State of Montana

Department of Natural Resources and Conservation

STATE FOREST LAND MANAGEMENT PLAN IMPLEMENTATION MONITORING REPORT

FISCAL YEARS 2017-2021

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FMB Chief SFLMP Memorandum

To: Amanda Kaster, DNRC Director, and Shawn Thomas, TLMD Administrator
From: Dan Rogers, FMB Chief
Subject: 5-year SFLMP Monitoring Report
Date: 9/26/2022

This memo reflects an abundance of work in developing the 2017-2021 SFLMP Monitoring Report and its communication to the field. It also executes an important requirement of ARM 36.11.448 – MANAGEMENT OF THE STATE FOREST LAND MANAGEMENT PLAN which states:

> *"(1) Beginning the year 2005 and every five years thereafter, the forest management bureau chief shall make a written report to the director of the department and the trust land management division administrator on the current status of state forest land management plan implementations and effectiveness, including a recommendation on the need for significant changes to the plan."*

The following recommendations presented at the end of each chapter in the 2017-2021 report provide the basis for my decision.

This memorandum serves as communication to you and the Trust Lands Administrator as to the status of the last 5 year's monitoring report as well as need for changes to the plan. At this time, it is my opinion that there is no need for change or revision to the plan.

If you have questions or wish to discuss this further, please let me know.

Kind Regards,

Chief
Forest Management Bureau
Trust Lands Management Division

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EXECUTIVE SUMMARY

Since the adoption of the State Forest Land Management Plan (SFLMP) in 1996 and the Administrative Rules for Forest Management (Forest Management Rules or Rules; ARM 36.11.401 through 456) in 2003, the Montana Department of Natural Resources and Conservation (DNRC), Forest Management Program has implemented the philosophy and intent of the SFLMP and the requirements set forth in the Rules primarily through project development and implementation, Montana Environmental Policy Act (MEPA) review, and monitoring. The following is a summary of accomplishments and monitoring results from fiscal years 2017 through 2021 (July 2016 through June 2021).

PLAN IMPLEMENTATION

The State Forest Land Management Plan was implemented on 119 timber sales that treated 40,683 acres that yielded 255 MMBF for the 2017-2021 monitoring period. Table EX-1 below provides context to this level of harvest in comparison to previous monitoring periods.

Table EX-1: Harvest levels for the reporting period and since the inception of the SFLMP.

Land Office	1997-2000		2001-2005		2006-2010		2011-2016		2017-2021	
	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)
NWLO	9,963	55,408	19,511	119,263	17,691	146,096	27,434	200,187	21,518	176,499
SWLO	11,494	50,722	15,202	72,205	11,277	73,815	15,437	88,371	13,220	63,884
CLO	1,678	10,699	1,900	16,190	2,625	14,883	5,447	30,936	3,157	9,830
Eastern Offices (SLO/NELO/ELO)	5,319	10,719	3,097	10,658	3,017	9,785	4,758	14,883	2,788	5,751
Total	28,454	127,548	39,710	218,316	34,610	244,579	53,076	334,377	40,683	255,964
Annual Average	7,114	31,887	7,942	43,663	6,922	48,916	8,846	55,730	8,137	51,193
Avg. Vol/Acre	4.5		5.5		7.1		6.3		6.3	

Timber Sale Inspection Reports

During the monitoring period, DNRC conducted 1,578 timber sale inspection reports on the above stated harvested acreage and volume which equates to 19,118 individual contract items that were inspected. Of these inspected items, 98.7% were rated as satisfactory in meeting the contract requirement demonstrating a high level of contractual compliance, and by default, exceptional implementation of the SFLMP mitigations as will be specifically detailed in this report.

MONITORING

Biodiversity

- 10 biodiversity field reviews were conducted on the Northwestern (4), Southwestern (3), Central (2) and Southern (1) Land Offices. Those reviews indicated that DNRC's forest management activities are typically successful in incorporating the biodiversity measures outlined by the SFLMP and ARM, and that those measures are readily integrated into the prescribed management activities without detriment to achieving silvicultural objectives. Five areas for improved application of biodiversity measures include selection of silvicultural prescription, post-harvest regeneration, areas of deferred management, old growth recruitment and maintaining a balance between biodiversity and sustainable yield.

- In 2020, the DNRC conducted a new sustainable yield calculation that included the 13,000 acres of former industry-owned timber land acquired by the DNRC since the previous calculation in 2015. The old growth constraint placed on the 2020 calculation reflects the Department's management of old growth and ensures that objectives for amounts of old growth will be met over the sustainable yield planning horizon and at the specified annual sustainable harvest level.
- Old growth amounts decreased slightly from 2017-2021 compared to the 2016 reporting period primarily due to updated inventory information that removed acres previously identified as old growth that no longer met DNRC's old growth criteria and the acquisition of forest land in younger timber age classes.
- Management activities are generally having desired impacts of increasing deficient amounts of shade-intolerant forest types (ponderosa pine, western larch/Douglas-fir, western white pine) and decreasing excessive amounts of shade-tolerant forest types (Douglas-fir, mixed conifer, subalpine fir). However, there continues to be excessive amounts of shade tolerant types and deficient amounts of shade-intolerant types relative to desired amounts.
- Continued post-fire photo-point monitoring on the Coal Creek State Forest.
- Post-fire mortality monitoring on a section in the Clearwater Unit burned in the 2007 Jocko Lakes fire was concluded in 2017.

Silviculture

- Average annual harvest volumes and acres harvested have decreased slightly since the last monitoring period, however several sales sold during the recent monitoring period have yet to be completed.
- Tree planting increased slightly compared to the previous monitoring period.
- Amounts of precommercial thinning, slash pile burning, and use of biological agents to control noxious weeds decreased from the prior monitoring period.
- Tractor-based logging accounted for 76% of harvested acres, while cable logging accounted for 16% and combination logging of both tractor and cable systems accounted for 8% of harvested acres.
- The use of even-aged regeneration harvest methods (clearcut, seed tree, shelterwood) decreased since the previous monitoring period, accounting for 52% of harvested acres. The overall amount of partial cutting increased since the last monitoring period, accounting for 40% of harvest acres from 2017-2021.
- Salvage harvesting declined compared to the previous monitoring period, occurring on 8% of harvested acres. About 68% of salvage harvesting was related to wildfire, 29% was related to wind events and approximately 14% was related to insects and disease.

Watershed and Road Management

- Road construction activities have decreased slightly during 2017-2021 compared to the previous reporting period.
- Road inventory process and procedures have been significantly assisted by mobile GIS technologies and as a result the miles of annual completed road inventory has substantially increased.
- The implementation and effectiveness of Best Management Practices and the Streamside Management Zone law continue to show high levels of successful compliance with substantial gains since the SFLMP inception.
- Long-term water quality monitoring was continued on six sites on the Stillwater State Forest.

- Stream discharge monitoring was continued on six sites on the Stillwater State Forest and six sites on the Swan River State Forest, including installation of stage height recorders to develop long-term rating curves for evaluation of water yield associated with timber sales.
- Stream temperature monitoring was conducted on a total of 30 sites including;
    - 6 sites associated with riparian timber harvest monitoring
    - 1 site associated with post-wildfire vegetation recovery
    - 3 sites associated with vegetation recovery following construction of grazing exclosures
    - 19 sites associated with long-term stream temperature trend monitoring
    - 1 site associated with recovery following windthrow

Fisheries

- Bull trout redd count monitoring was conducted in 11 streams on the Stillwater, Swan River, and Coal Creek State Forests. Trends suggest stable or slightly decreasing levels of adult spawning in the Stillwater, Coal Creek and Swan River State Forests.
- Bull trout spawning habitat assessments were completed on 14 streams on the Stillwater, Swan River, and Coal Creek State Forests. Three sites in the Swan River State Forest were noted to be above thresholds of concern during the monitoring period for at least one year; one of the three sites was noted to be at a level of impairment for one year.
- Bull trout rearing habitat assessments were completed on 13 streams on the Stillwater, Swan River and Coal Creek State Forests. Three sites were noted to have rearing conditions below suitable thresholds for at least one year and two of these sites were noted to have rearing conditions at levels of impairment for one year during the monitoring period.
- Fish habitat inventories were conducted on one stream on the Swan River State Forest.
- Large woody debris monitoring was completed as a part of riparian timber harvest monitoring on 15 sites during the reporting period.

Threatened, Endangered, and Sensitive Species and Big Game

- DNRC biologists participated on 10 interagency committees and working groups.
- During the monitoring period, DNRC implemented the Forest Management Habitat Conservation Plan (HCP), completed four annual HCP monitoring reports and the second five-year HCP monitoring report.
- DNRC Biologists surveyed 9 to 12 territories annually for bald eagle monitoring.
- DNRC biologists monitored 9 lakes annually in northwest Montana and supported the interagency Loon Ranger Program.
- DNRC completed monitoring under the Swan Valley Grizzly Bear Conservation Agreement (SVGBCA) in 2017 and was approved for termination of the SVGBCA in 2018, under the terms that monitoring metrics pertaining to grizzly bear measure on the Swan River State Forest are now reported in the DNRC HCP annual and 5-year reports.
- During the monitoring period, DNRC field staff monitored from 553 to 570 primary road closure devices on state trust lands annually for effectiveness within grizzly bear recovery zones. Approximately 31 closures received repairs within one year of detecting damages during the reporting period.
- DNRC biologists monitored snags, coarse woody debris, and snag recruitment trees on 17 sale areas. Pre- and post-harvest results were analyzed and reported for 14 timber sale projects.

- DNRC biologists obtained and reported 5 observation records for 4 species to the Montana Natural Heritage Program.
- DNRC biologists conducted project-related monitoring of eight goshawk nests.
- A DNRC biologist published an avian study that examined bird responses to old growth maintenance logging treatments on the Swan River State Forest.

Grazing on Classified Forest Lands

- 326 parcels licensed for classified forest grazing were inspected for range and riparian condition during the monitoring period of which 326 (61%) had riparian features.
- Of the inspected parcels with riparian features, 85% met narrative standards favorable for functioning riparian systems, a slight increase over previous reporting periods.

Weed Management

- 119 timber sales were inspected and monitored for noxious weed presence, establishment, and spread.
- 4,579 acres of noxious weeds were treated by various means on DNRC lands and road right-of-ways. Additional, 178 acres were treated with biological controls.

REVIEW AND MANAGEMENT OF THE PLAN

- Since the previous reporting period, DNRC has continued to successfully implement the Habitat Conservation Plan (HCP), which complements the SFLMP by clarifying DNRC's responsibilities under the Endangered Species Act (ESA), providing additional mitigation measures for T&E species and by providing water quality protections.
- Based on this review of the SFLMP and the information provided in this report (following ARM 36.11.448), *no significant changes were noted* involving new legislation, land board direction, changes to original assumptions supporting the plan, cumulative minor changes, new science, or changes in baseline conditions that are incompatible with the philosophy, intent and implementation of the plan that would trigger further necessary review and amendment of the SFLMP at this time.

INTRODUCTION

STATE FOREST LAND MANAGEMENT PLAN AND ADMINISTRATIVE RULES FOR FOREST MANAGEMENT

The State Forest Land Management Plan (SFLMP), approved by the State Board of Land Commissioners (Land Board) in June 1996, is the plan under which the Montana Department of Natural Resources and Conservation (DNRC) manages approximately 793,000 acres of forested state trust land. The SFLMP provides the philosophical basis and technical rationale for DNRC's forest management program. The SFLMP is based on the philosophy that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests as summarized in the following excerpt:

"Our premise is that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other uses. They would also help maintain stable trust income in the face of uncertainty regarding future resource values. In the foreseeable future, timber management will continue to be our primary source of revenue and primary tool for achieving biodiversity objectives." (Record of Decision (ROD) page 2)

The DNRC Administrative Rules for Forest Management (Forest Management Rules or Rules; ARM 36.11.401 through 456) are the specific legal resource management standards and measures under which DNRC implements the SFLMP and subsequently its forest management program. The Rules were adopted in March 2003 and provide the legal framework for DNRC's project-level decisions and provide field personnel with consistent policy and direction for managing forested state trust lands. The Rules subchapters correspond to resource areas identified by the SFLMP and incorporate language from the SFLMP Resource Management Standards (RMS). All forest management projects administered by DNRC on forested State trust lands must comply with both the SFLMP and the Forest Management Rules.

DNRC Land Offices, Administrative Units, and the Forest Management Bureau (FMB) continue to implement the philosophy and intent of the SFLMP and the requirements set forth in the Forest Management Rules primarily through project development and implementation, Montana Environmental Policy Act (MEPA) review, and monitoring.

PURPOSE OF THE MONITORING REPORT

According to the SFLMP (ROD page 11), beginning in 2000 and every five years thereafter, the FMB shall prepare a written report on the status and effectiveness of the SFLMP for the DNRC Director. ARM 36.11.448 reinforces this requirement and stipulates that DNRC shall monitor individual resources pursuant to the Forest Management Rules and compile the results of that monitoring into a report for the Land Board starting in 2005 and every five years thereafter. In October 2000 and 2005, DNRC published an Implementation and Monitoring Report that summarized SFLMP and Forest Management Rule monitoring results during fiscal years 1997 through 2000 and 2001 through 2005 respectively. In May 2011, DNRC published the monitoring report for fiscal years 2006 through 2010. In 2017, DNRC published the monitoring report for fiscal years 2011 through 2016. This document summarizes SFLMP and Forest Management Rules monitoring results from fiscal years 2017 through 2021 and will be reported to the DNRC Director, Trust Land Administrator, and the Land Board.

IMPLEMENTATION CHECKLISTS

In January of 1997, an SFLMP Implementation Checklist was finalized for use in planning timber sales. The checklist was comprised of specific Resource Management Standards pertinent to timber sale preparation and issues often raised concerning timber harvest. The Implementation Checklist was developed for two purposes: 1) as an internal check to ensure that the SFLMP philosophy and RMS are being incorporated in the project; and 2) for external accountability when presenting our projects to the Land Board.

In June 2003, the FMB revised this Implementation Checklist to correspond with the adoption of Forest Management Rules. The Rule Implementation Checklist identifies 48 items to address during timber sale planning. These include separate items from 9 of the 10 resource areas: Biodiversity, Silviculture, Road Management, Watershed, Fisheries, Threatened & Endangered Species, Sensitive Species, Big Game, and Weed Management. Rules for Grazing on Classified Forest Lands were excluded as not applicable.

SFLMP/Administration Rule Implementation Checklists were filled out for 119 timber sales that were sold from fiscal years 2017 through 2021. All sales complied with both the SFLMP and the Rules.

TIMBER SALE INSPECTIONS

DNRC field personnel oversee the implementation of timber sale contracts. Management foresters spend a substantial amount of time on the ground, visiting active sales to ensure contract compliance. Foresters communicate with purchasers and contractors and direct them in meeting stipulations and requirements of the contract. This often includes adjusting operations or prescribing actions to avoid contract deviations or resource impacts.

Table PM-1: SFLMP Implementation Monitoring through Timber Sale Contract Inspection Reports

Reporting Period	Number Of Sales	Number of Reports	Contract Items Inspected	Satisfactory	Needs Improvement	Violations
1998-2000	79	1,022	23,506	98.9%	1.0%	0.1%
2001-2005	106	2,224	16,881	97.3%	2.4%	0.3%
2006-2010	194	1,726	17,820	96.1%	3.6%	0.3%
2011-2016	153	3,142	58,713	98.4%	1.4%	0.2%
2017-2021	119	1,578	19,118	98.7%	1.2%	0.2%

During fiscal years 2017 through 2021, management foresters documented 1,578 timber sale inspections for 119 timber sales. Timber sale contract terms often have indirect ties to the SFLMP and Rules, and they reflect multiple observations of all operating timber sales. See Biodiversity Monitoring – Timber Sale Inspection Reports for a complete summary of timber sale inspection reports and Road Management Monitoring and Watershed, Fisheries, and Soils Monitoring for brief discussions.

MONTANA DNRC HABITAT CONSERVATION PLAN

In December 2011, the USFWS issued DNRC an incidental take permit authorizing take of grizzly bear, Canada lynx, bull trout, and two other fish species incidental to DNRC's forest management activities. A Habitat Conservation Plan (HCP) is a long-term management plan prepared under the Endangered Species Act (ESA) to conserve threatened and endangered species. Section 10 of the ESA, authorizes a landowner to develop a conservation plan to minimize and mitigate, to the maximum extent practicable, the impacts of related incidental take of threatened and endangered species while conducting lawful activities such as harvesting timber on State trust lands. The HCP is part of an application for obtaining an incidental take permit (Permit) from the USFWS in accordance with Section 10(a)(1)(B) of the ESA. The Permit authorizes DNRC to take federally listed species that are covered under the HCP.

During calendar years 2012 through 2021, DNRC has implemented the HCP. Monitoring is a requirement of the HCP, and DNRC has prepared the Montana DNRC Forested State Trust Lands HCP 5-Year Monitoring Report. That report will accompany this DNRC SFLMP Monitoring Report 2017-2021.

BIODIVERSITY MONITORING

BIODIVERSITY IMPLEMENTATION

The SFLMP and Forest Management Rules rely on forest management for biodiversity to accomplish the Department's fundamental management premise. Our efforts at implementing the coarse filter are focused on assessment and management of appropriate stand conditions at the landscape level, and emulation of natural disturbance processes in our selection of proper treatments. We have developed management tools for describing desired future conditions of our forests and for comparing them to current or existing conditions.

BIODIVERSITY FIELD REVIEWS

ARM 36.11.419 directs DNRC to conduct field reviews of forest management activities to evaluate the application of the biodiversity measures presented in the SFLMP and ARM. These reviews encourage accountability for considering and applying biodiversity measures in the timber sale planning process and provide a feedback mechanism between field staff and the Forest Management Bureau regarding such issues. The reviews are not intended to critique the work of individual foresters and field specialists, but are instead an opportunity to learn about, discuss, and refine management activities to better and more effectively accomplish DNRC’s mission when managing forested Trust Lands. These reviews focus on several topics related to biodiversity, including selection and implementation of silvicultural systems, regeneration, age classes and old growth, forest health, patch characteristics, rare and unique habitats, sensitive plants, forest genetics, snag and nutrient retention, economics, and wildlife (threatened, endangered, sensitive, and big game species).

Between 2017 and 2021, DNRC conducted 10 biodiversity field reviews on the Northwestern (4), Southwestern (3), Central (2), and Southern (1) Land Offices. Those reviews indicated that DNRC’s forest management activities are typically successful in incorporating the biodiversity measures outlined by the SFLMP and ARM, and that those measures are readily integrated into the prescribed management activities without detriment to achieving silvicultural objectives.

The reviews did identify several consistent areas for improved application of silviculture and biodiversity measures:

1. Silvicultural Prescriptions: there is a need for consistency in the terminology, definitions, and application of silvicultural prescriptions across the Forest Management program. In several reviews, implementation of harvest treatments followed prescribed leave tree amounts and spacing and was consistent with conditions that would be expected under naturally occurring disturbance regimes, but the prescription was labelled with terminology that would have led to a different expectation of the amount and spacing of leave trees. For example, some cutting units where seed tree harvests were prescribed resembled shelterwood harvests or individual tree selection harvests, or areas where commercial thinning was prescribed resembled seed tree or shelterwood harvests. Defining each silvicultural treatment and providing guidelines for implementation of each treatment in terms of objectives for treatment, relationship to naturally occurring regimes, and expected outcomes in terms of the number and spacing of leave trees, would provide consistency across the program.
2. Regeneration: in some timber sales where natural regeneration was expected following harvesting, the amount of regeneration did not achieve desired levels and/or was taking longer than expected to

establish. There are several factors that can influence successful natural regeneration, including adequate scarification/site preparation, competing vegetation, size and viability of cone crops/seed production, distance to seed source, and soil conditions/moisture. Timely monitoring of regeneration success through regeneration surveys is necessary to identify potential regeneration problems, causes, and solutions, as well as modifications to data and model parameters used in the sustainable yield calculation regarding the amount and length of time required for stands to regenerate.

3. Deferral of management: In some sales, areas that presented difficulty for harvesting due to terrain and/or quality of timber but that could have been harvested were excluded from harvest during timber sale design. Although these areas were not formally deferred from management, the exclusion of those areas from prior harvesting may prevent, or make future management difficult, as those areas may not be able to support economically feasible timber harvesting on their own. It is important when designing timber sales and cutting units to consider present versus future opportunities and costs to harvest such areas.
4. Old growth recruitment: in the reviews during the period where old growth stands were being harvested, implementation of maintenance, restoration, and removal treatments in old growth was consistent with the old growth constraint modeled in the 2015 and 2020 sustainable yield calculations. However, there was often no intentional management of stands as old growth recruitment. Further direction is needed to identify potential old growth recruitment stands and to design treatments in such stands that will facilitate the development of old growth in the future, as the ability to meet old growth objectives over a long term is heavily dependent on the ability to manage recruitment stands properly and effectively.
5. Balance between biodiversity and sustainable yield: at many of the reviews conducted during this period, the review teams discussed increasing harvest targets associated with recent sustainable yield calculations in 2015 and 2020 and how those may affect the ability to achieve biodiversity objectives or emulate natural disturbance regimes through silviculture. Thoughtful selection, implementation, and review of silvicultural treatments is needed to ensure that both biodiversity and harvest volume objectives are met.

OLD GROWTH

The ARM provides DNRC with a framework to manage old growth stands to meet biodiversity and fiduciary objectives. This framework includes quantitative old growth definitions adopted from Green et al. (1992) that require a minimum number and average age of large live trees, and stand-level basal area, for specific forest habitat types (Pfister et al., 1977) and cover types, and specifies the types of silvicultural treatments that the DNRC must consider when managing old growth stands.

In 2020, the DNRC conducted a new sustainable yield calculation. Since the previous calculation in 2015, the DNRC had acquired approximately 13,000 acres of former industry-owned timber land. In the context of calculating annual sustainable yield, the requirements set forth by SFLMP, ARM, and HCP were applied as management constraints in an optimization model used to calculate the annual sustainable yield. Constraints are limitations placed on the model that restrict when, where, which, and how often harvesting treatments may be applied. The 2020 calculation included constraints related to operability, wildlife habitat, water resources, and timber harvest and silviculture—including old growth.

The old growth constraint modeled in the 2020 calculation required that each administrative unit within the Northwestern and Southwestern Land Offices maintain at least 8% of their acres as old growth[1]. Each unit in the Central Land Office was required to maintain 4% of acres as old growth [2]. There was no specific constraint for old growth on Units in the ELO, NELO, and SLO[3]. The model was constrained to require units below the target old growth percentage to be managed in a manner to meet the target percentage as soon as possible, and that units above the target percentage would remain above that target percentage over time. Units that currently have less than 8% old growth were required to manage an amount of non-old growth acres needed to reach 8% using management pathways that would facilitate their development into old growth stands. The constraint prohibited the selection of existing old growth stands for regeneration harvesting that would remove them from old growth status until the administrative unit had at least 8% old growth. In all units, regardless of whether they were above or below the 8% threshold, old growth maintenance and restoration treatments that would maintain a stand's old growth status could be used in existing old growth stands. This method of constraining the model ensured that the intended old growth amount for each unit was met as quickly as possible and then maintained over time.

At the current annual sustainable harvest level of 68.3 MMBF (8.3 MMBF as "opportunity volume"), the model indicates that meeting and maintaining these objectives for old growth on state trust lands is achievable.

In 2016, Forest Management Bureau staff conducted a series of webinars as a training/refresher for field staff regarding DNRC's approach to managing old growth stands. The material covered in those webinars was summarized in an Old Growth Handbook that was released in June 2016 to provide clear and consistent direction to implement the ARM related to old growth. Topics addressed in the webinars and Handbook include a review of the ARM and laws (MCA) related to old growth, procedures for determining a stand's old growth type according to the Green et al. (1992) definitions, procedures for identifying and field-verifying old growth stands, explanation of the target amounts of old growth and rationale for those amounts, an overview of the treatments applicable for old growth stands and strategies to design/implement them, old growth recruitment, tools for describing attribute development in old growth stands, and how to describe old growth in MEPA documents.

[1] The SFLMP Final EIS estimated a target amount of old growth between 7.2 and 9.9 percent. During initial implementation of the SFLMP, DNRC estimated that 19.8 percent of its western Montana lands were historically old growth; an 8 percent target represents just under half of that percentage and falls within the range described in the SFLMP Final EIS.

[2] An analysis conducted by DNRC in 2014 when developing the old growth constraint for the 2015 sustainable yield calculation indicated that 4 percent of DNRC's ownership in the CLO may have historically been old growth, and that was used as the target percentage.

[3] Limited amounts of both historic and current data prevent meaningful identification and comparison of old growth amounts to develop a target percentage. Additionally, most management in old growth stands in those areas would be expected to maintain the age class structure of the stand.

OLD GROWTH AMOUNTS

Table BD-1 compares the age class distribution for the Northwestern and Southwestern Land Offices over the past four monitoring periods (ending in 2005, 2010, 2016, and 2021)[4]. In general, the age class distribution in the NWLO and SWLO changed very little compared to 2016. Since 2010, the percentage of older age classes (150+ and old growth) has decreased, while the amount of younger age classes has increased primarily due to the acquisition of previously managed former industrial timberlands that are currently dominated by seedling/sapling (0-39 year) and pole timber (40-99 year) age classes. Old growth percentages decreased by 1% since 2016 in both the NWLO and SWLO.

Table BD-2 compares the acres of old growth on each administrative Unit in each monitoring period, as well as the percentage of old growth on each Unit. At the Statewide level, there was a reduction of 4,121 acres of old growth compared to 2016. The cause for this reduction in acres varies by Land Office and Unit.

In the Southwestern (1,841 acres) and Central Land Offices, the reduction of acres is primarily due to updated inventory information that removed acres previously identified as old growth that no longer meet DNRC's old growth criteria. In 2021, the Department revised ARM 36.11.403(54) to include stand basal area as a requirement in the Department's old growth definition, although it had been operationally using that requirement since 2014. Examination of recent aerial imagery of harvested stands from timber sales prior to 2014 that were still classified as old growth revealed that several stands may not meet the basal area requirement and they were removed from old growth classification until field-verification occurs to confirm old growth status. Additionally, several stands that were classified as old growth were determined to no longer qualify as old growth through field-verification due to mortality of large, old trees caused by insects including Douglas-fir beetle, mountain pine beetle, and western spruce budworm.

In the Northwestern Land Office, old growth acres decreased by 1,155 acres compared to 2016. Old growth acreage on the Libby Unit increased by 701 acres due to field verification of stands that were previously not identified as old growth. On the Kalispell Unit, old growth acres decreased by 607 acres compared to 2016 due to updated inventory information that removed acres harvested in timber sales sold prior to 2014 that no longer meet the Department's updated old growth definition as described above. On the Stillwater Unit, timber harvesting in old growth stands was the primary cause in the reduction of acres; however, the percentage decrease from 15% to 12% is also due to the acquisition of 13,000 acres of former private industrial timberland that is almost entirely in young age classes.

Relative to old growth target amounts described in the 2020 sustainable yield calculation, four Units—Dillon, Libby, Stillwater, and Swan—are at or above target amounts, while the remaining Units are below target amounts. On the remaining Units in the Central, Eastern, Northeastern and Southern land offices, most of DNRC's forest inventory is based on photo-interpreted stand data, which limits the ability to quantify detailed data for some old growth attributes. Thus, ensuring that >4% old growth amounts are maintained in these areas is addressed at the project level.

Units that are currently below the threshold old growth percentages used in the 2020 Sustainable Yield Calculation are required to maintain and manage an amount of non-old growth acres needed to reach the

[4] Data for the Central, Eastern, Northeastern, and Southern Land Offices are not included, as much of those areas have not received detailed on-the-ground inventory that is necessary to determine age class.

identified threshold old growth percentage using harvest prescriptions that would facilitate their development into old growth stands. DNRC developed a model to identify stands that are candidates for recruitment into old growth in the Northwestern and Southwestern land offices (as mentioned above, most of DNRC's forest inventory in the Central, Eastern, Northeastern, and Southern land offices is based on photo-interpreted data and lacks the detail necessary to quantify stand attributes needed to identify potential recruitment stands through a modeling effort). Currently, all but three Units (Plains, Anaconda, Missoula) in the Northwestern and Southwestern land offices have enough potential old growth recruitment acres to meet the old growth thresholds when those stands achieve sufficient age or numbers of large trees to meet DNRC's old growth definition. Much of the Plains Unit was burned in the 1910 fire and has also had several sections burned more recently in the Chippy Creek (2007) and Copper King (2016) fires, and many of those stands are in younger age classes that do not yet qualify as old growth recruitment. The Missoula Unit has substantial acreage of former industry-owned lands that are primarily in younger age classes.

Table BD-1: Percentage of Age Class Distributions on the NWLO and SWLO by Reporting Period

Age Class (years)		No Age Data	0-39	40-99	100-150	150+	Old Growth
SWLO	2005	5%	11%	27%	33%	16%	8%
	2010	4%	16%	22%	33%	19%	6%
	2016	4%	15%	27%	37%	14%	3%
	2021	0%	16%	27%	40%	15%	2%
NWLO	2005	2%	12%	24%	23%	28%	11%
	2010	2%	11%	21%	24%	32%	10%
	2016	0%	16%	30%	33%	11%	10%
	2021	0%	15%	32%	31%	13%	9%
Total	2005	2%	12%	25%	27%	24%	10%
	2010	2%	13%	21%	27%	28%	9%
	2016	2%	16%	29%	34%	12%	7%
	2021	0%	15%	30%	35%	14%	6%

Table BD-2: Old Growth Acres and Percentage by Administrative Unit, 2010, 2016 and 2021

Land Office/Unit	Acres				Percentage		
	2005	2010	2016	2021	2010	2016	2021
Central Land Office		**763**	**2,726**	**1,743**	**1%**	**2%**	**2%**
Bozeman				118	0%	0%	1%
Conrad					0%	0%	0%
Dillon		542	2,488	1,440	2%	8%	4%
Helena		221	238	185	0%	0%	0%
Eastern Land Office					**0%**	**0%**	**0%**
Miles City					0%	0%	0%
Northeastern Land Office		**68**	**263**	**122**	**0%**	**1%**	**0%**
Glasgow					0%	0%	0%
Havre			56		0%	1%	0%
Lewistown		68	207	122	0%	1%	0%
Northwestern Land Office	**32,900**	**29,935**	**30,684**	**29,529**	**10%**	**10%**	**9%**
Kalispell		2,471	1,898	1,291	5%	4%	2%
Libby		2,652	2,721	3,422	9%	9%	11%
Plains		420	617	533	1%	1%	1%
Stillwater		12,180	16,971	15,838	10%	15%	12%
Swan		12,211	8,477	8,444	32%	16%	15%
Southern Land Office					**0%**	**0%**	**0%**
Billings					0%	0%	0%
Southwestern Land Office	**12,366**	**8,649**	**6,289**	**4,449**	**6%**	**3%**	**2%**
Anaconda		1,612	1,373	1,493	6%	5%	6%
Clearwater		3,090	3,355	2,250	7%	5%	3%
Hamilton		1,386	316	27	7%	1%	0%
Missoula		2,560	1,245	679	4%	1%	1%
Summary Total	**45,266**	**39,415**	**39,962**	**35,842**	**5%**	**5%**	**4%**

DESIRED FUTURE CONDITIONS

DNRC uses a site-specific model, described in ARM 36.11.405, to determine a desired future condition (DFC) for each forest stand it manages. Comparing a stand's current cover type to its desired cover type informs the management actions necessary to move a stand toward or maintain the desired cover type and to meet biodiversity objectives. Table BD-3 compares current cover type percentage against desired cover type percentages for the Northwestern and Southwestern Land Offices[5]. Timberland acquisitions slightly changed DFC target percentages for some cover types between 2010 and 2016; however, overall trends remained similar to prior years. On the SWLO, there is excess in Douglas-fir, mixed conifer, non-stocked, and alpine fir cover types, and deficiency in the ponderosa pine, lodgepole pine, and western larch/Douglas-fir cover types compared against desired conditions. The non-stocked acres are burned areas, primarily in ponderosa pine types, that are in the process of regenerating. The percentages of

[5] Sufficient inventory information is not yet available to make meaningful comparisons for the Central, Eastern, Northeastern, and Southern Land Offices.

ponderosa pine and western larch/Douglas-fir have increased slightly since 2010, indicating that management activities are resulting in progress toward meeting desired conditions. On the NWLO, there continues to be a large excess in the mixed conifer type and deficiencies in the ponderosa pine, western larch/Douglas-fir, and western white pine cover types compared to desired conditions. Percentages for each cover type show little change compared to those reported in 2016; this is primarily because of land acquisitions since 2016 with forest types dominated by late-successional, shade-tolerant species such as grand fir, subalpine fir, spruce, and Douglas-fir with lesser amounts of early-seral species such as western larch, western white pine, and ponderosa pine. The current cover types on the acquired lands essentially offset gains in percentages of desired cover types such as western larch/Douglas-fir on land owned and managed by DNRC prior to this reporting period.

Table BD-3: Percent of acres by cover type, 2000-2021, compared to DFC target for DNRC managed lands

Cover Type	SWLO (%)						NWLO (%)					
	2000	2005	2010	2016	2021	DFC Target	2000	2005	2010	2016	2021	DFC Target
Douglas Fir	21.5	21.7	23.8	22.2	22.9	15.1	2.4	5.2	5.2	5.9	6.7	1.8
Hardwoods	0.8	0.7	0.9	0.6	0.6	0.5	0.2	0.4	0.4	0.3	0.3	0.4
Lodgepole Pine	8.8	8.9	6.9	6.6	6.3	7.4	8.2	7.6	6.8	7.3	7.2	5.3
Mixed Conifer	4	4.2	4	7.7	6.1	1.4	23.8	25.1	21.9	23.9	24.1	7.5
NonStocked	0.7	6.6	11	4.3	3.5	0.0	0.7	1.8	2.7	1.5	1.3	0.0
Ponderosa Pine	45.3	39	34.4	38.3	39.6	51.8	19	18.6	18.8	17.2	16.3	23.3
Alpine Fir	3.7	3.4	3.5	3.8	4.5	0.9	13.6	13	13	13.4	13.7	7.9
Western Larch/ Douglas Fir	14.8	15.1	15.4	16.5	16.4	22.6	26.3	25.5	28.4	27.7	27.6	40.9
Western White Pine	0.2	0.1	0.1	0.1	0.1	0.5	5.6	2.9	2.9	2.7	2.9	12.9
Acres Included	157,271	158,127	157,746	206,084	206,210	206,210	284,647	293,223	293,169	304,279	318,423	318,423

OTHER BIODIVERSITY-RELATED MONITORING

During this monitoring period, DNRC concluded post-fire mortality monitoring in a Trust Lands section in the Clearwater Unit burned in the 2007 Jocko Lakes fire. The Jocko Lakes post-fire mortality monitoring project was visited annually from its establishment in 2008 through 2017 to collect data and monitor tree mortality, breakage, and wildlife use from 80 western larch and 46 Douglas-fir trees following the 2007 Jocko Lakes fire and subsequent salvage harvesting.

Western larch had a mortality rate of 34% (27 trees) over the monitoring period, with 17 trees dying in the first three years after the fire. Crown scorch greater than 60% appeared to be the most important factor influencing post-fire mortality of western larch, and diameter at breast height (dbh) less than 16 inches was secondary factor in predicting mortality. Among the western larch that died during the monitoring period, trees with greater than 60% crown scorch had a mortality rate of 83%. Of the trees with greater than 60% crown scorch, those with dbh greater than 16 inches had a mortality rate of 60% versus 77% for those with a dbh less than 16 inches. These results indicate that trees with crown scorch less than 60% and greater than 16 inches dbh have a high likelihood of survival following fire and are good candidates for retention during salvage harvesting.

Douglas-fir had a mortality rate of 74% over the monitoring period, with 35 of the 46 trees monitored dying following the fire. 67% of the trees that died did so within the first three years after the fire. In general, the results of this study indicate that Douglas-fir are generally not likely to survive a fire no matter the type or degree of damage sustained. Of the 11 Douglas-fir trees that survived, all had less than 30% bole scorch (in terms of the amount of bole scorched relative to total tree height), but among all trees with less than 30% bole scorch only 29% of them lived. There were no other factors (dbh, height, crown height, crown scorch, ground damage) that appeared to increase the probability of douglas-fir survival in conjunction with <30% bole scorch. This is consistent with the results of the Sula post-fire mortality monitoring study conducted by DNRC between 2000-2009 where bole scorch >=10% indicated a high probability of mortality. If Douglas-fir are to be retained in salvage harvest operations, they should have no or minimal apparent damage.

RECOMMENDATIONS

- Continue field-verification efforts to confirm old growth status, especially following the application of maintenance or restoration treatments in old growth stands. Results of field verification should be updated in DNRC's timber inventory in a timely manner to ensure that old growth amounts and percentages are up-to-date for analysis of direct, indirect, and cumulative effects to old growth in MEPA documents, and to inform allowable treatments (maintenance, restoration, or removal) at each Unit.
- Monitor the development of non-old growth stands for old growth recruitment, refine models to identify potential recruitment stands, and develop guidance and monitor harvest prescriptions in old growth recruitment stands to ensure that an adequate number of acres exist as old growth recruitment at each Unit and that those stands are actively moving toward reaching old growth status.
- Develop protocols for timely monitoring of regeneration using regeneration surveys to identify potential regeneration problems, causes, and solutions.

SILVICULTURE MONITORING

SILVICULTURE ACCOMPLISHMENTS - HARVEST BY LAND OFFICE

Table SI-1 shows timber volume and acres harvested by Land Office for each monitoring period. Average annual harvest volumes have increased steadily through each monitoring period, except for a slight decrease in average annual harvest volume between this and the previous monitoring periods. State law requires that DNRC's annual sustainable yield also serves as its annual timber sale planning target (MCA 77-5-223). In the most recent monitoring period, the annual sustainable yield increased from 56.9 million board feet (MMBF) in 2011-2016 to 60.0 MMBF with 8.3 MMBF as opportunity volume in 2020. The most recent calculation incorporated the addition of approximately 13,000 acres of former industrial timberland that DNRC acquired since 2015, located in the Stillwater State Forest. It is important to note that harvested volumes differ from sale planning targets for each fiscal year because harvesting often occurs in years after the sale date; as such, several sales sold during the most recent monitoring period have yet to be completed.

Table SI-1: Land office volume harvested and associated harvest acres by reporting period

Land Office	1997-2000		2001-2005		2006-2010		2011-2016		2017-2021	
	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)
NWLO	9,963	55,408	19,511	119,263	17,691	146,096	27,434	200,187	21,518	176,499
SWLO	11,494	50,722	15,202	72,205	11,277	73,815	15,437	88,371	13,220	63,884
CLO	1,678	10,699	1,900	16,190	2,625	14,883	5,447	30,936	3,157	9,830
Eastern Offices (SLO/NELO/ELO)	5,319	10,719	3,097	10,658	3,017	9,785	4,758	14,883	2,788	5,751
Total	28,454	127,548	39,710	218,316	34,610	244,579	53,076	334,377	40,683	255,964
Annual Average	7,114	31,887	7,942	43,663	6,922	48,916	8,846	55,730	8,137	51,193
Avg. Vol/Acre	4.5		5.5		7.1		6.3		6.3	

FOREST IMPROVEMENT ACCOMPLISHMENTS

The FI program uses fees from harvested timber to fund management actions whose goal is to improve the health and productivity of forested lands, but that are not typically done concurrently with timber harvesting. Accomplishments of the FI program are tracked by year and activity and are shown in Table SI-2. In 2018, DNRC developed and implemented an application called FM Pro to provide a platform to centralize planning and efficient implementation of the FI program. FI activities are tracked in FM Pro from inception to completion. Specific activities include tree planting, animal browse prevention including bloodmeal application or seedling net installation and maintenance, herbicide application to reduce competing vegetation, precommercial thinning, brush piling and scarification for site preparation, prescribed burning, management of tree improvement areas (such as seed orchards and test plantations), hand brush piling, cone collection, certain road maintenance activities, and noxious weed control. Road maintenance activities tracked in the FI program generally include road maintenance activities that are not associated with implementation of timber sales, including brushing, surface improvement, and crossing or closure improvement or installation. Noxious weed control includes herbicide application in harvest units, along roads, or spot applications, and release biological control agents (beetles).

Tree planting increased slightly during this monitoring period, with increases of approximately 48,000 seedlings planted and 525 acres planted. The increases compared to the previous monitoring period are more apparent on an annual level (the previous monitoring period covered six years instead of 5) where the number of seedlings planted annually climbed to approximately 272,000 versus 218,000, and the number of acres increase to 1,430 planted annually versus 1,104. The amount of browse protection associated with tree planting decreased as many locations that were planted between 2017-2021were in areas with less browse pressure from big game populations.

As with tree planting, the annual average amount of acres that were pre-commercially thinned increased by nearly 100 acres to 1,189 acres annually compared to the previous monitoring period (5,945 acres thinned in five years between 2017-2021 versus 6,575 acres thinned in six years from 2011 to 2016). The amount of prescribed burning (both piles and broadcast) and brush piling for site preparation decreased compared to the previous period.

The amount of noxious weed spraying appears to have substantially decreased during this monitoring period; however, this is due to the shift of using FM Pro to track noxious weed spraying activity. In previous periods, all noxious weed spraying, most of which occurs along roads, was reported as acres treated. FM Pro tracks noxious weed spraying along roads separately from noxious weed spraying in harvest areas, and in this monitoring period weed spraying along roads was reported as miles of road sprayed. Noxious weed spraying numbers for this monitoring period depict a more accurate representation of the actual accomplished activities than numbers from prior reports where all weed spray activities were reported as acres.

DNRC continues to manage its ponderosa pine seed orchard in Missoula, as well as two test plantations in the Swan Unit. There were no cone collection activities during this monitoring period as there were several years with poor cone crops; and DNRC's seed inventory remains adequate to supply its needs for growing seedlings for reforestation.

Table SI-2: Forest improvement accomplishments in fiscal years 1998 through 2021.

FI Activity	Units	Reporting Period				
		1998-2000	2001-2005	2006-2010	2011-2016	2017-2021
Plantation Regeneration Surveys	Acres	1,778	7,421	11,531	11,426	7,831
Tree Planting	Seedlings	*	*	2,293,117	1,309,714	1,357,576
Tree Planting	Acres	1,509	5,103	10,400	6,623	7,148
Tree Browse Prevention	Acres	504	2,836	5,379	3,077	1,912
Precommerical Thinning	Acres	5,449	8,659	5,263	6,575	5,945
Noxious Weed Area Spraying	Acres	2,106	17,170	17,971	18,328	4,236
Noxious Weed Road Spraying	Miles	*	*	*	*	343
Herbicide Application	Acres	3,776	2,084	2,360	289	199
Brush Piling	Acres	2,214	3,064	8,280	14,653	7,020
Pile Burning	Acres	3,490	10,077	22,079	43,156	24,638
Broadcast Burning	Acres	1,782	1,207	839	665	662
Tree Improvement Areas Managed	Acres	58	97	130	273	205
Hand Brush Work	Acres	426	268	1,083	2,112	69
Bio-Control Treatments	Acres	0	32	1,308	2,763	178
Cone Collection	Bushels	195	1,237	1,282	1,588	-
Data not available for these periods						

LOGGING SYSTEMS

Table SI-3 compares the percentage of various logging systems used on DNRC timber sales sold in each monitoring period. This information is compiled from DNRC timber sale contracts and maintained in the DNRC's Trust Land Management System (TLMS). In the most recent monitoring period, the amount of tractor-based logging decreased from 90 percent to 76 percent of harvested acres, while the amount of cable logging increased from 10 percent to 16 percent. Eight percent of acres were harvested using a combination of both tractor and cable systems. The were no sales that required helicopter logging between 2017 and 2021.

Table SI-3: Percentage of acres logged by logging system and monitoring period.

Period	Tractor	Cable	Combination	Helicopter
1998-2000	91	7	*	2
2001-2005	79	17	*	4
2006-2010	85	13	*	1
2011-2016	90	10	*	0
2017-2021	76	16	8	0

*data not available for these periods

HARVEST ACREAGE BY SILVICULTURAL TREATMENT METHOD

For all timber sales sold from fiscal years 2017 through 2021, DNRC collected data on acreages that would be treated under the various silvicultural systems. This information comes from the silvicultural prescriptions prepared for each timber sale. Descriptions of these silvicultural systems can be found in the SFLMP (DNRC 1996: Appendix SCN, p. 17-18)

Table SI-4: Percentage of silvicultural treatment method based on acreage, compared to SFLMP estimate.

Silivcultural Method	SFLMP Objective	1998-2000	2001-2005	2006-2010	2011-2016	2017-2021
Salvage	N/A	0%	26%	17%	11%	8%
Clearcut	10%	4%	4%	2%	4%	4%
Seed Tree	25%	8%	13%	23%	29%	28%
Shelterwood	5%	2%	6%	15%	22%	20%
Selection	40%	55%	34%	24%	28%	15%
Intermediate	20%	31%	17%	19%	6%	25%

As with prior monitoring periods, salvage harvesting to recover timber damaged by insect and disease outbreaks and wildfire occurred on a substantial portion (8 percent) of harvested acres; however, the percentage has been decreasing since the 2001-2005 monitoring period. Salvage harvesting occurred on 3,126 acres between 2017 and 2021. Fire salvage took place on 2,152 acres, compared to 1,285 acres in the previous monitoring period. Salvage related to wind events that blew down standing timber occurred on 929 acres. Salvage efforts related to insects and disease decreased substantially to only 45 acres during this monitoring period, from 4,470 acres in the previous period.

Two types of even-aged regeneration harvesting – seed tree and shelterwood – decreased from the previous monitoring period, with seed tree decreasing from 29% to 28% and shelterwood decreasing from 22% to 20%. Clearcut harvesting remained the same as the previous period at 4%. Seed tree and intermediate harvesting are the most commonly used methods, with each used on 28% and 25% of acres harvested, respectively, during the monitoring period. The amount of partial cutting (selection and intermediate treatments) increased from a combined 34% in 2011-2016 to 40% in the most recent monitoring period.

Excluding salvage acres, even-aged regeneration methods were used on 56% of acres, and partial cutting methods were used on 44% of acres. This is a substantially higher usage of even-aged treatments when compared to the levels estimated in the SFLMP of 40% for even-aged methods and 60% for partial cutting methods, however the usage of even-aged and partial cutting methods has decreased and increased by 5% each, respectively, since the pervious monitoring period. Biodiversity field reviews have indicated that prescriptions are being selected and applied appropriately on most sites, so the higher usage of even-aged methods is likely due to harvesting activities increasingly taking place in mid- and upper-elevation sites that have not been previously harvested. Mixed-severity and stand-replacing disturbance regimes are predominant on such sites, and even-aged methods are appropriately used to emulate those regimes.

RECOMMENDATIONS

- Develop standards to define regeneration success that will inform the need for future activities such as those necessary to bring inadequately stocked stands up adequate stocking levels, or control density in overstocked stands. Develop protocols to ensure that regeneration surveys are completed in a timely manner.
- Provide guidance on selecting appropriate prescriptions to match historic disturbance regimes to ensure that harvest treatments are consistent with the philosophy and intent of the SFLMP and with the ARM. Also provide guidance to differentiate between different harvest prescriptions that may have similar appearance and/or implementation, such as shelterwood vs. selection and selection vs. old growth maintenance, to ensure accurate accounting of acres treated with each prescription.

ROAD MANAGEMENT MONITORING

ROAD CONSTRUCTION AND MAINTENANCE

Road activities for the reporting period continued at rates previously reported which since 1998 have averaged approximately 31.3 miles of new road construction per year. Of note, road maintenance and BMP improvements have increased since the first monitoring period. Table RM-1 below outlines total road activities for the current reporting period as well as since the inception of the SFLMP while Table RM-2 shows road activities on a per year average.

Table RM-1: Total Road Activities by Reporting Period

Road Activity	Reporting Period				
	1998-2000	2001-2005	2006-2010	2011-2016	2017-2021
New Road Construction (mi)	105.9	149.0	146.7	197.0	146.0
Road Reconstruction (mi)	322.4	206.9	193.7	148.0	110.7
Road BMP Maintenance (mi)	86.4	411.7	520.6	1,050.0	846.0
Road Reclamation (mi)	20.5	34.3	34.8	71.0	34.7
Toal Road Activities	535.2	801.9	895.8	1,466.0	1,137.4

Table RM-2: Road Activities by Reporting Period as a Per Year Average

Road Activity	Per Year Average				
	1998-2000	2001-2005	2006-2010	2011-2016	2017-2021
New Road Construction (mi)	35.3	29.8	29.3	32.8	29.2
Road Reconstruction (mi)	107.5	41.4	38.7	24.7	22.14
Road BMP Maintenance (mi)	28.8	82.3	104.1	175.0	169.2
Road Reclamation (mi)	6.8	6.9	7.0	11.8	6.94
Toal Road Activities	178.4	160.4	179.2	244.3	227.5

ROAD INVENTORY AND MONITORING

Road inventory processes, procedures and data collection methods have been significantly refined and improved during this reporting period resulting in significantly more road miles and associated infrastructure inspected. Table RM-3 below reports on the amount of road miles, crossing structures and closures that have been inventoried and inspected during the reporting period. Road inventory processes, procedures and data collection methods have been significantly refined and improved during this reporting period resulting in significantly more road miles and associated infrastructure

Table RM-3: Road Inventory Summary by Reporting Period

Inventory Feature	Reporting Period				
	1998-2000	2001-2005	2006-2010	2011-2016	2017-2021
Roads (miles)	225	456	681	1,949	1,808
Crossing Structures	259	325	584	5,597	4,195
Closures Inspected	606	1,035	1,702	1,533	1,612

At the end of 2021, 94.8% of bull trout and 84.6% of Westslope Cutthroat watersheds (3,133 miles in total) have completed road inventories. 568 miles or 15% of roads in priority watersheds have yet to be inventoried and DNRC estimates that all inventoried will be completed by the end of 2023. It was found from these inventories that 2,843 miles or 91% of all inventoried road meet BMP standards. Of the 3,132 miles of road inventoried, 5.7 miles or <1% of all inventoried road had a moderate or high risk of direct sediment delivery to streams.

Table RM-4: Road Inventory Accomplishments and BMP Status by Year of Reporting Period

All Roads on DNRC Forested Trust Lands in 6th code watersheds supporting an HCP Fish Species					
Year	Total Roads	Total Inventory	% Inventoried	Inventoried Road	
				Meeting BMP's	% Meeting BMPS
2017	2,687	1,468	55%	1,179	80%
2018	2,729	1,635	60%	1,422	87%
2019*	3,722	2,550	69%	2,336	92%
2020	3,722	2,654	71%	2,378	90%
2021	3,701	3,133	85%	2,843	91%
HCP Transistional Lands Amendment #1					

Of the 4,977 culverts inspected, 1,181 or 24 % of all inventoried culverts did not meet BMP standards. Of all inventoried culverts, 302 or 6% posed a moderate or high risk of direct sediment delivery to a perennial or intermittent stream. During the last 5 years of SFLMP Implementation, 846 miles of road have had BMP upgrades and maintenance performed.

Table RM-5: Crossing Structure Inventory by BMP status and Sediment Delivery Risk

Crossing Structure Summary						
Crossing Type	Inventory Summary			Sediment Risk		
	Meets BMP's	Not Meeting BMP's	Total Inventory	Low	Moderate	High
Road Ditch Relief Culverts	2,350	618	2,968	2,893	62	13
Ephemeral Draw Crossings	591	175	766	744	19	3
Intermittent Stream Crossing	248	130	378	315	47	16
Perennial Stream Crossing	376	193	569	448	69	52
Seep or Spring	231	65	296	275	16	5
Summary	**3,796**	**1,181**	**4,977**	**4,675**	**213**	**89**
Summary (% of Total)	**76%**	**24%**	**100%**	**94%**	**4%**	**2%**

INTERNAL AND STATEWIDE BMP AUDITS

Another form of road monitoring is auditing the implementation and effectiveness of best management practices (BMPs) either during or after a timber sale is completed. BMP audit results for the current monitoring period remain consistent to those previously reported and overall, show slight improvements since the inception of the SFLMP. Table RM-4 below shows BMP audit results for all previous and current monitoring periods while Table RM-5 shows audit results for the implementation of the Streamside Management Zone law during timber sale projects.

Table RM-6: Internal and Statewide BMP Audit Results on State Timber Harvest Projects by Reporting Period and Land Office

BMP Metric		Application	Effectiveness	Minor Departure	Major Departure	Gross Negligent	Rated Practices
1998-2000	NWLO	96%	98%	9	1	0	820
	SWLO	94%	96%	21	2	0	525
	CLO	92%	95%	33	5	0	678
	Eastern Offices	97%	98%	17	1	0	732
	All Lands	**96%**	**97%**	**80**	**9**	**0**	**2,755**
2001-2005	NWLO	98%	99%	17	2	0	1,789
	SWLO	96%	97%	15	1	0	742
	CLO	96%	99%	7	0	0	468
	Eastern Offices	91%	91%	37	14	0	560
	All Lands	**96%**	**97%**	**76**	**17**	**0**	**3,559**
2006-2010	NWLO	98%	99%	14	4	0	1,258
	SWLO	97%	98%	24	0	0	1,116
	CLO	97%	98%	8	0	0	506
	Eastern Offices	94%	95%	33	3	0	634
	All Lands	**97%**	**98%**	**79**	**7**	**0**	**3,514**
2011-2016	NWLO	97%	99%	32	7	0	2,471
	SWLO	98%	98%	20	0	0	1,303
	CLO	95%	97%	21	3	0	613
	Eastern Offices	90%	93%	19	2	0	248
	All Lands	**97%**	**98%**	**92**	**12**	**0**	**4,635**
2017-2021	NWLO	99%	99%	28	0	0	996
	SWLO	99%	99%	5	0	1	398
	CLO	99%	100%	1	0	0	111
	Eastern Offices	NA	NA	NA	NA	NA	NA
	All Lands	**99%**	**99%**	**34**	**0**	**1**	**1,505**

Table RM-7: Internal and Statewide BMP Audit Results for SMZ Law Implementation on State Timber Harvest Projects by Reporting Period and Land Office

SMZ Metric		Application	Effectiveness	Minor Departures	Major Departures	Gross Neglegent	Rated Practices
1998-2000	NWLO	98%	100%	2	0	0	170
	SWLO	93%	99%	6	0	0	150
	CLO	94%	100%	3	0	0	126
	Eastern Offices	78%	100%	2	0	0	9
	All Lands	**91%**	**100%**	**13**	**0**	**0**	**455**
2001-2005	NWLO	99%	99%	2	0	0	337
	SWLO	100%	100%	0	0	0	108
	CLO	96%	100%	2	0	0	108
	Eastern Offices	92%	100%	3	0	0	72
	All Lands	**97%**	**100%**	**7**	**0**	**0**	**688**
2006-2010	NWLO	99%	100%	0	0	0	266
	SWLO	97%	97%	3	0	0	228
	CLO	100%	100%	0	0	0	118
	Eastern Offices	96%	96%	3	1	0	134
	All Lands	**98%**	**98%**	**6**	**1**	**0**	**746**
2011-2016	NWLO	97%	100%	9	0	0	534
	SWLO	98%	99%	4	1	0	298
	CLO	98%	98%	2	0	0	114
	Eastern Offices	95%	100%	1	0	0	38
	All Lands	**97%**	**99%**	**16**	**1**	**0**	**984**
2017-2021	NWLO	99%	100%	1	0	0	107
	SWLO	100%	100%	0	0	0	48
	CLO	100%	100%	0	0	0	10
	Eastern Offices	NA	NA	NA	NA	NA	NA
	All Lands	**99%**	**100%**	**1**	**0**	**0**	**165**

RECOMMENDATIONS

- Prioritize road inventory efforts to those watersheds that have the highest resource value as outlined in the Habitat Conservation Plan.
- Adaptatively incorporate information regarding sediment production from various road classifications (open, restricted, reclaimed) into the inventory priority and ultimately ARM's.
- Continue training and field workshops that help support the communication of roles, responsibilities and expectations of individual field staff in the road inventory process.

WATERSHED AND FISHERIES MONITORING

WATER QUALITY MONITORING – STILLWATER STATE FOREST

DNRC began monitoring water quality at selected sites on the Stillwater State Forest near Olney, Montana, in 1976 (Figure WS-1; Table WS-1). The objective of the monitoring program is to detect trends in discharge, nutrients, and sediments, to identify relationships between management activities and water quality, and to establish baseline values for comparison over time.

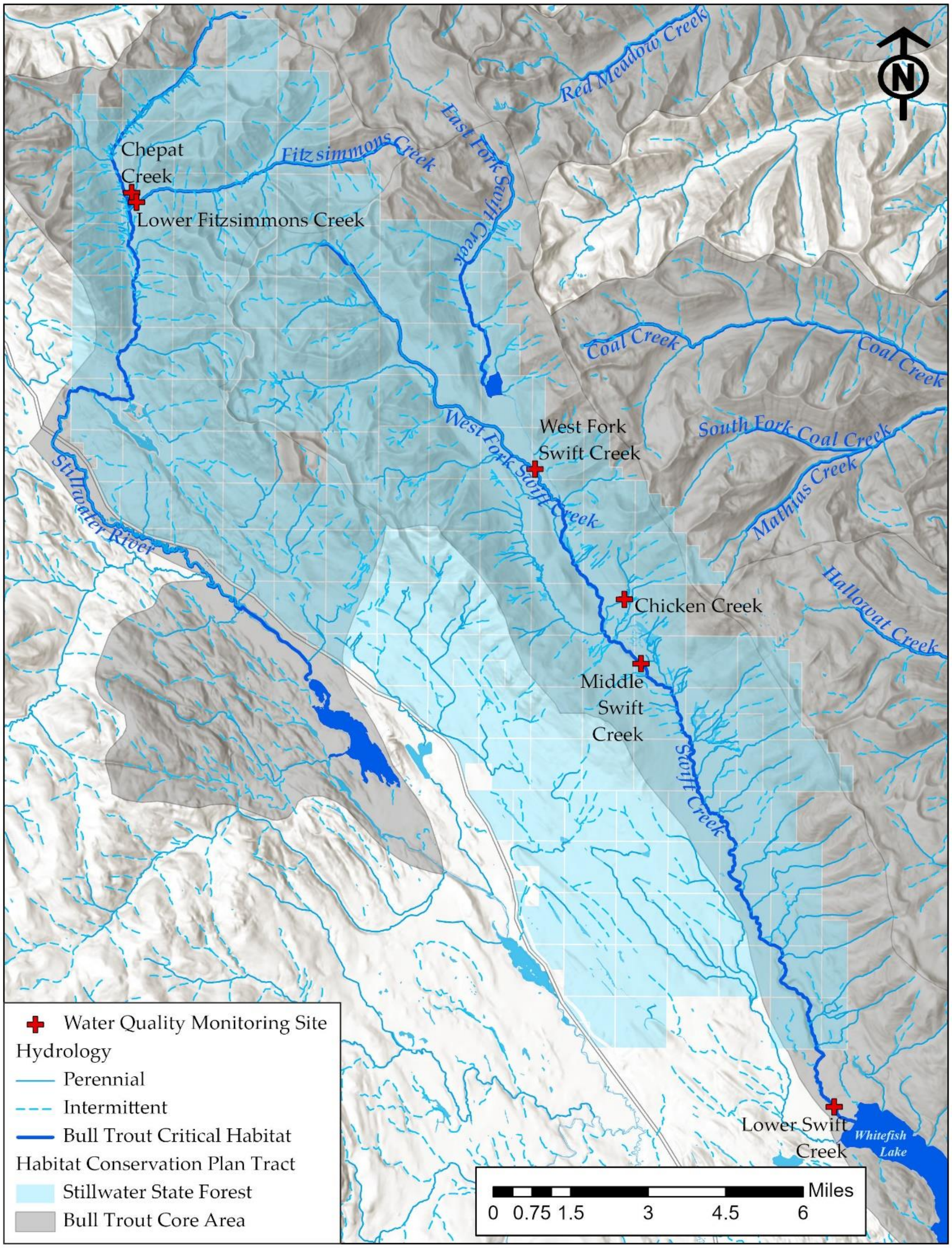
Sampling historically has occurred in both the Whitefish Lake and Stillwater River basins. During the 2017–2021 reporting period, water quality data were collected at six sites on the Stillwater State Forest weekly starting in early April and continuing through mid-June. Monitoring sites included watersheds where active forest management activities were occurring, as well as watersheds considered to be undisturbed due to the negligible amount of timber harvest and road building within the basins.

Sediments

Natural stream sediment load is largely determined by watershed soil type, the nature and extent of the streamside vegetation, stream discharge capacity, and precipitation events. Changes in any of these factors can alter the amount of sediment available to the stream, as well as the volume of sediment transported. Variation in suspended sediment concentration over time can indicate changes in water quality as phosphorus has been shown to be associated with sediment. Increases in fine sediment may also have detrimental effects on spawning success of fish, particularly native salmonids.

Yearly average total suspended solids (TSS; mg/L) on monitored streams in the Stillwater State Forest for the current reporting period are shown in Table WS-2. The majority of TSS concentrations observed during this period were within the observed range during the previous reporting period (Table WS-2). Increased levels of TSS were noted in samples collected in Lower Swift Creek in 2017, 2018, and 2019 due to high sediment values observed during spring runoff. These increases are associated with naturally-occurring mass wasting streambanks in the lower reaches of Swift Creek. Previous reports detail the relationship between the higher suspended sediment values in Swift Creek and the presence of large volumes of erosive glacial till in the lower part of the basin. Periodic increases in TSS may be explained by the lack of flushing flows followed by increased spring runoff volume during higher precipitation years. Sediment values in the upper parts of the watershed remain very low.

Figure WS-1: Water quality monitoring locations on the Stillwater State Forest



PROJECT SPECIFIC TURBIDITY MONITORING

The Montana Department of Natural Resources and Conservation, Forest Management Bureau has monitored continuous instream turbidity levels below various forest management activities for the past 12 years. The objective of these monitoring projects was to document; 1.) the magnitude and spatial extent of instream turbidity events associated with forest management projects, 2.) the effectiveness of timber sale mitigations and Best Management Practices (BMPs) to prevent sediment delivery to streams and 3.) to inform adaptive management. The forest management activities that were monitored with continuous, instream turbidity sondes are listed in Table WS-1: Project specific Turbidity Monitoring Results below.

Concentration-duration-frequency analysis was performed to describe the magnitude of instream turbidity events directly below project activities and, at some monitoring locations, the spatial extent downstream. Monitoring results have largely validated project level environmental effects assessments that forecast impacts to water quality that result from instream construction activities, such as culvert replacement. Impacts to water quality were found for very short durations and typically returned to background levels within 24 hours of instream activities. BMPs applied to the site after the corrective action were shown to provide protection to water quality during very intense precipitation or runoff events.

The spatial extent of downstream water quality impacts was localized at the reach scale and rapidly diminish as sediment plumes translate downstream. Results also demonstrate that timber sale mitigation measures, riparian buffers and BMPs are highly effective at mitigating effects to instream turbidity during timber harvest and instream construction activities.

These findings have refined DNRC practices during instream construction activities, application of riparian buffers, and site-specific BMPs and provides resource specialists in the design of timber sale mitigation measures, resulting in the reduction of water quality impacts during road-stream crossing construction and addressing sediment delivery sites. Future monitoring efforts hope to document annual and event turbidity signals, at watershed scale, that are under intense forest management practices.

Table WS-1: Project Specific Turbidity Monitoring Results

Site/Location	Year	Sample Length (days)	Objective	Results
Whitetail Creek (NWLO/SWN)	2009-2011	346.7	Background, short-term and long-term turbidity effects, at the watershed and reach scale, from the installation of a fish passage barrier.	Background turbidity in Whitetail Creek is very low, rarely exceeding 2.0 NTU (10% exceedance). Several significant turbidity events during installation all <1 hour. Background conditions resumed immediately after construction and BMP proved effective in subsequent years.
Upper Willow Creek (SWLO/ANA)	2010	1.1	Short-term turbidity effects, at the reach scale, of culvert removal and rock armored, improved ford installation.	Turbidity event from culvert removal and rock armor installation peaked at 1045 NTU and was less then typically culvert removals due to low fill depths. 10% exceedance for the sampling event was 28.4 NTU. Background conditions were obtained in approximately 24 hours.
Sweede Creek (NWLO/STW)	2010-2011	137.4	Background, short-term and long-term turbidity effects, at the reach and watershed scale, of culvert removal and installation of a stream simulation fish passage culvert on an open road.	Background turbidity in Sweede Creek is very low, rarely exceeding 2.0 NTU (10% exceedance). The 1% exceedance for the construction period was 27 NTU with a very quick return to background due to the steep channel grade.
Harris Creek (NWLO/LIB)	2012-2016	897.1	Background and long-term effects, at the watershed scale, from a intensive forest management project with steep slope road construction, even-age silviculture using skyline yarding systems and prescribed fire.	10% exceedance threshold prior to activities was 1.5 NTU and increased to a two year average of 19.7 NTU during and immediately after harvest operations. No clear point of sediment delivery was mapped and increased turbidity is assumed to be a response to significant spring runoff events mobilizing in-stream sediments. Significant channel adjustment was observed in the summer of 2014.
Ashby Creek (SWLO/MSO)	2012-2015	769.2	Background, short-term and long-term turbidity effects, at the watershed and reach scale, of a stream channel and road alignment project.	Background turbidity in Ashby Creek was the highest measured watershed at 19.1 NTU (10% exceedance). Stream relocation produced significant turbidity pulses as the channel adjusted but was within background 2 years post construction.
South Woodward Creek (NWLO/SWN)	2013	1.0	Short-term turbidity effects, at the reach scale and distally downstream, from culvert removal, fill removal and slope stabilization at a deep fill crossing on a large perennial, fish bearing stream.	Turbidity event 150' downstream of culvert removal peaked at 2,252 NTU for 1 minute. Downstream sites at 650' and 1,100 feet were delayed by 6 minutes and 11 minutes respectively. Downstream NTU's were reduced by 75% (558 NTU) and 91% (194 NTU) respectively.
Bear Creek (SWLO/MSO)	2014	7.1	Short-term turbidity effects both locally and at various ranges downstream of a culvert removal and bridge installation site.	Sensor 150' downstream of construction peaked at over 2,000 NTU for 2 mins. That same wave peaked at 160 NTU 650' downstream and was within water quality standards at 4.0 NTU 6,150' downstream of activity.
Fish Bowl Face (NWLO/STW)	2015	6.9	Short-term turbidity effects, at the reach scale, from the removal of a temporary Cross Laminated Timber (CLT) bridge on small, perennial stream.	No measurable change in NTU was detected during the removal if a temporary CLT bridge installation. A significant difference then if a temporary culvert was installed.
Cyclone Creek (NWLO/STW) Culvert Removal/Replacement	2016	50.0	Short and long-term turbidity effects, at the reach scale, of stream simulation, fish passage culvert replacement on an open road.	Turbidity spike of 1400 NTU for a minute and returns to background in approximately 2.4 hours. No turbidity signals observed in the following 20 days with 1.85 inches of rain when BMP's were in place.
Cyclone Creek (NWLO/STW) Culvert Removal	2016	37.0	Background and short-term turbidity effects, at the reach scale, of culvert removal and fill stabilization on a reclaimed road.	Two turbidity spikes during culvert removal and during reintroduction of stream water to new culvert. Both pulses were less than 4 mins and over 1600 NTU and 1000 NTU respectively. No turbidity signals observed when BMP's were in place post construction with intense rainfall.
Cyclone Creek (NWLO/STW) Bridge Removal	2016	50.0	Background and short-term turbidity effects, at the reach scale, of native bridge removal and fill stabilization on a restricted road.	Short term (<3 mins) turbidity pulse during removal of bridge abutments of 52 NTU. Other minor and short term spikes from equipment crossings. No turbidity signal during intense rainfall events when BMP's were in place.
South Woodward Creek (NWLO/SWN)	2017-2022 (On-going)	716.9	Background and event sampling turbidity effects, at the site scale, of Pre and Post-BMP corrective actions on a open road.	On-going
Arkansas Creek (SWLO/MSO)	2019-2021	342.9	Short-term and long-term turbidity effects, at the reach and watershed scale, of a stream simulation, fish passage culvert replacement on an restricted road.	Typical two spike turbidigraph resulting from stream diversion and reintroducing water to the culvert. Arkansas Creek background turbidity was 4.2 NTU (10% exceedance). Continued low level turbidity post-project as a result of long-term grade adjustment in the stream above the culvert.
Sweede Creek (NWLO/STW)	2021	73.8	Short-term turbidity effects, at the reach scale, of stream simulation, fish passage culvert replacement on a restricted road.	Typical two spike turbidigraph resulting from stream diversion and reintroducing water to the culvert. Turbidity spike peaked at 1010 NTU and 1500NTU respectively. No additional turbidity spikes were observed when BMP's were in place post-construction for 65 days of monitoring with 6.8 inches of rain.
Whitetail Creek (NWLO/SWN)	2021-2022	On-going	Seasonal turbidity effects, at the watershed scale, of upstream post-fire salvage logging.	On-going
Goat Creek (NWLO/SWN)	2022	On-going	Seasonal turbidity and Total Suspended Solids, at the watershed scale, of an intensely managed forested watershed in comparison to Lion Creek, a similar sized, adjacent watershed (control).	On-going

NUTRIENTS

Studies of Whitefish and Flathead Lakes have concluded that increases in nutrient concentrations will further stimulate algal productivity and should be minimized. Currently, Montana DEQ does not have a numeric standard for phosphorous and other nutrients in surface water during the portion of the year when samples are collected (MTDEQ 2014) because adequate information is not yet available to develop specific numeric standards. The Environmental Protection Agency (EPA) recognizes that numerical water quality standards for phosphorus must be developed on a site-specific basis. For comparison purposes, the phosphorus and total nitrogen targets for the Clark Fork River below the confluence with the Blackfoot River are 39 and 300 parts per billion respectively (Tristate Implementation Council 2010). Between 2017 and 2021, 336 water quality samples were collected from four sites in the Swift Creek watershed and two sites in the Stillwater River watershed.

Phosphorus

One of the primary objectives of the water quality monitoring on the Stillwater State Forest is to attempt to understand the relationship between forest management activities and phosphorus concentrations being delivered to downstream waterbodies. Table WS-1 shows the values for average total phosphorus and soluble reactive phosphorus (SRP) concentrations collected during the period of record for each station. There appears, from this data, to be poor correlation between forest management activities and SRP concentrations. For example, Chicken Creek and Chepat Creek, which have had very little timber harvest and road building activity, show concentrations near or above those of streams where recent timber harvest and road construction have taken place. During this reporting period, total phosphorus levels exceeded 39 ppb in 16 samples collected from lower Swift Creek and one sample from Fitzsimmons Creek, less than 5 percent of the total number of samples collected. At least one sample collected in every monitoring year exceeded 39 ppb in lower Swift Creek, with half of the samples collected in 2018 exceeding 39 ppb. No exceedances were noted in Chicken, Chepat, West Fork Swift or Middle Swift creek.

Nitrogen

From the data collected, nitrate-nitrite levels do not correlate with TSS or phosphorus. Monitoring data show the general decrease through the season, independent of discharge. This likely reflects the ability of riparian plants to take up nitrates and nitrites as the growing season progresses.

Since 2017, DNRC has collected 336 samples on the Stillwater State Forest at the 6 monitoring sites. Approximately 12 percent of these samples (40 of 336) had nitrate-nitrite levels at or below the reporting level of 0.01 milligrams per liter (also reported as parts per million). All samples exhibited levels well below the limit for drinking water standards in Montana, which is 10 milligrams per liter (parts per million) or 10,000 micrograms per liter (parts per billion).

Table WS-2: Period of record for water quality monitoring stations on the Stillwater State Forest.

Water Quality Parameter	Site Name	Period of Record	2011-2016 Average	Reporting Period									
				2017		2018		2019		2020		2021	
				Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range
TSS (mg/L)	Chicken	1976-2021	1.7	2.2	(0 - 10)	2.4	(0 - 9)	1.3	(0 - 4)	1.9	(0 - 9)	1.1	(0 - 3)
	Chepat	1976-2007, 2014-2021	1.3	3.8	(1 - 22)	2.1	(0 - 10)	1.1	(0 - 3)	4.1	(0 - 31)	2.1	(0 - 6)
	Fitzsimmons	1976-2007, 2014-2021	2.2	4.3	(0 - 24)	3.8	(0 - 29)	1.4	(0 - 6)	7.6	(0 - 64)	2.2	(0 - 10)
	West Fork Swift	1976-97, 2006-2021	4.7	5.9	(0 - 21)	4.2	(0 - 14)	2.4	(0 - 7)	4.9	(0 - 26)	3.1	(0 - 13)
	Middle Swift	1980-2021	9.9	9.4	(3 - 28)	7.7	(0 - 28)	4.0	(0 - 18)	8.4	(1 - 43)	8.0	(2 - 40)
	Lower Swift	1976-2021	90.7	92.5	(9 - 260)	147.8	(3 - 468)	38.2	(4 - 185)	84.9	(8 - 450)	76.5	(15 - 447)
Total Phosphorous (ppb)	Chicken	1976-2021	12.2	12.3	(7 - 23)	8.8	(6 - 17)	8.9	(6 - 12)	8.5	(7 - 11)	11.5	(9 - 20)
	Chepat	1976-2007, 2014-2021	5.4	7.5	(1 - 30)	4.4	(1 - 15)	4.3	(2 - 9)	4.3	(1 - 17)	4.9	(2 - 8)
	Fitzsimmons	1976-2007, 2014-2021	4.4	6.2	(1 - 21)	6.4	(2 - 20)	3.6	(1 - 9)	6.4	(1 - 40)	3.6	(1 - 10)
	West Fork Swift	1976-97, 2006-2021	5.2	7.8	(2 - 22)	5.1	(1 - 11)	3.4	(1 - 8)	3.1	(1 - 6)	6.4	(1 - 31)
	Middle Swift	1980-2021	8.0	7.8	(3 - 19)	6.9	(1 - 25)	3.6	(2 - 8)	5.1	(2 - 12)	9.3	(5 - 35)
	Lower Swift	1976-2021	32.6	29.4	(6 - 102)	57.8	(6 - 184)	13.0	(2 - 62)	19.9	(6 - 51)	35.5	(11 - 190)
Soluble Phosporous (ppb)	Chicken	1976-2021	7.9	8.6	(7 - 10)	7.2	(6 - 8)	6.9	(4 - 9)	7.3	(7 - 8)	7.9	(7 - 9)
	Chepat	1976-2007, 2014-2021	3.3	3.1	(1 - 4)	3.3	(2 - 6)	3.0	(2 - 8)	2.7	(1 - 6)	2.3	(2 - 3)
	Fitzsimmons	1976-2007, 2014-2021	3.4	2.3	(1 - 3)	2.4	(2 - 4)	2.0	(1 - 5)	2.6	(1 - 8)	1.3	(1 - 2)
	West Fork Swift	1976-97, 2006-2021	3.0	3.0	(1 - 4)	3.2	(2 - 10)	2.1	(1 - 3)	2.4	(1 - 6)	2.1	(1 - 4)
	Middle Swift	1980-2021	3.0	2.8	(2 - 4)	2.3	(2 - 3)	2.4	(2 - 3)	3.3	(2 - 8)	1.5	(1 - 3)
	Lower Swift	1976-2021	4.4	4.5	(2 - 8)	4.5	(2 - 14)	2.9	(2 - 4)	12.1	(4 - 38)	2.8	(2 - 6)
Nitrate-Nitrite (ppb)	Chicken	1976-2021	20.7	26.2	(10 - 50)	18.8	(5 - 60)	20.5	(5 - 40)	35.0	(20 - 70)	37.0	(20 - 80)
	Chepat	1976-2007, 2014-2021	8.3	15.8	(5 - 50)	5.4	(5 - 10)	12.0	(5 - 20)	18.5	(5 - 40)	19.5	(5 - 50)
	Fitzsimmons	1976-2007, 2014-2021	33.0	26.5	(5 - 60)	15.4	(5 - 30)	27.0	(10 - 40)	51.0	(20 - 70)	49.0	(30 - 70)
	West Fork Swift	1976-97, 2006-2021	81.2	74.6	(40 - 140)	53.1	(20 - 80)	57.0	(20 - 80)	79.0	(40 - 100)	89.0	(30 - 130)
	Middle Swift	1980-2021	65.5	57.7	(40 - 80)	48.5	(20 - 60)	50.0	(20 - 90)	61.0	(50 - 80)	68.0	(50 - 80)
	Lower Swift	1976-2021	49.0	43.8	(20 - 80)	30.4	(5 - 50)	30.5	(5 - 50)	35.0	(20 - 60)	45.0	(20 - 80)

DISCHARGE MONITORING

Discharge monitoring on the Stillwater and Swan River state forests have been collected intermittently between 1976 and 2021 (Table WS-3). Monitoring efforts prior to 2015 utilized fixed staff gages which were utilized to develop rating curves to estimate discharge during weekly water quality sample collections between April and June. Beginning in 2015, stage height recorders were used to collect water level at 30-minute intervals between March and November. Increasing the sensitivity of discharge monitoring is expected to provide more robust estimates of stream discharge data by identifying short-term increases in discharge resulting from precipitation events which may not have been captured by the previous monitoring methodology. Stage height recorders were installed in the six sites on the Stillwater State Forest in 2015, with the additional six sites on the Swan River State Forest installed in 2016 and 2017. Estimated base discharge, peak discharge, and peak discharge timing were determined for the monitoring period and are presented in Table WS-3. Discharge rating curves will be included during the next reporting period (2022–2026).

RECOMMENDATIONS

- Continue collection of long-term water quality datasets in the Stillwater State Forest
- Continue to utilize remote stage height data recorders to increase the accuracy of discharge data.
- Establish precipitation monitoring data in concert with discharge estimates to establish more robust estimates of water yield.

Table WS-3: Ongoing stream discharge monitoring sites on the Stillwater and Swan River state forests.

			Sampling Period		Estimated Discharge (cfs)		Peak Discharge
State Forest	Stream	Year	Start	End	Base	Peak	Date
Stillwater SF	Chepat Creek	2015	29-Mar	28-Jul	2.6	16.1	2-Jun
		2016	21-Mar	18-Oct	2.5	14.3	23-May
		2017	14-Mar	15-Nov	1.2	27.1	1-Jun
		2018	26-Mar	15-Oct	Stream channel adjustment; Data not reported		
	Chicken Creek	2015	29-Apr	28-Jul	4.5	16.2	4-Jun
		2016	21-Mar	1-Nov	3.2	30.3	23-May
		2017	14-Mar	14-Nov	3.4	30.6	1-Jun
		2018	26-Mar	2-Dec	3.1	32.6	26-May
		2019	1-Apr	3-Dec	2.9	22.5	17-May
		2020	31-Mar	3-Dec	2.7	30.3	31-May
		2021	1-Apr	21-Nov	4.1	16.1	4-Jun
	Fitzsimmons Creek	2015	29-Apr	14-Oct	16.5	111.5	3-Jun
		2016	21-Mar	18-Oct	15.2	209.7	23-May
		2017	14-Mar	15-Nov	14.0	318.5	1-Jun
		2018	26-Mar	2-Dec	12.4	343.2	17-May
		2019	2-Apr	28-Nov	15.6	171.7	17-May
		2020	1-Apr	3-Dec	14.8	326.2	31-May
		2021	31-Mar	21-Nov	14.7	230.9	4-Jun
	West Fork Swift Creek	2015	29-Apr	28-Jul	-	171.3	3-Jun
		2016	21-Mar	18-Oct	15.8	196.2	23-May
		2017	14-Mar	15-Nov	12.9	260.8	1-Jun
		2018	26-Mar	5-Dec	9.7	283.1	26-May
		2019	2-Apr	28-Nov	13.3	142.6	3-Jun
		2020	1-Apr	4-Dec	14.9	346.9	31-May
		2021	31-Mar	21-Nov	13.1	244.8	4-Jun
	Middle Swift Creek	2017	13-Mar	14-Nov	49.8	884.7	1-Jun
		2018	26-Mar	3-Dec	41.3	970.0	26-May
		2019	1-Apr	3-Dec	46.4	608.3	17-May
		2020	31-Mar	3-Dec	50.9	1081.4	1-Jun
		2021	1-Apr	21-Nov	63.8	884.2	25-May
Swan	South Woodward Creek	2017	6-Jul	27-Nov	37.4	-	-
		2018	7-Mar	2-Dec	36.1	53.3	1-Jun
		2019	11-Apr	1-Dec	27.1	35.2	17-May
		2020	1-Apr	2-Dec	36.1	67.2	21-May
		2021	1-Apr	19-Nov	28.4	67.6	25-May
	Woodward Creek	2017	11-Jul	27-Nov	58.7	-	-
		2018	7-Mar	2-Dec	82.2	132.0	1-Jun
		2019	10-Apr	2-Dec	52.2	75.2	20-Apr
		2020	1-Apr	2-Dec	73.8	117.4	21-May
		2021	1-Apr	18-Nov	58.2	131.5	25-May
	Soup Creek	2017	6-Jul	28-Nov	8.4	-	-
		2018	22-Mar	3-Dec	7.3	129.1	11-May
		2019	11-Apr	1-Dec	5.0	78.6	17-May
		2020	31-Mar	2-Dec	6.1	126.0	21-May
		2021	31-Mar	18-Nov	5.3	84.2	26-May
	South Fork Lost Creek	2017	11-Jul	30-Nov	8.5	-	-
		2018	23-Mar	3-Dec	9.5	243.2	10-May
		2019	11-Apr	29-Nov	10.1	207.6	17-May
		2020	1-Apr	3-Dec	10.8	273.0	31-May
		2021	31-Mar	18-Nov	6.6	230.0	26-May
	Whitetail Creek	2017	11-Jul	27-Nov	5.0	-	-
		2018	30-Mar	3-Dec	3.9	22.7	29-Apr
		2019	11-Apr	2-Dec	1.4	8.4	21-Apr
		2020	1-May	31-Oct	2.3	7.8	1-May
		2021	1-Apr	18-Nov	2.6	18.1	25-May
	Cilly Creek	2020	1-Apr	2-Dec	3.8	28.8	22-May
		2021	1-Apr	19-Nov	4.1	64.9	27-May

BULL TROUT MONITORING ON THE COAL CREEK, STILLWATER, AND SWAN RIVER STATE FORESTS

In August 1988, the Flathead Basin Commission sponsored a study to address questions regarding potential impairment of water quality and fisheries from past and present forest management in the Flathead Basin. The fisheries study module was completed in 1991 and suggested direct or indirect linkages between measures of on-the-ground activity and fish habitat parameters and fish populations. Results from 2017 to 2021 are detailed in this subsection.

Spawning redd counts were conducted in streams where spawning by bull trout is known or suspected. Substrate score is an assessment of streambed surface conditions and is an indicator of juvenile bull trout rearing habitat quality. Juvenile bull trout prefer streambed substrate in the cobble to boulder particle size range for daytime cover (Baxter and McPhail 1997). Particle size and the percentage of fine materials filling interstitial spaces (embeddedness) at the streambed surface are visually assessed. Low substrate scores indicate smaller streambed particles and greater embeddedness. Bull trout rearing habitat may be threatened when substrate scores are below 10 and may be impaired when substrate scores are below 9. McNeil coring is a measurement of the proportion of various particle sizes within streambed gravels (McNeil and Ahnell 1964). McNeil core results are an indicator of risk of bull trout alevin entombment and general bull trout and westslope cutthroat trout spawning habitat quality. Bull trout and westslope cutthroat trout spawning habitat may be threatened or impaired when McNeil core results indicate that the percentage of fine particles (<6.35 mm) are greater than 35% or 40%, respectively.

Bull trout redd counts are one measure of the species population status, results from the 2017 to 2021 monitoring period are shown in Table F-1. During the current reporting period, redd counts were conducted on two streams in the Coal Creek State Forest, four streams on the Stillwater State Forest, and five streams on the Swan River State Forest. McNeil core samples were collected in all spawning streams with the exception of Cyclone Creek, where recent redd counts have indicated minimal spawning with a single redd counted during surveys in 2021. Substrate scores were collected in all spawning streams including Cyclone Creek for the entire reporting period (Table F-1).

Coal Creek and Stillwater State Forests

Similar to the previous reporting period, redd counts in Coal and Cyclone creeks remain low. Coal Creek redd counts decreased by 40 percent during the current reporting period, while redd counts in Cyclone Creek found no redds in 2017 and 2018, and a single redd during 2021. No redd counts were conducted in Cyclone Creek in 2019 or 2020. Declines in Bull trout redds were also observed in the Stillwater River and Fitzsimmons Creek while abundance remained stable, but low in both Swift and West Fork Swift Creek (Table F-1). Redd counts in other Upper Flathead basin spawning tributaries indicated a general decline basin-wide, with redd counts across federal lands also observing declines of approximately 10 percent compared to 2011 to 2016 reporting period. While redd counts indicated declining abundance of Bull trout in surveyed watersheds on DNRC ownership, habitat conditions do not appear to be the primary driving factor behind the decline. McNeil core samples collected in the Coal Creek and Stillwater State Forests were stable, no threatened (35-40 percent <6.35 mm substrate) or impaired (>40 percent <6.35mm substrate) samples were collected. Slight increases were noted in Fitzsimmons Creek from 26.2 percent in 2011-2016 to 28.8 percent during the current monitoring period, well below threatened levels. The remainder of the monitored streams in the Upper Flathead on DNRC ownership were stable (Table F-1). Juvenile rearing habitat conditions in the Upper Flathead basin on DNRC ownership indicate high quality rearing habitat, substrate score in all monitored streams was greater than 11, with the exception of 10.9 in Cyclone Creek in 2020. No threatened or impaired substrate scores were collected during the monitoring period.

Based on current bull trout redd counts and assessment of spawning and rearing habitat quality, bull trout habitat on the Coal Creek and Stillwater State Forests appear to generally be in stable conditions. Most populations continue to exhibit low spawning abundance, however, stream habitat conditions generally reflect that the primary limiting factor in bull trout abundance in spawning tributaries on DNRC ownership. Continued monitoring and evaluation habitat conditions on DNRC ownership is warranted, as well as evaluation of other potential limiting factors including range or abundance increases in populations of non-native competing or hybridizing species and thermal regimes in spawning habitat.

Swan River State Forest

Redd counts in the Swan River watershed have declined substantially from basin-wide peaks in the late-1990's as a result of introduction of Lake trout in Swan Lake. Overall, populations in the Swan River watershed have declined by nearly 50 percent, with observed declines on both federal and state ownership (Table F-1). Lake trout suppression efforts were discontinued following completion of an eight-year effort to reduce populations in Swan Lake following illegal introduction in the late-1990's (Rosenthal et al. 2017). While long-term population declines have been noted, relative abundance of redds appears to have stabilized over the last 10 years on DNRC lands (Figure F-1). While spawning Bull trout abundance has declined substantially, spawning and rearing habitat conditions are generally of adequate quality to sustain populations in the absence of other limiting factors. McNeil core samples collected in Swan River spawning tributaries was stable or increased slightly in 4 of 6 populations during the most recent monitoring period. The amount of fine sediment increased slightly, though not significantly in both Squeezer and South Fork Lost creeks, both streams remain well below threatened ratings with 32.3 and 31.6 percent of substrate <6.35 mm. Soup, Woodward, and South Woodward creeks were the only streams exhibiting threatened or impaired status for spawning habitat, with 36.2 percent fine sediment observed in Soup Creek in 2018, which declined to an average of 33.3 percent from 2019 to 2020, with 2021 samples yet to be collected. Fine sediment levels in Woodward Creek remain elevated, as monitoring between 2017 and 2020 resulted in threatened (36.5 percent) or impaired (40 percent in 2018) ratings. While these levels rate as threatened or impaired, redd counts remain stable in this watershed and are slightly lower than during the previous reporting period (37.9 percent), suggesting that a higher baseline level of fine sediment may be the reference condition in this watershed due to relatively moderate fluctuation in the yearly hydrograph and general groundwater influence. Juvenile rearing conditions were not threatened or impaired in Squeezer, Goat, or South Fork Lost creeks during the current monitoring period (Table F-1). Over the entire monitoring period, rearing conditions in South Woodward Creek were rated as threatened in 2020, subsequently rated as non-impaired in 2021. In Woodward Creek, rearing habitat was rated as impaired in 2020, and threatened in 2021. Soup Creek rearing habitat was rated as threatened from 2017 to 2019, impaired in 2020, and threatened in 2021. Continued monitoring of rearing habitat conditions in South Woodward and Woodward creeks is warranted as reductions in rearing habitat for the monitoring period declined for both streams in comparison with values observed from 2011 to 2016. Monitoring in Soup Creek suggests that reductions in rearing habitat quality since monitoring began in the early 1990's have occurred.

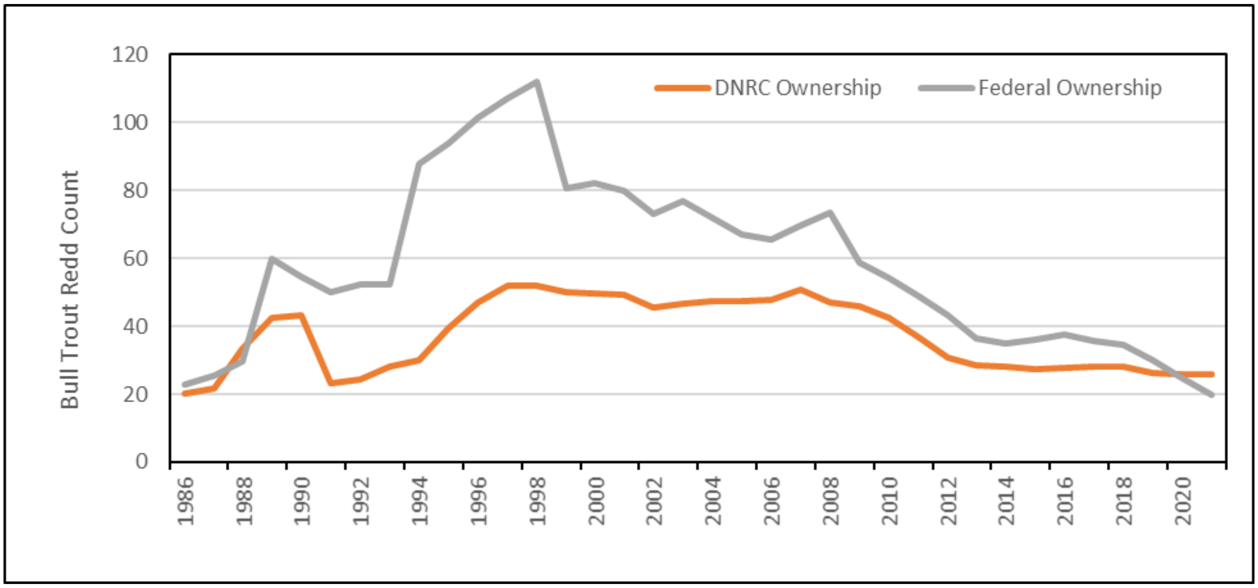


Figure F-1: Five-year rolling average of bull trout redd counts in the Swan River watershed, 1986–2021. Illegal introduction of Lake trout in Swan Lake occurred in the late 1990's, with Lake trout suppression efforts conducted in the lake between 2008 and 2016.

Table F-1: Bull trout redd counts, substrate score, and McNeil Core results from the Coal Creek, Stillwater, and Swan River state forests. Threatened (orange) or impaired (red) spawning or juvenile rearing habitat metrics are identified for each monitoring site.

Metric	Watershed	Stream	Period of Record	2011-2016 Average	Reporting Period 2017	2018	2019	2020	2021
Bull trout redd counts	North Fork Flathead	Coal Creek	1980-2021	11.8	4	5	8	12	5
		Cyclone Creek	1993-2018	1.4	0	0	*	*	1
	Upper Flathead	Swift Creek	1994-2021	5.6	8	8	6	6	6
		West Fork Swift Creek	1993-2021	6.0	6	5	8	4	4
		Stillwater River	1994-2021	21.5	25	12	23	11	12
		Fitzsimmons Creek	1995-2021	14.0	4	13	14	13	1
	Swan	Squeezer Creek	1982-2021	42.0	57	24	12	39	37
		Goat Creek	1982-2021	22.8	23	33	25	29	8
		Soup Creek	1991-2021	4.0	7	6	*	8	4
		South Lost Creek	1995-2021	16.2	19	17	19	19	14
		Woodward Creek	1991-2021	75.7	64	84	67	70	65
McNeil Core (Spawning Habitat)	North Fork Flathead	Coal Creek	1981-2021	33.6	32.6	31.6	34.9	32.8	-
		Cyclone Creek	1995-2016	35.1	*	*	*	*	*
	Upper Flathead	Swift Creek	2001-2020	30.1	33.4	31	30	28.5	-
		East Fork Swift Creek	2007-2020	32.2	30.6	32.6	*	30.6	-
		West Fork Swift Creek	1997-2020	30.0	26.8	29.4	32	29	-
		Lower Stillwater River	1992-2020	31.2	30.4	33	32.1	30.5	-
		Upper Stillwater River	1999-2020	30.5	32	30.4	31.2	28.1	-
		Fitzsimmons Creek	2011-2020	26.2	32.5	30.1	29.4	23.2	-
	Swan	Squeezer Creek	1987-2020	31.3	31.6	33.3	30.2	34.1	-
		Goat Creek	1987-2020	30.2	23.8	26.9	24.6	29.5	-
		Soup Creek	1993-2020	35.0	33.4	36.2	31.8	34.7	-
		South Lost Creek	1994-2020	28.7	33.2	33.4	26.6	33.4	-
		Woodward Creek	1996-2020	37.9	37.4	40	36.6	35.7	-
		South Woodward Creek	1996-2020	31.6	32.2	31	25.6	35.7	-
Substrate Score (Rearing Habitat)	North Fork Flathead	Coal Creek	1984-2021	10.2	10.3	10.1	10.8	10.9	10.9
		Cyclone Creek	1995-2021	11.1	11	10.7	10.3	10	10.8
	Upper Flathead	Swift Creek	2002-2021	12.6	12.3	12	11.8	11.5	11.4
		East Fork Swift Creek	1991-2021	12.1	11.5	11.3	11	10.9	11
		West Fork Swift Creek	1996-2021	12.1	11.7	11.6	11.4	11.1	10.8
		Stillwater River	1992-2021	12.7	12.6	12.1	11.8	11.4	11.5
		Fitzsimmons Creek	2008-2021	13.0	13.2	12.8	12.2	11.4	12.5
	Swan	Squeezer Creek	1988-2021	10.5	10.3	10.2	10.6	11	10.8
		Goat Creek	1988-2021	11.4	11.0	10.9	11.5	11	11.3
		Soup Creek	1992-2021	9.2	9.1	9.4	9.2	8.4	9.5
		South Lost Creek	1994-2021	11.9	12.4	12.8	11.7	11.6	11.9
		Woodward Creek	1997-2021	10.5	10.6	10.4	10.2	8.9	9.3
		South Woodward Creek	1996-2021	11.3	11.3	11.7	11.4	9.4	10.6

*' designates years during which surveys were not completed

-' designates spawning years for which analysis has not been completed

Evaluating long-term trends in substrate score remains imprecise, however, evolving datasets from continuously surveyed reaches allow for inference in comparing state ownership to adjacent non-state-owned lands. Generally, substrate scores have been lower on state trust lands than on adjacent ownership. Results may be a consequence of watershed geology, fire, forest management history, or sample size. Substrate scores in the Coal Creek, Stillwater, and Swan state forests generally were stable or improved during this reporting period in comparison the previous 5 years of data (Table F-1). Declines in average substrate score during the reporting period were noted in Soup (-0.7), and Fitzsimmons (-0.6) creeks.

Observed trends in bull trout redd count, substrate scores, and McNeil core samples suggests that the bull trout populations in both the Flathead and Swan River basins are likely affected through a combination of episodic climate events and local stream habitat conditions. Additionally, adfluvial bull trout in the Swan River basin have been subject to increased competitive effects of non-native species through competition, predation, and hybridization. These effects have impacted all life stages of bull trout in the watershed including spawning and rearing habitat in the headwaters, as well as lower elevation habitat in the mainstem Swan River and Swan Lake (MFWP 2017).

FISHERIES HABITAT INVENTORY

Fisheries habitat surveys have been conducted on Trust Lands on blocked forest ownership since 2001. Prior to 2021, the R1/R4 Fish Habitat Standard Inventory (Overton et al 1997) was used to describe existing conditions and temporal changes in the different stream habitats used by bull trout, westslope cutthroat trout, and other native fisheries. The variable amounts of slow and fast fish habitats, large woody debris frequency and volume, sediment class abundance, and streambank stability are some of the important variables assessed during the inventories. In 2021, the habitat survey protocol shifted to incorporate aspects of both the R1/R4 protocol (Overton et al. 1997) as well as the Pacfish-Infish Biological Opinion (PIBO) sampling protocol conducted by the USFS to evaluate forest management effects on fisheries populations (Kershner et al. 2004, Al-Chokhachy et al. 2011, Archer et al. 2012). Modification of the survey protocol will allow comparison across temporal and spatial scales, allowing comparison across time at DNRC monitoring sites as well as spatial comparisons with other PIBO sites in managed and reference watersheds on the Flathead National Forest.

In 2021, a monitoring site was established on Goat Creek to evaluate habitat conditions during the planning and compliance process for an upcoming timber sale on the Swan River State Forest.

Habitat metrics collected during the Goat Creek survey in 2021 include; habitat type, bankfull and wetted width, width:depth ratio, substrate composition, discharge, bank stability, undercut bank depth, large woody debris, and stream shade. Establishment of the habitat monitoring site was determined by estimating bankfull width and delineating a reach that is 20 times average bankfull width. Transects were then established in major habitat units throughout the reach, with permanent transects identified and monumented for repeated measure in the future.

Goat Creek habitat surveys were completed between 10 August and 12 August 2021, during base discharge conditions. Discharge was collected on 12 August at the completion of the survey and was estimated to be 3.6 cubic feet per second (cfs). Total reach length was approximately 900 feet, in which 20 transect were established. Within the survey reach, pool habitat comprised approximately 32 percent of the total habitat, while riffle and run habitat comprised the remaining 68 percent. Average bankfull width in the reach was 31.9 ± 5.4 feet, width:depth ratio averaged 30.3 ± 5.4, and wetted width averaged 18.9 ± 2.3 feet (Figure F-2). Substrate composition was dominated by coarse gravel to large cobble, with d50 of 54 mm (Figure F-2). Streambank stability was rated based on covered/uncovered and stability based on Overton et al. (1997) ratings, with 90 percent of the streambanks surveyed rated as stable. Undercut streambanks were noted at

15 percent of the transects with an average undercut depth of 19.4 inches. Large woody debris provided instream cover at multiple transects with a total reach count of 32 pieces, or approximately 35 pieces/1000 feet of stream. Stream shade was collected at each transect to evaluate the contribution of riparian stands to shade, and subsequently stream temperature. Monthly shade measurements noted average canopy cover of 58.3, 60.2, 63. 7, and 71.3 during June, July, August, and September respectively (Figure F-2).

RECOMMENDATIONS

- Establish habitat monitoring sites on the remainder of Swan River State Forest bull trout critical habitat between 2022 and 2025
    - Squeezer
    - Soup
    - South Fork Lost Creek
    - Woodward Creek
    - South Woodward Creek
- Following completion of habitat surveys, conduct analysis to evaluate temporal change at each site compared to R1/R4 data and compared to reference conditions at PIBO monitoring sites on Flathead National Forest.

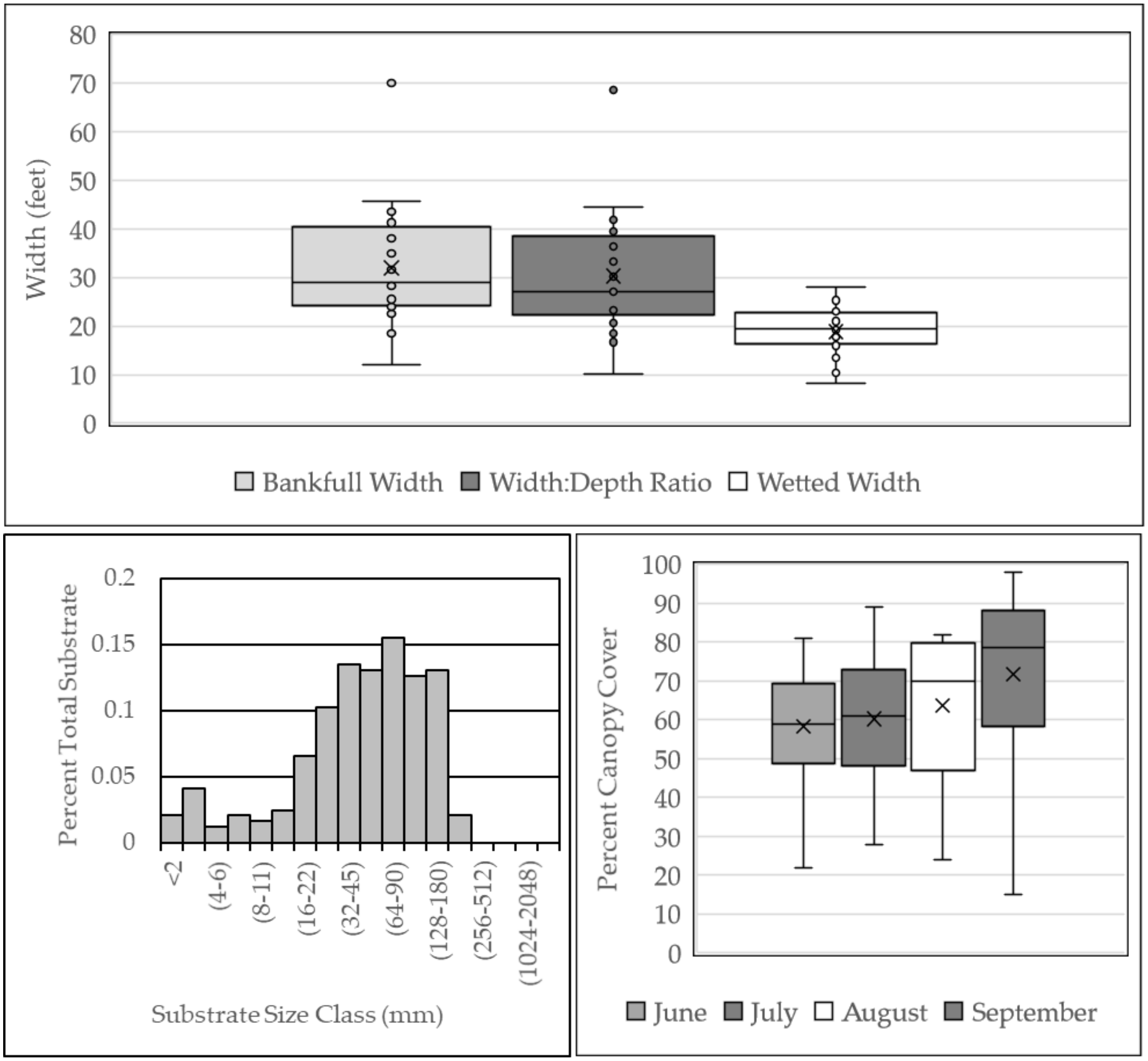


Figure F-2: Stream habitat survey results from Goat Creek, Swan River State Forest.

RIPARIAN HARVEST MONITORING

The effects of riparian management zone (RMZ) timber harvest on stream habitat typically occurs through alteration of recruitment regimes of large woody debris (LWD) to streams or through the reduction of stream shading by riparian vegetation. Pre-harvest data were collected to establish baseline stream habitat conditions, with post-harvest data collected at least one year after completion of timber harvest prescriptions. Monitoring sites were established to encompass timber harvest treatment units. After establishment of each site, LWD surveys were conducted according to R1/R4 monitoring protocol during which any piece of woody material greater than 0.1 m diameter and at least 3.0 m or two-thirds of the wetted width was counted. Stream shading (ACD) was measured using a Solar Pathfinder, which provides hourly measurements of solar radiation inputs to the stream during June, July, August, and September. Shade measurements were taken at a minimum of 4 locations at each RMZ site, at a set distance interval in an effort to collect representative samples throughout the monitoring site.

Large woody debris RMZ monitoring was completed at 15 sites during the current reporting period. LWD loading levels generally met targets for various forest types based on modelling conducted during development of the HCP (DNRC 2010). Across all monitoring sites, LWD pre-harvest loading rates averaged 93.9 pieces/1000’ of stream (Range: 37.7–174.5; Table F-2). Stream shade was estimated at 19 sites during the current reporting period. Shade was estimated for each stream for June, July, August, and September, either as a part of an ongoing RMZ harvest monitoring site, or as a part of timber sale planning and data collection for MEPA analysis. Monthly shade measurements were averaged for each stream across multiple sites within the monitoring reach (Table F-3). Detailed results and analyses are presented in DNRC-Riparian Timber Harvest Monitoring (DNRC 2022).

Table F-2: Large woody debris monitoring conducted on DNRC lands as a part of riparian timber harvest monitoring and fieldwork associated with detailed MEPA analyses.

Stream	Watershed	LWD pieces/1000 feet		% Change
		Pre-Harvest	Post-Harvest	
Tributary to Bear Creek	Blackfoot	48	61	27.1
Warm Springs Creek		62	-	
Upper Dry Cottonwood Creek		102	-	
Cottonwood Creek		39	-	
East Fork Timber Creek	Middle Clark Fork	41	53	29.3
Chippy Creek		112	-	
Colonite Creek	Middle Kootenai	139	131	5.7
Upper Dingley Creek	Upper Missouri	156	106	-32.1
Lower Dingley Creek		177	167	-5.6
Limestone Creek		39	-	
Gurnett Creek		67	-	
Bear Creek	Rock	106	127	19.8
Tributary to Willow Creek		10	38	280
Upper Beaver Creek		69	116	68.1
Lower Beaver Creek		25	49	96
Swede Creek	Stillwater	171	186	8.7
Upper Dog Creek		114	126	10.5
Lower Dog Creek		116	110	-5.2
Tributary to Dog Creek, North		94	146	55.3
Tributary to Dog Creek, South		108	130	20.4
South Fork Lost Creek	Swan	130	-	
Cilly Creek		91	-	
Soup Creek		174	-	

Table F-3: Large woody debris and stream shade monitoring conducted in stream reaches adjacent to riparian management zone harvest on the NWLO, SWLO, and CLO.

Watershed	Site Name	LWD/1000' stream			Average Monthly Shade		
		Pre	Post	% Change	Pre	Post	% Change
Stillwater	Dog Creek, Upper	122.6	135.5	10.5	89.3	82.3	-7.0
	Dog Creek, Lower	96.5	91.5	-5.2	83.3	77.5	-5.8
	Tributary to Dog Creek, North	73.4	114.0	55.3	85.8	83.8	-2.0
	Tributary to Dog Creek, South	87.3	105.1	20.4	--	--	--
	Swede Creek	138.1	150.2	8.8	77.3	78.8	1.5
Rock Creek	Tributary to Willow Creek	7.6	28.8	278.9	74.8	48.0	-26.8
	Beaver Creek, Upper	63.9	107.4	68.1	82.5	70.8	-11.8
	Beaver Creek, Lower	9.2	17.9	94.6	55.5	56.3	0.8
	Bear Creek	28.7	34.4	19.9	56.0	53.3	-2.8
Upper Missouri	Dingley Creek, Upper	120.4	94.1	-21.8	47.3	76.5	29.3
	Dingley Creek, Lower	112.1	107.7	-3.9	43.5	70.5	27.0
Blackfoot	Bear Creek	28.7	34.4	19.9	72.3	65.3	-7.0
Middle Clark Fork	East Fork Timber Creek	31.8	41.1	29.2	70.5	66.3	-4.3
Middle Kootenai	Colonite Creek	139.0	--	--	87.0	--	--

STREAM TEMPERATURE MONITORING

The DNRC stream temperature monitoring program on state trust lands began June 2001 in an effort to monitor the effects of land management activity on stream shading and subsequently stream temperature. Stream temperature monitoring sites included in this report are found in Table F-4, and include ongoing, completed, or discontinued efforts on 30 streams, focused on management actions including; 1) riparian management zone timber harvest, 2) post-wildfire recovery, 3) grazing exclosure, and 4) long-term trend monitoring.

Complete status reports for all stream temperature monitoring on state trust lands can be found in DNRC FMB – Stream Temperature Monitoring and Summary (DNRC 2022).

RECOMMENDATIONS

- Continue to provide support for collection of bull trout population metrics in the Stillwater and Swan River state forests.
- Remain involved in the Swan Valley Bull Trout Work Group and associated Lake Trout Suppression efforts in Swan Lake.
- Evaluate potential restoration of sites designated as threatened or impaired for bull trout spawning and rearing habitat.
- Increase post-harvest LWD and ACD data collections at RMZ sites on 5-, 10-, and 25-year intervals to evaluate long term LWD loading and ACD following timber harvest.
- Establish a 5-year planning list for continued collection of stream habitat datasets to inform forest management activities and fisheries monitoring.
- Establish RMZ monitoring sites to continue to build monitoring datasets to inform timber management activities.
- Develop a stream temperature monitoring protocol to continue to develop long-term datasets to monitor trends associated with climate change.

Table F-4a: Stream temperature monitoring sites on DNRC-Northwest Land Office streams associated with riparian timber harvest and long-term trend monitoring between 2017–2021.

					Sampling Period		Daily Maximum		MWMT		Days >			Hours >		
Unit Office	Waterbody	Objective	Monitoring Site	Year	Start	End	Date	Temp	Date	Temp	10.0 C	15.0 C	21.1 C	10.0 C	15.0 C	21.1 C
Stillwater	Upper Whitefish Lake	Long-Term	Lake bed	2021	6-Mar	16-Oct	7-Aug	17.4	5-Aug	16.9	110	43	0	2,585	907	0
			Lake surface		6-Mar	16-Oct	6-Jul	20.5	4-Aug	19.5	118	76	0	2,688	1,573	0
			Lake outlet		1-Jan	12-Oct	31-Jul	21.8	31-Jul	21.0	122	82	2	2,680	1,557	11
	Chicken Creek	Long-Term	Lower Chicken	2017	18-Jul	14-Nov	2-Sep	9.9	31-Aug	9.7	0	0	0	0	0	0
				2018	12-Jun	2-Dec	10-Aug	10.6	10-Aug	9.9	4	0	0	13	0	0
				2019	11-Jun	22-Oct	7-Aug	10.0	5-Aug	9.6	0	0	0	0	0	0
				2020	15-May	19-Oct	19-Aug	10.2	2-Aug	9.6	2	0	0	2	0	0
				2021	20-Apr	16-Oct	31-Jul	10.6	1-Aug	10.1	8	0	0	19	0	0
	East Fork Swift Creek	Long-Term	Lower East Fork Swift	2017	18-Jul	31-Dec	30-Jul	10.8	31-Jul	10.7	19	0	0	48	0	0
				2018	13-Jun	31-Dec	1-Aug	11.1	16-Jul	10.4	22	0	0	56	0	0
				2019	1-Jan	15-Oct	7-Aug	10.7	4-Aug	10.5	20	0	0	43	0	0
				2020	24-May	31-Dec	2-Aug	10.8	2-Aug	10.4	13	0	0	29	0	0
				2021	1-Jan	17-Oct	29-Jul	10.9	30-Jun	10.6	31	0	0	84	0	0
	Swift Creek	Long-Term	Lower Swift Creek	2017	18-Jul	14-Nov	30-Jul	13.5	31-Jul	13.3	57	0	0	430	0	0
				2018	12-Jun	1-Dec	10-Aug	13.5	30-Jul	12.7	64	0	0	457	0	0
				2019	11-Jun	22-Oct	7-Aug	13.7	4-Aug	13.2	77	0	0	478	0	0
				2020	15-May	19-Oct	2-Aug	13.8	30-Jul	13.2	69	0	0	438	0	0
				2021	20-Apr	15-Oct	29-Jul	13.9	28-Jul	13.4	82	0	0	624	0	0
	West Fork Swift Creek	Long-Term	Lower West Fork Swift Creek	2017	18-Jul	14-Nov	30-Jul	11.1	29-Jul	10.9	26	0	0	92	0	0
				2018	12-Jun	2-Dec	1-Aug	11.4	16-Jul	10.8	31	0	0	118	0	0
				2019	11-Jun	22-Oct	7-Aug	11.2	4-Aug	10.9	24	0	0	84	0	0
				2020	15-May	19-Oct	2-Aug	11.1	30-Jul	10.7	16	0	0	61	0	0
				2021	20-Apr	17-Oct	29-Jul	11.6	28-Jul	11.1	40	0	0	169	0	0
Swan	Goat Creek	Long-Term	Lower Goat Creek	2017	6-Jul	27-Nov	2-Aug	12.3	31-Jul	12.2	68	0	0	545	0	0
				2018	19-Jun	2-Dec	10-Aug	12.2	10-Aug	11.7	55	0	0	317	0	0
				2019	6-Jun	27-Oct	7-Aug	12.7	4-Aug	12.6	60	0	0	429	0	0
				2020	1-Jul	20-Oct	19-Aug	12.0	2-Aug	11.5	41	0	0	249	0	0
				2021	23-Jun	10-Oct	16-Aug	13.4	13-Aug	12.7	69	0	0	631	0	0
	Soup Creek	Long-Term	Lower Soup Creek	2017	6-Jul	27-Nov	29-Jul	18.0	30-Jul	17.5	72	44	0	1,696	399	0
				2018	22-Jun	9-Nov	10-Aug	16.8	17-Jul	16.3	87	34	0	1,653	230	0
				2019	9-Jul	27-Oct	2-Aug	17.9	4-Aug	17.6	80	34	0	1,784	320	0
				2020	15-May	19-Oct	2-Aug	17.5	31-Jul	16.9	101	22	0	1,779	181	0
				2021	23-Jun	10-Oct	1-Aug	17.9	1-Aug	17.5	91	50	0	1,934	550	0
	South Woodward	Long-Term	Lower South Woodward Creek	2017	6-Jul	27-Nov	8-Jul	10.3	31-Jul	9.9	7	0	0	17	0	0
				2018	19-Jun	2-Dec	18-Jul	10.5	15-Jul	10.4	23	0	0	60	0	0
				2019	6-Jun	27-Oct	2-Aug	10.7	4-Aug	10.5	32	0	0	93	0	0
				2020	15-May	20-Oct	2-Aug	10.6	31-Jul	10.2	13	0	0	29	0	0
				2021	23-Jun	10-Oct	30-Jun	11.3	1-Jul	11.2	41	0	0	195	0	0
	South Fork Lost Creek	Long-Term	Lower South Fork Lost Creek	2017	6-Jul	28-Nov	29-Jul	12.0	31-Jul	11.8	61	0	0	633	0	0
				2018	22-Jun	2-Dec	10-Aug	11.7	17-Jul	11.3	50	0	0	432	0	0
				2019	6-Jun	27-Oct	2-Aug	11.8	4-Aug	11.6	50	0	0	425	0	0
				2020	15-May	20-Oct	2-Aug	12.1	2-Aug	11.7	42	0	0	345	0	0
				2021	8-Jul	9-Oct	1-Aug	12.7	1-Aug	12.2	43	0	0	668	0	0
	Squeezer Creek	Long-Term	Lower Squeezer Creek	2017	6-Jul	27-Nov	30-Jul	13.6	31-Jul	13.3	70	0	0	765	0	0
				2018	19-Jun	2-Dec	10-Aug	13.1	9-Aug	12.6	64	0	0	522	0	0
				2019	6-Jun	27-Oct	1-Aug	13.4	4-Aug	13.2	67	0	0	590	0	0
				2020	1-Jul	20-Oct	2-Aug	13.1	2-Aug	12.5	53	0	0	442	0	0
				2021	23-Jun	11-Oct	16-Aug	13.9	13-Aug	13.3	77	0	0	862	0	0
	Whitetail Creek	Long-Term	Fish Barrier	2017	6-Jul	21-Nov	8-Jul	8.7	27-Jul	8.4	0	0	0	0	0	0
				2018	19-Jun	2-Dec	10-Aug	8.5	16-Jul	8.3	0	0	0	0	0	0
				2019	6-Jun	27-Oct	2-Aug	10.3	5-Aug	10.0	8	0	0	36	0	0
				2020	15-May	24-Aug	2-Aug	9.1	31-Jul	8.9	0	0	0	0	0	0
				2021	23-Jun	11-Oct	16-Aug	10.7	14-Aug	10.2	9	0	0	55	0	0
	Woodward Creek	Long-Term	Lower Woodward Creek	2017	6-Jul	27-Nov	8-Jul	12.5	15-Jul	12.0	59	0	0	374	0	0
				2018	19-Jun	2-Dec	14-Jul	12.3	16-Jul	12.1	64	0	0	379	0	0
				2019	6-Jun	27-Oct	12-Jul	13.2	3-Aug	12.7	79	0	0	559	0	0
				2020	15-May	20-Oct	2-Aug	11.9	31-Jul	11.5	70	0	0	397	0	0
				2021	23-Jun	11-Oct	29-Jun	13.3	30-Jun	13.1	68	0	0	495	0	0
Kalispell	Schmidt Creek	Windthrow monitoring	Lower	2020	1-Jul	20-Oct	19-Aug	14.5	2-Aug	14.0	77	0	0	1,021	0	0
			Upper		1-Jul	20-Oct	31-Jul	12.4	2-Aug	11.9	43	0	0	451	0	0
			Lower	2021	7-Jul	13-Oct	31-Jul	15.7	1-Aug	14.8	78	2	0	1,326	9	0
			Upper		7-Jul	13-Oct	31-Jul	13.5	1-Aug	12.7	60	0	0	817	0	0
Libby	Colonite Creek	Riparian Timber Harvest Monitoring	Lower	2014	29-May	30-Sep	3-Aug	13.4	3-Aug	13.1	70	0	0	1,273	0.0	0.0
			Upper		29-May	30-Sep	31-Jul	11.8	3-Aug	11.7	58	0	0	881	0.0	0.0
			Lower	2015	10-Jun	21-Sep	4-Jul	14.6	1-Jul	14.2	89	0	0	1,579	0.0	0.0
			Upper		10-Jun	21-Sep	4-Jul	12.9	1-Jul	12.5	76	0	0	1,187	0.0	0.0
			Lower	2016	16-Jun	13-Oct	30-Jul	13.8	28-Jul	13.0	65	0	0	965	0.0	0.0
			Upper		16-Jun	13-Oct	30-Jul	12.1	28-Jul	11.5	48	0	0	610	0.0	0.0
			Lower	2017	13-Jun	17-Oct	8-Jul	13.6	1-Aug	13.2	86	0	0	1,666	0.0	0.0
			Upper		13-Jun	17-Oct	4-Aug	11.9	1-Aug	11.6	79	0	0	1,195	0.0	0.0
			Lower	2018	15-Jun	21-Oct	11-Aug	14.3	10-Aug	13.2	67	0	0	1,055	0.0	0.0
			Upper		15-Jun	14-Jul	14-Jul	11.4	11-Jul	10.7	11	0	0	98	0.0	0.0

Table F-4b: Stream temperature monitoring sites on DNRC-Southwest Land Office streams associated with riparian timber harvest and long-term trend monitoring between 2017–2021.

					Sampling Period		Daily Max		MWMT		Days >			Hours >		
Unit Office	Waterbody	Monitoring Objective	Monitoring Site	Year	Start	End	Date	Value	Date	Temp	10 C	15 C	21.1 C	10 C	15 C	21.1 C
Missoula	Arkansas	Long-Term	Lower Arkansas	2017	5-May	7-Nov	15-Jul	12.0	16-Jul	11.5	79	0	0	328	0	0
				2019	2-Jun	5-Dec	2-Aug	11.3	4-Aug	11.1	53	0	0	159	0	0
				2020	15-May	3-Nov	2-Aug	11.7	31-Jul	11.3	63	0	0	220	0	0
				2021	5-Jun	30-Sep	11-Aug	11.6	2-Jul	11.4	55	0	0	278	0	0
	Ashby	Grazing Exclosure	Lower	2017	5-May	4-Oct	4-Oct	16.7	6-Jul	13.3	113	1	0	1,442	3	0
			Upper		5-May	4-Oct	4-Oct	17.3	6-Jul	14.9	120	10	0	1,623	22	0
			Lower	2020	16-May	3-Nov	2-Aug	15.2	31-Jul	14.5	108	1	0	1,295	2	0
			Upper		16-May	3-Nov	2-Aug	13.8	31-Jul	13.2	95	0	0	1,083	0	0
			Lower	2021	17-Jun	30-Sep	1-Jul	15.3	2-Jul	15.1	95	5	0	1,471	7	0
			Upper		17-Jun	30-Sep	1-Jul	14.3	1-Jul	14.1	87	0	0	1,333	0	0
	Bear	Long-Term	Lower Bear Creek	2017	5-May	31-Dec	30-Jul	12.4	1-Aug	12.1	92	0	0	881	0.0	0.0
				2018	1-Jan	31-Dec	12-Aug	11.7	10-Aug	11.5	72	0	0	465	0.0	0.0
				2019	1-Jun	31-Dec	5-Aug	12.1	4-Aug	11.9	92	0	0	617	0.0	0.0
				2021	5-Jun	30-Sep	11-Aug	12.6	13-Aug	12.0	95	0	0	899	0.0	0.0
	Game Creek	Long-Term	Lower Game Creek	2017	5-May	7-Nov	30-Jul	10.4	1-Aug	10.1	13	0	0	40	0	0
				2019	1-Jun	31-Dec	4-Sep	10.4	5-Aug	10.2	15	0	0	61	0	0
				2020	1-Jan	3-Nov	17-Aug	11.4	20-Aug	10.9	33	0	0	214	0	0
				2021	5-Jun	30-Sep	16-Aug	10.6	13-Aug	10.3	15	0	0	92	0	0
Clearwater	Blanchard Creek	Grazing Exclosure	Lower	2019	31-May	11-Oct	14-Jul	18.8	3-Aug	18.2	118	71	0	2,592	589.0	0.0
			Middle		31-May	11-Oct	14-Jul	17.9	3-Aug	17.1	117	58	0	2,550	395.5	0.0
			Upper		31-May	17-Oct	14-Jul	17.3	13-Jul	16.3	115	42	0	2,468	248.0	0.0
	North Fork Blanchard Creek	Grazing Exclosure	Lower	2019	31-May	10-Oct	12-Jul	15.8	13-Jul	15.0	110	7	0	2,087	20.0	0.0
			Upper		31-May	11-Oct	12-Jul	16.6	13-Jul	15.9	113	28	0	2,334	142.5	0.0
	Chamberlain Creek	Long-Term	Lower	2018	5-Jun	4-Oct	12-Aug	16.3	10-Aug	15.4	92	12	0	1,520	30	0.0
				2019	1-Jun	24-Oct	5-Aug	16.9	4-Aug	16.4	105	20	0	1,845	76	0.0
				2020	19-May	4-Oct	2-Aug	16.9	3-Aug	15.8	92	12	0	1,458	40	0.0
				2021	6-Jun	4-Oct	31-Jul	18.5	1-Aug	17.6	103	45	0	1,896	342	0.0
			Middle	2017	5-May	5-Oct	15-Jul	16.7	27-Jul	15.8	102	22	0	2,025	127	0.0
				2018	5-Jun	4-Oct	12-Aug	15.2	10-Aug	14.4	91	2	0	1,563	6	0.0
				2019	1-Jun	24-Oct	5-Aug	15.2	5-Aug	14.8	104	1	0	1,879	5	0.0
				2020	10-Jun	4-Oct	2-Aug	15.9	3-Aug	15.0	82	4	0	1,390	19	0.0
			Lower	2017	5-May	5-Oct	15-Jul	15.5	27-Jul	14.8	98	5	0	1,830	16	0.0
				2018	5-Jun	4-Oct	12-Aug	14.8	10-Aug	14.1	84	0	0	1,369	0	0.0
				2019	1-Jun	24-Oct	5-Aug	14.8	5-Aug	14.4	93	0	0	1,648	0	0.0
				2020	19-May	4-Oct	2-Aug	15.3	3-Aug	14.4	82	2	0	1,259	8	0.0
				2021	5-Jun	4-Oct	1-Aug	17.0	1-Aug	16.2	94	25	0	1,815	185	0.0
	West Fork Chamberlain Creek	Long-Term	Lower	2017	5-May	5-Oct	15-Jul	15.4	12-Jul	14.4	113	2	0	1,863	9	0
				2018	5-Jun	4-Oct	14-Jul	14.6	12-Jul	14.1	89	0	0	1,370	0	0
				2019	1-Jun	24-Oct	5-Aug	14.2	5-Aug	13.8	100	0	0	1,668	0	0
				2020	19-May	4-Oct	2-Aug	15.2	3-Aug	14.4	93	1	0	1,286	3	0
				2021	5-Jun	5-Oct	1-Aug	16.5	1-Aug	15.7	94	20	0	1,710	98	0
	East Fork Chamberlain Creek	Long-Term	Lower	2017	5-May	5-Oct	30-Jul	11.0	30-Jul	10.6	51	0	0	147	0	0
				2018	5-Jun	4-Oct	12-Aug	10.2	12-Jul	9.8	6	0	0	12	0	0
				2019	1-Jun	24-Oct	4-Sep	10.4	7-Aug	10.1	9	0	0	26	0	0
				2020	20-May	4-Oct	2-Sep	10.2	20-Aug	9.9	3	0	0	7	0	0
				2021	5-Jun	5-Oct	31-Jul	11.2	1-Aug	10.9	24	0	0	200	0	0
	Cottonwood Creek	Riparian Timber Harvest Monitoring	Lower	2018	19-Jun	4-Oct	12-Aug	13.6	10-Aug	13.2	73	0	0	821	0	0
			Upper		19-Jun	4-Oct	12-Aug	13.4	10-Aug	12.9	71	0	0	765	0	0
			Lower	2019	14-Jun	13-Nov	5-Aug	14.8	3-Aug	14.6	92	0	0	1,132	0	0
			Upper		14-Jun	13-Nov	5-Aug	14.5	3-Aug	14.3	90	0	0	1,054	0	0
			Upper	2020	11-Jun	6-Oct	2-Aug	14.6	2-Aug	13.8	81	0	0	784	0	0
	Upper Dry Cottonwood Creek	Riparian Timber Harvest Monitoring	Upper	2019	14-Jun	13-Nov	9-Sep	8.4	5-Aug	8.1	0	0	0	0	0	0
			Lower		14-Jun	13-Nov	5-Aug	8.7	5-Aug	8.6	0	0	0	0	0	0
			Upper	2020	10-Jun	8-Oct	2-Aug	8.7	3-Aug	8.4	0	0	0	0	0	0
			Lower		10-Jun	8-Oct	2-Aug	9.1	3-Aug	8.8	0	0	0	0	0	0
			Upper	2021	3-Jun	14-Oct	31-Jul	9.2	1-Aug	8.9	0	0	0	0	0	0
			Lower		3-Jun	14-Oct	31-Jul	9.6	1-Aug	9.3	0	0	0	0	0	0
	Lower Dry Cottonwood Creek	Riparian Timber Harvest Monitoring	Upper	2018	5-Jun	16-Oct	11-Aug	10.5	10-Aug	10.1	10	0	0	27	0	0
			Lower		5-Jun	16-Oct	12-Aug	10.9	10-Aug	10.7	35	0	0	175	0	0
			Upper	2019	14-Jun	13-Nov	5-Aug	10.9	5-Aug	10.7	29	0	0	172	0	0
			Lower		14-Jun	13-Nov	4-Sep	10.5	5-Aug	10.2	14	0	0	43	0	0
			Upper	2020	10-Jun	8-Oct	2-Aug	10.6	3-Aug	10.2	11	0	0	40	0	0
			Lower		10-Jun	7-Oct	2-Aug	10.9	3-Aug	10.5	21	0	0	136	0	0
			Upper	2021	3-Jun	14-Oct	31-Jul	11.1	1-Aug	10.6	26	0	0	137	0	0
			Lower		3-Jun	14-Oct	31-Jul	11.6	1-Aug	11.0	40	0	0	331	0	0
Hamilton	Lyman Creek	Wildfire	Lower	2017	30-Jun	26-Oct	3-Sep	20.3	1-Sep	17.7	77	8	0	1,622	53	0
			Lower	2019	8-Jun	10-Oct	4-Sep	16.0	3-Sep	14.9	87	3	0	1,513	10	0
Anaconda	Tributary to Willow Creek	Riparian Timber Harvest Monitoring	Lower	2018	14-Jun	2-Nov	10-Aug	17.0	9-Aug	16.4	97	34	0	1,149	127	0
			Upper		14-Jun	2-Nov	10-Aug	15.2	9-Aug	14.7	91	2	0	1,024	3	0
			Lower	2019	1-Jun	31-Dec	5-Aug	17.2	5-Aug	16.1	112	29	0	1,522	90	0
			Upper		1-Jun	31-Dec	5-Aug	15.2	5-Aug	14.4	102	1	0	1,334	2	0
			Lower	2020	9-Jun	15-Sep	2-Aug	17.5	2-Aug	16.5	91	34	0	1,232	109	0
			Upper		10-Jun	15-Sep	2-Aug	15.6	2-Aug	14.8	86	1	0	1,081	3	0
			Lower	2021	26-May	26-Sep	30-Jul	16.9	2-Jul	16.2	117	41	0	1,803	155	0
			Upper		26-May	26-Sep	16-Aug	14.8	14-Aug	14.3	113	0	0	1,644	0	0

Table F-4c: Stream temperature monitoring sites on DNRC-Central Land Office streams associated with riparian timber harvest and long-term trend monitoring between 2017–2021.

				Sampling Period		Daily Max		MWMT		Days >			Hours >		
Unit Office	Waterbody	Monitoring Objective	Year	Start	End	Date	Value	Date	Value	10.0 C	15.0 C	21.1 C	10.0 C	15.0 C	21.1 C
Helena	Gurnett Creek	Riparian Timber Harvest Monitoring	2017	9-May	21-Sep	15-Jul	18.5	16-Jul	17.6	118	49	0	2,135	381	0
			2018	12-Jun	9-Sep	13-Jul	16.7	12-Jul	16.2	84	33	0	1,367	157	0
Bozeman	Limestone Creek	Long-Term	2016	12-Jul	13-Oct	31-Jul	12.6	28-Jul	12.2	48	0	0	257	0	0
			2017	9-May	24-Sep	30-Jul	12.3	1-Aug	11.9	74	0	0	332	0	0
			2018	11-Apr	24-Sep	11-Aug	11.0	11-Aug	10.6	38	0	0	79	0	0

WILDLIFE MONITORING

DNRC PARTICIPATION IN WILDLIFE WORKING GROUPS

During the monitoring period from 2017 to 2021, DNRC biologists participated on the following interagency committees and working groups: the Grizzly Bear Northern Continental Divide Ecosystem (NCDE) Subcommittee, NCDE Conservation Strategy Team, Swan Valley Liaison Team, Western States Wolverine Conservation Baseline Survey Team, Northern Rocky Mountain Fisher Survey Team, Montana Bald and Golden Eagle Work Group, Harlequin Duck Working Group, Partners in Flight, Montana Common Loon Work Group, and the Montana Bat Working Group.

THREATENED AND ENDANGERED SPECIES MONITORING

In 2011, DNRC initiated implementation of the DNRC Forest Management Habitat Conservation Plan (HCP). Compliance with the HCP requires that DNRC conduct annual and 5-year monitoring and reporting on implementation of conservation measures and their effectiveness to the U.S. Fish and Wildlife Service (USFWS). This monitoring now provides the primary basis for the monitoring of federally listed threatened and endangered species associated with the DNRC forest management program for the 50-year life of the plan. DNRC conducted annual meetings with the USFWS from 2017 to 2021. Annual monitoring reports were also provided to the USFWS during this period and the first 5-year monitoring report was completed and submitted in June 2018.

BALD EAGLE MONITORING

From 2017 to 2021 DNRC biologists on the NWLO and SWLO surveyed 6 to 12 territories annually. With the increase in bald eagle nesting pairs in Montana, the Bald Eagle Working Group found it necessary to streamline data collection for this species. Fish, Wildlife & Parks and the Montana Natural Heritage Program (MNHP) are collecting and reporting monitoring data through the online MNHP data collection and reporting website. In conjunction with these changes, only observations of nests and individual eagles are now recorded. Territory names and numbers are generally not tracked through interagency efforts. DNRC will continue to report incidental observations of nests, nesting activity and individual sightings of eagles.

MONTANA COMMON LOON WORKING GROUP

DNRC biologists actively participated in the Montana Common Loon Working Group and monitoring efforts from 2017 to 2021. This working group supports activities related to the conservation and management of common loons. During the monitoring period, DNRC biologists monitored 9 lakes annually in northwest Montana, and participated in monitoring efforts for chick survival, capturing and tagging studies, coordinating actions to reduce human disturbance to nesting loons, and information/education efforts. Monitoring information was reported to the Montana Common Loon Working Group annually.

In 2002, DNRC became a cooperator in the Loon Ranger Program and has continued to support these efforts through 2021. The Loon Ranger Program provides support and direction for several Loon Rangers that regularly monitor loon activity on over 30 lakes in western Montana, locate nests, maintain awareness signs, assist with banding efforts, provide public education at lakes where nesting has been documented, and provide evening-fireside talks for the public. Field reports are completed at the end of each field season. This program has been successful in providing valuable monitoring information and public outreach.

NORTHERN CONTINENTAL DIVIDE ECOSYSTEM (NCDE)

DNRC remains an active cooperator on the NCDE Subcommittee of the Interagency Grizzly Bear Committee (IGBC). During the monitoring period, DNRC continued to support and partially fund ongoing cooperative habitat monitoring and road updating efforts of the subcommittee. Primary involvement during the monitoring period included participation of DNRC staff in the development and finalization of the Post-Delisting NCDE Grizzly Bear Conservation Strategy. The strategy contains a comprehensive set of conservation and monitoring commitments of all cooperating entities (including DNRC) that will ensure the grizzly bear population will remain healthy and viable into the future. DNRC has participated in this cooperative monitoring effort since 2005.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT (SVGBCA) MONITORING

DNRC monitored parameters required under the SVGBCA through year 2017, which was the first year of the monitoring period for this report. On August 3, 2018, DNRC notified the USFWS and U.S. Forest Service Flathead National Forest and requested the termination of the SVGBCA. Under the terms of the conservation agreement (Section 7a) cooperating parties could cancel the conservation agreement with 30 days of providing written notice to the other cooperators. In the notification, DNRC indicated that their participation in the Agreement would be effectively cancelled upon the date the USFWS issued DNRC an Amended Incidental Take Permit for the Forest Management Habitat Conservation Plan (HCP). The USFWS issued DNRC the Amended Permit on August 31, 2018, which officially cancelled DNRC's participation in the Agreement. As of the effective termination date, forest management projects planned and implemented on the Swan River State Forest were required to incorporate all applicable measures contained in the HCP. Monitoring metrics pertaining to grizzly bear measures applied on the Swan River State Forest are now contained in the DNRC HCP annual and 5-year monitoring reports.

FOREST ROAD CLOSURE MONITORING ON HCP-COVERED LANDS IN GRIZZLY BEAR RECOVERY ZONES

Following adoption of the Forest Management HCP in February 2012, DNRC initiated efforts to identify and monitor all primary road closure devices located in grizzly bear recovery zones for effectiveness as required by HCP commitment GB-RZ3. Primary closure devices are those devices typically situated immediately off of open road systems. They are closures identified as being primarily responsible for restricting access on particular roads and/or road systems. Six DNRC unit offices (including Swan River State Forest) conducted annual checks during the monitoring period. An average of 560 primary road closures were checked for effectiveness annually from 2017 to 2021 (range 553 to 570) (Table WL-1). Annual differences in the number of closures checked was primarily due to locating, mapping and refining the key closures that needed to be checked across all work units. Overall closure effectiveness during the period averaged 96% in grizzly bear recovery zones and ranged from 81% to 100% (Table WL-1). Approximately 31 closures received repairs during the monitoring period.

Table WL-1. Number of road closure devices checked annually in grizzly bear recovery zones from 2017 to 2021, and the percentages that were deemed to be effectively restricting access.

Year	Clearwater		Kalispell		Libby		Plains		Stillwater		Swan		Summary By Year	
	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)
2012	15	87%	45	93%	41	98%	35	97%	178	90%	193	93%	**507**	**92%**
2013	16	88%	46	96%	49	94%	29	93%	180	92%	223	98%	**543**	**95%**
2014	24	96%	45	100%	48	83%	27	96%	200	96%	242	99%	**586**	**96%**
2015	24	100%	45	98%	51	86%	28	96%	198	96%	240	99%	**586**	**97%**
2016	23	100%	33	91%	48	94%	28	100%	196	96%	229	95%	**557**	**96%**
2017	22	100%	50	86%	49	100%	27	100%	195	96%	227	98%	**570**	**96%**
2018	22	100%	48	94%	46	98%	27	96%	183	97%	227	96%	**553**	**96%**
2019	21	100%	46	91%	49	100%	28	100%	193	100%	227	95%	**564**	**97%**
2020	21	100%	43	81%	46	89%	28	100%	191	95%	226	96%	**555**	**94%**
2021	21	100%	44	100%	47	94%	27	89%	195	95%	224	98%	**558**	**96%**
Summary By Unit	**188**	**97%**	**401**	**92%**	**427**	**94%**	**257**	**98%**	**1714**	**95%**	**2034**	**96%**	**5,021**	**96%**

SNAG, SNAG RECRUITMENT, AND COARSE WOODY DEBRIS MONITORING

Snags, snag recruitment trees, and coarse woody debris (CWD) are important habitat attributes for many species. Pre-harvest and post-harvest abundance of snags, snag recruitment trees and CWD were sampled to evaluate compliance with minimum retention levels for snags, residual live trees, and CWD specified in the Biodiversity Rules (36.11.411), and to gain broader insight into the effects of our management activities on these habitat components. ARM 36.11.411(1)(d) allows for the substitution of snags and recruitment trees to help ensure the retention of the largest legacy structures available on each particular site (eg. in stand-replacing burn areas live trees are absent and additional snags may be retained to meet the numeric requirement for live recruitment trees). In January 2021, Forest Management ARM 36.11.411(1)(a) pertaining to snags and snag recruits was revised, which now requires that… "in all timber harvest units post-harvest, the department shall retain an average of two snags and two recruitment trees over 21 inches dbh per acre". This revised requirement should be reflected in results presented in future monitoring reports.

Methods

Accurate snag estimates are difficult to obtain with reasonable levels of sampling effort due to their distribution and relatively low density across the landscape (Bull et al. 1990). Consistent with prior monitoring from 2000 to 2016, methods similar to those of Bevis (1996) were used for this report. DNRC SLI data collection procedures with increased sample transect length (660 ft.) were used to estimate CWD amounts. Weight estimates for CWD (in tons) continue to follow those developed by Brown (1974).

During the monitoring period from 2017 to 2021, sampling was conducted on 17 stands within 17 sale areas (Table WL-2 see highlighted stands). The stands were located on representative unit and land offices and occurred within various cover types and treatment types. Pre-harvest data for snags, CWD, and large live trees (potential recruitment trees ≥15 inches DBH) were collected on each selected project. The same data were then also collected on the same identical plots for comparison relatively soon after logging had taken place. Fourteen sales/stands were sampled both pre-harvest and post-harvest (Table WL-2).

Results – Snags

Consistent with earlier findings, reported snags/acre values by size class suggest that existing snag densities on pre-harvest sites are occasionally lower than guidance recommendations -- even before logging occurs. This is not surprising as factors that may contribute to this include: past harvest that emphasized the removal of unhealthy and larger trees, stands of young age with few large trees, firewood cutting, and natural variation in snag distribution such as that noted by Harris (1999). The stands sampled reflect a range of stand types and harvest intensities across Units on the NWLO and SWLO.

Snags Pre-harvest

On stands sampled during the 2017 to 2021 monitoring period, snags that were ≥8 inches DBH were present on all sample units (Table W-2). However, the following projects had relatively low numbers of snags prior to harvest: Rhodes Draw, Bear Square, Cow Camp, Burr Saddle, Rattler Gulch, and Pearson Patches. Of the 17 stands sampled during the monitoring period prior to harvest, 7 had one or more snags greater than 21 inches DBH per acre -- hereafter termed "Large Snags" (Table WL-2). Of these 7 stands, only 1 contained two or more Large Snags per acre. Four of the 17 stands contained no Large Snags. Thus, at least 10 stands prior to scheduled harvest were limited in their ability to provide minimum required numbers of Large Snags. Medium-sized snags (16 to 21 in. DBH) were generally more abundant within the stands sampled (Table WL-2). Seven of the 17 stands sampled (41%) possessed averages of ≥ 2.0 snags per acre in the 16 to 21-inch size class, 5 of which supported averages ≥4.0 snags per acre. As expected, very large snags ≥27 inches DBH were rare and only 2 stands of the 17 sampled pre-harvest (11.8%) possessed densities greater than 1 per acre (Table WL-2). Pre-harvest snag totals for all medium and large snags >16 inches DBH per acre for the 11 projects that also were sampled post-harvest (those depicted in highlight), ranged from 0.3 to 9.0 per acre (Table WL-2) and averaged 3.0 medium and/or large-sized snags per acre.

Snags Post-harvest

Of the 7 sample stands during the 2017 to 2021 monitoring period that contained 1 or more Large Snags per acre prior to harvest, 6 stands maintained similar pre- and post-harvest levels of Large Snags per acre (Ewing Central, Fish Bull Face, King Hemlock, Kozy Korner, Bear Square, Lone Lake --Table WL-2). Post-harvest, medium-sized (16 to 21 inch DBH) snag densities ranged from 0 to 2.7 per acre and averaged 0.8 per acre. Density of the combined large and very large snag classes (≥22 inches DBH) ranged from 0 to 1.7 snags per acre, but averaged 0.7 snags per acre (calculated from Table WL-2). Snag totals for all medium and large snags >16 inch DBH per acre for the 11 projects sampled post-harvest ranged from 0 to 5.7 per acre (Table WL-2) and averaged 1.8 snags per acre. Two harvest units had post-harvest estimates of 0.0 snags per acre and both had 0.3 to 1.0 snags per acre of medium or large size prior to harvest.

Table WL-2. Pre- and post-harvest snag retention summary results on selected DNRC timber sales sampled from 2011 to 2021. Those depicted in highlight were sampled during the current 2017 to 2021 monitoring period.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Plots Sampled	Total Snags Recorded		Snags/Acre 16"-21"		Snags/Acre 22"-27"		Snags/Acre >27"	
				Pre	Post	Pre	Post	Pre	Post	Pre	Post
Fortine-Old Highway (2008/2011)	NWLO	ES	3	14	9	1.0	0.3	0.0	0.3	0.0	0.0
Cliff Lakes (2008/2012)	NWLO	L/DF	4	15	10	0.3	1.0	0.3	0.0	0.0	0.0
Iron School House (2012/2013)	NWLO	L/DF	3	50	5	6.7	0.7	0.7	0.0	0.0	0.0
Scout Lake II (2012/2015)	NWLO	L/DF	3	53	18	4.7	2.7	0.3	0.3	0.7	0.3
Shiloh Road (2009/2012)	NWLO	PP/DF	4	19	5	1.0	0.5	0.3	0.0	0.3	0.0
Liverstone Park (2012/2014)	SWLO	PP/DF	3	63	10	1.0	1.0	1.3	1.0	0.7	0.7
Tarkio (2012/2015)	SWLO	PP	3	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	27	8	1.3	0.3	1.8	1.0	0.8	0.8
County Line (2013/2016)	SWLO	PP/DF	3	11	0	0.3	0.0	0.7	0.0	0.0	0.0
Good Shepherd (2013/2016)	SWLO	PP/DF	3	7	1	0.3	0.0	0.0	0.0	0.0	0.0
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	184	30	7.0	1.8	0.0	0.5	0.0	0.0
Deep Blue (2014/2016)	NWLO	PP/DF	4	10	2	2.5	0.0	0.0	0.0	0.0	0.0
Scout Lake III (2014/2016)	NWLO	MC	4	38	25	1.5	1.0	0.5	0.3	0.3	0.0
Spencer South (2014/2015)	NWLO	L/DF	5	52	44	1.8	1.6	0.6	0.4	0.0	0.0
Upper Indian (2016/2021)	NWLO	MC	3	77	11	4.3	0.7	3.0	0.7	1.7	0.0
Rhodes Draw (2016/2018)	NWLO	MC	4	10	11	0.0	0	0.3	0	0.0	0.0
Dirty Donovan (2015/2017)	SWLO	DF	3	30	4	0.7	0.7	0.3	0.7	0.0	0.0
Ewing Central (2013/2019)	NWLO	MC	3	53	19	2.3	1.7	0.3	1.7	1.3	0.3
Belmont (2014/2017)	SWLO	L/DF	3	18	2	0.7	0.7	0.0	0.7	0.0	0.0
Fish Bull Face (2014/2018)	NWLO	MC	3	28	7	0.7	0.7	0.3	0.7	0.3	0.7
King Hemlock (2015/2019)	NWLO	MC	3	71	28	5.3	2.7	0.7	2.7	0.3	0.3
Kozy Korner (2018/2021)	SWLO	PP/DF	3	19	4	0.3	0.3	0.0	0.3	0.3	0.3
Bear Square (2019/2021)	SWLO	L/DF	3	5	3	0.7	0.3	0.7	0.3	0.3	0.3
Cow Camp (2020/2021)	NWLO	L/DF	3	11	1	1.0	0.0	0.0	0.0	0.0	0.0
Lone Lake (2018/2020)	NWLO	L/DF	3	60	13	6.3	0.7	0.7	0.7	0.3	0.7
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Plots Sampled**	**Total Snags Recorded**		**Snags/Acre 16"-21"**		**Snags/Acre 22"-27"**		**Snags/Acre >27"**	
				Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Cilly Graves (2017/	NWLO	MC	3	96	n/a	10.7	n/a	1.0	n/a	0.0	n/a
Elk Sales (2021/	NWLO	MC	4	100	n/a	4.8	n/a	0.0	n/a	0.0	n/a
Bottom Wood (2021/	NWLO	L/DF	3	20	n/a	3.0	n/a	0.7	n/a	0.7	n/a
Burr Saddle (2019/	SWLO	PP/DF	3	5	n/a	0.0	n/a	0.0	n/a	0.0	n/a
Rattler Gulch (2018/	SWLO	DF	3	5	n/a	0.3	n/a	0.7	n/a	0.0	n/a
Pearson Patches (2021/	SWLO	DF	3	5	n/a	0.0	n/a	0.3	n/a	0.0	n/a

Results – Snag Recruitment Trees

During this monitoring period ARM 36.11.411 (a) and (b) required DNRC to retain an average of two snag recruitment trees greater than 21 inches DBH on stands in the "warm and moist" and "wet" Habitat Type Groups (Green et al. 1992). For all other Habitat Type Groups, retention of an average of one snag recruitment tree >21 inch DBH was required. Retention of snag recruitment trees is intended to ensure that Large Snags will be recruited and available through time on managed lands.

Recruitment Trees, Pre-harvest

Of the 17 total stands sampled pre-harvest during the monitoring period, all had large live trees present, 3 had less than 2 large live trees per acre (Kozy Korner, Rattler Gulch and Pearson Patches), and 14 had 2 or more large live trees per acre (Table WL-3). Densities of large, live trees suitable for future snag recruitment on the 17 sample stands indicated that ample numbers were generally present to meet snag recruitment requirements. Large live tree density on the 17 stands ranged from 0.3 to 25.7 trees per acre (Table WL-3) and averaged 5.7 per acre. For the 11 stands sampled both before and after logging, pre-harvest density also ranged from 1.0 to 10.3 large trees available per acre, and averaged 5.3 trees per acre.

Recruitment Trees, Post-harvest

Eight of the 11 stands (73%) that were sampled after logging during the monitoring period possessed an average of at least 1.0 large live trees per acre (Table WL-3). The three remaining stands that had less than 1.0 large live tree per acre all had at least 2.3 medium-sized trees per acre. Post-logging tree density estimates for the 8 stands that supported ample large live trees ranged from 1.0 to 9.0 large trees per acre (Table WL-3) and averaged 3.7 per acre. Ample numbers of additional smaller live trees were retained in the 15 to 21 inch dbh class in each of the 11 stands sampled after logging. Species composition of retained trees was weighted to those species that tend to make desirable future snags, such as ponderosa pine, western larch and Douglas-fir (Table WL-3).

Table WL-3. Pre- and post-harvest large live tree retention summary results for selected DNRC timber sales from 2011 to 2021. Those projects depicted in highlight were sampled during the current 2017 to 2021 monitoring period.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Plots Sampled	Total Large Trees >21"		Average Trees per Acre >21"		Post Harvest Species Composition Trees ≥ 15"
				Pre	Post	Pre	Post	
Fortine-Old Highway (2008/2011)	NWLO	ES	3	116	16	8.7	3.4	CW 38%, DF 25%, L 19%, ES 12%, PP 6%
Cliff Lakes (2008/2012)	NWLO	L/DF	4	7	8	1.8	2.0	DF 82%, L 15%, PP 3%
Iron School House (2012/2013)	NWLO	L/DF	3	30	8	10.0	2.7	DF 73%, L 27%
Scout Lake II (2012/2015)	NWLO	L/DF	3	34	31	11.3	10.3	L 53%, DF 37%, ES 6%, PP 2%, GF 2%
Shiloh Road (2009/2012)	NWLO	PP/DF	4	8	6	2.0	1.5	PP 64%, L 23%, DF 13%
Liverstone Park (2012/2014)	SWLO	PP/DF	3	15	16	5.0	5.3	PP 60%, DF 37%, LP 3%
Tarkio (2012/2015)	SWLO	PP	3	23	19	7.7	6.3	PP 100%
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	50	38	12.5	9.5	PP 86%, L 9%, DF 5%
County Line (2013/2016)	SWLO	PP/DF	3	4	5	1.3	1.7	PP 76%, DF 24%
Good Shepherd (2013/2016)	SWLO	PP/DF	3	13	8	4.3	2.7	PP 68%, DF 23%, L 9%
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	10	1	2.5	0.3	L 80%, PP 20%
Deep Blue (2014/2016)	NWLO	PP/DF	4	38	30	9.5	7.5	DF 50%, PP 45%, L 2%, WRC 2%
Scout Lake III (2014/2016)	NWLO	MC	4	42	20	10.5	5.0	L 88%, DF 9%, LP 3%
Spencer South (2014/2015)	NWLO	L/DF	5	11	8	2.2	1.6	DF 90%, L 10%
Upper Indian (2016/2021)	NWLO	MC	3	19	1	6.3	0.3	L 100%
Rhodes Draw (2016/2018)	NWLO	MC	4	12	12	3.0	3.0	DF 59%, L 20%, ES 11%, ASP 9%, CW 1%
Dirty Donovan (2015/2017)	SWLO	DF	3	10	2	3.3	0.7	DF 100%
Ewing Central (2013/2019)	NWLO	MC	3	29	5	9.7	1.7	L 33%, DF 33%, WRC 25%, GF 8%
Belmont (2014/2017)	SWLO	L/DF	3	9	3	3.0	1.0	L 70%, DF 30%
Fish Bull Face (2014/2018)	NWLO	MC	3	23	18	7.7	6.0	L 55%, WRC 26%, DF 18%
King Hemlock (2015/2019)	NWLO	MC	3	9	4	3.0	1.3	DF 58%, GF 17%, L 17%, WWP 8%
Kozy Korner (2018/2021)	SWLO	PP/DF	3	3	3	1.0	1.0	PP 41%, DF 26%, L 33%
Bear Square (2019/2021)	SWLO	L/DF	3	31	27	10.3	9.0	L 42%, DF 33%, PP 25%
Cow Camp (2020/2021)	NWLO	L/DF	3	21	20	7.0	6.7	L 64%, DF 33%, PP 3%
Lone Lake (2018/2020)	NWLO	L/DF	3	13	1	4.3	0.3	DF 56%, L 44%
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Plots Sampled**	**Total Large Trees >21"**		**Average Trees per Acre >21"**		**Pre Harvest Species Composition Trees ≥ 15"**
				Pre	**Post**	**Pre**	**Post**	
Cilly Graves (2016/	NWLO	MC	3	15	n/a	5.0	n/a	DF 54%, GF 20%, WL 13%, WWP 4%, WRC 3%, BIR 3%,
Elk Sales (2021/	NWLO	MC	4	8	n/a	2.0	n/a	DF 68%, GF 15%, L 12%, ES 2%, SF 2%, WWP 2%
Bottom Wood (2021/	NWLO	L/DF	3	108	n/a	25.7	n/a	WRC 62%, L 27%, GF 7%, DF 2%, ES 1%, WWP 1%
Burr Saddle (2019/	SWLO	PP/DF	3	13	n/a	4.3	n/a	DF 73%, PP 24%, L 3%
Rattler Gulch (2018/	SWLO	DF	3	1	n/a	0.3	n/a	DF 100%
Pearson Patches (2021/	SWLO	L/DF	3	1	n/a	0.3	n/a	DF 54%, L 31%, PP 15%

Given that some substitution of dead snags and live recruitment trees is allowable under ARMs to ensure that larger legacy material remains in harvest units post-treatment, snag and live tree estimates were combined to derive total snag/recruit estimates for each of the 11 stands with post-harvest data. Post-harvest estimates of combined medium snags, large snags and large live trees ranged from 1.7 to 9.9 per acre and averaged 4.6 per acre. Two sample units (Upper Indian at 1.7 per acre and Kozy Korner at 1.9 per acre) had estimates that fell below the minimum requirement for snags and recruitment trees of 2 total per acre (1 large snag and 1 large recruit in various combinations). However, looking further into the data, these units also contained a number of medium-sized live trees and snags from 16 to 21 inches dbh that boost numbers from 3.0 to 9.0 combined live trees and snags per acre. Additional medium-sized trees were present on all harvest units sampled during the monitoring period, further ensuring that some legacy trees and snags would be present in treated stands through time.

Conclusions and recommendations regarding snag and recruitment tree retention

Consistent with previous findings, results from this monitoring period also suggest that Large Snags are often not abundant on stands selected for sampling even prior to logging. Thus, continued attention by forest managers to the retention of Large Snags over time remains an important consideration. As noted in earlier reports, it further stresses the importance of retaining ample recruitment trees. In general, total post-harvest levels of snags of all sizes decreased considerably from pre-harvest levels (Table WL-2, columns 5 and 6). Such reductions are not unexpected as snags are often removed for their commercial value, are inadvertently felled by equipment during harvest operations, are intentionally felled for human safety reasons, are vulnerable to windthrow, and are removed for firewood etc. Thus, balancing these attrition factors and demands in managed forests will likely remain a perpetual challenge for forest managers.

Given the relatively low density and availability of Large Snags to retain in harvest units, ARM 36.11.411 provides flexibility to retain the next smaller-sized snags and recruitment trees when larger ones are not available. ARM 36.11.411 also allows for some substitution of snags and large trees for each other if availability of one is poor. For example, in stand replacing burns, the entire recruitment tree requirement must be met with charred snags because live trees are often not available under these circumstances. Given these factors, our analysis of compliance considers the collective post-harvest abundance of all snags >15 inches DBH and all live recruitment trees ≥ 15 inches DBH. All 11 of the projects where both pre- and post-harvest snag and recruitment tree sampling was conducted complied with the requirements of ARM 36.11.411. However, large live tree retention (>21 inches DBH) on the Upper Indian, Dirty Donovan, and Lone Lake sample units was low (i.e., 0.3 to 0.7 large live trees per acre), despite the relatively high initial pre-harvest availability of large trees onsite (i.e., 3.3 to 6.3 available per acre pre-harvest).

Given the general rarity of large snags and numerous attrition factors that influence the presence of snags in managed stands, we recommend that foresters continue to work diligently to meet large snag and large live tree recruitment density requirements on each project. We also recommend only substituting between snags and live recruitment trees when necessary to help ensure ample densities of larger snags and replacements are present over time. Additionally, we continue to stress retention of the larger snags and recruits when available on each site. Leaving smaller material should generally *only* be incorporated when larger trees and snags are not available. On any site, preference should always be given first to larger snags and recruits of desirable species, particularly given their apparent rarity and numerous attrition factors.

Results – Coarse Woody Debris

Downed logs and woody material are important for providing long-term soil structure, nutrients, and habitat structure important for many species of wildlife. ARM 36.11.414 specifies that DNRC will maintain adequate levels of coarse woody debris at the project level using scientifically accepted technical references. For this purpose, DNRC considers suitable amounts to be those based on Graham et al. (1994).

Coarse Woody Debris, Pre-harvest

One of the 11 stands sampled both before and after harvest (Bear Square) had a pre-harvest CWD estimate of 5.2 tons/acre, which was relatively low considering recommendations by Graham et al. (1994) for maintenance of site productivity (Table WL-4). However, two additional tons of CWD were accumulated following harvest, which resulted in a post-harvest estimate of 7.2 tons/acre. In contrast, the

Upper Indian Unit had a pre-harvest CWD level of 19.4 tons/acre and then fell below Graham et al. (1994) recommended levels to 3.2 tons/acre post-harvest. The remaining stands had estimates that fell well within the recommended ranges from Graham et al. (1994). Factors that may have contributed to low pre-harvest levels of CWD detected on some sites include: past harvest in some stands that emphasized the removal of unhealthy trees and older trees; young stand age; amount, type and timing of past natural disturbances; firewood cutting; and natural variation in distribution of downed wood. Weight estimates of weedy debris found on each site before logging ranged from 5.2 to 28.1 tons/acre (Table WL-4) with an average of 10.1 tons/acre. The total number of large logs (≥15 inch diameter at large end) found on the 11 sample stands pre-harvest ranged from 0.3 to 8.3 per transect and averaged 2.7 large logs per transect. The total number of small logs (<15 inch large end diameter) found on the 11 sites pre-harvest ranged from 15.3 to 62.0 logs per transect and averaged 45.6 small logs per transect (Table WL-4).

Coarse Woody Debris, Post-harvest

Similar to snag and recruitment tree monitoring as previously described, of the 17 total stands sampled for CWD, only 11 were also sampled post-harvest for CWD during the 2017-2021 period (Table WL-4). One of the 11 stands sampled post-harvest possessed a greater amount of woody material onsite than was present before logging (Bear Square; Table WL-4). Woody debris weight estimates following logging ranged from 3.2 to 26.6 tons/acre and averaged 10.1 tons/acre. The total number of large logs (≥15-inch diameter at large end) found on the 11 sites post-harvest ranged from 0.0 to 5.3 per transect and averaged 1.5 large logs per transect. The total number of small logs (<15-inch large end diameter) found on the 11 sites post-harvest ranged from 11.0 to 59.3 logs per transect and averaged 38.8 small logs per transect (Table WL-4). Consistent with monitoring results obtained on projects from 2011 to 2016, retained logs post-logging were overwhelmingly in the small diameter class (Table WL-4).

Table WL-4. Summary results of pre- and post-harvest coarse woody debris (CWD) and downed log retention within selected DNRC timber sales (2011-2021). Those projects depicted in highlight were sampled during the current 2017 to 2021 monitoring period. Shaded individual cells indicate low amounts observed.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Transects Sampled	Total CWD ≥3" Tons/Acre		Average Count of Large Logs per 660 ft. Transect >15.5" Large End Dia.		Average Count of Small Logs per 660 ft. Transect <15.5" Large End Dia.	
				Pre	Post	Pre	Post	Pre	Post
Fortine-Old Highway (2008/2011)	NWLO	ES	3	15.1	6.2	3.7	1.3	45.7	20.3
Cliff Lakes (2008/2012)	NWLO	L/DF	4	4.4	4.4	1.3	1.5	9.3	12.3
Iron School House (2012/2013)	NWLO	L/DF	3	14.4	9.0	5.3	1.0	35.7	50.3
Scout Lake II (2012/2015)	NWLO	L/DF	3	16.6	13.2	6.3	2.7	26.3	29.3
Shiloh Road (2009/2012)	NWLO	PP/DF	4	5.7	3.9	0.5	0.3	31.5	28.3
Liverstone Park (2012/2014)	SWLO	PP/DF	3	10.2	6.0	2.7	0.3	28.3	26.3
Tarkio (2012/2015)	SWLO	PP	3	1.7	2.0	0.0	0.0	10.7	10.0
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	6.0	6.1	1.3	0.8	18.0	28.3
County Line (2013/2016)	SWLO	PP/DF	3	4.0	4.5	0.3	0.0	22.3	20.7
Good Shepherd (2013/2016)	SWLO	PP/DF	3	2.6	4.3	0.3	0.7	13.0	24.3
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	15.1	16.8	2.5	3.8	47.0	46.5
Deep Blue (2014/2016)	NWLO	PP/DF	4	3.1	2.8	0.3	0.0	15.0	14.5
Scout Lake III (2014/2016)	NWLO	MC	4	19.3	16.5	6.5	3.0	48.5	48.0
Spencer South (2014/2015)	NWLO	L/DF	5	6.3	5.7	2.2	0.4	21.8	22.4
Upper Indian (2016/2021)	NWLO	MC	3	19.4	3.2	5.7	2.0	60.3	11.0
Rhodes Draw (2016/2018)	NWLO	MC	4	10.1	8.4	0.3	0.5	56.3	49.8
Dirty Donovan (2015/2017)	SWLO	DF	3	12.2	9.4	0.3	0.3	41.7	36.7
Ewing Central (2013/2019)	NWLO	MC	3	28.1	26.6	8.3	5.3	62.0	59.3
Belmont (2014/2017)	SWLO	L/DF	3	9.8	8.2	1.0	0.0	38.3	39.3
Fish Bull Face (2014/2018)	NWLO	MC	3	16.2	10.8	4.0	2.0	56.3	53.7
King Hemlock (2015/2019)	NWLO	MC	3	17.2	11.2	3.0	2.3	54.7	34.7
Kozy Korner (2018/2021)	SWLO	PP/DF	3	8.3	6.5	1.3	0.0	28.3	28.0
Bear Square (2019/2021)	SWLO	L/DF	3	5.2	7.2	0.7	1.0	15.3	23.0
Cow Camp (2020/2021)	NWLO	L/DF	3	10.1	9.1	1.7	1.3	49.3	47.3
Lone Lake (2018/2020)	NWLO	L/DF	3	11.5	10.0	3.3	1.3	38.7	44.0
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Transects Sampled**	**Total CWD ≥3" Tons/Acre**		**Average Count of Large Logs per 660 ft. Transect >15.5" Large End Dia.**		**Average Count of Small Logs per 660 ft. Transect <15.5" Large End Dia.**	
				Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
Cilly Graves (2017/	NWLO	MC	3	20.0	n/a	6.7	n/a	37.7	n/a
Elk Sales (2021/	NWLO	MC	4	13.8	n/a	2.8	n/a	34.5	n/a
Bottom Wood (2021/	NWLO	L/DF	3	20.1	n/a	7.3	n/a	28.3	n/a
Burr Saddle (2019/	SWLO	PP/DF	3	7.1	n/a	0.3	n/a	39.3	n/a
Rattler Gulch (2018/	SWLO	DF	3	5.2	n/a	1.3	n/a	24.3	n/a
Pearson Patches (2021/	SWLO	L/DF	3	3.1	n/a	0.0	n/a	13.7	n/a

Conclusions and recommendations regarding retention of coarse woody debris

Under current practices, forest managers are generally meeting or exceeding recommendations of Graham et al. (1994). Ten of the 11 stands sampled post-harvest possessed ample amounts of CWD, however, 1 stand contained relatively low amounts at 3.2 tons (Table WL-4). This low estimate is of concern given the unit possessed 19.4 tons prior to logging. All harvest unit transects had at least some ≥15.5-inch large logs present prior to logging. However, two units (Belmont and Kozy Korner) possessed no large logs following harvest. The Upper Indian Unit had a dramatically reduced amount of small logs present following harvest, given the amount that was onsite prior to harvest. This unit was broadcast burned following logging, which likely contributed to this finding. As a general observation, the relative amounts of coarse woody debris on sample units post-logging appeared to be related to pre-harvest levels.

When comparing results between this monitoring period and previous monitoring periods, 100% and 78% of harvest units sampled from 20012 to 2005 and from 2006 to 2010, respectively, contained greater post-harvest levels of downed wood than pre-harvest levels. However, only 36% of the harvest units samples from 2011 to 2016 contained greater levels of downed wood post-harvest compared to pre-harvest, and similarly 9% of the units sampled from 2017 to 2021 contained greater post-harvest downed wood levels than pre-harvest levels. Notably though, pre-harvest CWD levels in all stands sampled from 2001 to 2021 were not excessive and were never greater than 28.1 tons/acre. These observations suggest that potentially less effort has recently been placed on retaining and/or returning CWD material back to harvest units. Given these findings and the relatively low number of large logs detected in the harvest units sampled from 2011 to 2021, managers need to place greater emphasis on and continue to be diligent about retaining ample large snags, snag recruitment trees and downed logs in harvest units.

REPORTING OF TERRESTRIAL SPECIES OBSERVATIONS

During the monitoring period, DNRC compiled notable terrestrial species observations reported by DNRC biologists and field personnel. Most of these observations were obtained incidentally while conducting typical work-related activities. Data entries documenting species, observation date, observer, number of adults and young, general habitat association, location of sighting, associated project area and unit office were reported to the Montana Natural Heritage Program (MNHP) in September 2018 for inclusion in their state-wide database. Observation data will continue to be collected and reported in a cooperative effort to improve understanding of the distribution and occurrence of various species of interest.

Results

A total of 5 records were reported during the monitoring period, which contained sightings obtained from 2017 to 2021. These included 4 sets of grizzly bear tracks, 2 porcupines, 2 pikas, and 1 wolverine.

FOLLOW-UP MONITORING FOR MISCELLANEOUS MITIGATION

Occasionally, situations arise where mitigations are developed for specific habitat elements such as nest sites, foraging areas, rookeries etc. Reviewing the application and effectiveness of such mitigations is important for determining if adjustments are necessary to achieve desired results in the future. During the monitoring period, DNRC monitored and collected information on two project sites to evaluate the application and effectiveness of specified mitigations pertaining to wildlife habitat. Methods and timing of monitoring efforts were tailored to the specific species, site and habitat element (e.g. nest, cover patch, etc.). The project biologist was responsible for developing and maintaining a monitoring schedule, and compiling results of monitoring efforts.

- Goshawk nest monitoring was conducted for a total of eight goshawk nests during the 2017 to 2021 monitoring period. The eight nests were located on the NWLO and seven of them were occupied during some portion of the monitoring period. No nests requiring monitoring were encountered on the SWLO during the monitoring period.

OTHER MONITORING AND COOPERATIVE PARTICIPATION

During the monitoring period, DNRC biologists and staff participated in a number of additional monitoring efforts for species associated with forested habitats in western Montana. A listing of these efforts is provided below:

- Avian Response to Old Growth Maintenance Logging in the Swan River State Forest -- 2012 to 2020. Manuscript published in Intermountain Journal of Sciences, Volume 26, No. 1-4, December 2020.
- Participant --Harlequin Duck Habitat Use, Migration, and Connectivity Research Project (2014 to 2018).
- Participant --Northern Rockies Fisher Survey (2018 to 2019)
- Participant --USGS North American Breeding Bird Survey (2016-2021)
- Participant --North American Bat Acoustic Monitoring (2020-2021)
- Participant –White-nose Syndrome Sampling (2021)
- Participant –Western States Wolverine Conservation Baseline Survey (2017)
- Participant – Northern Rocky Mountain Fisher Survey (2018-2019)
- 2018 FWP cooperative monitoring of a wolf pack rendezvous site on NWLO

GRAZING MANAGEMENT MONITORING

GRAZING EVALUATIONS

The SFLMP and Rules (ARM 36.11.444) established the goals of maintaining healthy and functional riparian areas and preventing non-point source pollution on State Trust Lands licensed for grazing. Specific objectives under these goals include:

- Minimize loss of riparian and streambank vegetation;
- Minimize structural damage to streambanks;
- Maintain or restore healthy and vigorous riparian-wetland plant communities;
- Leave sufficient vegetation to filter sediment and protect streambanks from erosion; and
- Minimize physical damage to streambanks to maintain channel stability and morphological characteristics.

These objectives were quantified into a set of numeric criteria that are utilized as a course filter to indicate the potential for unacceptable adverse impacts. The numeric criteria are as follows:

- Continuous season-long grazing will only be authorized when the levels of forage utilization do not exceed 59 percent and healthy riparian function is maintained;
- No percentage of shrubs will be in the heavily hedged form class and less than 25 percent of the shrubs will be in the moderately hedged form class;
- Streambank disturbance induced by livestock trampling will be limited to less than 10 percent alteration.

Riparian condition on classified forest state lands licensed for summer woodland grazing is evaluated prior to the license being issued and renewed as well as at the midpoint of the license term. Riparian function metrics that are evaluated include browse utilization, forge utilization and streambank alteration. For the current reporting period, riparian condition was found to be functional on 85% of the parcels that were evaluated over the 5-year period. Summary results of these riparian inspections can be found in Table GR-1 below.

Table GR-1: Grazing License Inspection Results by Land Office and Inspection Year

Year	SWLO		NWLO		CLO		All Lands	
	Parcels	Acceptable	Parcels	Acceptable	Parcels	Acceptable	Parcels	Acceptable
2017	73	86%	3	100%	4	100%	80	88%
2018	76	86%	3	100%	11	100%	90	88%
2019	55	69%	31	84%	13	100%	99	78%
2020	18	94%	4	100%	2	100%	24	96%
2021	23	83%	8	75%	2	100%	33	82%
Total	**245**	**82%**	**49**	**86%**	**32**	**100%**	**326**	**85%**

Since the inception of the SFLMP, riparian condition on classified forest parcels licensed for grazing has had a stable if not improving trend over the past 25 years. Table GR-2 shows this trend with the rise in total evaluations attributed to the Potomac block land acquisition on Missoula unit. Much of these parcels are high elevation lands that lack riparian features and thus the decline in riparian habitats.

Table GR-2: Grazing License Inspection Results by Reporting Period

Reporting Period	Parcels Evaluated	Parcels Containing Riparian Habitats	Acceptable Riparian Condition
1997-2000	30	83%	70%
2001-2005	228	80%	78%
2006-2010	250	78%	72%
2011-2016	495	69%	80%
2017-2021	326	61%	85%

RECOMMENDATIONS

- Continue to assess riparian conditions at both license renewal and at midterm of the license to provide information to support license stipulations that support riparian function.
- Prioritize the development and implementation of mobile technology to complete grazing evaluations and facilitate timely information sharing across the program.
- Continue to prioritize grazing corrective actions on parcels supporting cold-water fisheries and/or HCP covered species.
- Continue annual training and support for field staff completing riparian assessments.

WEED MANAGEMENT MONITORING

COOPERATIVE AGREEMENTS AND WEED MANAGEMENT PLANS

DNRC completed cooperative agreements with all County Weed Districts where both forested and non-forested state lands occur. These plans typically span a 6-year period and are updated every two years. These cooperative agreements must include:

- A 6-year integrated noxious weed management plan
- The goals for noxious weed management
- A specific plan of operations and a budget for the biennium
- A biennial performance report, completed by the district weed board and submitted to the Department of Agriculture's State Weed Coordinator regarding the success of the plan.

DNRC Area Offices have also developed weed management plans under the guidance of the Montana Weed Management Plan which was revised in 2008. These plans are used to prioritize follow up reviews and inspections of weed infestations, and to help prioritize what weed management projects are funded with our limited financial resources.

119 timber sale project records were reviewed for noxious weeds for the period of 2017-2021. Results indicate that approximately 4,579 acres of noxious weeds were treated by various means on DNRC lands and along road rights-of-way. Additionally, 178 acres were treated with biological controls. Weeds were principally located along roadside edges and timber harvest landing areas. Most projects that had existing noxious weed infestations occurred in western Montana. Noxious weeds are less extensive on forest sites in the Central and Eastern Montana.

PREVENTION

All timber sale projects require use of weed-free equipment by obligating washing and inspection of equipment prior to entry to sale areas. DNRC was one of the first agencies to require clean equipment as part of harvest operations. Compliance is recorded on timber sale inspection forms.

DNRC proactively manages timber sale contracts to avoid excessive soil disturbance and thus the aerial extent of potential noxious weed establishment and spread.

All new roads (average 29.2 miles/year) and newly disturbed reconstructed roads were revegetated with site-adapted grasses to provide competition with weeds and reduce erosion. All grass seed mixtures utilized included native species. On weed competitive sites, more resilient introduced grasses comprised a higher percentage of grass mixes.

EDUCATION

DNRC has cooperated with County Weed Districts to provide training in weed identification, safe herbicide application and weed management to field personnel.

As of 2021, 28 DNRC personnel are certified herbicide applicators for spot and field infestations of noxious weeds and numerous other employees have attended training on how to evaluate and oversee weed control projects.

TREATMENT

DNRC has adapted an integrated weed management plan that uses various treatment methods to prevent the establishment and spread of noxious weeds. All DNRC timber sale contracts included stipulations and control measures with the intent of controlling the spread of noxious weeds.

Herbicide treatments for roadside weed control have been primarily completed through contracts with County Weed Districts and licensed applicators. Priorities for herbicide treatment are new invaders, small infestations of new weeds and to control or contain the leading edge of established weeds based on site evaluation.

DNRC has an active role in establishing new insectaries of approved biocontrol insects on state lands to aid in the control of noxious weeds and seed production. Most biocontrol agents are better adapted to open forest or range sites. DNRC continues to redistribute insects on State lands and share available insects with County Weed Districts, Montana FWP and private landowners.

MONITORING

As part of ongoing forest management activities, DNRC project administrators monitor the implementation of noxious weed control measures on all timber sales. Through sale administration DNRC attempts to minimize the levels of ground disturbance to those that are needed to achieve silvicultural objectives.

On forest management projects where noxious weeds are a concern, DNRC periodically monitors for new invaders and follow-up treatments as needed or may enlist the assistance of County Weed Districts.

DNRC administrators also record weed infestations with grazing licenses on classified forest land as part of license renewal and midterm inspections. When weeds are noted during these reviews, administrators are to fill out a Weed Monitoring form and complete a weed control plan with grazing licensee.

RECOMMENDATIONS

- Continue contract requirement that stipulates all sale projects use weed-free equipment by requiring washing and inspection of equipment prior to entry to sale areas.
- Continue to proactively manage timber sale contracts to avoid excessive soil disturbance and thus the aerial extent of potential noxious weed establishment and spread.
- Continue to use mobile technology that was designed to map noxious weed infestations and track treatment history.

REVIEW AND MANAGEMENT OF THE STATE FOREST LAND MANAGEMENT PLAN

The Record of Decision for the SFLMP, under Managing the Plan (ROD page 10; ARM 36.11.448), described circumstances under which the SFLMP might be revised. The SFLMP recognizes the importance of adaptive management and identifies that the FMB Chief can change management direction if the change is compatible with the fundamental intent as reflected in the SFLMP. The SFLMP supports the use of new scientific information to adjust management.

The SFLMP can be reviewed and changed to comply with new legislation, new direction from the Land Board, or if the FMB Chief judges that original assumptions supporting the Plan no longer apply. Part of our responsibilities are to identify emerging issues and challenges to implementing the SFLMP and evaluate the potential need for amendments to the SFLMP to adapt to these circumstances. Considerations that DNRC examined to evaluate potential need to revise or amend the plan are included below.

- **Legislation –** No additional legislation has been passed affecting DNRC that would be inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan.
- **Direction from the Board of Land Commissioners** -- No direction from the Board of Land Commissioners has been provided to DNRC that would be inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan.
- **DNRC Land Acquisitions and Disposals –** Within the last 10 years, DNRC has acquired approximately 96,000 additional acres of forest land in western Montana. While these acquisitions have expanded DNRC's manageable forest land base by approximately 12%, expanding the land base upon which the Plan and ARMs applies has not proven to be inconsistent with original assumptions supporting the Plan, nor is managing an expanded land base incompatible with the philosophy, intent or implementation of the Plan.
- **DNRC Forest Management HCP and Amendments –** In February 2012, the U.S. Fish and Wildlife Service issued DNRC an Incidental Take Permit (ITP) associated with a Habitat Conservation Plan under Section 10 of the Endangered Species Act (ESA) for DNRC Forest Management Activities across 548,500 acres. An additional 81,000 acres of forest land were included for coverage under the HCP and ITP in November 2018, which addressed several recent land acquisitions. More recently in 2021, DNRC added an additional 14,642 acres within the Stillwater State Forest for coverage under the HCP and ITP. While the HCP represents a sizable programmatic commitment and added requirements for the Forest Management Program, adopting and implementing the HCP is consistent with the SFLMP Resource Management Standards pertaining to federally listed Threatened and Endangered Species and ARM 36.11.428, and the HCP clarifies DNRC's obligations and requirements under the ESA. Adopting the HCP is consistent with original assumptions supporting the Plan and managing under the HCP is compatible with the philosophy, intent and implementation of the Plan.
- **DNRC Conservation Easements –** During the last 5 years DNRC has acquired approximately 13,428 acres of land that possess conservation easements held by other agencies or parties. While the conservation easements require additional commitments and monitoring, acquiring and managing the lands containing conservation easements is consistent with the SFLMP Resource Management

Standards pertaining to wildlife and fisheries. Acquiring lands possessing conservation easements and additional conservation protection measures is not inconsistent with original assumptions supporting the Plan, nor is managing under the HCP incompatible with the philosophy, intent or implementation of the Plan.

- **Species Listings –** The federal listing status for several species has changed during the last 10 years. In this time, bald eagles, peregrine falcons, and gray wolves were delisted. The northern long-eared bat and yellow-billed cuckoo were recently listed as threatened species in parts of Montana, however, these two species are minimally affected by DNRC's Forest Management Program. The wolverine and fisher are currently proposed for federal listing. Canada lynx and grizzly bears are currently being considered for de-listing. While these species listings and de-listings can influence the suite of mitigation measures and requirements applied to projects at the local level, such changes were anticipated at the time the SFLMP was adopted. Thus, additions and deletions from federal lists do not create inconsistencies with original assumptions supporting the Plan, nor is adjusting suites of required mitigations over time for such species incompatible with the philosophy, intent or implementation of the Plan. Such changes are consistent with requirements for federally listed Threatened and Endangered Species as required under ARM 36.11.428.
- **Climate Change –** During the last 5 years, the science, conversations and concerns surrounding climate change have expanded. In 2017 a Montana Climate Assessment was published (http://montanaclimate.org/chapter/executive-summary), which was compiled in an effort to synthesize, evaluate, and share credible and relevant scientific information about climate change in Montana. The Assessment is the result of a two-year effort by university faculty, students, state and federal agency researchers, non-profit organizations, resource managers and citizens from across Montana. Impacts to forests of Montana are expected to be variable and may positively affect forest productivity and growth in wet areas and increase forest mortality in warmer, more arid regions. Climate change may also exacerbate indirect effects to forests such as, increasing mortality associated with larger fires during longer fire seasons, and increased mortality due to increases in insects such as the mountain pine beetle and forest pathogens. By managing forests to emulate natural conditions prior to European settlement in Montana, DNRC continues to implement many of the adaptation strategies identified in the 2017 report (MCA 2017:183-184). These include actions such as regenerating multiple tree species from diverse seed sources, retaining diversity of native tree species, promoting legacy trees, managing for a variable mosaic of tree species and ages, managing for landscape connectivity, favoring species adapted to disturbance, retaining woody debris to retain soil moisture and promote nutrient cycling, conducting fire suppression and using prescribed fire and thinning to minimize fuel loading and favor fire-resistant species, managing insect pests and diseases, and maintaining an active planting and regeneration program. Through the use of those actions and by managing to emulate conditions that plant and animal species evolved with in Montana, DNRC's Forest Management Program is maintaining consistency with the original assumptions supporting the Plan and is compatible with the philosophy, intent and implementation of the Plan as originally envisioned. Thus, no amendment or revision of the SFLMP is warranted.
- **Sustainable Yield Calculations –** During the monitoring period, one sustainable yield calculation, as required by MCA 77-5-222, was conducted by Mason, Bruce & Girard, Inc. This calculation was conducted in 2020 and provided yield estimates of 60.0 MMBF, with 8.3 MMBF as opportunity volume. This calculation included the constraints contained in the ARM for Forest Management and additional constraints associated with the Forest Management HCP. The 2020

calculation was based on improved stand data and included over 13,000 acres of newly acquired lands. Applicable constraints associated with all rules, laws, and regulations DNRC must adhere to are included as a part of each calculation, and they influence the level of harvest that can be removed during each period between calculations. While the calculations themselves fluctuate with the many different parameters that are modeled each period, they remain consistent with the original assumptions supporting the Plan, and are compatible with the philosophy, intent and implementation of the Plan as originally envisioned. Thus, no amendment or revision of the SFLMP is warranted because of this calculation.

In Summary, a number of noteworthy program-level events have occurred since the last monitoring report was published in 2017. However, none of these changes or events are inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan. Revisions to Forest Management ARMs have also occurred during this period and will continue to occur as a part of necessary "housekeeping and maintenance" over time. Any future revisions to ARMs will occur through the Montana Administrative Procedures Act (MAPA) process and may address such things as definition revisions, revisions to listed and down-listed species, and HCP-related requirements where the department deems revisions may be necessary.

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ACRONYMS AND ABBREVIATIONS

ALPFIRsubalpine fir

ARM	Administrative Rules of Montana
BMP	Best Management Practices
CWD	coarse woody debris
dbh	diameter at breast height
DF	Douglas-fir
DFC	Desired Future Conditions
DNRC	Montana Department of Natural Resources and Conservation
ESA	Endangered Species Act
FI	Forest Improvement
FIA	Forest Inventory and Analysis
GIS	geographic information system
HCP	Habitat Conservation Plan
Land Board	Board of Land Commissioners
LP	lodgepole pine
MBF	thousand board feet
MC	mixed conifer
MEPA	Montana Environmental Protection Act
MFWP	Montana Department of Fish, Wildlife and Parks
MNHP	Montana Natural Heritage Program
MMBF	million board feet
MOU	Memorandum of Understanding
NWLO	Northwest Land Office
PP	ponderosa pine
RMS	Resource Management Standards
RP	reference point

ROD	Record of Decision
Rules	Administrative Rules for Forest Management
sd	standard deviation
SFLMP	State Forest Land Management Plan
SLI	stand-level inventory
SMZ	streamside management zone
SWLO	Southwest Land Office
T&E	threatened and endangered (species)
TMDL	total maximum daily load
USFWS	United States Fish and Wildlife Service
WL	western larch
WWP	western white pine

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30 copies of this public document were published at an estimated cost of $9.39 per copy, for a total cost of $281.80, which includes $281.80 for printing and $0.00 for distribution.