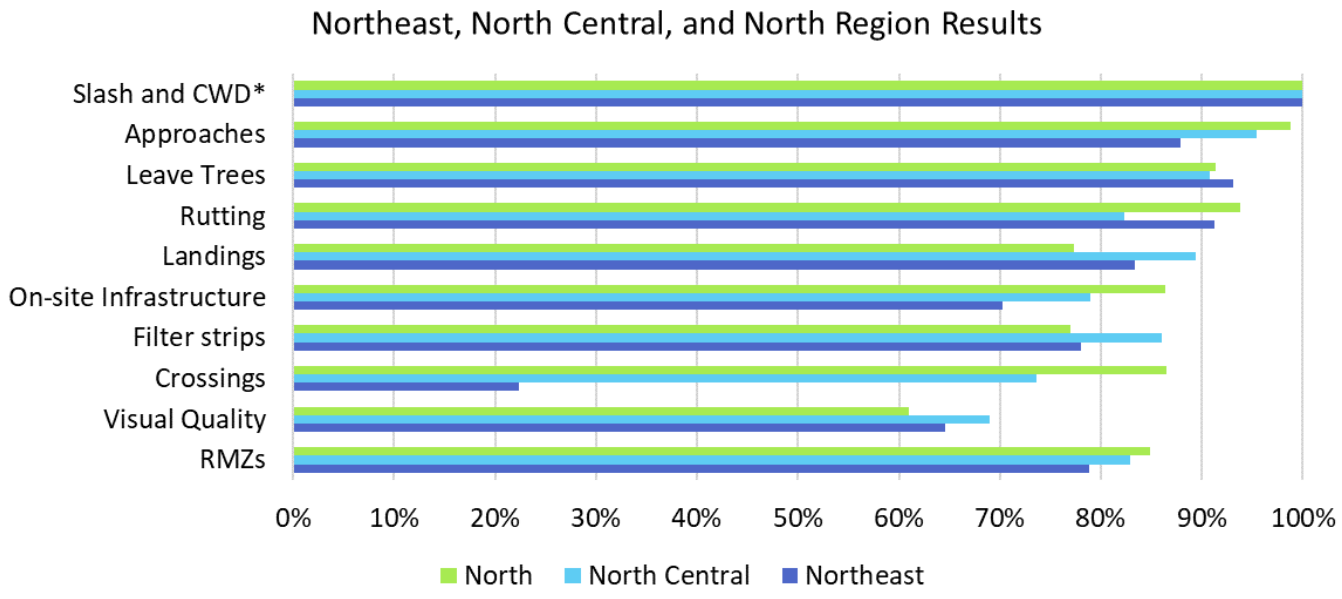


Figure 5. Northeast, North Central, and Northern region overall compliance across all surveyed areas of FMGs; compliance rates (x-axis) represent summary results as noted in the report.

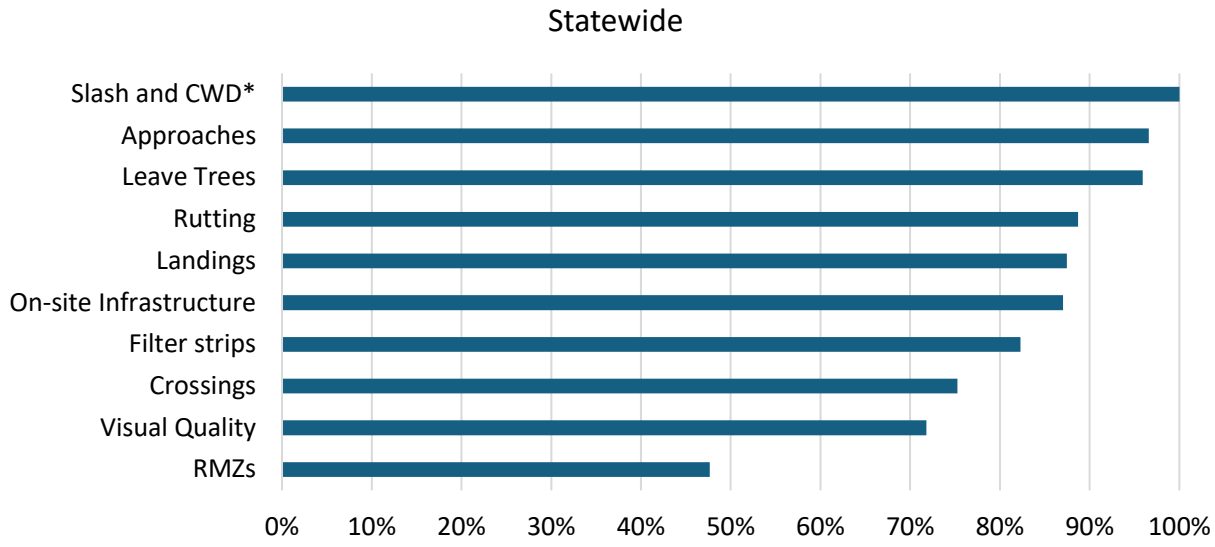


Figure 6. Breakdown of state results for compliance with FMG areas; x-axis shows the overall compliance rating percentage for each FMG area.

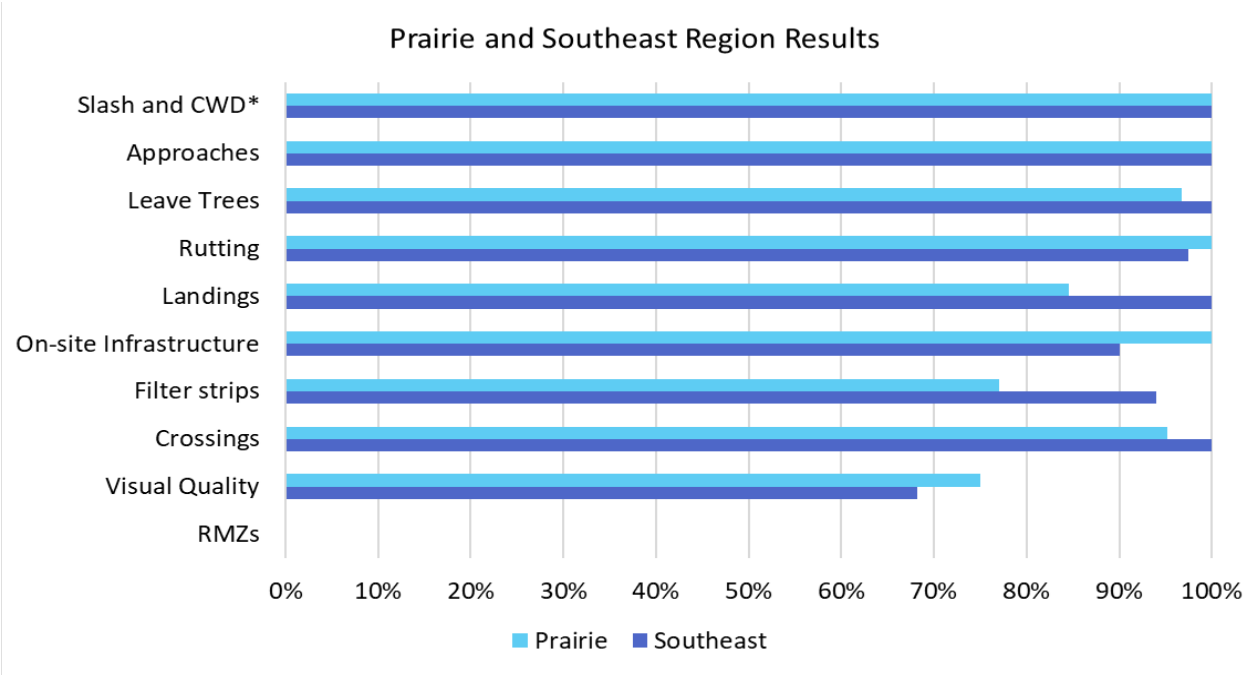


Figure 7. Prairie and Southeast Region overall compliance across all surveyed areas of FMGs; compliance rates (x-axis) represent summary results as noted in the report.