National Park Service

US Department of the Interior

GLACIER NATIONAL PARK

Montana

Waterton-Glacier International Peace Park

Fire Management Plan

Programmatic Environmental Assessment

NPS-121694

January 2025

Photo: Fireweed (*Chamerion angustifolium*) sprouts from underneath a burnt log.

Table of Contents

Contents

Figures

Tables

Appendices

Chapter 1 – Purpose and Need for the Action

Introduction

The National Park Service (NPS) is proposing to update Glacier National Park's (Glacier, park) Fire Management Plan (FMP). Under the updated FMP (or Plan), the Glacier National Park Wildland Fire Management program would respond to all wildfires using a risk-based approach. Specific strategies and tactics would be selected dependent on the location and defined incident protection and resource objectives. Additionally, the park would use prescribed fire and non-fire fuels treatments to accomplish programmatic and project specific objectives, such as to reduce fuel accumulation and maintain desired conditions. The updated FMP would replace the park's current FMP, last updated in 2003, and is based on direction contained in existing park planning documents.

This programmatic Environmental Assessment (EA) describes and broadly analyzes all management strategies proposed in the updated FMP based on what is known or can be reasonably assumed at this time. Additional project-level and site-specific environmental review and compliance is required for prescribed fire and non-fire fuels treatments prior to their implementation (see also "Chapter 2, Alternatives" in this EA).

Purpose and Need for Action

The purpose of the updated FMP is to define a program of work to manage wildfire, prescribed fire, and non-fire fuel treatments; protect the public and park communities; and protect park values, including natural and cultural resources and infrastructure. The Plan's purpose is consistent with the mission of the NPS Wildland Fire Program.

An updated FMP is needed to ensure Glacier's fire management guidelines are consistent with current conditions and the latest NPS policy, and to continue to provide for fire personnel and public safety, protect park values, and remain consistent with the park's resource objectives. Each park unit with burnable vegetation is required to have an approved FMP, in accordance with Directors Order #18, Wildland Fire Management, NPS 2008.

Relevant sections of the proposed FMP are incorporated into this EA and the FMP is available on the NPS Planning, Environment, and Public Comment (PEPC) website along with the EA.

Proposed Programmatic FMP Goals and Objectives

The following are goals and objectives of the updated FMP. Plan goals and objectives incorporate the park's overall direction as well as federal fire policy and strategy. They encompass risk management, wildfire response, prescribed fire, fuels management implementation, science, and collaboration. They provide program direction consistent with associated National Environmental Policy Act (NEPA) requirements and are forward looking for future climate scenarios.

Goal 1

For all fire management activities, risk management to employees and the public is given the highest priority.

Goal 1 Objectives

- All personnel involved with fire management and decision making would be provided the appropriate situational risk information with leader's intent to make informed decisions prior to exposure to risk.
- Ensure communication to park staff, visitors, neighbors, and partners as it applies to fire management actions or conditions.

- Apply risk management processes in all decision making.

Goal 2

Protect property, infrastructure, cultural and natural resources from unwanted fire effects and damage from fire management activities.

Goal 2 Objectives

- Monitor environmental conditions to ensure adequate equipment and personnel are available for wildfire response.
- Minimize negative impacts to values caused by fire management activities through training and the use of resource advisors.
- Prevent human-caused wildfires with fire prevention strategies.
- Identify and prioritize values at risk from wildfire and fire management activities to inform protection and mitigation strategies.
- Manage wildland fuels associated with resources and assets to reduce risk of unwanted fire effects.

Goal 3

Promote ecological and social conditions that create, maintain, or restore fire-resilience to the landscape where the natural role of fire can function in the ecosystem.

Goal 3 Objectives

- Use fuels treatments to simulate the desired effects of wildfires.
- Manage wildfires to allow natural processes to function unimpaired by human activity where successful risk mitigation is probable.
- Continuously monitor prescriptive elements for wildfires and fire management activities to guide and adapt future fire management decisions.
- Educate the public about how wildfire and associated strategies affect the ecosystem and wilderness character of the park.

Goal 4

Foster and maintain a wildland fire management program that aligns with the park's core purpose and promotes values of shared stewardship.

Goal 4 Objectives

- Cultivate and maintain internal and external relationships through collaboration, communication, and coordination by fostering understanding and support among staff, stakeholders, and partners.
- Incorporate Indigenous knowledge and traditional practices when restoring fire to the landscape.
- Use current science to guide an adaptive and innovative fire management program.
- Utilize strategic approaches for all fire management activities that include interdisciplinary and interagency coordination.

- Facilitate reciprocal fire management activities through cooperative agreements and working relationships with tribal, international, state, federal and county government fire management entities.

Description of the Project Area

The project area for the FMP is Glacier National Park (Figure 1). The park comprises 1,013,595 acres and is located in the Northern Rocky Mountains of northwest Montana, bordered on the west and southeast by the Flathead National Forest, the east by the Blackfeet Reservation and Helena-Lewis and Clark National Forest, and to the north by Waterton Lakes National Park and provincial lands of Alberta and British Columbia, Canada. The Continental Divide separates the east and west sides of the park. Glacier National Park and Waterton Lakes National Park of Canada are designated the world's first International Peace Parks and are part of the 18 million acres known as the Crown of the Continent, which is one of the most diverse and mostly intact temperate zone ecosystems in the world. Waterton-Glacier International Peace Park also has been designated an International Biosphere Reserve and a World Heritage Site. Over 90% of the park (928,699 acres) was recommended for inclusion in the national Wilderness Preservation System in 1974. NPS policy requires recommended wilderness be managed as designated wilderness until Congress formally designates the land as such or rejects the recommendation. Because fire management actions under the updated FMP would affect wilderness character and include uses prohibited under Section 4(c) of the Wilderness Act, a minimum requirements analysis (MRA) is required by NPS policy. The MRA is being developed concurrently with the NEPA analysis and will be supplemental to the decision document.

Vegetation is diverse throughout the park and is influenced by different climates on the east and west sides of the Continental Divide. Forests cover two-thirds of Glacier's land area. The west side of the park is generally moister than the east side, supporting mixed forest types with dense vegetation, as well as cedar-hemlock forests in some areas. The landscape east of the Continental Divide is generally drier and more sparsely vegetated, characterized by mixed forest types and grasslands.

Fire behavior in Glacier National Park can range from a creeping fire and/or smoldering to a fast-moving crown fire through the trees depending on factors such as fuels (e.g., vegetation and downed woody material), drought, weather, and topography. The Continental Divide can modify fire behavior, serving as either a natural barrier to fire spread due to lack of vegetation in the alpine environment, or by influencing local weather and wind patterns (e.g., strong west winds on the east side of the park).

When drought conditions are present, vegetation moisture content can drop to extremely low levels and wildfires can be expected to exhibit extreme fire behavior and continue to burn actively through the night, particularly on slopes. Dry cold fronts out of the Pacific Northwest can be associated with frontal wind shifts and speeds that cause intense fire behavior.

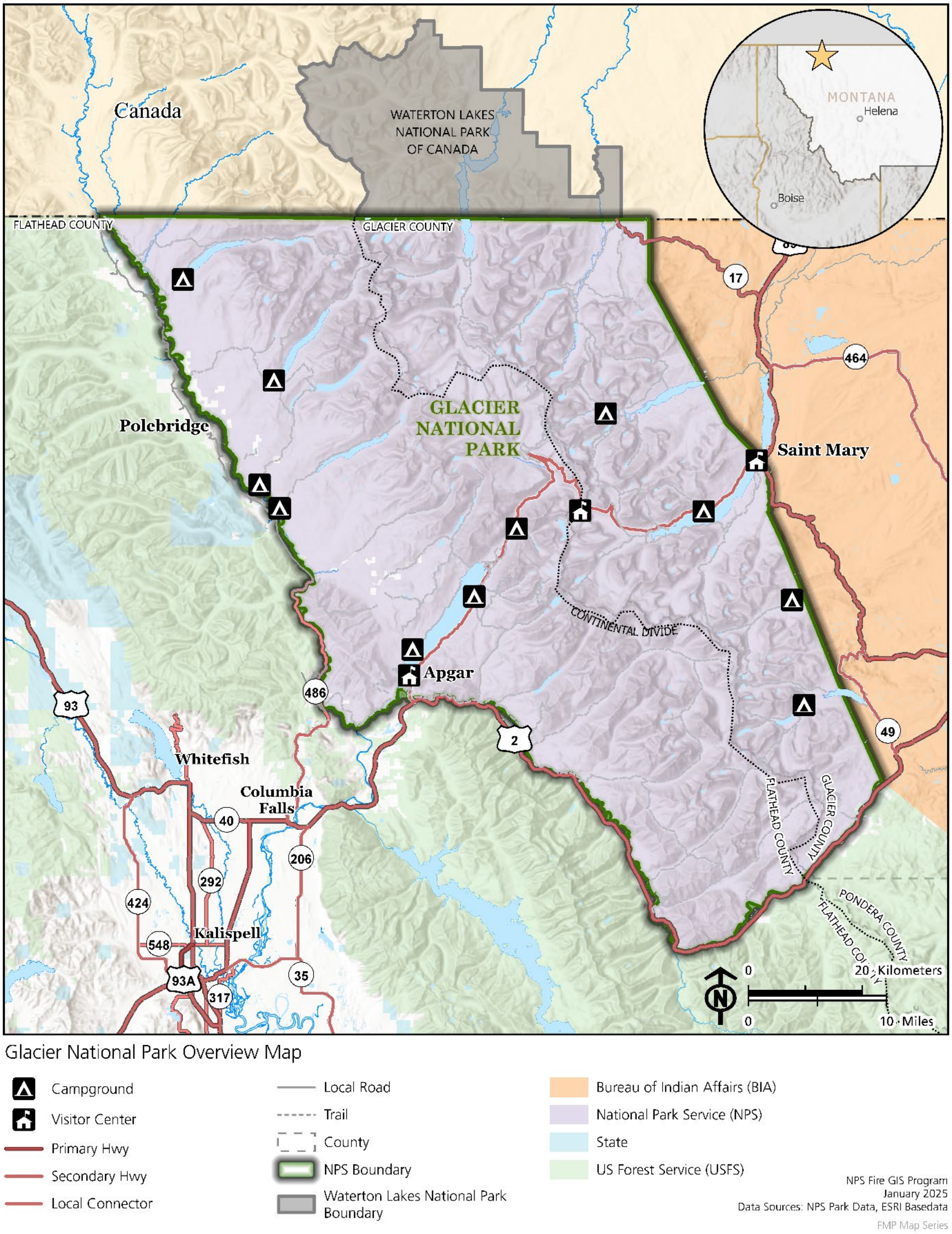

Figure 1: General vicinity map of Glacier National Park

Chapter 2 – Alternatives

Two alternatives, an action alternative (Alternative A) and a no-action alternative (Alternative B), have been carried forward for detailed analysis and are described below. Three alternative elements were identified but dismissed from detailed analysis as described in Appendix C.

Elements Common to Both Alternatives

The following elements would be applicable to both the action and no-action alternatives.

Initial Response Procedures

When a wildfire is detected, Glacier would request fire personnel to respond through the Kalispell Interagency Dispatch Center. The type and number of fire personnel asked to respond to the wildfire would be based on the location of the wildfire and current and expected weather.

Priorities for assigning critical or limited fire personnel to wildfires would be based on the following criteria:

- public and fire personnel safety,
- protection of improvements and private property,
- protection of cultural and natural resources,
- fire behavior potential as determined by fuels, weather, and topography,
- risk, and
- fire personnel response times to the wildfire location.

If a response to a wildfire is near the park's boundary, Glacier fire personnel would work with neighboring agencies to jointly determine priorities.

Minimum Impact Strategy and Tactics (MIST)

Minimum Impact Strategy and Tactics (MIST) incorporates fire personnel and public safety priorities, includes requirements for the protection of natural and cultural resources during a response to a wildfire, and is the policy of the NPS. Measures under MIST would be applicable to all management strategies under the updated FMP. Agency-wide MIST are described in NPS Reference Manual (RM) 18, Chapter 2, Managing Wildland Fire*,* and are incorporated by reference into the Best Management Practices for this EA in "Appendix B". All fire management activities in Glacier would be conducted to cause the least impact to resources.

Wildfire Prevention

Wildfire prevention activities in Glacier would continue to consist of signs and other educational materials about wildfire danger posted at key locations. The park would also continue to share fire prevention messages through interpreters and other staff contacts and may consider fire restrictions or area closures in collaboration with surrounding partners. Restrictions and closures would be designed to reduce human-caused fire risk, and to provide increased public safety by controlling occupancy of public lands that may be threatened by wildfire.

Post-Fire Programs and Response

Glacier is responsible for taking prompt action after a wildfire to minimize threats to life or property, and to prevent unacceptable degradation of natural and cultural resources. These activities are addressed programmatically in this EA and require separate environmental review and compliance before implementation, including an MRA for any actions proposed within recommended wilderness. Damages resulting from wildfires are addressed through the following four activities:

Suppression Repair: This effort intends to repair wildfire suppression damages;

Emergency Stabilization: The intent is to protect life, property, and critical resources;

Rehabilitation: The intent is to repair wildfire-damaged lands that are unlikely to recover naturally to management-approved conditions, or to repair or replace minor facilities damaged by wildfire; and

Restoration: The intent is to continue the rehabilitation efforts started in the rehabilitation process beyond the time limitation set by the Department of Interior.

RM - 18, Chapter 18, Post Wildfire Programs and the Red Book, Chapter 11, Incident Management and Response provide direction on current processes and timeframes.

Alternative A – Proposed Action and Preferred Alternative

Update Glacier National Park's Fire Management Plan (FMP) to provide comprehensive guidance for wildfire preparedness and management, the use of prescribed fire, and non-fire fuel treatments.

The entire draft of the updated FMP (or Plan) is posted to the NPS PEPC website with the EA for reference during public review. Section 3 of the draft FMP describes the management of wildfire and fuels treatments. The description below includes actions that could be taken using excerpts from the draft Plan that are most relevant for analysis of impacts to park resources in "Chapter 3" of this EA. Procedures and requirements described above under "Elements Common to Both Alternatives" would be in place.

Under Alternative A, all wildfires that occur within Glacier National Park would receive a management response.

- The initial response for human caused wildfires would be suppression.
- Lightning ignited wildfires may have an initial response strategy other than suppression (e.g., point protection, monitor strategy, or a combination; see below), depending on location and risk management factors.
- Wildfire management strategies would be selected to meet Goals and Objectives listed in Chapter 1 of this EA and described in Section 2.1 of the draft FMP.

Glacier would also use prescribed fire and non-fire fuel treatments to accomplish resource objectives and reduce hazardous fuel loading. Prescribed fire and non-fire fuel treatments are described in more detail below, under "Fuels Management with Prescribed Fire and Non-Fire Fuels Treatments." Prescribed fire and non-fire fuels treatments are addressed programmatically in this EA and would require project-level and site-specific environmental review and compliance before they could be implemented, including completing a MRA for any actions proposed within recommended wilderness.

Management of Wildfires

All wildfires that occur within Glacier would be managed with protection objectives. The safety of the public and fire personnel is the primary concern when considering the protection of infrastructure and resources threatened by wildfire. Wildfires may be managed concurrently to protect life safety, property and infrastructure, and also to achieve resource objectives.

To achieve risk management objectives, the following wildfire management strategies may be authorized as a single strategy or combination of strategies on different areas of a wildfire.

- Control - a suppression strategy to complete a control line around a fire and to cool down all hot spots that are immediate threats to the control line until the line can be reasonably expected to hold under foreseeable weather conditions.
- Containment – a suppression strategy to contain or surround a fire with a perimeter defined by a control line or by utilizing natural barriers to fire spread that can reasonably be expected to mitigate the spread of a wildfire under prevailing and predicted weather conditions.
- Confinement – a strategy to limit fire spread within a predetermined area principally by use of natural or pre-constructed barriers and/or environmental conditions. This strategy is often a combination of suppression strategies and strategies that do not include full suppression.
- Point protection – a strategy to utilize suppression actions and best management practices to protect infrastructure or resources from unwanted fire effects without directly halting the continued spread of the wildfire. This strategy could include wrapping structures with fire resistant material, weed whacking brush or tall grass around a building, setting out sprinklers, and other similar measures.
- Monitor – a strategy to maintain surveillance of a wildfire or portion thereof to monitor risk factors and inform periodic validation of management decisions. Monitoring could be used on a portion of a wildfire using multiple strategies or as a single strategy on a wildfire.

Suppression

Suppression actions would be taken on all wildfires that threaten human life and infrastructure to provide for public and fire personnel safety and protect public and private resources. Suppression would include all actions taken to extinguish or control the growth of fires. These actions can include but are not limited to:

Fireline construction - removing fuels (e.g., vegetation and downed woody material) on the edge of a fire and digging a line down to mineral soil to stop the spread of fire on the ground. Fireline can be constructed using hand tools, chainsaws, and other motorized tools. Use of fireline explosives and heavy equipment require approval in writing from the Superintendent; heavy equipment would very rarely be used.

Fuel break construction – create a change in fuel to affect fire behavior such that fire can be more readily controlled. Fuel breaks (a break in vegetation and downed woody materials) may be created along roads (using mowers or chippers, for example) or adjacent to values at risk, or shaded fuel breaks may be created in timbered areas by thinning and pruning trees.

Use of water – water can be delivered by pumps, hoses, engines, and aircraft to suppress a fire. Aircraft (planes or helicopters) may drop water from tanks loaded at airbases or from water scooped from nearby lakes or rivers. Water sprinklers may also be used near values at risk (e.g., a building or natural or cultural resource) to lessen the chance of the value igniting and burning.

Firing – the deliberate ignition of fuels to influence the effectiveness of other suppression actions. Firing can include 1) burning out, which is done to consume unburned fuel between the control line and the main fire and hasten line construction, increase safety margins, and limit resource impacts, and 2) backfiring, which is designed to eliminate fuel in advance of a wildfire to widen firelines, slow the progress of a fire, or reduce the intensity (e.g., flame lengths) of a progressing wildfire.

Use of chemical fire retardant – chemical retardants may be used on fires, typically applied via aircraft. Chemical fire retardants would not be used within the park without written authorization from the Superintendent unless there is an imminent threat to life or property. Chemical retardant has only been applied in the park once in the last 17 years, with the last application occurring in 2007.

Mop-up – the complete extinguishment of fire, embers, and smoldering material within the fireline to ensure the fire does not escape its existing perimeter. This can be 100 percent of the fire area or on a larger fire it may be a certain distance from the fire edge (e.g., 100 feet or 150 feet) depending on conditions. Mop-up typically requires sawing up burning trees and logs, digging up burning organic material, and water application. To minimize impacts to natural resources and wilderness character during mop-up activities, mop-up in the park would be kept to the minimum necessary to prevent the fire from escaping its existing perimeter.

Suppression actions often require the establishment of fire camps or spike camps to support fire personnel. Developed campgrounds and administrative areas are typically used for fire camps where there is convenient access to the fire. Spike camps are generally utilized when risk management and logistical considerations make travel to and from the fire area ineffective or unsafe (i.e., when fires are several miles from roads). Aerial operations, for transport of personnel, delivery of equipment, water drops, and reconnaissance and monitoring, for example, may be necessary during a suppression action; aircraft could include helicopters, fixed-wing, or uncrewed aircraft systems (UAS).

Other Wildfire Management Strategies

Wildfire management strategies that do not involve fully suppressing a fire to the smallest size possible may be used under Alternative A. Under such strategies, wildfires may be managed concurrently to protect life safety, property, and infrastructure and to achieve resource objectives, such as those listed above under "Proposed Programmatic FMP Goals and Objectives". These strategies could suppress portions of a fire depending on the location and conditions of the fire and risk management objectives. Operational activities for strategies that do not involve full suppression could include some or all the activities described above for suppression but would potentially be less frequent and at a smaller scale.

A wildfire that is not immediately suppressed would be managed with established policy and be subject to periodic validation by the park Superintendent. The safety of the public and fire personnel is the primary concern when considering the protection of infrastructure and resources threatened by wildfire.

Fire Management Units

Under the updated FMP, Glacier would be divided into two FMUs to help fire managers define fire management strategies and considerations for each FMU. The goals and objectives listed above in "Proposed Programmatic FMP Goals and Objectives" (and "Section 2.1" of the updated FMP) would be applied consistently to both FMUs; however, differing conditions in each FMU warrants attention to decision criteria for management of and response to wildfires.

The two FMUs are: West FMU and East FMU, with the dividing line being the Continental Divide (Figure 2). The West FMU is made up of all land within Glacier west of the Continental Divide, while the East FMU constitutes all land within Glacier east of the Continental Divide.

West FMU– This FMU consists of all park lands west of the Continental Divide. Typical fire spread in this FMU is to the east or northeast, towards the Continental Divide and higher elevations of the park, where wildfire is significantly slowed due to lack of burnable vegetation. Because the Continental Divide acts as a natural barrier to fire spread, and prevailing weather patterns typically push fires towards the Continental Divide, the probability of successfully protecting property and infrastructure values from negative fire effects is higher in this FMU than the East FMU. All wildfires that start in this FMU would use protection objectives (i.e., protect all highly valued resources and assets from wildfire) to guide wildfire management strategies and tactics. When risk factors allow, resource objectives (i.e., manage wildfire to allow natural processes to function unimpaired by human activity) may also be used. Strategic objectives for the West FMU (Section 3.1.2 of updated FMP) would be to confine all fires to the west side of the Continental Divide and minimize impacts to wilderness character.

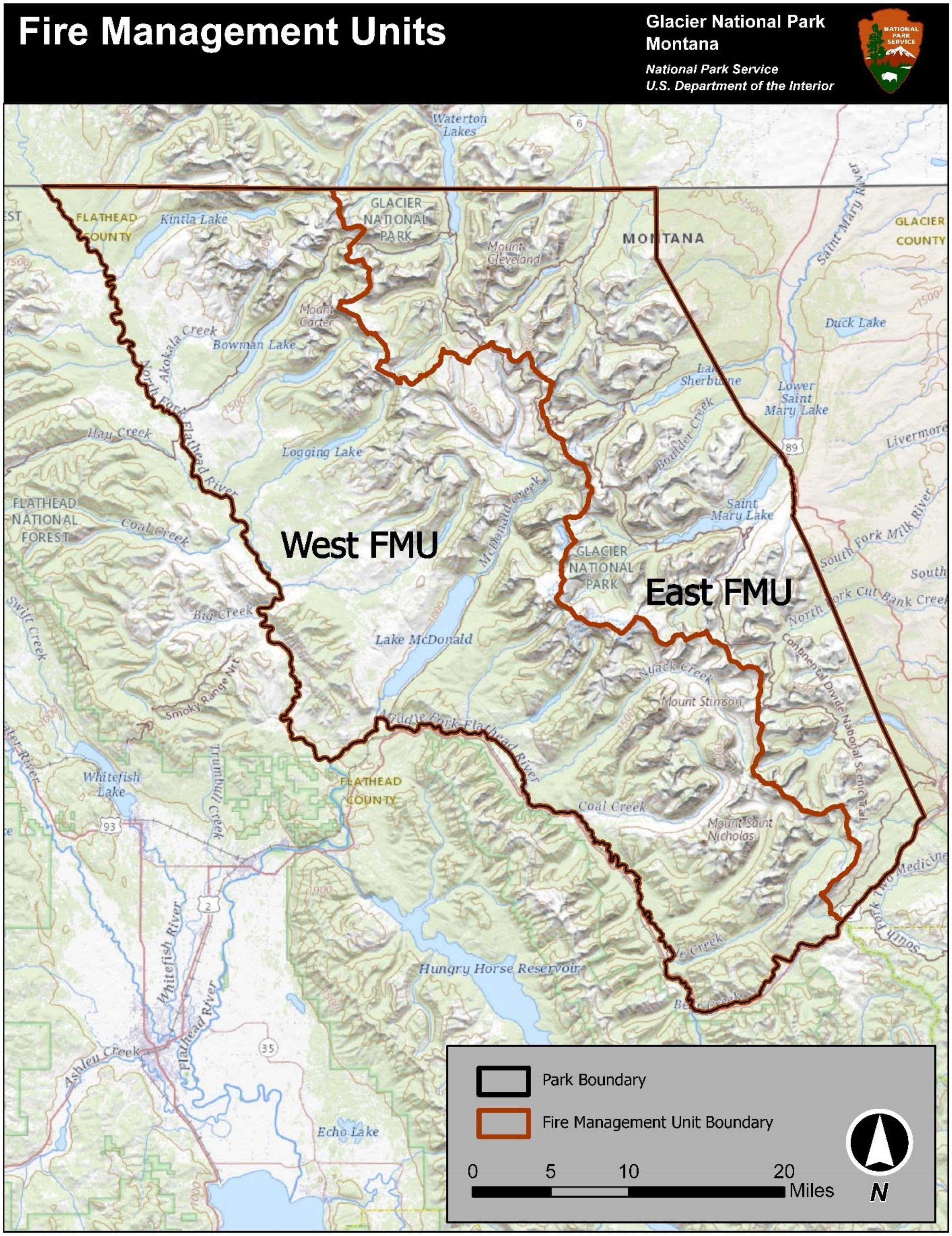

Figure 2: Fire Management Units (FMUs)

East FMU– This FMU consists of all park lands east of the Continental Divide and presents more complex wildfire management conditions than the West FMU. Typical wildfire spread is to the east or northeast, pushed by strong west winds created by air flowing over the Continental Divide. Wind speed increases as it is funneled through aligned topography to the east. Many days on the east side of the park are characterized as breezy. Most of the property and infrastructure values in this FMU are downwind of fuels and there are very few natural barriers to keep fire from leaving the park boundary. Social tolerance of wildfires occurring in this FMU is also low among the public, stakeholders, and partners due to impacts from previous wildfires. Because of these conditions, all wildfires would be managed with only protection objectives and suppression strategies (i.e., protect all high value resources and assets from wildfire).

Fuels Management with Prescribed Fire and Non-Fire Fuels Treatments

Glacier National Park's programmatic fuel management goals and objectives are:

- Goal: Restore fire to the landscape where opportunities are limited for wildfire to meet resource objectives.
    - *Objective:* Use prescribed fire to mimic wildfire effects in a planned environment.
- Goal: Maintain, restore, and promote fire resilience in diverse habitats and cultural landscapes.
    - *Objective:* Use prescribed fire or non-fire treatments to manipulate specific plant communities.
- Goal: Safe and effective wildfire response is enhanced through vegetation management and values at risk have improved resiliency to fire-related impacts.
    - *Objective:* Use fuels treatments to reduce vegetation accumulation associated with wildfire risk in proximity to values.
    - *Objective*: Create and maintain defensible space, as described in the Plan, for infrastructure values.

These goals and objectives support the Glacier fire management programmatic goals listed above in "Chapter 1, Proposed Programmatic FMP Goals and Objectives" ("Section 2" of the updated FMP).

Glacier uses a long-term planning process to track all stages of fuels project implementation over the entire planning horizon and would continue this process under the updated FMP. Fire managers would continue to work with park staff, including an interdisciplinary team (ID team), natural and cultural resource managers, and other specialists, on each proposed treatment project to review and update the fuels program's strategic direction. The annual review includes analyses of completed structure and/or risk assessments for park values. Each prescribed fire and non-fire fuels treatment would have a site-specific plan outlining goals, objectives, methods, and best management practices, and an ID team would review the plan. The ID team would consist of natural and cultural resource managers (e.g., wildlife biologist, botanist, archeologist, wilderness coordinator, and environmental compliance specialist), fire personnel, and other park staff as required. Neighboring agencies would be consulted when appropriate, and all treatments would have project level environmental review and compliance completed as necessary, including an MRA if a project is in recommended wilderness. A multi-year treatment plan for fiscal years (FY) 2025-2029 is appended to the draft FMP (incorporated here by reference) and is a broad framework for projects that may occur over the course of the next few years. The current multi-year treatment plan includes anticipated pile burns, fuels thinning in areas ranging in size from five to 20 acres on both the east and west sides of the park, and prescribed burning in the North Fork District. These activities would be subject to project specific environmental review and compliance.

Activities proposed in the updated FMP would be planned and implemented in accordance with RM 18, Chapter 7, Fuels Management, the NWCG Standards for Prescribed Fire Planning and Implementation, and the Red Book, Chapter 17, Fuels Management.

Prescribed Fire

Glacier would use prescribed fire (planned ignition) treatments to achieve specific protection and resource objectives. Prescribed fire treatments could occur in both the West and East FMUs. Prescribed fire is the deliberate ignition of fire and would be used to return fire to the ecosystem and maintain and/or restore plant communities, reduce hazardous fuel accumulations, reduce future fire suppression costs, and for other protection or resource objectives. Prescribed fire includes broadcast burns and pile burning; broadcast burns are controlled applications of fire to an area, and pile burning is typically the ignition of debris piles created during mechanical fuel treatment.

While prescribed fire could occur in other areas of the park, under the current multi-year treatment plan, prescribed fire (broadcast burning) is expected to be implemented in the North Fork District within ponderosa pine stands at Sullivan Meadow and grassland areas in Big Prairie (Figure 3). The purpose of these prescribed burn treatments would be to maintain the ponderosa pine stands and open grasslands as a continuation of maintenance that began in the 1990s. Prescribed burn treatments are currently anticipated for a total of approximately 400 acres of grassland and approximately 150 acres of ponderosa pine over the next five to 20 years. The amount of area burned per year would likely vary according to conditions and operational resources. Prescribed burning could also occur in other areas of the park if determined appropriate, subject to separate environmental review and compliance.

If management determines prescribed fire is the best method to accomplish a proposed treatment, the most current Interagency Prescribed Fire Planning and Implementation Procedures Guide would be used. All burn plans would be developed with input from the ID team and approved by the Superintendent. Pile burns are a type of prescribed fire; therefore if a fuels treatment takes place and the preferred method for disposing of cut vegetation and woody material is using pile burns, an approved burn plan would be used.

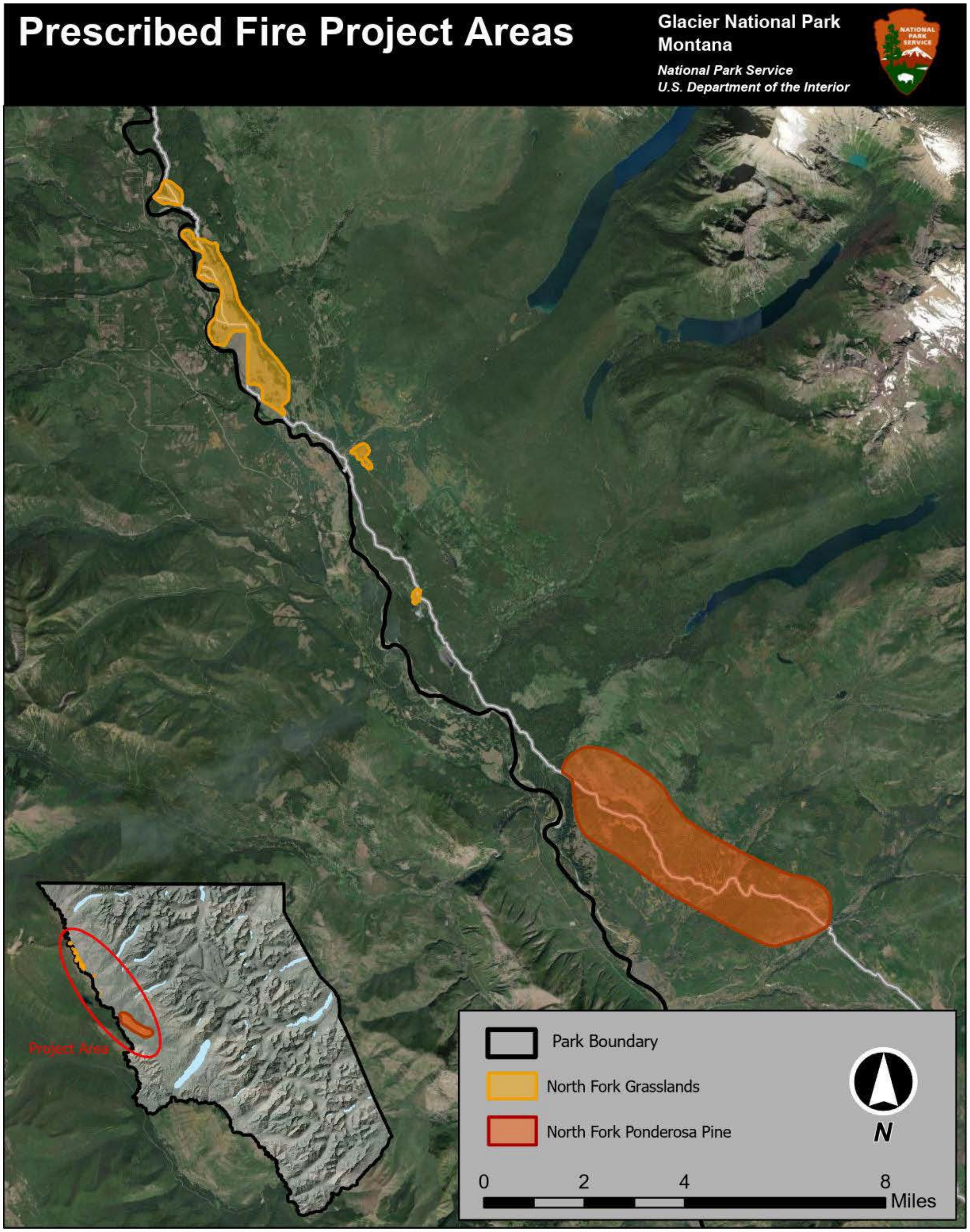

Figure 3: Anticipated prescribed burn project areas in the North Fork District under the updated FMP.

Non-Fire Fuel Treatments and Defensible Space

Non-fire fuel treatments, or mechanical fuels reduction, would be implemented near developments or other values (e.g., cultural, natural, and other resources) that may be damaged or destroyed by a wildfire. In many instances mechanical fuels reduction projects would occur in areas where fuel accumulations are too high to use prescribed fire safely and effectively.

Defensible space treatments would typically include activities such as removing dead and dying plant material, mowing, irrigating grasses, thinning live woody vegetation, and pruning low branches. These treatments reduce the likelihood of a structure igniting during a wildfire incident and provide fire personnel with safe opportunities for effective suppression actions.

Mechanical treatments could take place in any vegetation type that surrounds the value to be protected, and treatments would generally extend between 300 to 500 feet into surrounding vegetation. Defensible space treatments would be most intensive within 30 to 50 feet of the value at risk (e.g., building, resource site, etc.), where most or all the combustible surface fuel would be removed, most or all small to mid-diameter trees would be removed, and the largest trees would be limbed up to break up fuel continuity between the ground and the tree canopy. From 50 to 150 feet from the value at risk, most dead and downed fuels would be removed, some small to mid-diameter trees would be left in a spaced configuration that prevents fire spread from canopy to canopy and does not create a fuel ladder to overstory trees. Some logs that have decayed into the ground would be left in place. Beyond 150 feet from the value, the concentration of surface fuel retained would increase with the distance from the value and phase into natural or near natural conditions at 400 to 500 feet. Species composition of the forest is a key factor in how many trees would be removed. Volatile, low branched trees like firs, for example may be spaced at 20 feet intervals within the first 50 feet of the treatment area, whereas lodgepole, with its lack of lower branches, may be spaced 8 to 12 feet apart. Typical tools used during mechanical fuels reduction would include motorized chainsaws, brushers, chippers, and weed whips, in addition to hand operated pole saws, handsaws, loppers, and clippers.

All government owned structures within Glacier have been assessed for wildfire risk using the NPS Wildfire Risk Assessment program. Privately owned structures within the park have varying degrees of assessment for wildfire risk. Current information and future updates on NPS Structure Protection needs can be found at NPS Wildland Fire Risk Assessment (WFRA). These structure assessments are valuable in determining where to allocate limited fuels management resources.

During mechanical fuel treatments, disposal of the cut fuels (e.g., vegetation and woody material) can be accomplished by a variety of methods. Below is a description of how biomass material may be disposed of, and any one method or combination of methods can be used during a treatment.

- Burning on site: creating small burn piles of woody material from fuels treatments that are typically burned during the fall and spring.
- Hauling and burning off site: woody material from fuels treatments can be hauled off site to large, consolidated burn piles in safe locations preapproved by park management. There are several locations that are used annually, and all new consolidated pile locations will be approved through the park ID team.
- Chipping: this method would chip small diameter woody materials and scatter the chips on site or haul the chips offsite for disposal. This method is possible near roadways but may not be an option for an entire treatment unit.
- Scattering: cut material is dispersed away from values without creating additional fuel hazards.
- Fuelwood: Woody material cut during fuels treatments would be used for fuelwood if of the appropriate size, etc.

- Building materials: larger diameter fuels can be used as parking barricades, posts, corral rails, amphitheater seats, and as replacement logs in historic structures.

Best management practices for mechanical fuel treatments are listed in Appendix B. The NPS has adopted the International Code Council's (ICC's) International Urban-Wildland Interface Code (2021) through the parameters described in Executive Order 13728: Wildland-Urban Interface Federal Risk Mitigation (May 18, 2016). Contained in the ICC's code (sections 603 and 604) are descriptions of defensible space and maintenance requirements for wildland urban interface (WUI) areas. See RM 18, Chapter 7, Fuels Management for additional information.

Air Quality/Smoke Management

Glacier is a member of the Montana/Idaho Airshed Group. The purpose of the Airshed Group is to minimize or prevent smoke impacts to communities while using fire to accomplish land management objectives. The Montana/Idaho Airshed Group Operating Guide contains agreements, guidelines, plans, and procedures for the successful operation of the Airshed Group, including compliance with all federal, state, and local regulations for open burning. Each agency supports and adheres to the standards of the Airshed Group.

Glacier would obtain necessary burn and/or air quality permits from the State of Montana prior to implementation of any prescribed burning. All prescribed fire plans would include appropriate consideration of smoke production, duration, and impacts. Also, all prescribed fires would be reported to Kalispell Interagency Dispatch ahead of time and follow all smoke management guidelines and restrictions.

All prescribed fire smoke would be monitored from ignition until the project is complete for adverse impacts to nearby sensitive areas, Class 1 airsheds, and impact zones. Primarily, this includes the Flathead Valley as an impact zone. If smoke direction or amount is deemed to be undesirable during the test fire, the prescribed fire would not continue and would be extinguished. Additionally, Glacier would report prescribed fire acreages to the Montana/Idaho Airshed Group annually and review total acreages for the smoke permit.

Additional Smoke Management information can be found in RM 18, Chapter 9, Air Quality and Smoke Management.

Monitoring (Section 4.0 of the draft FMP)

Glacier National Park's fire ecology program consists of a Fire Ecologist and Fire Effects Monitors. The fire ecology program supports the programmatic goals and objectives of the fire management program.

Goals of the Glacier fire ecology monitoring program are as follows.

- Verify the prescribed fire program objectives are being met through documentation and analysis of fire effects.
- Inform fire management decisions with analysis of conditions in the fire environment and verify the effectiveness of implemented decisions and actions taken using appropriate temporal monitoring and analysis.
- Increase knowledge of fire behavior and effects on ecosystems to apply to adaptive fire management decisions.
- Use monitoring data and analysis to inform the public.
- Identify topics where research should be initiated.
- Promote opportunities for the program to sustain skillsets and innovate in the field of fire ecology and monitoring.

Fire monitoring is part of the adaptive management process and required by policy. Fire monitoring includes wildfire, prescribed fire, and non-fire fuels treatments and is described in RM 18 Chapter 8, Fire Ecology and Monitoring with more details in the NPS Fire Monitoring Handbook (NPS 2003). The 2003 NPS Fire Monitoring Handbook (FMH) defines four levels of monitoring for short and long term, along with standardized plot protocols. The variables to be monitored would be those determined according to fire management goals and objectives, and by consulting the Glacier Fire Ecologist.

Climate Change Adaptation ("Section 4.3" of the draft FMP)

Climate change is affecting vegetation structure, composition, function, and ecosystem processes throughout the United States and within Glacier National Park, presenting new challenges for managing wildfires in and near Glacier as the fire environment changes with the climate. Trends point toward increases in temperature, reduced snowpack, more severe drought, increase in area burned by wildfires, tree mortality, and biome shifts (Gonzalez 2020).

A changing climate can affect wildland fire management by extending the length of the fire season. More days of fire season can lead to more days with intense fire behavior, higher burn severity, increased fire frequency, and larger fire size, than were previously common in Glacier. These changes may alter ecosystems, vegetation patterns, fire regimes and the way wildland fires are managed on the landscape.

Data show current temperatures in Glacier have shifted above the historic range of variability (Hegewisch and Abatzoglou 2024) and are predicted to increase 2-4°F between the years 2025-2049 (Alder and Hostetler 2024). Wildfires are already burning areas more frequently and at higher severities than in the past (Parks and Abatzoglou 2020). If future fire environments are warmer and precipitation patterns change, protecting life safety, and park values will become more challenging.

There is opportunity for the park to evaluate areas as fire refugia to maintain seed sources and habitats, and thereby resist climate change impacts. Wildland fire may also be a beneficial disturbance function in creating resilience to climate change, and opportunities for the park to identify areas where wildland fire will create more climate change resilient conditions.

Glacier keeps climate change and sustainability at the forefront of all management through adaptation, science, communication, and mitigation. Under the updated Plan, fire managers would learn and respond to climate change concurrently with the park and partners. The monitoring and adaptive management principles employed throughout this plan would be used to help managers address climate change as it pertains to wildfire risk and wildland fire effects.

Annual Fire Management Plan Update (Section 4.4 of the draft FMP)

If the draft FMP is approved, an annual review of the Plan and appendices would be required. The review process is described in RM 18, Chapter 4, Fire Management Plans. Any needed updates to the FMP and appendices would be identified and made a part of this process along with new Superintendent and FMO signatures to the plan every year as a part of the review.

Alternative B – No Action Alternative

The no-action alternative provides a benchmark for a decision maker to compare what would happen to the environment if current management were to continue, versus what would happen to the environment if one of the action alternatives were selected for implementation.

Glacier's existing FMP is no longer valid because it no longer meets NPS policy. Under no action, the NPS would not update Glacier's FMP, would suppress all wildfires, and would not receive funding for fuels treatments.

At this time, current NPS management direction would direct the No Action Alternative. Under current NPS management direction (and under Alternative B, No Action), prescribed fire and non-fire fuel treatments would not be authorized and would discontinue without an updated and valid FMP that provides guidance on the implementation of these strategies. Additionally, only suppression strategies on wildfires would be allowed, i.e., all wildfires would have an initial response suppression strategy, with full suppression as the objective.

Suppression strategies authorized under Alternative B would include control, containment, and confinement, as described above for Alternative A. These strategies would be implemented as part of a larger, full suppression effort. Suppression would include all actions taken to extinguish or manage the growth of fires, as described for Alternative A. Suppression fires would be targeted with prompt, safe, and cost-effective actions utilizing a strategy indicated by the specific circumstances. Procedures described at the beginning of this chapter under "Elements Common to Both Alternatives" would be in place.

Chapter 3 – Affected Environment and Environmental Impacts

This chapter considers potential impacts to park resources that could occur due to the proposed action and for which a detailed analysis is necessary and analyzes the environmental impacts of not taking the action under consideration. The existing conditions for each resource are described followed by an analysis of impacts. Issues are retained for detailed analysis if they are pivotal or central to the proposed action, necessary to make a reasoned choice between alternatives, a major point of contention among the public or other agencies, and/or associated with resources that could be negatively affected if the proposed action is implemented. Direct, indirect, and cumulative impacts as applicable are discussed in this section. Impact topics that have been dismissed from detailed analysis are described in Appendix D.

Air Quality

Affected Environment

Glacier National Park is a designated mandatory Class I area under Section 162(a) of the Clean Air Act. This means that air-quality-related values are to be maintained at the highest level under the law. The park currently monitors meteorological data in the park as well as particulates, visibility, wet deposition, dry deposition, ozone, and chemical concentrations through the following cooperative national and state programs:

- Clean Air Status and Trends Network (CASTNET)

  Weekly ambient concentrations of gaseous pollutants and particulates including nitric acid, sulfur dioxide, nitrate, ammonium, and sulfate, as well as the base cations magnesium, calcium, and potassium. Sodium and chloride are also measured along with hourly ozone concentrations.

- National Atmospheric Deposition Program

  1. National Trends Network. Wet deposition measurements include acidity (measured as pH), sulfate, nitrate, ammonium, chloride, sodium and the base cations (positively charged ions) including magnesium, calcium, and potassium, as well as precipitation.

  2. Mercury Deposition Network. The only network providing a long-term record of total mercury concentration and deposition in precipitation in the United States and Canada.

- Interagency Monitoring of Protected Visual Environments (IMPROVE)

  Measures visual range, air temperature, relative humidity; also collects fine particulates of ammonium sulfate, ammonium nitrate, elemental carbon, soil, organic mass, sea salt, and coarse mass. Data are used by regional planning organizations to measure reasonable progress and set long-term goals for improvement of visibility in Class I areas both within and outside the state (NPS 1999).

- Glacier National Park Air Quality Monitoring Program

  Ozone specific measurements along with meteorological data.

Air quality overall in the park is considered fair with a varied trend, meaning some components (e.g., pollutants, visibility, etc.) are in good condition and others are in poor condition (NPS 2022b). Air quality conditions and trends for Glacier are available at the NPS Air webpage. Based on data from 2022, ozone levels are in good condition for vegetation health and fair condition for human health; mercury is in good condition; nitrogen and sulfur depositions are in poor condition; and particulate matter and visibility are in fair condition (NPS 2022b).

Air quality in Glacier is degraded temporarily by smoke from wildfires burning not only within the park, but also regionally. The degree of smoke emissions depends on the size and intensity of the fire and is determined largely by meteorological conditions (e.g., temperature, wind speed and direction), fuel type and moisture content, and fuel loading (i.e., mass of combustible materials). Wildfire smoke contains pollutants such as carbon monoxide and can increase airborne particulate matter, potentially increasing health concerns for those within the affected airshed. Wildfire smoke can also affect visibility and obscure immediate and distant viewsheds both within and outside the park.

The U.S. Environmental Protection Agency (EPA) developed the Air Quality Index (AQI) to provide daily reporting to the public of air pollution that could pose a risk to human health (EPA 2009).

The AQI (Table 1) shows values from 0 to 500; the higher the AQI value, the greater the level of air pollution and the greater the health concern. For each pollutant (including six criteria pollutants; carbon monoxide, nitrogen dioxide, ground level ozone, particulate matter (both PM2.5 and PM10), lead, and sulfur dioxide), an AQI value of 0 to 50 indicates that air quality is generally good; AQI values exceeding 100 can be unhealthy.

Table 1: Air Quality Index (AQI) for Ozone and Particulate Pollution (EPA 2009).

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality risk is satisfactory and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for sensitive groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

AQI monitoring locations adjacent to the park include Babb, East Glacier, Browning, West Glacier, Columbia Falls, Whitefish, and Kalispell. The AQI in the park is generally good in the winter and tends to degrade in summer primarily due to smoke from wildfires burning both regionally and locally. Depending on atmospheric conditions, the AQI in the park can reach unhealthy levels.

Activities that can affect air quality in the park include building and infrastructure operation (e.g., heating and cooling systems); maintenance, demolition, or construction activities that use gas-powered machinery, including road and trail construction; administrative vehicle use; and administrative helicopter flights. Visitor vehicle traffic in the park is ongoing and high in the summer months, especially along the Going-to-the-Sun Road, which traverses the park between West Glacier at the park's west boundary and St. Mary at the east boundary. Vehicle traffic associated with populated areas outside the park is also typically high during the summer and represents an ongoing trend affecting air quality in the park.

Climate change is an environmental trend that can impact air quality, and predictions are for increases in temperature, reduced snowpack, more severe drought, and increases in acreage burned by wildfires (Gonzalez 2020). Data show temperatures in Glacier have shifted above the historic range of variability

(Hegewisch and Abatzoglou 2024) and are predicted to increase 2-4°F between the years 2025 through 2049 (Alder and Hostetler 2024). Wildfires in western US forests are burning areas more frequently and at higher severities (Parks and Abatzoglou 2020). Increased fire activity in the Northern Rockies is expected to continue as the climate warms (Clark-Wolf et al. 2023). Records from Natural Resources Conservation Service (NRCS) snow telemetry (SNOTEL) sites show a trend toward decreased snowpack and peak snow water equivalent arriving and melting out earlier, which directly affects fire season length and summer fuel moisture (Pederson et al. 2011).

Glacier is undertaking efforts to reduce the park's contribution to a warming climate, including a recycling program, replacing standard light bulbs with LEDs, a campaign to reduce unnecessary idling, the installation of EV charging stations, and the use of solar arrays for electricity in some locations, among other measures (NPS 2024).

Environmental Consequences

Air Quality

Alternative A – Preferred Alternative

<u>*Impacts from wildfire suppression.*</u> Suppression operations would be implemented to extinguish or control the growth of a wildfire. Since wildfire smoke can negatively affect air quality (e.g., by the introduction of pollutants, increased particulate matter, and decreased visibility) and can potentially degrade the AQI, suppression operations that extinguish or control the size, intensity, and/or active burn time of a wildfire would benefit air quality and help maintain healthier AQI levels by minimizing the amount and duration of smoke produced by the fire. Benefits to air quality from successful suppression actions would extend parkwide and potentially regionally, depending on the size of the fire and the influence of wind and other weather conditions. While the use of equipment and vehicles during suppression would contribute emissions, the impacts to air quality from emissions would not likely change existing conditions in any meaningful way since high levels of vehicle traffic are already present in the park. Any adverse impacts from vehicle and equipment emissions would be of little consequence compared to the effects of prolonged and widespread wildfire smoke. Effects would also be temporary, ending when suppression operations are over.

<u>*Impacts from other wildfire response strategies*</u>. Wildfire management strategies that do not involve full suppression would result in the presence of wildfire in areas of the park, which would have adverse impacts to air quality from smoke due to increased particulate matter and pollutants and decreased visibility. The amount of smoke and associated degree of impact would depend on environmental factors such as fuel loads, moisture content, and weather conditions. Smoke would adversely impact visibility locally and potentially parkwide and outside the park. The extent of the impacts to visibility would be highly variable, depending on the location and size of a given fire or fires, prevailing wind direction, and inversions and other weather conditions.

Over time, naturally recurring wildfire reduces fuel loads that increase the potential for severe wildfires outside of normal ranges. A decreased potential for severe wildfire would mean a decrease in the potential for prolonged and widespread smoke, thus benefitting air quality within and outside the park for the long term.

<u>*Impacts from the use of prescribed fire.*</u> Prescribed fire would have negative impacts to air quality from smoke (e.g., increases in particulate matter and pollutants, decreases in visibility). Impacts would be limited in scale and intensity since prescribed burning is a controlled operation over a relatively small area that could range in size from one or two acres to 100 or more acres depending on the type of burn, i.e., pile burning or broadcast burns (prescribed burning is currently anticipated on approximately 400 acres of grassland and 150 acres of ponderosa pine in the North Fork District over the next five to 20 years; acres burned per year would vary according to conditions and operational resources). Impacts would generally be localized to the vicinity

of the burn area depending on weather conditions, and would be of short duration, ending once the burn operation is complete. Prescribed fire is a planned event with coordination among cooperating agencies to protect air quality and smoke forecasting that would give managers the ability to burn when environmental conditions are favorable for smoke dispersion. All prescribed fire smoke would be monitored from ignition until the treatment is complete for adverse impacts to nearby sensitive areas, Class 1 airsheds, and impact zones, including the Flathead Valley outside the park. If smoke direction or amount is deemed to be undesirable during the test fire, the prescribed fire would not continue and would be extinguished. For these reasons, adverse impacts to air quality from prescribed fire are not expected to increase health concern levels or have prolonged or widespread impacts to visibility.

Prescribed fire would have some long-term beneficial impacts to air quality by reducing fuel loads where it is applied, thereby minimizing the potential for severe wildfires outside of normal ranges that produce heavy smoke levels.

Impacts from non-fire fuel treatments. The use of gas-powered equipment (e.g., chainsaws) during mechanical fuels reduction would contribute emissions, but this would not likely change existing conditions in any observable way given the existing use of similar equipment and high levels of vehicle traffic already occurring in the park. Emissions and associated impacts would be intermittent and very short-term, occurring only when the equipment is in use.

Non-fire fuel treatments would have long-term beneficial impacts to air quality because the treatments would reduce fuel loads where implemented and help decrease the potential for higher severity wildfires outside of normal ranges that produce smoke.

Cumulative Impacts. Past, ongoing, and reasonably foreseeable actions in the park with impacts to air quality include construction and infrastructure projects and trail and road maintenance that include the use of gas-powered machinery, building and infrastructure operation (e.g., heating and cooling systems), administrative helicopter flights, and NPS and visitor vehicle traffic. Air quality is adversely impacted by emissions from vehicles and gas-powered equipment during these activities. Similar activities outside the park, including vehicle traffic (heavy in the summer), road construction, air traffic, and burning on adjacent private land also contribute to the overall emissions affecting air quality in the park. When the impacts of Alternative A are combined with those from past, present, and reasonably foreseeable actions, the cumulative impact to air quality is adverse, with other actions contributing most of the impact due to their ongoing and widespread nature. Although overall adverse cumulative effects would continue, Alternative A would contribute a beneficial effect to the overall cumulative impact over time by reducing the potential for heavy and widespread smoke in areas where fuel loads that contribute to high-severity wildfires are reduced.

Alternative B – No Action

Adverse impacts to air quality from wildfire suppression would generally be as described above for Alternative A. Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for large, high-severity wildfires outside of normal ranges. These types of fires could be more difficult to suppress and contain if they occur in multiple areas, and could require frequent, prolonged responses. Resources could become limited, further decreasing operational effectiveness. The result could be widespread and prolonged smoke from wildfires burning in multiple locations for several months until they are extinguished by fall or winter weather conditions. The increased potential for prolonged, widespread smoke would adversely impact air quality by increasing the potential for airborne pollutants and particulate matter, thus increasing health concern levels and negatively affecting visibility parkwide and at a regional level.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to air quality are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to air quality is primarily adverse. Currently, other actions are likely to contribute most of the adverse impact, but over time the cumulative impact attributable to Alternative B would increase due to smoke from potentially large, high-severity wildfires outside of normal ranges.

Vegetation and Soils

Including federally listed (whitebark pine) and state listed plant species of concern

Affected Environment

Vegetation

The contrast between the climates of the east and west sides of the Continental Divide, sharp topographic relief, and variability in soils characteristics contribute to a wide diversity of vegetation throughout the park. Over 1,100 vascular plant species have been recorded (Lesica 2002); of these, approximately 100 are state listed species of concern and/or rare in Montana. The integrity of the park's plant communities remains largely intact, although some communities have been affected by human activities such as introductions of exotic species, especially near roads and developed areas, and fire exclusion.

The major vegetative community classes in the park consist of grasslands (dry herbaceous), pine or woodland savannahs (open, dry coniferous and deciduous), bottomland forests (mesic herbaceous and deciduous), ponderosa pine/Douglas-fir forests (open, dry coniferous), western red cedar/western hemlock forests (dense, mesic coniferous), spruce/fir forests (dense, mesic coniferous), and alpine communities (mesic herbaceous and barren). Also included are marshes, swamps, riparian areas, and barren, rocky talus slopes (Habeck 1970).

Forests cover two-thirds of Glacier National Park's land area. Lodgepole pine is widespread at lower and intermediate elevations, along with western larch and some western white pine on the west side of the park. The Lake McDonald area supports western red cedar and western hemlock, with spruce, Douglas-fir, and subalpine fir also occurring on the west side. Ponderosa pine makes up a minor portion of total conifer stands in the park and is found only on the west side. It occupies the warmest and driest sites that support forests and grades into savanna communities. Douglas-fir occupies slightly cooler, more mesic (moist) sites than ponderosa. The western red cedar and western hemlock forests include nearly every species of tree that grows in the park. Both require shady conditions for seedling establishment. Near the eastern park boundary, lodgepole pine intergrades with a mix of prairie community, quaking aspen groves, limber pine, and Douglas-fir. Whitebark pine is also present, primarily on the east side of the park; whitebark pine is described in detail below, under "Federally Listed Threatened Species, Whitebark Pine."

Grassland communities include the fescue-wheatgrass prairie, which is dominated by rough fescue and other grasses. East-side prairie landscape is dominated primarily by Idaho fescue, with introduced timothy and brome.

Pine or woodland savannahs include quaking aspen and black cottonwood groves, with open lodgepole pine, ponderosa pine, and limber pine stands. Limber pine is confined to the east side of the park and is afflicted with white pine blister rust. The five needle pines, white pine, limber pine, and whitebark pine are all suffering serious ecological effects as a result of habitat changes resulting from fire exclusion and increasing mortality from the exotic blister rust. Conservation efforts targeting whitebark pine are occurring within the park. Please see "Federally Listed Threatened Species, Whitebark Pine" section of this document (below) for more information.

Historically, fire has been a major disturbance event that has provided for diversity of plant communities in many areas of the park. Natural fire regimes have changed, however, in response to climate change and earlier practices of fire suppression and elimination of the native cultural practice of igniting fires (Barrett

1993). In some vegetation communities, fire exclusion has altered historical age-class structures and the natural forest mosaic. As a result, some forests that historically experienced mixed-severity fires now experience high-severity, stand-replacement fires resulting in increased tree density, decreased overall tree size, and increased surface fuel load. These changes in fuel loads and altered forest structure have left many forests vulnerable to subsequent high-severity fires resulting in vegetation communities outside of desired conditions (Stephens et al 2009).

In addition to native plant communities, non-native plants have been present in the park for many years, adjacent to and within native plant communities. Non-native (or exotic) species "occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities," and are not considered a natural part of the ecosystem because they have not evolved with native species (NPS Management Policies 2006). Spread occurs when people, vehicles, animals, wind, and water transport seeds. Non-native plants often establish communities along trail corridors, river corridors, recently disturbed areas, and livestock trespass sites. They have spread at an increasing rate, and several are considered invasive (have invasive characteristics such as the ability to produce large quantities of seed, aggressive root systems that spread long distances from a single plant and inhibit the growth of other plants).

Some non-native invasive plant species have invaded the park's recommended wilderness, threatening native plant communities. Non-native invasive plant species often out-compete native species, diminishing or even eliminating some native competitors from their habitat. The most threatening, such as spotted knapweed, may spread rapidly and have a detrimental impact on native communities through increased soil erosion, altered fire behavior, disruption of native plant-animal associations, reduction in biodiversity, and a decrease in suitable wildlife habitat. Such effects are occurring in the park where non-native plants are established, with varying levels of severity depending on infestation size and native and non-native species composition. Glacier continues to work to prevent, control, and monitor the spread of non-native invasive plant species. Approximately 150 species of non-native plants (Lesica 2002) were introduced intentionally or accidentally; approximately 18 non-native species are considered invasive.

Whitebark Pine – Federally listed species

In February 2023, whitebark pine was listed as a threatened species under the Endangered Species Act (ESA). Principal threats to whitebark pine are associated with disease inflicted by non-native white pine blister rust, predation by native mountain pine beetles, habitat loss from climate change, and habitat alteration from wildfire suppression (USFWS 2014b).

Whitebark pine occurs at the highest elevations of western tree species (Arno and Hoff 1990, Keane et al. 2011). Whitebark pine is a slow-growing and long-lived tree present at locations often consisting of poor soils, steep slopes, and windy exposures that are predominantly associated with tree line and subalpine communities (Tomback et al. 2001). At its northernmost latitudes it occurs at elevations as low as 5,500 ft (1,680 meters). As a keystone and foundation species, whitebark pine influences ecosystem processes on a landscape level. Whitebark pine has been shown to supply a quality food source relied upon by various wildlife species, including grizzly bears and Clark's Nutcrackers (Kendall and Arno 1990); stabilize soil and snowpack; and subsidize the establishment and perpetuation of community succession (Arno and Weaver 1990).

The park is restoring whitebark pine in core areas identified as suitable for whitebark pine based on habitat, fire history, land uses, watersheds, wildlife habitat and climate modeling (Jenkins et al. 2022). Cones are first collected from plus trees. Plus trees are individuals that have shown natural genetic resistance to blister rust. The cones from plus trees are then germinated in nurseries, and then replanted as seedlings in core areas throughout the park (Figure 4), thus building genetic resistance in the population.

The majority of whitebark pine habitat occurs on the east side of the park, primarily in the St. Mary, Many Glacier, and Belly River districts (Peterson 1999), although whitebark pine stands have been found in the

North Fork, Lake McDonald and Two Medicine/Walton districts, generally at 6,000 feet elevation and above. Glacier has mapped the location of habitat types that support dominate seral whitebark pine populations. Roughly 87,500 acres have been identified as seral whitebark pine habitat within the park. Most of the identified habitat occurs on the east side of the park, primarily in the St. Mary, Many Glacier, and Belly River areas and generally above 6,000 feet in elevation (Peterson 1999).

Soils

Soil types throughout the park vary, but in general include glacial, landslide, and mixed soils; bedrock quartzite/argillite; and bedrock limestone with sandy/loam glacial till soils; deep quartzite/argillite colluvial forest soils; mixed glacial and colluvial soils; deep and moderately deep quartzite/argillite colluvial forest soils; deep and moderately deep colluvial soils on limestone; shallow quartzite/argillite soils; alpine meadow soils; limestone rock outcrop; quartzite rock outcrop; and moderately deep and shallow limestone soils.

Soils in Glacier National Park reflect a variety of parent materials and carry a range of ratings (low to high) related to productivity. The ability of soils to support and/or re-establish vegetation depends on nutrient- and water-holding capacity. Most are very susceptible to invasion by non-native invasive plants when disturbed and have a low to moderate erosion potential depending on sand content (NPS 1999).

Ongoing and planned actions with the potential to disturb vegetation and soils in the park include infrastructure construction and rehabilitation projects, trail and road maintenance, utility improvements, research activities that involve specimen and sample collection, and the Blackfeet Nation's reintroduction of free-ranging bison on tribal land adjacent to the park. Other actions conserve and protect vegetation and soils, such as five-needle pine restoration (including whitebark pine), non-native invasive plant control, management of trespassing livestock, hazard tree management, restoration of disturbed areas, and vegetation monitoring and conservation research.

Climate change is an ongoing environmental trend that is expected to continue to impact vegetation through alterations in temperature regimes, changes in precipitation patterns, and longer and more intense drought conditions which can change plant species persistence, distribution, and abundance and lead to soil erosion and composition changes. Increased fire activity in the Northern Rockies is expected to continue as the climate warms (Clark-Wolf et al. 2023). Climate change presents new challenges for managing wildfires as the fire environment changes with the climate. Predictions include increases in temperature, reduced snowpack, more severe drought, and increases in tree mortality and the amount of area burned by wildfires (Gonzalez 2020). (See also "Trends and Planned Actions for Air Quality", above).

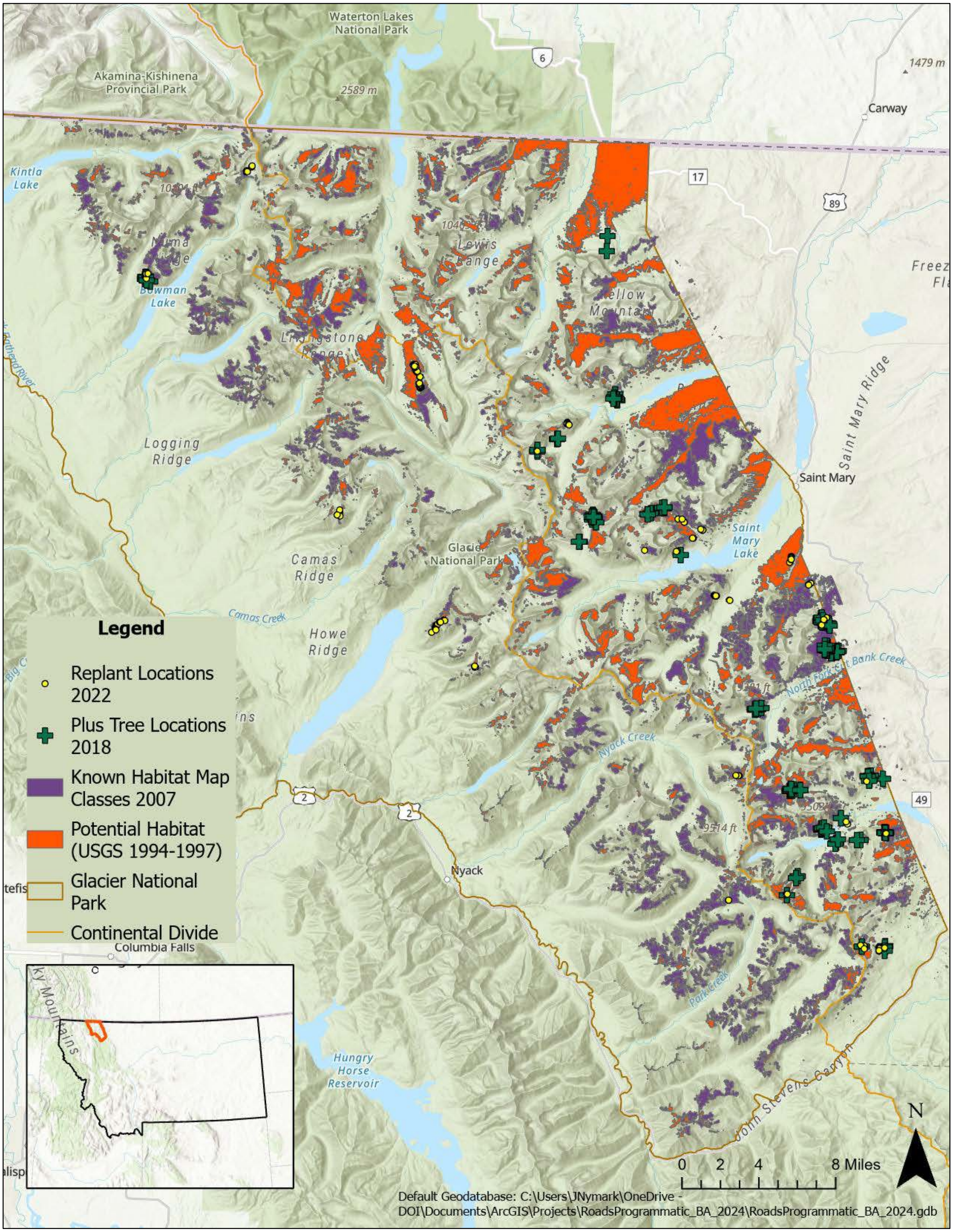

Figure 4: Whitebark Pine Locations

Environmental Consequences

Vegetation and Soils

Alternative A – Preferred Alternative

Impacts from wildfire suppression. Activities associated with wildfire suppression, such as fireline and fuel break construction, burn outs and backfiring, fire personnel camps, equipment staging, and constructing helicopter landing zones, would negatively impact vegetation through trampling, disturbance, or removal. These activities could also cause the disturbance and compaction of soils, with more pronounced impacts on steeper slopes where there is a greater potential for erosion. In general, impacts would be localized, affecting only the immediate area of any given activity (e.g., the width and length of a fire line break or the perimeter of a staging area). The degree of impact would depend on the size, location, and severity of the fire. Larger fires requiring extensive control lines or burn out operations and more personnel and equipment in more areas for prolonged periods, and fires in densely vegetated areas, would likely affect vegetation and soils over a larger area and impact a greater number of plant species. Impacts would primarily be limited to individual plants, but larger suppression efforts could affect some species at the local community level, such as within a meadow or drainage. Adverse impacts would not generally be expected at the population level because many species of native vegetation are present throughout the park, suppression activities typically occur within a relatively localized area, and implementation of MIST and other best management practices would minimize widespread impacts. Adverse impacts would be temporary since areas disturbed during suppression would be restored, and affected grasses, forbs, and smaller woody plants would be expected to recover within one to two seasons after the fire. If trees are removed for fireline or fuel break construction, adverse impacts would be long term, until trees regenerate. The amount of tree removal along fuel breaks or firelines would be minimized as much as possible and would only affect trees within a relatively small area (along the fuel break), with no changes to overall tree species composition in the area. If suppression actions must occur within whitebark pine habitat, whitebark pine trees would be avoided whenever feasible and protection measures would be in place to conserve PLUS trees and restoration sites (Figure 4).

If it occurs, the application of chemical fire retardant during wildfire suppression would likely be very infrequent (chemical retardant has only been applied in the park once in the last 17 years, with the last application occurring in 2007). Any use of retardants and other fire suppression chemicals would adhere to interagency policy for aerial and ground delivery of wildland fire chemicals near waterways and other avoidance areas (DOI 2024). The US Forest Service (USFS) contracted an Ecological Risk Assessment for the Use of Fire-Fighting Chemicals, in which known studies were reviewed (Auxilio Management Services for USFS 2023). A few studies have evaluated the potential effects of fire retardants on terrestrial vegetation. Overall, they indicate the possibility of phytotoxic (or poisonous) effects to individual plants of more sensitive species at the application rates typically used but generate no expectation of widespread or enduring impacts. It was determined that fire-fighting chemicals would have a minimal short-term impact since limited areas are treated with these products. Conversely, the vegetation would be severely affected by the fire without the use of the retardants. Labat Environmental reviewed several studies for an evaluation of the ecological effects of long-term fire retardants. In summary, the inquiry suggests that individual plants of sensitive species may be susceptible to toxicity (potentially affecting seed germination or causing damage to foliage) but also does not indicate long-term or widespread impacts (Labat Environmental 2013). The authors also note the potentially severe effects to vegetation from fire when retardant is not used. Substantial impacts to vegetation from retardant would not be likely because, if used at all, applications would likely be very infrequent, allowing any affected areas to recover, and highly localized to targeted sites, affecting a relatively small area. Impacts would be expected at the level of individual plants, with no impacts at the population level. Retardant applications could alter soil chemistry through the contribution of compounds such as ammonia, nitrates, or phosphorus; however, a study of retardant use on soils found that the application of retardants did not alter soil chemistry beyond typical topsoil conditions and did not raise the soil pH (Yu et al. 2021).

Suppression activities could contribute to the spread of nonnative invasive plant species through ground disturbance, transport on vehicles and firefighting equipment, and the use of nutrient-rich retardant. Best management practices (Appendix B) to prevent establishment or spread of non-native invasive species would be implemented to minimize this risk, and post-disturbance restoration would include the control of non-native invasive species.

Impacts from other wildfire response strategies. Where wildfire management strategies do not involve full suppression, naturally occurring wildfire would return to the landscape. There would be direct adverse impacts from the loss of vegetation to fire, the potential spread of non-native invasive plants, and effects to soils, including erosion and compaction in areas with heavy vegetation loss. These impacts would likely be short-term as soils, grasses, forbs, and smaller woody plants would be expected to recover within one or two growing seasons. Impacts would be longer term where large trees are lost to wildfire, with regeneration potentially requiring several years depending on the species.

Much of the native vegetation in the park has adapted to fire, and the presence of naturally recurring wildfire would maintain fire's ecological role. Beneficial effects would include nutrient cycling in soils and reproductive benefit for some plant species, such as lodgepole pine and certain shrubs, including serviceberry and huckleberry, which resprout after a fire, producing a more vigorous plant. Fire can also be a positive influence for whitebark pine, which needs disturbance to regenerate. Naturally recurring wildfire promotes different vegetation age classes and species diversity as vegetation regenerates after a fire, leading to a mosaic assemblage that is more resilient to fire and stressors such as climate change, non-native invasive plants, and insects. Recurring fire also reduces fuel loads that increase the potential for severe wildfires outside of normal ranges, which can cause high levels of vegetation mortality, create unfavorable conditions for whitebark pine, and degrade soil composition and function across larger areas for longer periods of time.

Impacts from the use of prescribed fire. Prescribed fire, including broadcast burns and pile burning, would have direct adverse impacts from the loss of vegetation. Impacts would be short-term as vegetation recovers within one or two growing seasons. The extent of impacts would be limited to the burn area, ranging in size from one or two acres to 100 or more acres depending on the type of burn, i.e., pile burning or broadcast burns (prescribed burning is currently anticipated on approximately 400 acres of grassland and 150 acres of ponderosa pine in the North Fork District over the next five to 20 years; acres burned per year would vary according to conditions and operational resources). Adverse impacts to whitebark pine from prescribed fire would be highly unlikely because prescribed burns would not be implemented in areas where whitebark pine is present. If a prescribed burn is planned where whitebark pine could be present, surveys would be conducted prior to the treatment to identify any whitebark pine, especially seedlings. Any whitebark pine found would be marked and avoided, protected, or salvaged for future replacement.

Impacts to soils would primarily be beneficial from increased nutrient cycling. Adverse impacts to soils would not be expected because prescribed burns are a controlled operation, where heat intensity would not likely be high enough to negatively affect soils. If negative impacts do occur, they would likely only affect patches within the burn area, with no widespread impacts to soil and no changes to overall soil value and function.

There could be an increase in non-native invasive plants in areas where populations were present before the prescribed fire actions and/or as a result of the fire activities. Impacts would be short-term and contained since treatment areas would be monitored for invasive plants after the burn and any spread would be controlled.

Prescribed burns would benefit ponderosa pine and grasslands. Prescribed fire in ponderosa pine stands (currently planned for Sullivan Meadow in the North Fork District) would minimize the long-term risk of losing remnant ponderosa pine stands to wildfire and would open the understory of treatment areas for ponderosa pine regeneration. For grasslands, prescribed burning (currently planned for Big Prairie in the North Fork) would preserve grassland habitat by removing encroaching conifers that limit the extent and productivity of grassland communities.

High severity fires would be highly unlikely during prescribed fire, as prescribed burning is a controlled operation that includes measures to protect resources and are planned to take place when fuel and weather conditions are conducive to low-to-moderate severity burns.

Impacts from non-fire fuel treatments. Non-fire fuel treatments, including mechanical fuels reduction, could take place in any vegetation type that surrounds a value to be protected (e.g., a structure) and could include activities such as mowing, limbing trees, and brushing (e.g., removing shrubs). Non-fire fuel treatments would have adverse impacts from the removal of vegetation, including small to mid-diameter trees. Impacts would be most pronounced within 30 to 50 feet of the value at risk, where most of the vegetation would be removed. The intensity of impact would lessen over distance from the value, since an increasing number of small to mid-diameter trees would remain within approximately 50 to 400 feet, phasing into natural or near natural conditions beyond approximately 400 feet.

Impacts from non-fire fuel treatments would be localized to a given project site, with impact areas likely ranging in size from an estimated one to 20 acres, possibly more depending on objectives; creating and maintaining buffers along roads, for example, could result in a greater area of impact. Impacts to woody vegetation would be long-term, since maintaining reduced fuels at a given site would require repeated removal of new growth. Impacts to some non-woody species (e.g., grasses and forbs) may be temporary, as treatments would allow for some regeneration. Since adverse impacts would be highly localized, they would not change the overall distribution of native plant species or species diversity, abundance, and composition, and the essential ecological character of vegetation communities in the park would remain unchanged. Non-fire fuel treatments would not negatively impact whitebark pine because, if proposed in whitebark pine habitat, treatment areas would be surveyed ahead of time and any whitebark pine found would be marked and avoided whenever feasible or salvaged for future replacement. Sensitive locations of whitebark pine trees will be provided to the Fire Management Officer from the Vegetation Program Manager at the beginning of the work season, and ongoing coordination will occur before any brushing or vegetation removal.

Non-fire fuel treatments would have little negative effect to soils given the localized nature of the work and because treatments would not involve soils excavation. Soils could be compacted by work crews and the use of equipment, and vegetation removal could increase the potential for erosion. Minimizing access routes, the use of the least impactful equipment, and soil restoration as needed would minimize the extent and severity of effects, and soils would be expected to recover within one or two seasons.

Non-fire fuel treatments would have beneficial effects to vegetation and soils by reducing the potential fire severity under extreme fire weather conditions.

Cumulative Impacts. Past, present, and reasonably foreseeable actions with impacts to vegetation and soils include construction activities, utility and other infrastructure replacements and repairs, trail and road maintenance, non-native invasive plant control, research projects that involve sample collection, and soil and vegetation restoration. Construction and infrastructure projects, maintenance, and research projects involving sample collection have adverse impacts when they cause the disturbance or removal of vegetation or the excavation or compaction of soils. Restoration of disturbed areas and control of non-native invasive species benefit vegetation and soils by restoring native plant species to previously impacted areas, restoring soil layers, and protecting native vegetation from the detrimental effects of invasive species. The Blackfeet Nation's reintroduction of free-ranging bison on tribal land adjacent to the park also has the potential to impact vegetation if, as anticipated, bison range within the park for the long term. Impacts from bison have the potential to be adverse from trampling but also beneficial from the return of the historic role of bison to the landscape. Grazing bison remove layers of built-up dead vegetation that can create habitats for non-native invasive species and create open areas by wallowing or trampling the ground, which allows new seeds to germinate. Wildflower abundance can increase since bison graze primarily on grasses, resulting in a more biodiverse grassland that benefits birds and pollinating insects (Nature Conservancy 2018). Bison consumption of grasses also removes light, flashy fuels that may contribute to the spread of a wildfire.

When the impacts of Alternative A are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to vegetation and soils is both adverse and beneficial. Adverse cumulative impacts would increase from the loss of vegetation to fire (during prescribed fire and when wildfires are not fully suppressed) and in areas where vegetation removal during suppression and non-fire fuel treatments overlap spatially with other actions that result in ground disturbance or vegetation removal; restoration of disturbed areas would limit the overall adverse cumulative impact to areas affected by wildfire. For the long term, cumulative impacts would be beneficial, with Alternative A contributing the greater effect where vegetation responds to the ecological benefits of the presence of fire on the landscape.

Alternative B – No Action

Adverse impacts to vegetation and soils from wildfire suppression would generally be as described above for Alternative A. Since this alternative would require full suppression on every wildfire, suppression activities under Alternative B would be more frequent and likely at a larger scale than under Alternative A, likely requiring more equipment, personnel, and resources. This would lead to potentially extensive adverse impacts from trampling, compaction, and disturbance, depending on the frequency, size, and duration of wildfire incidents.

Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for large, high-severity wildfires outside of normal ranges. Severe wildfires can cause high levels of vegetation mortality, affecting multiple species and age classes. This combined with the lack of fire disturbance during different years would, over time, likely result in vegetation conditions that are outside of historic ranges, including less age class diversity within vegetation communities, reduced species diversity and abundance, changes to species composition (with a higher density of species that respond well to fire or are resilient to competition from non-native invasive plants, for example), a uniform shade regime, and increased susceptibility to diseases. Severe wildfires are unfavorable for whitebark pine survival by reduction of cone production and the likelihood of natural seedling establishment, aiding the expansion of pine beetles into higher elevation areas, and facilitate the spread of white pine blister rust (Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee 2011; Jewett 2009).

Vegetation communities may take longer to re-establish following a high-severity fire, and vegetation loss from large, severe fires could lead to abnormal water runoff and soil erosion during or after heavy precipitation events (especially in steep areas). Severe fires can also increase the spread of non-native invasive plants. Adverse impacts under no action could be long term and have potentially widespread impacts to vegetation and soils, possibly affecting entire drainages and/or landscapes throughout the park. Ponderosa pine would be adversely impacted since prescribed burning would not be used to reduce understory ladder fuels that increase the risk of losing ponderosa stands to wildfire. Similarly, grasslands would be at an increased risk of degradation or loss due to encroaching conifers that would not be controlled with prescribed burning. These impacts could eventually become irreversible over time, resulting in a permanent loss of these vegetation communities.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to vegetation and soils, including sensitive and listed plant species, are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to vegetation and soils is primarily adverse, with Alternative B contributing most of the effect. This is because of the potentially widespread adverse impacts to vegetation and soils that could occur over the long term from large, high severity wildfires.

Wildlife

Including Aquatic and Federally and State Listed Species

Affected Environment

Wildlife

Glacier National Park provides habitat for an abundant diversity of wildlife. The NPS estimates that Glacier supports over 70 species of mammals and 275 bird species. The park is also inhabited by 17 species of native fish as well as reptiles and amphibians. Glacier is a refuge for terrestrial and aquatic wildlife on a continental scale given the park's intact, relatively undisturbed ecosystems that can sustain a high level of biodiversity. The park is one of the few places in the lower 48 states where natural populations of all indigenous carnivores are still present, including grizzly bears (*Ursus arctos horribilis*), black bears (*Ursus americanus*), mountain lions (*Puma concolor*), Canada lynx (*Lynx canadensis*), gray wolves (*Canis lupus*), and wolverines (*Gulo gulo*). Riparian areas, meadows, and shrub fields provide important winter range for deer (*Cervidae spp.*), elk (*Cervus canadensis*), and moose (*Alces alces*). Grasslands and forest environments provide important spring range for deer, elk, and grizzly bears. Higher elevations provide important summer habitat for bears, bighorn sheep, and mountain goats. Lower elevation valleys in the fall and spring are important habitat for almost all the park's wildlife species. The park provides nesting habitat for numerous raptor species, including bald and golden eagles. Many documented raptor migration routes follow mountain ranges and ridges in the park.

Although all native fish species are still in the park's lakes and streams, species composition and their relative numbers have changed substantially. Natural aquatic systems and associated indigenous fisheries were dramatically altered in the last century by the introduction and invasion of non-native fish, such as lake trout (*Salvelinus namaycush*), eastern brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*). The stocking of non-native sport fish in park waters began in 1912, peaked between 1920-1955, and stopped in 1972. During that time, several species of non-native fish became established in park waters.

Wildlife in the park includes federally (Endangered Species Act [ESA]) and state listed species. Federally listed species are the threatened grizzly bear, Canada lynx, wolverine, bull trout, western glacier stonefly (*Zapada glacier*), and meltwater lednian stonefly (Lednia tumana); federally listed species are discussed below. Species proposed for listing on the ESA include the monarch butterfly (*Danaus Plexippus*) and Suckley's cuckoo bumble bee (*Bombus suckleyi*). State listed species of concern are those species that are rare, endemic, disjunct, vulnerable to extirpation, in need of further research, or likely to become threatened or endangered if limiting factors are not reversed. Likewise, a species may be of concern because of characteristics that make them particularly sensitive to human activities or natural events (MNHP 2024). State listed species of concern in the park include 10 species of mammals, 26 bird species, seven fish species, 24 invertebrate species, and one species of amphibian (MNHP 2024).

Grizzly Bears – Federally listed as threatened

Glacier National Park is part of the Northern Continental Divide Ecosystem (NCDE) Grizzly Bear Recovery Zone. A genetic analysis of hair samples collected from 1998 to 2000 resulted in a population estimate of 241 grizzly bears in the Greater Glacier Area (Kendall et al. 2008). No population estimate has been developed exclusively for the park. Data from the NCDE grizzly bear population trend monitoring project indicates that the ecosystem's grizzly bear population trend is increasing at 2.3% per year (data from 2004-2014; Costello and Roberts 2017).

Grizzly bear habitat is found throughout the park from the valley bottoms to the highest peaks. Grizzly bears require large areas of undeveloped habitat, including a mixture of forests, meadows, grasslands, and riparian habitats, and a substantial amount of solitude from human interactions (USFWS 1993). They have home ranges of 50 to 500 square miles (130 to 1,300 square kilometers) (USFWS 1993). Grizzly bear seasonal movements and habitat use are tied to the availability of different food sources. In spring, grizzly bears feed on dead ungulates and early greening herbaceous vegetation at lower elevations (Martinka 1972). During the summer, some bears move to higher elevations in search of glacier lilies and other roots, berries, and army cutworm moths. Avalanche chutes provide an important source of herbaceous forage for grizzly bears in the early summer and fall (Mace and Waller 1997). During the winter, grizzly bears hibernate in dens, typically at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow. The denning season in the western portion of the NCDE usually begins in early October, and females might linger near dens until late May (Mace and Waller 1997). Grizzly bears in Glacier begin emerging from dens around mid-April (J. Waller, NPS, personal communication).

Glacier was placed into grizzly bear management “situations” in accordance with Interagency Grizzly Bear Committee (IGBC) guidelines (USFS 1987, and as directed by the Grizzly Bear Recovery Plan (USFWS 1993). Over one million acres of the park (recommended wilderness) are established as Management Situation 1, in which management decisions favor the needs of the grizzly bear when grizzly habitat and other land-use values compete, and grizzly-human conflicts are resolved in favor of grizzlies unless a bear is determined to be a nuisance (NPS 2010a/b). The remainder of the park is developed front-country and established as Management Situation 3, where grizzly habitat maintenance and improvement are not the highest management considerations, grizzly bear presence is actively discouraged, and any grizzly involved in a grizzly-human conflict is controlled (NPS 2010a/b).

Grizzly bear/human interaction is a management concern that can threaten bears as well as human safety. Bears that are familiar with humans have the potential to become habituated to human presence, leading to further habituation and increased potential for bear/human encounters. Habituated bears are at greater risk of becoming food conditioned and may aggressively seek human food. Habituated bears are usually relocated or hazed from developed areas, and food conditioned bears are usually removed from the population.

Canada Lynx – Federally listed as threatened

In April 2000, the Canada lynx (lynx) was listed as a threatened species. The 2013 Lynx Conservation Assessment and Strategy identify several human-caused influences that could affect lynx and lynx habitat. These actions include a first “tier” of climate change, vegetation management, wildland fire, and habitat fragmentation, and a second tier that includes incidental trapping, recreation, mineral/energy exploration and development, illegal shooting, forest/backcountry roads and trails, and domestic livestock grazing (USFS 2013a). In Glacier, the primary risk factors are wildland fire, climate change, roads and trails, winter recreational trails, and human developments that degrade and fragment lynx habitat.

Lynx habitat is generally described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Lynx often prefer advanced successional stages of forests for denning and dense conifer stands for foraging. Lynx generally forage in young conifer forests, especially where their primary prey, snowshoe hare, is abundant. Other prey includes squirrels, grouse, martens, and voles. Lynx may also forage in dense, multi-storied mature conifer forests, especially during winter. Travel corridors are thought to be an important factor in lynx habitat because of the species’ large and variable home ranges, generally eight to 738 square kilometers (Ruediger et al. 2000). Den sites have been documented in older regeneration stands and mature coniferous and mixed-coniferous stands with the requisite component of coarse woody debris (i.e., logs, stumps, clumps of timber, or similar tangles of roots and branches) that provide thermal and hiding cover for kittens (Ruediger et al. 2000). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May through August) (Claar et al. 1999).

Historically, lynx were considered “more or less common” in Glacier (Bailey and Bailey 1918). Sightings declined during the 1970s and 1980s and have increased in recent years (NPS files). Lynx designated critical habitat is located throughout much of the park (USFWS 2014a). Preliminary lynx habitat modeling for the park defined moist conifer forest above 4,000 feet elevation as most likely to support lynx. Although no lynx den sites have been documented in the park, lynx family groups have been observed via remote camera stations, and winter tracking efforts have indicated the presence of resident lynx populations in the North Fork, Middle Fork, Many Glacier, and Two Medicine Valleys and elsewhere on the east side of the Continental Divide.

Wolverine – Federally listed as threatened

On January 2, 2024, the wolverine was federally listed as a threatened species. The USFWS concluded that threats to wolverines include habitat loss and fragmentation from decreased snowpack in the late spring resulting from higher temperatures associated with climate change, as well as winter recreation, trapping, logging, and human development (Federal Register 2013 and USFWS 2017).

The wolverine is a rarely seen resident of coniferous forests and alpine meadows, although wolverine sighting and track observations have been documented in the park on both sides of the Continental Divide, with observations occurring throughout the year (NPS files). Wolverines occur in low densities and have large home ranges, making detection difficult. They utilize a range of habitats including alpine areas, mature forests, ecotonal areas, and riparian areas. During winter, wolverines move to lower elevations where they search for carrion in ungulate winter ranges.

Average home ranges documented for wolverines in Glacier are 324 square miles (521 square kilometers) for males and 86 square miles (139 square kilometers) for females (Copeland and Yates 2008). Wolverine population monitoring in the park from 2009 to 2012 modeled a population estimate of 33 individuals (Anderson et al. 2023). The research by Copeland and Yates (2008) and Anderson et al. (2023) suggests that Glacier has very high-quality wolverine habitat due to extensive alpine areas, rugged topography, remoteness, and diverse ungulate populations. The data indicated an increasing population, a result also obtained by Squires et al. (2007).

Wolverines seem to avoid areas of both motorized and non-motorized winter recreation with off-road recreation eliciting a stronger response than road-based recreation; however, female wolverines exhibit stronger avoidance of off-road motorized recreation and experienced higher indirect habitat loss than did male wolverines. This may indicate avoidance of human activity in a more general sense, including fire management activities, mechanical tool use, and helicopter flights. However, for some resident wolverines, over 40% of the home range has been documented within the footprint of winter recreation, suggesting that at some scale wolverines tolerate human activity (Heinemeyer et al. 2019).

Bull Trout – Federally listed as threatened

Once abundant in the Columbia River basin, bull trout have declined in distribution and abundance in recent decades and the USFWS listed the species as threatened in 1998 (USFWS 1999). The two greatest threats to their continued existence are degradation of habitat and competition with and predation by introduced species; however, bull trout populations are also influenced by poor water quality, past fisheries management practices, as well as impoundments and dams (USFWS 2008).

Bull trout appear to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Key habitat characteristics associated with the distribution and abundance of bull trout include cold water temperatures, stream size (i.e., larger tributaries), substrate composition with limited fine sediments, habitat connectivity to support their migratory life history, and complex cover (Rieman and McIntyre 1993). At all life stages, bull trout require complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Watson and Hillman 1997). Juveniles and adults frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). Riparian vegetation, large wood, variable stream channel morphology including deep pools, side-channels, undercut banks and substrates, and in some cases access to downstream environments provides cover and shelter, which supports individual and population growth and allows for normal bull trout behavior (USFS 2013b).

Glacier's waters are an important stronghold for bull trout, since the park contains approximately one-third of the remaining natural (i.e., undammed) lake core habitat areas supporting bull trout in the US (C. Downs, NPS, personal communication). Designated critical habitat for bull trout is present in the park on both sides of the Continental Divide. Bull trout are widely distributed throughout Glacier, although their status and population trends in many park waters are of serious concern (Fredenberg et al. 2007; Downs et al. 2020; Downs et al. 2024). Recent survey work (Fredenberg 2002; Downs et al. 2020) documented significant declines in bull trout abundance in several of the park's largest west-side lakes. This decline has been attributed to an increasing abundance of lake trout in the system (Fredenberg 2002).

Western Glacier and Meltwater Lednian Stoneflies – Federally listed as threatened

The meltwater lednian stonefly and western glacier stonefly live in high-elevation, cold-water streams near permanent snowpacks and in groundwater-fed springs in alpine areas in the park. Both were federally listed as threatened in 2019. Alterations in aquatic habitat, including changes in temperature, water flow, and streambed characteristics, can affect stoneflies in general (MNHP 2023). The primary threat to both meltwater lednian stonefly and western glacier stonefly is habitat fragmentation and degradation (e.g., increasing water temperatures and decreasing stream flows) resulting from a warming climate (Draft IEM Economic Analysis Memo, USFWS, 2016).

The meltwater lednian stonefly is found in extremely cold glacial, snowmelt-fed springs and streams at high elevations, within a few hundred meters of snowfields. The species is only known to occur in the Northern Rocky Mountains with very limited distribution including Banff National Park, Glacier, and collections occurring on nearby USFS and Confederated Salish and Kootenai Tribal lands (Giersch et al. 2017). Research suggests that populations in Glacier may be fragmenting and undergoing range contractions from habitat changes due to climate change (MNHP 2023).

The western glacier stonefly prefers cold water temperatures, and therefore is most often found within the first 2000 feet (about 600 meters) of a stream and immediately downstream from sources of frozen water, such as glaciers and snowfields. It is also found in the outlet areas of glacially/snowmelt-fed high elevation lakes. The species has been documented in Glacier and areas of the Beartooth Mountains in Montana and Grand Teton National Park in Wyoming (MNHP 2023). Viability of the species is closely linked to the persistence of glaciers and snowfields and the continued presence of meltwater habitat.

Monarch Butterfly – Federally Proposed threatened

In December 2024, the USFWS proposed to list the monarch butterfly as a threatened species under the ESA. Monarch butterflies are pollinators that are well known for long-distance migration. Monarch caterpillars eat milkweed (genus *Asclepias*) exclusively, and adult butterflies only lay their eggs on the undersides of milkweed leaves. The USFWS has identified several threats to the monarch butterfly including loss and degradation of breeding, migratory, and overwintering habitat, exposure to insecticides, and the effects of climate change (USFWS 2024a).

There are no confirmed sightings of monarch butterflies in the park; the nearest known observation is from outside the park near Spot Mountain (Two Medicine area) in 2023 (T. Carolin, Crown of the Continent Research Learning Center, personal communication). The species is likely uncommon in Glacier due to the lack of milkweed in the park; only one known milkweed population has been recorded in the Glacier, near the southern border of the park (T. Graves, USGS Wildlife Biologist, personal communication).

Suckley's Cuckoo Bumble Bee – Federally Proposed endangered

In December 2024, the USFWS proposed to list the Suckley's cuckoo bumble bee (*Bombus suckleyi*) as an endangered species under the ESA. The cuckoo bumble bee is a social parasite, which is known to occur among less than 1% of all bee species. Cuckoo bumble bee females take over the nests of host bumble bees, destroying eggs, forcing out larvae, killing the host queen, and laying their own eggs which the host workers will then feed and care for (USFWS 2024b). The bee depends on other host bumble bee species, primarily the

Western bumble bee (*Bombus occidentalis*) and the Nevada bumble bee (*Bombus nevadensis*), which are also in decline. Other major threats to the cuckoo bumble bee include pesticides, habitat fragmentation and conversion, and climate change (USFWS 2024b).

A wide range of native flowering plants throughout the foraging season is a crucial habitat requirement, especially in areas of continuous vegetation cover where nest and overwintering sites can remain undisturbed by land use and development. The species has been documented in a range of habitat types, including prairie, grassland, meadow, and woodland habitats as well as agricultural and urban areas. (USFWS 2024b). Historically, the cuckoo bumble bee was widely distributed in North America, with records from several western and mid-western states as well as Canada. The species was last confirmed in the United States in Oregon in 2016 (MNHP 2024).

Ongoing and planned actions with the potential to affect terrestrial wildlife, including federally and state listed species, include construction and rehabilitation projects, backcountry structure maintenance, utility improvements, administrative helicopter flights, trail and road maintenance, fire management and fuels reduction, wildlife management and research activities, and visitor use management. Planned actions with the potential to affect aquatic wildlife include non-native fish removal, native fish restoration, fire management, and aquatic invasive species (AIS) management.

Climate change is an ongoing environmental trend that is expected to continue to impact terrestrial and aquatic wildlife through alterations in temperature regimes, changes in precipitation patterns and runoff, and longer and more intense drought conditions which can alter habitat conditions. Increased fire activity in the Northern Rockies is expected to continue as the climate warms (Clark-Wolf et al. 2023). Data show temperatures in Glacier have shifted above the historic range of variability (Hegewisch and Abatzoglou 2024) and are predicted to increase 2-4°F between the years 2025 through 2049 (Alder and Hostetler 2024). (See also Trends and Planned Actions for Air Quality, above).

Environmental Consequences

Wildlife, including Aquatic and Federally and State Listed Species

Alternative A – Preferred Alternative

Impacts from wildfire suppression. Activities associated with wildfire suppression could disturb and displace terrestrial wildlife in and near areas where operations are underway. Effects could range from undiscernible physiological responses (e.g., increased heart rate) and no observable physical displacement, to disruptions of behaviors such as foraging, to the observable physical displacement of one or more individuals from the area. The degree of disturbance would depend on the type, scale, and duration of suppression activities. Use of motorized equipment (e.g., chainsaws, water pumps, generators, chippers, etc.), large fire camps, and helicopter landings would have the greatest potential to disturb or displace wildlife. UAS could be in use and have a high frequency (pitch) that can be disruptive to some species of wildlife. The extent and duration of impact would vary depending on species; smaller animals may find undisturbed habitat only a short distance away (e.g., a few feet or meters), while larger animals may need to travel further to achieve a comfortable distance from the source of disturbance. Reproduction could be adversely impacted for some species if suppression operations occur during nesting and denning periods. This could result in a loss of reproductive effort from nest abandonment or nest failure for some species, such as raptors and migratory birds. Known bald and golden eagle nesting locations would be communicated to the Fire Management Office and avoided if possible, to minimize the potential for disturbance during aircraft operations.

The impacts just described for wildlife would generally be similar for the federally listed grizzly bear, Canada lynx, and wolverine. Grizzly bears may be particularly sensitive to helicopter operations, as low-level flights have the potential to displace and/or disrupt normal behavior patterns of grizzly bears present along flight paths. Several studies have documented the behavioral responses of grizzly bears to various types of aircraft disturbance. A summary of the literature by the Interagency Grizzly Bear Committee (USFS 1987) concluded that there is wide variability in the reaction of grizzly bears to aircraft disturbances. Factors which may affect the way in which bears respond to aircraft include the degree of habituation to the activity, availability of escape cover, and the type, noise level, altitude, and movements of the aircraft involved. Impacts of aircraft on bears can include possible displacement, or physiological responses without overt display of being stressed. Bears may be less likely to flee from aircraft while they are feeding. Bears that move away from a disturbance risk expending extra energy and possibly entering an area occupied by another bear. Bears that stay in the area may experience stress (McLellan and Shackleton 1989).

The potential for impacts to wildlife from disturbance and displacement would be temporary, lasting until suppression operations are over. Impacts to wildlife would be mitigated by implementation of measures under MIST, which generally result in less habitat disturbance. Impacts would likely be limited to a single season and occur at the individual level, with no effects to populations. Depending on the conditions of the fire (e.g., location, topography, size, weather conditions, etc.), suppression operations could last weeks or even months. Some suppression efforts could be underway until fall precipitation events extinguish the fire and operations are no longer needed. Some species may be displaced by natural disturbances related to the fire and unrelated to suppression operations. Displaced species would be expected to resume use of the area once operations are over. Except for aircraft obtaining water for aerial water drops (e.g., via aerial bucketing or scooping), wildfire suppression operations would be highly unlikely to occur within or immediately adjacent to park waters because these areas act as natural buffers to wildfire. Any potential for impacts to aquatic habitats and species, including the federally listed bull trout and the western glacier and meltwater lednian stoneflies, would be reduced due to measures under MIST, which require best practices for avoiding or minimizing sedimentation, erosion, and other possible negative effects. The park's Aquatics Program Manager would be consulted for any additional best management practices prior to work that could affect stream channel beds or banks.

Dipping for aerial water drops typically occurs in the middle of large water bodies (i.e., lakes) where there is clearance for the aircraft. Bull trout would not likely be at risk during dipping operations because juveniles are closely associated with cover in streams and unlikely to be on the lake surface during daylight, and adult and sub-adult bull trout would be expected to be deeper than the bucket or scooper. Bull trout prefer cover, darkness, and cold water. Surface water is generally at its warmest while the lakes are stratified and bull trout would be expected to avoid the warmer water by seeking refuge at or below the thermocline. Tanked aircraft would not be expected to introduce non-native fish that could compete with bull trout because aircraft drop water in terrestrial environments. In addition, tanked aircraft and helicopter buckets utilized in Glacier National Park are required to be decontaminated for AIS prior to the first use in any water source unless there is imminent threat to human life or property and when moving between watersheds to minimize transport of species or pathogens from one watershed to another.

If it occurs, the application of chemical fire retardant during wildfire suppression would likely be very infrequent (chemical retardant would typically only be used in an emergency and has only been applied in the park once in the last 17 years, with the last application occurring in 2007). Retardant use is not expected to impact terrestrial wildlife because the amounts and concentrations used would not be high enough to result in toxicity and animals would not ingest enough of the chemical for a toxic response (USFS 2021). The use of retardants and other chemicals in the park would adhere to interagency policy for aerial and ground delivery of wildland fire chemicals near waterways and other avoidance areas (DOI). This includes a 300-foot waterway buffer for all wildland fire chemical use and reporting guidelines for chemical entry into a waterway buffer or body of water. Chemical retardant would not be applied directly to surface water. Chemical applications that inadvertently fall or drift into surface water would have the most potential to harm native fish, including bull trout, if ammonia concentrations reach levels that are lethal to fish. Norris and Web (1989) studied the fate of chemical retardant in five streams and documented rapidly decreased concentrations downstream within a few hours of application. Given the low likelihood of retardant use, and the best management practices and precautions that would be employed, it is highly unlikely that retardants would enter riparian areas or waterways and impact bull trout and other aquatic species.

Impacts from other wildfire response strategies. Where wildfire management strategies do not involve full suppression, the influence of fire on the landscape would benefit wildlife for the long term, since naturally occurring wildfire creates a range of successional vegetational stages and diverse habitat types that in turn support a diversity of wildlife. Fire provides openings in the forest where forbs and grasses grow, providing important foraging habitat for elk and deer. Large predators that prey on ungulates, such as coyotes, wolves, mountain lions, and bears, may benefit from higher prey densities that may occur in response to the presence of early seral-stage forest patches and improved winter and spring range. The opening and maintenance of herbaceous meadows by fire attracts small mammals, which benefits species that prey on small mammals. Bears may benefit from the availability of productive fruit-bearing shrub fields as wildfires create openings in the forest that invigorate huckleberry and other berry production (Martin 1979, Zager 1980). Pollinators, such as the monarch and cuckoo bumble bee, would benefit from the restoration of forbs and flowering plants in these ecosystems after a fire. Wildfire also benefits grizzly bear habitat by stimulating whitebark pine reproduction. The forest mosaic created by wildfire would benefit Canada lynx since a mosaic of forest types appears to distinguish good lynx habitat (Ruggiero et al. 1999) and because snowshoe hares, the primary prey for lynx, tend to be most numerous in early seral-stage forests (Koehler and Brittell 1990). Similarly, prey species for wolverine are expected to respond positively to wildland fire habitat effects. Wildfires benefit raptors and other predatory birds by reducing forest undergrowth, which can increase visibility for foraging. Woodpeckers, particularly black-backed, three-toed, and Lewis' woodpeckers, benefit from wildfire since they primarily forage in recently burned stands and insects are abundant in snags left by fire. Snags also provide important nesting and roosting habitat and forage for migratory birds and bats (McMahon and deCalesta 1990) and provide perch sites for eagles.

Wildlife may be directly injured or killed by wildfire heat or smoke. The degree of adverse impact would depend on the species and the size, severity, and season of the fire. Larger mammals and avian species are usually capable of moving away from a fire, and many ground dwelling species of small mammals may escape fire by going underground. Impacts to wildlife from mortality would be expected primarily at the individual level. When small mammals are killed, the burned areas likely recolonize quickly because of short reproductive cycles (McMahon and deCalesta 1990, Whelan 1995) such as for rodents like mice, which may have litters of 5 to 10 offspring up to 8 to 10 or more times per year. Juveniles or litters could be lost during fires that burn during denning or nesting periods, but reproduction would be expected to resume or recover in the same or following years, depending on the species and time of year. Timeframe for populations to recover could range from the same year to decades and is linked to the availability of food sources after the fire (L. Bate, NPS, personal communication). If a large number of small mammals die during a fire event, localized prey sources for raptors and other predators may be temporarily impacted until the populations recover (Tiedemann et al. 2000). Invertebrates, especially ground dwelling species, could be killed during a wildfire; however, surviving individuals would be expected to repopulate shortly after a fire due to short reproductive cycles and high numbers of offspring. Offspring numbers range in insects from 2 to 750,000 per generation (Jones 2022). Many insects have one generation each year while some beetles and moths need two or three years to complete one generation. Other insects have more than one generation each year (Beers and Warner 1993). Most insect species would be anticipated to begin normal reproduction in the same, or year following a fire.

Wildfire in riparian areas is possible, but not likely to occur. Severe fires may remove virtually all riparian vegetation and groundcover and result in soil erosion, sedimentation, and increased water temperatures in nearby water bodies temporarily impacting aquatic-dependent species such as bull trout and macroinvertebrates. However, fires severe enough to negatively impact these species are unlikely. This is because riparian areas contain high moisture levels and act as natural fire buffers. Moderate- to light-severity fires generally have little influence on riparian vegetation and ground litter removal, and subsequent surface erosion; therefore, would not negatively impact aquatic species such as bull trout. Wildfires are unlikely to burn in high elevation, riparian, glaciated areas where glacier and meltwater lednian stoneflies exist because of unvegetated surfaces, steep slopes, and high moisture content near glaciers and in turn would have no substantial impact on ESA-listed stoneflies.

Impacts from the use of prescribed fire. Prescribed fire could disturb or displace wildlife due to human activity associated with the burning operations and from the fire itself. Disturbance from equipment used during a prescribed fire (including the possible use of aircraft and UAS) would cause impacts that are similar to those described above for wildfire suppression. Impacts would likely be shorter in duration, however, since prescribed burning operations are typically underway for only a few days. Impacts would also be limited to the area of the fire (prescribed burning is currently anticipated on approximately 400 acres of grassland and 150 acres of ponderosa pine in the North Fork District over the next five to 20 years; acres burned per year would vary according to conditions and operational resources). The potential for disturbance or displacement would be temporary, ending once the fire has burned and operations are complete. Adverse impacts from displacement and disturbance would occur at the individual level, with no effects to populations or species distribution. Displaced animals would be expected to resume use of the affected area once the prescribed burning is complete, and/or once burned vegetation recovers within one or two growing seasons.

The potential for impacts to aquatic habitats and species, including the federally listed bull trout and the western glacier and meltwater lednian stoneflies, would be very low (or non-existent) because prescribed fire is a carefully controlled operation that would not likely occur close enough to any water sources to cause effects. If necessary, MIST and best management practices (Appendix B) would be implemented to avoid or minimize sedimentation, erosion, and other possible negative effects. The park's Aquatics Program Manager would be consulted for any additional best management practices prior to a prescribed fire.

Beneficial impacts to wildlife habitat and adverse impacts from the potential for wildlife mortality would generally be as described above for strategies that do not involve suppression, but at a much smaller scale and lesser degree, since prescribed burning is a highly controlled operation and occurs over a relatively small area. Several of the spring seasonal foraging plants that are used by pollinators, like the federally-listed proposed monarch and cuckoo bumble bee, are found within the park. The use of prescribed fire could fragment local insect foraging habitat by removing individual foraging plants within the immediate project treatment area. Nesting habitat may be altered by prescribed burns, but effects would be limited to a relatively small area at a time (anticipated at approximately 400 acres of grassland and 150 acres of ponderosa pine over the next five to 20 years), and habitat adjacent to the burn area would be expected to support the next season's nesting cycle with no changes in overall nesting or reproductive success. Prescribed burning would not occur during the nesting period (generally between June 1 and mid to late July) to avoid impacts to nesting birds. Vegetation would likely be affected in a patchwork, with pollinator foraging plants remaining available within the treatment area; foraging plants would be unaffected outside the treatment area. Effects would be temporary until vegetation recovers within one or two growing seasons.

Impacts from non-fire fuel treatments. Non-fire fuels treatments and mechanical fuels reduction could disturb or displace wildlife due to human activity and noise produced by motorized equipment, such as chainsaws. Impacts would be localized to treatment areas, which would vary in size but are generally anticipated to be approximately 20 acres or less. Disturbance impacts would be most likely during treatments in remote, less developed areas to protect resources such as historic backcountry cabins or lookouts, where wildlife are less accustomed to human presence. Most non-fire fuel treatments happen in or adjacent to developed areas in the park's front country, at the wildland-urban interface. Impacts to wildlife in these areas would be less pronounced since wildlife in these areas are generally more accustomed to human activity. Since these areas are established as Management Situation 3, where grizzly bear use is discouraged, little to no change is expected in the degree to which grizzly bears use treatment areas. The potential for impacts to Canada lynx and wolverine from non-fire fuel treatments in front country areas is low, given the existing human activity. The potential for impacts to wildlife from disturbance or displacement from non-fire fuel treatments would be temporary, ending once the treatments are over. Wildlife would be expected to resume use of a treatment area once the work has concluded, and some species (such as squirrels, insects, and other rodents and some bird species) may continue to use a treatment area during the work. Non-fire fuel treatments would not occur during the nesting season, so would not affect nesting migratory birds. Vegetation removal during treatments could alter nesting habitat for some bird species and foraging habitat for pollinators, but vegetated areas adjacent to the treatment area would likely support the next season's nesting and foraging cycles with no changes in overall nesting or reproductive success.

Non-fire fuels treatments would not impact aquatic species, including bull trout and the federally listed stoneflies, because treatments would not occur in streams, rivers, or riparian areas. The park's Aquatics Program Manager would be consulted prior to work activity that could affect stream channel beds or banks, and best management practices would be implemented to minimize any potential for sedimentation and erosion.

Cumulative Impacts. Past, present, and reasonably foreseeable actions with impacts to wildlife, including federally and state listed species, include construction projects, utility and other infrastructure replacements and repairs, trail and road maintenance, visitor use management, AIS management, and wildlife research projects that involve the handling of wildlife. Construction, maintenance, and research activities have the potential to disturb or displace wildlife, with a higher degree of impact in undeveloped areas where wildlife are less accustomed to human activity. Visitor use management may benefit wildlife for the long term by moderating human activity in sensitive wildlife areas. AIS management benefits aquatic species by protecting park waters against the extremely detrimental effects of non-native aquatic invasive species. When the impacts of Alternative A are combined with those of past, present, and reasonably foreseeable actions, the cumulative impacts to wildlife would continue to be both adverse and beneficial, with little to no change from current cumulative impacts since fire management has been ongoing in the park prior to the proposed updated FMP. Cumulative adverse impacts would continue because of the potential for disturbance or displacement, with impacts from Alternative A and other past, present, and reasonably foreseeable actions that are temporary (ending once a given action is complete) and localized to a given project area. Where wildfires are not fully suppressed, there would be beneficial cumulative impacts, with Alternative A contributing most of the effect because recurring wildfire on the landscape would maintain habitat diversity.

Alternative B – No Action

Adverse impacts to wildlife from wildfire suppression would generally be as described above for Alternative A. Since no action would require full suppression, suppression under Alternative B would likely be more frequent and at a larger scale than under Alternative A, requiring more equipment, personnel, and resources. This would lead to a higher and more widespread potential for disturbance, depending on the frequency, size, and duration of wildfire incidents.

Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for large, high-severity wildfires. Severe wildfires can cause high levels of vegetation mortality, which can result in reduced habitat diversity, and prolonged recovery periods (possibly years). Landscape scale conversion of conifer forests to open or shrub habitat types because of large, high severity wildfires could have long-term and negative impacts on Canada lynx (USFWS 2023). Severe fires can also increase the spread of non-native invasive plants, which can alter wildlife forage, nesting and denning habitats, and security. High-severity fires, that remove all riparian vegetation and groundcover, can cause soil erosion and sedimentation of water bodies and negatively affect important habitats for aquatic-dependent species. Adverse impacts would likely be long term since habitat diversity could take years to recover. Severe fires also present an increased risk of mortality or severe injury to wildlife.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to wildlife, including federally and state listed species, are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to wildlife is primarily adverse, with Alternative B contributing most of the effect. This is because of the potentially widespread adverse impacts that could occur over the long term from large, high-severity wildfires.

Cultural Resources

Affected Environment

People have been drawn to the area now known as Glacier National Park for more than 10,000 years. Many Indian tribes have strong connections with this area. American Indians have identified the landscape and associated resources as important to their identity and continuation of their way of life, creating a rich ethnographic history. Ethnographic resources are defined as sites, structures, objects, landscapes, or natural resource features assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it (NPS 2006 Chapter 5.3.5.3).

The Blackfeet Nation, Confederated Salish and Kootenai Tribes, Chippewa-Cree Indians of the Rocky Boy's Reservation, and the Kiowa Tribe have a long-standing traditional association with Glacier and the surrounding area. The entire park holds oral history and ethnographic significance to area tribes. They have frequented the region for hunting and camping; gathering plants and other resources for food, medicine, and spiritual purposes; and carrying out religious ceremonies. Numerous natural resource features hold significance to area tribes, including lakes, waterfalls, islands, and specific mountains and valleys. In addition, certain rocks and minerals are located throughout the park which continue important roles in traditional culture.

Historically, the Confederated Salish and Kootenai Tribes and the Blackfeet peoples used fire extensively to renew the land. For example, the Kootenai applied cultural burning methods to meadows in the North Fork of the Flathead River valley to renew culturally important vegetation. The Blackfeet also used fire as a tool to renew grazing areas on the east side of the Continental Divide (Thompson 2015) and to attract wildlife for harvest.

A historic property (or historic resource) is defined in the National Historic Preservation Act (NHPA) (54 USC §300308) as any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places, including artifacts, records, and material remains related to such a property or resource." An archaeological site is defined as "a location that contains the physical evidence of past human behavior that allows for its interpretation" (Little et. al. 2000, National Register Bulletin No. 36). The term archaeological site refers to those that are eligible for or are listed on the National Register of Historic Places (NRHP) as well as those that do not qualify for listing on the NRHP. Pre-contact and historic-era (beginning around the 1860s) archeological materials (NRHP listed and unlisted) are found throughout the park. Baseline studies completed in the 1990s reveal a diverse array of human presence through time. Pre-contact archeological sites in the park include camps, quarries, culturally modified trees, trail networks, and animal drive lines. Historic archeological sites include camps, homesteads, mining activities, roadways, communications, and trash dumps. Materials within the park's archeological sites are equally diverse and include worked stone artifacts (projectile points, maul, quarry locations), hearths, wood, bone, and pictographs from pre-contact sites, and wood, bone, ceramic, metal, leather, and glass from historic-era sites. Site types and material preservation are closely aligned to site formation processes, micro-climates, soil chemistry, and exposure.

Historic buildings and structures in the park reflect administrative needs and management throughout Glacier's history and include backcountry patrol and trails cabins, housing, offices, backcountry and front-country ranger stations, chalets, and maintenance buildings, among others. Often, groups of buildings and structures represent historic districts and/or cultural landscapes. The NRHP defines a historic district as a geographically definable area with buildings, sites, structures, or objects "united by past events or aesthetically by plan or physical development," or separate elements "linked by association or history" (36 CFR §60.3). There are over 40 historic districts in Glacier National Park, including those listed as such in the NRHP and others that have been recommended or are eligible for consideration. The NPS treats eligible structures, districts, and landscapes as if they are NRHP listed properties. Historic districts and landscapes share feature qualities and include homestead sites; remains of timber, mining and energy exploration and development; early park administrative and concessions facilities; and trails and road systems. NRHP status has been granted to numerous buildings and structures throughout the park, of which six are also National Historic Landmarks (NHLs). NHLs are historic properties that represent an outstanding aspect of United States history and culture (NPS 2022a). There are additional properties that the Montana State Historic Preservation Officer (SHPO) and the park have mutually agreed to listing on the NRHP through consensus determinations of eligibility. NHL status represents national heritage themes and holds properties to the most stringent preservation standards in the NPS.

Historic buildings and structures are located parkwide, including within recommended wilderness. The immediate setting of the historic buildings and structures are equally important, as there may be remnant orchard, ornamental plantings, or landscape features associated with the siting of the built environment. Buildings and structures may be constructed out of a variety of materials such as dry stack stonework, masonry, logs, or stick built construction methods. Roofing systems could include wood shingle, rolled asphalt, or membranes.

Ongoing and planned actions relating to cultural resources include historic structure maintenance and preservation; archeological site preservation; non-historic building, utility, and infrastructure maintenance and improvements within historic districts and cultural landscapes; viewshed management along the Going-to-the Sun Road, a National Historic Landmark; and maintenance of historic trails and roads. Blackfeet Nation bison reintroductions are also ongoing, as are several cultural resource inventories, archeological surveys, and research projects, including a proposed inventory of ice patches that are at risk from climate change.

Climate change is an environmental trend that can make cultural resources vulnerable to degradation or loss (Rockman et al. 2016). (See also Trends and Planned Actions for Air Quality, above). Increased temperatures, freeze and thaw cycles, and flood events resulting from a warming climate can directly affect archeological and historic structures. Increased temperatures can affect vegetative cover at archeological sites, potentially increasing risk of erosion at sites, and can dry out structural components of historic structures, increasing risk of degradation. Larger, higher severity wildfires are expected under future climate scenarios (Barbero et al. 2015), which can damage or destroy cultural resources.

Environmental Consequences

Cultural Resources

Alternative A – Preferred Alternative

Impacts from wildfire suppression. Suppression of wildfires would primarily benefit cultural resources because it would minimize the potential for fire to spread and damage or destroy historic buildings and other cultural sites. Suppression would also benefit cultural resources through the implementation of structure protection measures. Complete fireproofing of historic structures and other resources is not possible, but the probability of losing a structure to a wildfire would be reduced substantially through methods such as wrapping structures with fire resistant materials, use of water sprinklers, and the creation of defensible space (e.g., fireline or fuel break construction).

Suppression activities that result in ground disturbance, such as fireline or fuel break construction, could adversely impact archeological materials and ethnographic resources associated with archeological sites through disturbance or destruction, especially if locations are not previously surveyed and the presence of subsurface materials has not been documented. Impacts from ground disturbing activities or work in areas with recorded archeological resources would be minimized or avoided altogether by archeological monitoring during suppression and recording resources if present. Removal of trees and other vegetation during suppression could negatively impact historic structures and districts and cultural landscapes and by altering historic viewsheds. Since suppression measures would preserve character defining structural elements (e.g., buildings), changes to viewsheds would not likely change the NRHP eligibility of affected properties. Removing vegetation during suppression activities could also adversely impact ethnographic sites that are tied to vegetation characteristics, such as plants harvested for traditional purposes. Impacts to traditionally harvested plants would likely be too localized to affect traditional harvest overall, affected areas would be restored, and many plant species would be expected to recover within one or two seasons after the fire. Noise from equipment used during suppression operations (e.g., machinery and chainsaws) and visibility of equipment, wrapped structures, and fire camps, etc. could also adversely impact the soundscapes and visual qualities of cultural sites. These types of impacts would be temporary, with no lasting changes to soundscapes or historic viewsheds, since they would end once fire management operations are over and personnel and equipment have left the area. See also “Natural Soundscapes” section of this document below for more discussion on soundscapes.

If it occurs, the application of chemical fire retardant during wildfire suppression would likely be very infrequent (chemical retardant has only been applied in the park once in the last 17 years, with the last application occurring in 2007). Any use of retardants and other fire suppression chemicals would adhere to interagency policy for aerial and ground delivery of wildfire chemicals near waterways and other avoidance areas (DOI, 2024). If used for structure protection, a chemical retardant could cause corrosion and staining to historic structures. In the highly unlikely event that a firefighting chemical would be proposed to protect historic structures, the park’s cultural resources staff and/or READ would be consulted to ensure avoidance of sensitive cultural sites, including archeological and ethnographic areas.

Impacts from other wildfire response strategies. Fire would be present on the landscape where wildfire management strategies do not involve full suppression. The likelihood of such strategies causing negative impacts to cultural resources would be very low because protection objectives would remain in effect (as with any wildfire response under the plan), including the protection of historic structures and other cultural resource sites. Wildfires that are not fully suppressed could damage or destroy unknown archeological sites. Direct impacts to unknown archeological resources would vary depending on the severity and duration of the fire. High-severity and longer duration fires can result in deeper heat penetration into soils, with impacts that vary depending on the type, composition, and fragility of surface and subsurface materials (Ryan et al. 2012). Some material may tolerate fire better than others; for example, metal and lithic scatter (rock) would likely withstand a wildfire better than wood or bone fragments. Indirect adverse impacts to archeological resources could occur from post-fire erosion or runoff and other conditions that may expose unknown sites previously obscured by vegetation or duff layers. Access to ethnographic sites could also be limited or restricted during wildfires that are not fully suppressed; impacts to access would be temporary, ending once the fire is over.

Not fully suppressing wildfires would have indirect benefits to cultural resources for the long term because, over time, recurring fire would reduce fuel loads and the potential for high-severity fires outside of normal ranges. As a result, the potential for fire-related impacts to cultural resources that cannot be prevented or mitigated and the overall potential for damage or loss of cultural resources would also decrease. Ethnographic resources would benefit in certain areas where wildfire is not fully suppressed (such as ponderosa pine stands) due to the restoration of historic fire regimes to the human and natural landscape and enhancing the vegetative diversity and vigor of plants considered ethnologically important.

Impacts from use of prescribed fire. Impacts to cultural resources from the use of prescribed fire, including broadcast burns and pile burning, would be beneficial from the reduction of fuel loads in proximity to cultural resource sites and the maintenance of ethnologically important vegetation, such as ponderosa pine stands in the North Fork district and culturally scarred trees. Noise and visibility of equipment associated with prescribed burning operations would have adverse impacts to the soundscapes and visual characteristics of historic districts, cultural landscapes, and ethnographic sites. These types of impacts would be temporary, ending once the burn is over, and localized to the treatment area, which could range in size from one or two acres to 100 or more acres depending on the type of burn, i.e., pile burning or broadcast burns (prescribed burning is currently anticipated on approximately 400 acres of grassland and 150 acres of ponderosa pine in the North Fork District over the next five to 20 years; acres burned per year would vary according to conditions and operational resources).

Impacts from non-fire fuel treatments. Impacts to cultural resources would be beneficial from the reduction of fuel loads in proximity to cultural resource sites. Removal of vegetation could negatively impact historic structures and districts and cultural landscapes and by altering historic viewsheds. Since non-fire fuel treatments would preserve character defining structural elements (e.g., buildings), changes to viewsheds would not likely change the NRHP eligibility of affected properties. Noise and visibility of equipment associated with mechanical fuel reduction would have adverse impacts to the soundscapes and visual characteristics of historic districts, cultural landscapes, and ethnographic sites. These types of impacts would be localized to the project area, which could range in size from an estimated one to 20 acres, possibly more depending on objectives; creating and maintaining buffers along roads, for example, could result in a greater area of impact temporary. Impacts from noise and visibility of equipment would be temporary, ending once the treatment is over.

For all of the actions considered above, an adverse effect to cultural resources under Section 106 of the NHPA would not be expected given project-specific environmental review and compliance, consultation, and best management practices listed in Appendix B.

Cumulative Impacts. Past, present, and reasonably foreseeable actions with impacts to cultural resources include historic structure maintenance and preservation; non-historic building and infrastructure maintenance, construction, and improvements within historic districts and cultural landscapes; viewshed management; trail and road maintenance and rehabilitation; installation of telecommunications infrastructure; utility maintenance; Blackfeet Nation bison reintroductions; and cultural and natural resource inventories, surveys, and research projects. Historic structure maintenance and preservation benefit cultural resources by maintaining historic character and preserving the NRHP eligibility of historic properties. Other infrastructure maintenance and construction projects have the potential for adverse impacts to historic properties from temporary noise and visibility of equipment. Adverse effects under Section 106 of the NHPA are avoided in most cases through consultation and the implementation of best management practices. The Blackfeet Nation's reintroduction of free-ranging bison on tribal land adjacent to the park has the potential to impact archeological sites if, as anticipated, bison range within the park for the long term. Impacts from bison have the potential to be adverse from trampling and soil compaction, but also beneficial to ethnographic resources from the return of the bison to the landscape. Adverse impacts to previously unidentified archeological resources from resource inventories and research are avoided through consultation and best management practices.

When the impacts of Alternative A are combined with those of past, ongoing, and reasonably foreseeable actions, the cumulative impact to cultural resources is both adverse and beneficial. Adverse cumulative impacts would occur from ground disturbance, the removal of vegetation, and temporary project noise and visibility of equipment. Impacts from ground disturbance would be minimized by archeological monitoring and recording resources if present; impacts from vegetation removal would be minimized by restoration. For the long term, cumulative impacts would be beneficial, with Alternative A contributing the greater effect where fire management activities reduce fuel loads that increase the potential for severe wildfires outside of normal ranges that can damage or destroy cultural resources.

Alternative B – No Action

Adverse impacts to cultural resources from wildfire suppression would generally be as described above for Alternative A. Since Alternative B would require full suppression on every wildfire, suppression under Alternative B would be more frequent and at a larger scale than under Alternative A, requiring more equipment, personnel, and resources. This would lead to potentially extensive adverse impacts from disturbance to cultural sites and from noise and visibility of equipment, depending on the frequency, size, and duration of wildfire incidents.

Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for large, high-severity wildfires outside of normal ranges. This would increase the potential for adverse impacts to cultural resources, since defensible spaces could not be maintained, and fuels would not be managed around historic structures or archeological resources. Over time, cultural resources would become more vulnerable to loss or damage from wildfire events.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to cultural resources are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to cultural resources is primarily adverse, with Alternative B contributing most of the effect. This is because of the potentially widespread adverse impacts that could occur over the long term from large, high severity wildfires, and the commensurate increase in risk to cultural sites and resources.

Recommended Wilderness

Affected Environment

In 1973, Glacier completed a wilderness study and environmental impact statement (EIS) to comply with the 1964 Wilderness Act. The Wilderness Study/EIS identified 927,550 acres in Glacier (over 90 percent of the park) for Wilderness designation (NPS 1974) and resulted in a recommendation of the same by the President of the United States to Congress. Congress has not enacted legislation to formally designate Glacier's wilderness. Per policy, the NPS manages recommended wilderness to ensure that wilderness character is preserved and will take no action that would diminish the wilderness eligibility of any area possessing wilderness characteristics until the legislative process of wilderness designation has been completed (NPS Management Policies 2006, Chapter 6.4).

The defining qualities of wilderness derived from the Wilderness Act include untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, and other features of value including scientific, educational, scenic, or historical. Wilderness is managed according to these five different qualities of wilderness character; the following discussion describes the current status of each in Glacier. An initial wilderness character assessment has been conducted (Glacier National Park Recommended Wilderness Building Blocks for Wilderness Stewardship [2022]), data being gathered though the monitoring protocol is ongoing, and a trend in wilderness character has not been determined.

Untrammeled Quality

Untrammeled is defined as an area that is "essentially unhindered and free from the intentional actions of modern human control or manipulation" (NPS Reference Manual 41, pg. 27). Preserving the untrammeled quality hinges on restraint from the intentional manipulation of the biophysical environment. Recommended wilderness in Glacier is a largely untrammeled, unmanipulated landscape. Past actions that manipulated the biophysical environment before an area was designated as wilderness are not considered trammeling actions because the provisions of the 1964 Wilderness Act do not apply to an area prior to designation. Some management of the biophysical environment occurs to protect other park resources and/or preserve the natural condition of wilderness character. Such management actions that have occurred or could occur include but are not limited to controlling the spread of non-native invasive plants, whitebark pine restoration, native fish conservation activities, fire suppression, and bear management.

Undeveloped Quality

Undeveloped is defined as an area "retaining its primeval character and influence, essentially without permanent improvement or modern human occupation" (NPS Reference Manual 41, pg. 33). The majority of Glacier's recommended wilderness is undeveloped, despite the presence of historic, administrative, and scientific structures and installations. Scientific monitoring instruments and project equipment (i.e., remote cameras, tree markers, gill nets, water pumps, generators, drip stations, and data loggers) may be present on the landscape. These types of installations may be present for several years but are in most cases are removed when no longer in use. The park uses non-motorized, traditional hand tools and non-mechanical transport for administrative activities in recommended wilderness whenever feasible, but motorized equipment (i.e., chainsaws, portable generators, motorized trail brushers, etc.) must sometimes be used during trail, backcountry cabin and campsite maintenance. Motorboats are currently used at four lakes in the park's recommended wilderness, including Quartz and Logging Lakes for lake trout suppression (NPS 2014), and Bowman and Kintla Lakes where NPS Park Rangers maintain boats for limited administrative purposes or emergencies. Helicopters may also be used in the park's recommended wilderness when approved to fly materials and equipment to remote project areas, for administrative purposes (i.e., chalet and radio and telecommunications maintenance, etc.), and in emergency search and rescue operations, as needed.

Natural Condition

Natural condition of wilderness is defined as "ecological systems which are substantially free from the effects of modern civilization" (NPS Reference Manual 41, pg. 29). The natural condition of recommended wilderness in Glacier is characterized by native plants and animals, healthy terrestrial and aquatic ecosystems, biodiversity, air and water quality, geologic processes, and other natural processes. Glacier is at the core of the Crown of the Continent Ecosystem, one of the most ecologically intact areas remaining in the temperate regions of the world and is noted for its remarkable number and diversity of plant and animal species.

Solitude or Primitive and Unconfined Recreation

Qualities of solitude or primitive and unconfined recreation are defined as areas that have "outstanding opportunities for solitude or a primitive and unconfined type of recreation" (NPS Reference Manual 41, pg. 36). Glacier's recommended wilderness provides numerous outstanding opportunities for primitive and unconfined recreation including hiking, fishing, and backcountry camping. The park's recommended wilderness also gives visitors the opportunity to experience solitude and self-reliance. This quality of wilderness character depends on remoteness from the sights and sounds of human activity and the ability to recreate freely without constraints, whereby visitors rely upon their own skills.

Other Features of Value

Wilderness areas may also contain "ecological, geological, or other features of scientific, educational, scenic, or historical value" defined as other features of value (NPS Reference Manual 41, pg. 42). These features are those that play an integral role in defining the meaning and value of the area as wilderness. Two of these features, scenery and cultural heritage, are mentioned in the purpose statement in the park's Foundation Document: "The purpose of Glacier National Park, part of the world's first international peace park, is to preserve the scenic glacially carved landscape, wildlife, natural processes, and cultural heritage at the heart of the Crown of the Continent for the benefit, enjoyment, and understanding of the public" (NPS 2016).

Glacier National Park has many integral and iconic viewsheds that visitors travel to the park to see, as well as views that are important to local tribes most of which include recommended wilderness. The NPS Enjoy the View Visual Resource Inventory Database monitors 44 scenic viewpoints within the park such as at foots of major lakes and pullouts along the Going to the Sun Road, and four (4) outside of the park boundary such as Duck Lake Road and Chief Mountain Overlook (NPS ETV Database, Internal Resource). The Glacier National Park Recommended Wilderness Building Blocks for Wilderness Stewardship (2022) document outlines additional viewpoints including Hidden Lake, Avalanche Lake, Iceberg Lake, Chief Mountain, the views from Fifty Mountain, Boulder Pass, Brown Pass, and the Belly River Ranger Station, and any view of a glacier.

The affected environment and environmental consequences of the proposed action on Glacier's cultural and historic features of value is discussed in the "Cultural Resources" section above.

Ongoing and planned actions within the park's recommended wilderness include five-needle pine restoration, administrative helicopter flights, backcountry cabin maintenance, trail maintenance, fire management, invasive plant control, bear management, and certain resource monitoring and research activities (such as those that involve installations or specimen collection). Climate change is an ongoing trend that is expected to continue to impact wilderness character primarily through alterations to the natural condition, including changes in temperature regimes and precipitation patterns, and longer and more intense drought conditions. Wildfires in western US forests are burning more area and at higher severity (Parks and Abatzoglou 2020). Increased fire activity in the Northern Rockies is expected to continue as the climate warms (Clark-Wolf et al. 2023). (See also "Trends and Planned actions for Air Quality", above).

Environmental Consequences

Recommended Wilderness

Alternative A – Preferred Alternative

Impacts from wildfire suppression. Suppression of naturally ignited wildfires would negatively impact the untrammeled quality of wilderness because it would be a direct manipulation of the biophysical environment disrupting the natural influence of wildfire on the landscape. These impacts to the untrammeled quality from suppression activities would be temporary, ceasing when the suppression actions are over, and the affected area is once again influenced primarily by the forces of nature. Fire season generally lasts from July/August until October/November or when natural weather events contribute to diminishing or extinguishing a fire; suppression activities throughout the park would not be anticipated to last longer than four months per year.

Suppression activities would cause adverse impacts to the undeveloped quality of recommended wilderness from the use of motorized equipment and tools and from helicopter and UAS landings, which are prohibited uses under Section 4(c) of the Wilderness Act unless determined to be the minimum activity necessary for the administration of wilderness. Any retardant or water application by aircraft would also be considered aircraft landings. The establishment of temporary fire camps and other infrastructure in recommended wilderness would negatively affect the undeveloped quality because they would be installations, which are also prohibited uses under Section 4(c) unless determined to be the minimum activity necessary for wilderness administration. Impacts to the undeveloped quality would be temporary, ceasing once the suppression activities are over and equipment can be removed from the project area; the timeframe would vary based on need of response for a given wildfire incident.

Suppression activities could also negatively affect scenic features of value due to the visual presence of fire management camps, equipment, and personnel. These types of impacts would be temporary, ending once a fire is either suppressed or naturally extinguished by rain or snow, and when fire management operations are over, and personnel and equipment are no longer onsite.

Wildfire suppression would negatively impact the natural quality because equipment noise, especially from aircraft operations, could disturb or displace wildlife, and activities such as fireline and fuel break construction, burn outs, backfiring, and creation and use of staging areas and camps would result in ground disturbance and the removal of trees and other vegetation. See also "Natural Soundscapes" section of this document below for more discussion on soundscapes. Adverse impacts to the natural condition would be short term because impacts from noise would end once the suppression activities are complete and disturbed areas would be restored and expected to recover within one or two seasons. Suppression of wildfires would benefit the natural condition of wilderness character by minimizing the potential for fire damage to vegetation and wildlife habitat.

Noise and human activity during suppression actions could disturb recreationists, potentially affecting opportunities for solitude, and area closures could limit access and affect opportunities for unconfined recreation; impacts would be temporary, ending once operations conclude and any closures are lifted. Impacts would be highly localized to the treatment area, leaving the vast majority of park's 927,550 acres of recommended wilderness unaffected. Wildfire suppression would benefit historic features of value that may be at risk from fire, such as backcountry cabins.

All suppression activities would follow MIST guidelines and other best management practices (Appendix B) to minimize impacts to wilderness resources.

Impacts from other wildfire response strategies. Where wildfire is not suppressed, the natural influence of fire would be present without (or with limited) human interference or manipulation, and this would preserve the untrammeled quality of recommended wilderness. The presence of fire on the landscape would also benefit the natural condition of wilderness character through the ecological benefits of fire, including nutrient cycling and more diverse and fire-resilient vegetation communities. Aerial operations, for reconnaissance and monitoring may be necessary during a wildfire event; aircraft could include helicopters, fixed-wing, or UAS. The presence of aircraft would impact the natural and undeveloped quality, and the opportunity for solitude and primitive recreation. Impacts from aircraft operation such as sound and visual presence would be temporary, lasting for a season or less, until the fire is naturally extinguished by rain or snowfall.

Depending on the size and location of the fire, alternative strategies could adversely affect opportunities for unconfined recreation if large areas are closed to public access for prolonged periods; impacts would be temporary, lasting for a season or less, until the fire is naturally extinguished by rain or snowfall.

In areas where wildfire management strategies do not fully suppress a fire, there could be long-term or permanent changes to both distant and immediate scenic features of value from the visual presence of a burned landscape, the loss of trees and other vegetation, and the eventual regeneration of a burn. These impacts would be a result of natural events, contributing to the dynamic visual quality of the park's natural condition and demonstrate the ecological processes of wildfire over time. Scenic impacts would be temporary as the burn scar naturally regenerates.

Impacts from use of prescribed fire. Equipment, such as chainsaws, used during prescribed burning would cause impacts to wilderness character that are similar to those described above for wildfire suppression, including from the possible use of aircraft and UAS. Impacts would likely be shorter in duration since prescribed burning operations are typically underway for only a few days. Impacts would also be limited to a relatively small area, ranging in size from one or two acres to 100 or more acres depending on the type of burn, i.e., pile burning or broadcast burns (prescribed burning is currently anticipated on approximately 400 acres of grassland and 150 acres of ponderosa pine in the North Fork District over the next five to 20 years; acres burned per year would vary according to conditions and operational resources).

Prescribed fire would negatively impact the untrammeled quality of wilderness because it would be an intentional manipulation of the biophysical environment. Prescribed fire would also have some adverse impacts to the natural quality from disturbance to vegetation and wildlife; adverse impacts would be temporary since they would end once the action is complete and because vegetation would likely recover within one or two growing seasons. Prescribed fire would be primarily beneficial to the natural quality by maintaining native vegetation communities and wildlife habitat, such as grasslands and ponderosa pine stands. Prescribed fire at a larger scale could also reduce the potential for high-severity fires, thereby reducing the need for other trammeling and the negative impacts to natural and undeveloped qualities associated with more severe fire and suppression activities.

Prescribed fire could negatively impact opportunities for solitude and unconfined recreation due to operational noise and if area closures are needed; impacts would be temporary, ending once the operation is complete. Operational noise for any individual prescribed fire typically lasts one to two days, while monitoring staff may be present on-site for weeks. Prescribed fire could benefit certain historical features of value for the long term, such as ponderosa pine stands that contain culturally marked trees. Prescribed fire treatments are generally underway for only a few days, so impacts would be of relatively short duration. While the disturbance would be noticeable for recreationists seeking solitude at or near a treatment site, impacts would be highly localized to the treatment area, leaving the vast majority of park's 927,550 acres of recommended wilderness unaffected. Adverse impacts to wilderness character would be temporary, ending once the treatments are complete.

Impacts from non-fire fuel treatments. Non-fire fuels treatments may occur in wilderness areas surrounding backcountry structures such as patrol cabins and fire lookouts. If non-fire fuels treatments are used in recommended wilderness, it would negatively impact the untrammeled quality because the removal of vegetation would be an intentional manipulation of the biophysical environment. The natural condition would also be adversely impacted by vegetation removal and noise during mechanical fuels reduction (e.g., from chainsaws or brushers) that would disrupt natural soundscapes and potentially disturb wildlife (see also analysis of impacts to Natural Soundscapes, below). The use of motorized tools and equipment would also negatively impact the undeveloped quality, and noise could disrupt opportunities for solitude. The noise would not represent a change in the overall level and type of noise that already occurs in the park's recommended wilderness (e.g., it would be similar to what occurs during trails maintenance). Non-fire fuel treatments are generally underway for only a few days, so impacts would be of relatively short duration. The use of motorized tools is minimized to the extent possible in areas managed as wilderness, depending on conditions and treatment goals and if the activity is determined to be the least impactful method. The use of motorized tools during non-fire fuels treatments in recommended wilderness would be limited as much as feasible. While the disturbance would be noticeable for recreationists seeking solitude at or near a treatment site, impacts would be highly localized to the treatment area, leaving the vast majority of park's 927,550 acres of recommended wilderness unaffected. Adverse impacts to wilderness character would be temporary, ending once the treatments are complete.

Non-fire fuel treatments would have beneficial impacts to historic features of value because they would establish defensible space around cultural resource assets, such as historic buildings, and protect them against damage or loss from a wildfire.

Because fire management actions would affect wilderness character and include uses prohibited under Section 4(c) of the Wilderness Act (motorized equipment, installations, and helicopter landings), an MRA is required by NPS policy. The MRA is being developed concurrently with the NEPA analysis and will be supplemental to the decision document.

Cumulative Impacts. Past, present, and reasonably foreseeable future actions with impacts to wilderness character include trail maintenance, historic building maintenance, radio repeater installations, non-native invasive species control (including plants and fish), native species restoration, administrative helicopter landings, administrative use of motorboats (at four lakes), bear management, and research and resource monitoring projects that involve the installation of equipment. These actions have temporary adverse impacts to the undeveloped quality of wilderness character through the use of motorized equipment, installations, and administrative helicopter landings and motorboat use; the natural quality through increased potential for disturbance to wildlife and the removal or disturbance of vegetation; the untrammeled quality by the removal of non-native invasive species and the restoration of native species (which are intentional manipulations of the biophysical environment); and opportunities for solitude and unconfined recreation from noise and area closures (e.g., for bear management). Non-native invasive species control, native species restoration, and monitoring and research also benefit the natural quality by protecting native species and promoting a better understanding of natural and cultural resource conservation needs. Historic building maintenance benefits historical features of value by preserving culturally valuable assets.

When the impacts of Alternative A are combined with those of past, present, and reasonably foreseeable future actions, the cumulative impact to recommended wilderness is both adverse and beneficial. Wildfire suppression, the use of prescribed fire, non-fire fuel treatments, the use of motorized tools and equipment, and helicopter landings under Alternative A would contribute to the overall cumulative adverse impact on the untrammeled and undeveloped qualities, as well as opportunities for solitude and primitive and unconfined recreation. The increase would not substantially change the type, amount, and degree of cumulative adverse impacts already occurring. Wildfire suppression would contribute the greatest amount of adverse impact, especially for large fires that require a prolonged suppression effort. Cumulative beneficial impacts to the natural condition would increase under Alternative A where prescribed burns are implemented and in areas where wildfires are not fully suppressed. Cumulative beneficial impacts to historic features of value would also increase under Alternative A from minimizing the risk of fire to cultural assets.

Alternative B – No Action

Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for, high-severity wildfires outside of historic ranges. Severe fires would adversely impact the natural condition of wilderness character from potentially high levels of vegetation mortality, loss of or extreme changes to wildlife habitat, and increases in the potential for non-native invasive vegetation to become established. Depending on the severity, location, and duration of a fire, impacts could be long term and widespread. Areas may regenerate in a permanently altered state of species composition following unusually high severity wildfires.

Large, high-severity wildfires can require closures to public access over extensive areas for prolonged periods, which would adversely impact opportunities for solitude and unconfined recreation. Impacts would end once the fire is naturally extinguished by rain or snowfall but could occur repeatedly if severe fires become more common. Increased fuel loads would put historic features of value, such as historic cabins, at increased risk of damage or destruction from severe fire.

Adverse impacts to wilderness character from wildfire suppression would generally be as described above for Alternative A. With increased fuel loads, however, suppression could be more frequent, at a larger scale, require more equipment, personnel, and resources than for small to moderate fires, and could be underway for longer periods of time. This would increase the potential for adverse impacts to the undeveloped quality and opportunities for solitude from motorized equipment and noise, the natural condition from trampling, compaction, disturbance, and longer regeneration times, and recreational opportunities from area closures.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to recommended wilderness are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to wilderness character is primarily adverse, with Alternative B contributing the majority of the effect. This is because of the potentially widespread and long-term adverse impacts to wilderness character that could occur from large, high-severity wildfires. Suppression for all fires under Alternative B would increase the cumulative impacts to the natural and undeveloped qualities because of more frequent, large scale suppression actions that may require more motorized equipment on the landscape for prolonged periods. Cumulative impacts under Alternative B would include an increased risk to historical features of value since fuel treatments that establish defensible space would not be implemented.

Natural Soundscapes

Affected Environment

An important part of the NPS mission is to preserve the acoustic resources and natural soundscapes of national parks and units (NPS Management Policies 2006 4.9 and Director's Order 47). Natural soundscapes are the sounds of nature. Acoustic resources and natural sounds have intrinsic value as part of Glacier's unique environment, and they predominate throughout most of the park. Glacier's natural soundscapes are characterized by quiet and stillness as well as low decibel background sound, such as birdsong and the sound of wind, rain, and water. Natural soundscapes vary across the park, depending on elevation, proximity to water, vegetative cover, topography, time of year, weather, and other influences.

Anthropogenic noise affects natural soundscapes by masking biologically important sounds and, thus, degrading habitat, and can cause behavioral and physiological changes among wildlife (Shannon et al. 2015, Zeller et al. 2024). Noise can also interfere with visitors' experience and sense of solitude (Benfield et al. 2018, Ferguson et al. 2024). The effects of noise typically diminish as the distance from the noise source increases (attenuation). Anthropogenic noise in the park varies depending on time of year and location. The park's backcountry is primarily dominated by natural sounds, while elevated noise levels are generally concentrated in visitor service zones near campgrounds, lodges, roads, and developed areas.

The term "natural ambient" refers to natural sound conditions in a given area, measuring only natural sounds and excluding sounds that are mechanical or otherwise caused by humans. "Existing ambient" refers to all sounds that can be heard in a certain area, including those that are natural and those originating from human activity (US DOT 2009). Depending on the degree of development, existing ambient sound in a developed area of the park can include people talking, noise from vehicles and traffic, and maintenance activities, such as grounds keeping (e.g., lawn mowers). Depending on the location, other sources of artificial noise may include motorboats, railroad traffic, and aircraft.

Sound can be reported in terms of decibels (dB), indicating how intense a sound is perceived; higher decibels equate to a more intense sound. A-weighting (dBA) is weighted dB for frequencies the human ear is more or less sensitive to and can be applied to sound levels to account for the sensitivity of the human ear. Common sound levels, both natural and human generated, are listed below in ***Table 3***.

Table 2: Sound level (dBA) of common sound sources.

Common Sound Sources	Sound Level (dBA)
Whispering; leaves rustling	20
Crickets at five meters, or a residential area at night	40
Conversation at five meters, or a busy restaurant	60
Cruiser motorcycle at 15 meters, or curbside of busy street	80
Jackhammer at two meters, or thunder	100
Train horn at one meter, or a military jet at 100 meters above ground level	120

In areas of the park managed as wilderness and away from human development, median natural ambient sound levels generally range from approximately 19 to 34 decibels and median existing ambient sound levels generally range between approximately 20 to 34 decibels (US DOT 2009). The acoustic environments in these areas managed as wilderness are characterized almost exclusively by natural sounds but interrupted at times by hiking parties, aircraft traffic, or park administrative activities, such as trail and wilderness campground maintenance, and by noise from NPS administrative flights or search and rescue flights. In visitor service or developed areas, the sound environment includes both natural sounds and sounds from human activity, with median natural ambient sound levels generally ranging between approximately 23 and 30 decibels and median existing ambient sound levels generally ranging between approximately 27 to 42 decibels (Austraw et al. 2019).

Ongoing and planned actions with the potential to affect natural soundscapes in the park include vehicle traffic, construction and rehabilitation projects, backcountry structure maintenance, utility improvements, trail, campground, and road maintenance, fire management and fuels reduction, and NPS administrative flights. With recent completion of Glacier National Park's Final Air Tour Management Plan and consistent with the park's 1999 General Management Plan, commercial air tours in the park will be phased out through attrition or until December 31, 2029, when all operating authority for the park will be terminated, whichever occurs first (NPS 2022c). Until that time, existing commercial air tour operators are authorized to provide up to 144 air tours per year on a defined route that follows current on-the-ground road infrastructure at an altitude no lower than 2,600 feet above ground level (AGL).

Environmental Consequences

Natural Soundscapes

Alternative A – Preferred Alternative

Impacts from wildfire suppression. Suppression actions would have adverse impacts to acoustic environments primarily due to noise from machinery. Machinery most likely to be in use for wildfire suppression typically includes chainsaws and other motorized equipment for fireline and fuel break construction and mop up, for example. Heavy equipment would very rarely be used and only by Superintendent approval. Equipment such as mowers or chippers may be used along roadsides to clear vegetation. Generators may also be in use, at fire camps for example, and high-pressure pumps for delivering water in hose lays. In general, when in use, chainsaws (and heavy equipment if used) could be expected to produce noise at approximately 80 dBA, depending on the type and model. High pressure water pumps can produce noise up to 113 dBA. Chippers would likely produce noise at approximately 52 dBA. Generator types and models vary widely; a 1000 to 3000-watt generator produces noise at an estimated 50 to 70 dBA. Larger models would be louder.

Aircraft may also be used during wildfire suppression, including the use of UAS, fixed-wing aircraft during reconnaissance and mapping, and helicopters. Noise from aircraft would vary widely depending on the activity and type of aircraft. Helicopter noise would likely be most audible and disruptive when the helicopter hovers at low elevation during sling-load operations. Figure 5 illustrates how sound levels from different types of helicopters increase when the aircraft hovers at lower distances above ground level. The graph is adopted from the environmental assessment prepared to rebuild the Sperry Chalet (NPS 2018b); while the type of helicopters that could be used during wildfire suppression operations are not known at this time, they could be similar to those shown in Figure 5. Generally, helicopter noise increases with the weight and size of the machine. UAS have lower sound levels than helicopters but have a high frequency (pitch) that can be disruptive to people and some species of wildlife. As with helicopters, noise from UAS varies by flight patterns and different models.

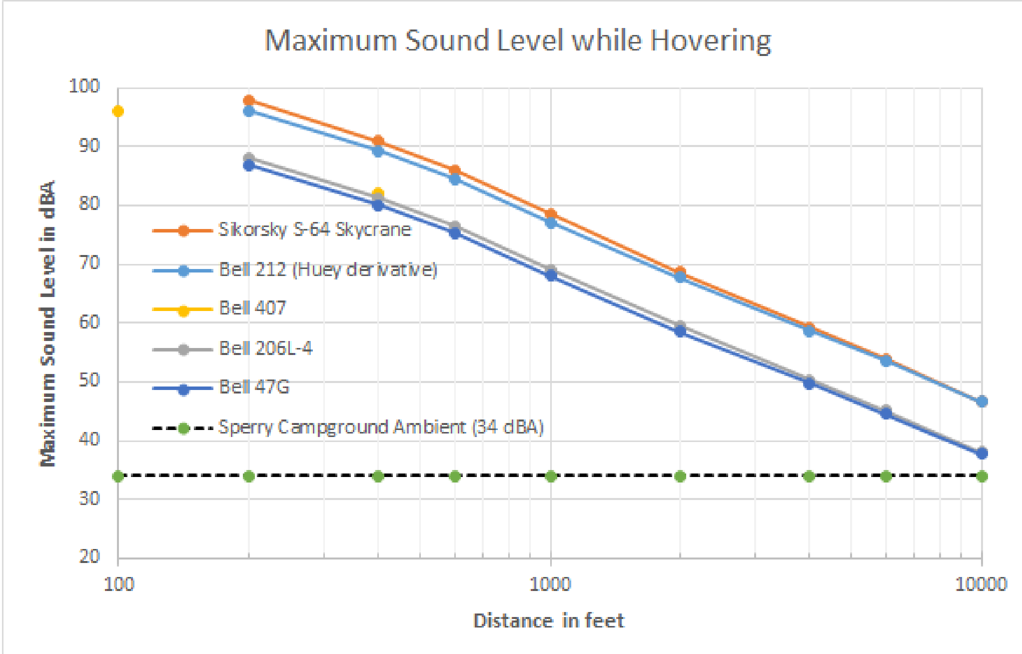

Figure 5: Helicopter noise levels while hovering (from the EA to rebuild the Sperry Chalet [NPS 2018b])

The degree and duration of noise impacts during wildfire suppression would vary, depending on the level, type, location, and duration of the suppression action. Noise from equipment and machinery would be loudest at the source and attenuate, or reduce in amplitude over distance, until it reaches background ambient sound levels and eventually completely attenuates. The noise would still be audible until it attenuates to 8 dB below the ambient level (64 Fed. Reg. 134 1999). In general, noise from chainsaws, mowers, and generators would be expected to attenuate to natural ambient levels (approximately 20 to 35 decibels) between one and five kilometers from the source (based on previous sound modeling by the NPS Natural Sounds and Night Skies Division (NSNSD) for similar types of equipment) (NPS 2021). Noise from the chipper would be expected to attenuate within approximately 750 meters, and noise from the high-pressure water pumps would be expected to attenuate to natural ambient levels within approximately 30 kilometers (NPS NSNSD, personal communication). These estimations are based on attenuation calculation and do not account for location-specific conditions, such as terrain shielding (when terrain blocks noise) or the attenuating effects of vegetation. The estimates also do not account for weather conditions, such as temperature, humidity, and changes in wind direction, which also influence sound. The likelihood of noise from water pumps travelling 30 km in the park would be highly unlikely, given topography, trees and other vegetation, and other environmental factors.

Adverse impacts to natural soundscapes during wildfire suppression could disrupt a sense of solitude and the experience of natural sounds for visitors recreating in the backcountry, especially nearby and along aircraft flight paths. However, areas where active suppression operations are underway are usually temporarily closed to visitor access, and most park visitors would not be in close enough proximity for noise to impede one's ability to experience natural sounds.

Noise would also have the potential to displace animals, cause behavioral and physiological changes, and mask biologically important sounds (sounds that would alert animals to threats or foraging opportunities, for example). Noise would be too localized to interfere with biological processes beyond the action area (or beyond the distance at which the noise would attenuate to below ambient levels), and the acoustic environment in most of the park would remain unaffected. Many noises would also likely be sporadic, occurring only when noise-producing equipment is in use, with intermittent periods that are uninterrupted by operational noise. Impacts from noise during wildfire suppression would be temporary, ceasing once the suppression action is over. Impacts could occur at any time of year between spring and fall, but the duration of impacts would depend on the timing and severity of the fire and the duration of the response.

Impacts from other wildfire response strategies. Where wildfires are not fully suppressed, there would be no impacts to the acoustic environment from anthropogenic noise. Naturally occurring wildfire could alter acoustic conditions within the burn area due to changes to vegetation or wildlife (if bird species are displaced, for example). But most of these types of changes would likely be temporary, expected to recover within the same or following years as a burn area regenerates.

Impacts from use of prescribed fire. Equipment, such as chainsaws, used during prescribed burning would cause impacts to natural acoustic environments that are similar to those described above for wildfire suppression, including from the possible use of aircraft and UAS. Impacts would likely be shorter in duration, however, since prescribed burning operations are typically underway for only a few days. Impacts would also be limited to a relatively small area, anticipated at approximately 400 acres of grassland and 150 acres of ponderosa pine over the next five to 20 years.

Impacts from non-fire fuel treatments. Non-fire fuel treatments and mechanical fuels reduction in both front country and wilderness areas may involve the use of chainsaws and other power tools, which would have impacts to natural soundscapes that are similar to those described above for wildfire suppression. The use of motorized tools would be minimized to the extent possible in areas managed as wilderness, depending on conditions and treatment goals and if the activity is determined to be the least impactful method. Mechanical fuel reductions are generally underway for only a few days, so impacts would be of relatively short duration. Impacts would also be localized to the treatment area, which would vary in size but is generally anticipated to be approximately 20 acres or less. The distance over which noise would be audible during non-fire treatments would vary, depending on the environmental conditions of the site. Impacts would be temporary, ending once the treatment is over.

Cumulative Impacts. Past, present, and reasonably foreseeable future actions with impacts to the acoustic environment include construction projects, utility and other infrastructure replacements and repairs, trail and road maintenance, historic building maintenance, administrative overflights, and administrative and concessioner use of motorboats. These activities produce artificial noise that disrupts the acoustic environment and natural soundscapes to varying degrees, with impacts that are more notable in quiet areas and areas managed as wilderness. Noise from actions in developed areas is often not an observable change from existing conditions, since noise from vehicles, maintenance, and other activities is already present and these noises mask each other. Noise from past, present, and reasonably foreseeable actions is usually temporary, ending once a given action is over. When the impacts of Alternative A are combined with those of past, present, and reasonably foreseeable future actions, the cumulative adverse impact to the acoustic environment and natural soundscapes from artificial noise would continue, with impacts that are temporary (ending once a given action is complete) and localized to a given project area. There would be little to no change from current cumulative impacts since fire management has been ongoing in the park prior to the proposed updated FMP.

Alternative B – No Action

Adverse impacts to the acoustic environment from wildfire suppression would generally be as described above for Alternative A. Since Alternative B would only authorize suppression of wildfires (this alternative would not authorize prescribed fire, non-fire fuel treatments, or alternatives to full suppression), the potential for higher fuel loading in the park would increase over time, which would increase the potential for large, high-severity wildfires outside of normal ranges. Suppression under Alternative B would likely be more frequent and at a larger scale than under Alternative A, potentially requiring more frequent use of noise-producing equipment and aircraft, and for longer periods of time. This would lead to an increased and more widespread potential for impacts to the acoustic environment and natural soundscapes, depending on the frequency, size, location, and duration of wildfire incidents.

Cumulative Impacts. Past, present, and reasonably foreseeable actions and associated impacts to natural soundscapes are as described above for Alternative A. When the impacts of Alternative B are combined with those of past, present, and reasonably foreseeable actions, the cumulative impact to natural soundscapes would be adverse, with Alternative B potentially contributing greater effects over time. This is because of the potentially widespread adverse impacts that could occur for the long term from large, high-severity wildfires.

Chapter 4 - Consultation and Coordination

List of Agencies and Persons Consulted

The following agencies and organizations were contacted and invited to participate in the planning process. Affiliated tribes were also invited to participate in the planning process and are listed below under National Historic Preservation Act and Tribal Consultation.

US Fish and Wildlife Service
Montana State Historic Preservation Office
Blackfeet Nation
Confederated Salish and Kootenai Tribes
Chippewa Cree Tribe
Kiowa

National Historic Preservation Act and Tribal Consultation

National Historic Preservation Act Section 106 compliance consultation is currently being conducted with the Montana SHPO and federally recognized tribes in accordance with 36 CFR Section 800.8(a)(1). As required by Section 106 of the National Historic Preservation Act (NHPA), the park consulted with four federally recognized tribes (Blackfeet Nation, Confederated Salish Kootenai [CSKT], Chippewa Cree, and Kiowa Tribes) during scoping. For this FMP EA, informal consultation with Tribes was initiated on February 27th, 2024. The park met in person with the CSKT on March 21st, 2024 and followed up with a phone call to the Blackfeet Nation on March 26th, 2024. No comments were received at the time. The EA will be sent to the tribes and SHPO and project specific consultation will occur as needed.

Endangered Species Act

USFWS was notified of the proposed plan during the public scoping period on February 27th, 2024. NPS is preparing a biological assessment (BA) for the proposed plan in accordance with 16 U.S.C 1531-1544 and as part of formal consultation under the ESA (NPS 2023), which will be submitted to the USFWS with this EA.

EA Preparers and Contributors

Name/Title	Contribution
Amy Secrest, Branch Manager, Environmental Planning and Compliance, Glacier National Park	Prepared, reviewed and edited EA sections, coordinated EA schedule, agency consultation, and public review.
Jeremy Harker, Fire Management Office, Glacier National Park	Developed FMP, provided technical support on EA.
Rebecca Smith, IMR Northern Zone Fire Planner	Developed FMP, provided technical support on EA.
Jessica Nymark, Environmental Protection Specialist, Glacier National Park	Drafted and edited EA sections, coordinated public review.
Mark Biel, Natural Resources Program Manager, Glacier National Park	Provided technical support on wildlife.
Sierra Mandelko, Cultural Resources Specialist, Glacier National Park	Provided technical support on cultural resources.
Dawn LaFleur, Restoration Biologist, Glacier National Park	Provided technical support on vegetation, soils, and wetlands.
John Waller, Wildlife Biologist, Glacier National Park	Provided technical support on wildlife.
Lisa Bate, Wildlife Biologist, Glacier National Park	Provided technical support on wildlife.
Chris Downs, Aquatic and Physical Science Programs Manager, Glacier National Park	Provided technical support on water and aquatic resources.
Jon McCubbins, Fisheries Biologist, Glacier National Park	Provided technical support on water and aquatic resources.
Ed Eberhardy, Physical Science Technician, Glacier National Park	Provided technical support on air quality.

Appendices

Appendix A – References

Alder, J. R. and S. W. Hostetler, 2024. USGS National Climate Change Viewer. US Geological Survey https://doi.org/10.5066/F7W9575T. Accessed 05 Dec 2024

Anderson, Alissa K., J.S. Waller, and D. H. Thornton. 2023. Canada lynx occupancy and density in Glacier National Park. *Journal of Wildlife Management*, 2023;e22283. https://doi.org/10/1002/jwmg.22383.

Arno, S.F. and R.J. Hoff. 1989. Silvics of whitebark pine (*Pinus albicaulis*). U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. *General Technical Report INT253*. January 1989. 11 pp.

Arno, S.F. and T. Weaver. 1990. Whitebark pine community types and their patterns on the landscape. Proceedings – Symposium on Whitebark Pine Ecosystems: Ecology and management of a high mountain resource, March 29-31, 1989, Bozeman, MT. *USDA Forest Service General Technical Report INT-270*. 118-130 pp.

Austraw, A., C. Brooks, N. Lynch, and A. Sevinsky. 2019. Glacier National Park 2019 Ambient Sound Study. Worcester Polytechnic Institute Submission.

Auxilio Management Services for Fire and Aviation Management and National Technology and Development Program; US Forest Service. July 2023. Ecological risk assessment of wildland fire-fighting chemicals: long-term fire retardants.

Bailey, V. and F.M. Bailey. 1918. Wild animals of Glacier National Park: The mammals. USDI, National Park Service, Washington, DC.

Barbero, Renaud & Abatzoglou, John & Larkin, Narasimhan & Kolden, C & Stocks, B. (2015). Climate change presents increased potential for very large fires in the contiguous United States. International Journal of Wildland Fire. 24. 10.1071/WF15083.

Barrett, Stephen W. 1993. Fire history of Tenderfoot Creek Experimental Forest, Lewis and Clark National Forest. Final Report INT-92679-RJVA. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Fire Sciences Laboratory. 23 p.

Beers, E. and G. Warner. 1993. Insect Growth and Development. Washington State University. Tree Fruit: Comprehensive Tree Fruit Site. Accessed 03 Jan 2025 from https://treefruit.wsu.edu/crop-protection/opm/insect-growth-and-development/#:~:text=Many%20insects%20have%20one%20generation,a%20constant%20number%20of%20generations.

Benfield J, Taff BD, Weinzimmer D and Newman P. 2018. Motorized Recreation Sounds Influence Nature Scene Evaluations: The Role of Attitude Moderators. Front. Psychol. 9:495 doi: 10.3389/fpsyg.2018.00495

Claar, J.J., N. Anderson, D. Boyd, M. Cherry, B. Conard, R. Hompesch, S. Miller, G. Olson, H. Ihsle Pac, J. Waller, T. Wittinger, H. Youmans. 1999. Carnivores. Pages 7.1-7.63 In: Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of the Wildlife Society. 307 pp

Clark-Wolf, K., P.E. Higuera, B.N. Shuman, K.K. McLauchlan. 2023. Wildfire activity in northern Rocky Mountain subalpine forests still within millennial-scale range of variability. *Environmental Research Letters*, Volume 18, Issue 9, id.094029, 11 pp.

Copeland, J.P. and R.E. Yates. 2008. Wolverine Population assessment in Glacier National Park, Comprehensive Summary Update (preliminary results). 15 pp.

Costello, C.M., and L.L. Roberts. 2017. Northern Continental Divide Ecosystem Grizzly Bear Monitoring Team Annual Report, 2016. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901. Unpublished data.

Department of the Interior (DOI). 2024. Interagency Standards for Fire and Fire Aviation Operations. Interagency Standards for Fire and Fire Aviation Operations Group, National Interagency Fire Center, Boise, ID.

Downs, C.C., J.L. McCubbins, and E.R. Eberhardy. 2020. Glacier National Park Fisheries and Aquatic Invasive Species Programs 2018-2019 Annual Report. GLAC Division of Science & Resource Management. West Glacier Montana.

Downs, C.C., J.L. McCubbins, and E.R. Eberhardy. 2024. Glacier National Park Fisheries and Aquatic Invasive Species Programs 2021-2023 Report. GLAC Division of Science & Resource Management. West Glacier Montana.

Environmental Protection Agency (EPA). 2009. Air Quality Index (AQI) Basics. Accessed 05 Dec 2024 from https://www.airnow.gov/aqi/aqi-basics/

Ferguson, L.A., B.D. Taff, J.I. Blanford, D.J. Mennitt, A.J. Mowen, M. Levenhagen, C. White, C.A. Monz, C.D. Francis, J.R.. Barber, and P. Newman. 2024. Understanding Park visitors' soundscape perception using subjective and objective measurement. PeerJ 12:e16592 https://doi.org/10.7717/peerj.16592

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology and population status of migratory Bull Trout (Salvelinus confluentus) in the Flathead Lake and river system, Montana. Northwest Science. 63(No. 4):133-143

Fredenberg W.A. 2002. Further evidence that lake trout displace bull trout in mountain lakes. Intermountain Journal of Sciences 8, 143–151

Fredenberg, W., M. Meeuwig, and C. Guy. 2007. Action plan to conserve bull trout in Glacier National Park. U.S. Fish and Wildlife Service, Creston, Montana.

Giersch, J. J., S. Hotaling, R. R. Kovach, L. A. Jones, and C. C. Muhlfeld. 2017. Climate-induced glacier and snow loss imperils alpine stream insects. *Global Change Biology*, 23, 2577–2589.

Glacier National Park Conservancy (GNPC) 2019. Unraveling the mystery of golden eagle nests. Accessed 05 Dec 2024 from https://glacier.org/newsblog/unraveling-the-mystery-of-golden-eagle-nests/

Gonzalez, P. 2020. Human-caused climate change in United States national parks and solutions for the future. Parks Stewardship Forum, 36(2). http://dx.doi.org/10.5070/P536248262 Retrieved from https://escholarship.org/uc/item/9443s1kq

Greater Yellowstone Coordinating Committee: Whitebark Pine Subcommittee. 2011. Whitebark Pine Strategy for the Greater Yellowstone Area. 41 p. Accessed 02 Jan 2025 from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.fedgycc.org/_files/ugd/a0f00b_a5e0ef096eba4cbbbb1f18c61250b648.pdf

Habeck, J.R. 1970. "The Vegetation of Glacier National Park." Prepared for the National Park Service. On file at Glacier National Park. Accessed on 06 Dec 2024 from https://irma.nps.gov/DataStore/Reference/Profile/338090

Hegewisch, K. C. and J. T. Abatzoglou. 'Historical Climate Tracker' web tool. Climate Toolbox (https://climatetoolbox.org/) accessed on 06 Dec 2024.

Heinemeyer, K., J. Squires, M. Hebblewhite, J. J. O'Keefe, J. D. Holbrook, and J. Copeland. 2019. Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation. Ecosphere 10(2):e02611. 10.1002/ecs2. 2611

Jenkins, Melissa B., Schuette, A.W., Wright, J.W., Anderson, K.A., Fortier, J., Hoang, L., Incasola, T., Keane, R., Krakowski, J., LaFleur, D.M., Mellmann-Brown, S. Meyer, E.D., Pete, S., Renwickey, K., Sissons, R.A. 2022. Restoring a forest keystone species: A plan for the restoration of whitebark pine (Pinus albicaulis Engelm.) in the Crown of the Continent Ecosystem. Forest Ecology and Management Vol. 522.

Jewett, J. T. 2009. Spatiotemporal relationships between climate and whitebark pine mortality in the Greater Yellowstone Ecosystem. Thesis, Montana State University, Bozeman. 77 p.

Jones, R. 2022. "Do any insects give birth to live young?" BBC Wildlife: Discover Wildlife. 2024. Accessed 03 Jan 2025 from https://www.discoverwildlife.com/animal-facts/insects-invertebrates/do-any-insects-give-birth-to-live-young

Keane, Robert E.; Loehman, R A.; Holsinger, L M. 2011. The FireBGCv2 landscape fire and succession model: a research simulation platform for exploring fire and vegetation dynamics. Gen. Tech. Rep. RMRS-GTR-255. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 137 p.

Kendall, K. C. and S.A. Arno. 1990. Whitebark pine -- An important but endangered wildlife resource. Proc. Whitebark Pine Symposium. USDA Forest Service Gen.Tech. Rep. INT-270. Pg. 264-273.

Kendall, K.C., J.B. Stetz, D.A. Roon, L.P. Waits, J.B. Boulanger, and D. Paetkau. 2008. Grizzly Bear Density in Glacier National Park, Montana. *Journal of Wildlife Management*. 72(8): pg. 1693-1705.

Koehler, G.M. and J.D. Brittell. 1990. Managing spruce-fir habitat for lynx and snowshoe hares. Journal of Forestry. 88(10): 10-14.

Labat Environmental for US Forest Service Fire and Aviation Management. 2013. Ecological risk assessment of wildland fire-fighting chemicals: long-term fire retardants. Boise, ID.

Lesica, P. Flora of Glacier National Park. Oregon State University Press, January 2002.

Little, B., E.M. Seibert, J. Townsend, J.H. Sprinkle, Jr., and J. Knoerl. 2000. US Department of the Interior, National Park Service. National Register, History and Education. National Register Bulletin No. 36. *Guidelines for Evaluating and Registering Archeological Properties*.

Mace, R. and J. Waller. 1997. Spatial and Temporal Interaction of Male and Female Grizzly Bears in Northwestern Montana. *Journal of Wildlife Management*, 61:39-52.

Martin, Patricia A. E. 1979. Productivity and taxonomy of the Vaccinium globulare, V. membranaceum complex in western Montana. Missoula, MT: University of Montana. 136 p. Thesis

Martinka, C. 1972. Habitat relationships of grizzly bears in Glacier National Park. Progress report. On file at Glacier National Park. West Glacier, Montana.

McLellan, B.N. and D.M. Shackleton. 1989. Immediate reactions of grizzly bears to human activities. Wildl. Soc. Bull. 17:269-274.

McMahon, T.E., and D.S. deCalesta. 1990. Effects of fire on fish and Wildlife. Pgs. 233-250; In: Walstad, J.D., S.R. Radosevich, D.V. Sandberg, eds. Natural and Prescribed Fire in Pacific Northwest Forests. Corvallis, OR. Oregon State University Press. 317 pp

Montana Natural Heritage Program (MNHP). 2023. Western Glacier Stonefly – Montana Field Guide. Accessed 11 December 2024 from https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IIPLE0U060.

Montana Natural Heritage Program (MNHP). 2024. Environmental summary export for latitude 48.58669 to 48.76827 and longitude -113.38684 to -113.77874. Accessed on 5 May 2024.

National Park Service (NPS), US Dept. of the Interior. 1974. Environmental Statement, Wilderness Recommendation, Glacier National Park, West Glacier, Montana.

____. 1999. Final General Management Plan and Environmental Impact Statement, Volumes I and II. Glacier National Park: A portion of Waterton-Glacier International Peace Park, Flathead and Glacier Counties, Montana. Glacier National Park, West Glacier, MT. 340 pp

____. 2003. Fire Monitoring Handbook. Boise (ID): Fire Management Program Center, National Interagency Fire Center. 274p.

____. 2006. Management Policies 2006. Department of the Interior; National Park Service, Lakewood, Colorado.

____. 2010a. Glacier National Park Bear Management Plan. Glacier National Park, West Glacier, Montana.

____. 2010b. Glacier National Park Bear Management Guidelines. Glacier National Park, West Glacier, Montana.

____. 2014. Continued Lake Trout Suppression on Quartz Lake & Lake Trout Removal and Bull Trout Conservation in the Logging Lake Drainage Environmental Assessment. Glacier National Park, West Glacier, Montana.

____. 2016. Foundation Document Glacier National Park. October 2016. Glacier National Park, West Glacier, Montana.

____. 2018a. Glacier National Park aquatic invasive species action plan 2018. Glacier National Park, West Glacier, Montana.

____. 2018b. Glacier National Park Rebuild Sperry Chalet for the next 100 years Environmental Assessment 2018. Glacier National Park, West Glacier, Montana.

____. 2021. Natural Sounds and Night Skies Division. Department of the Interior. Lakewood, Colorado. Accessed 05 Dec 2024 from https://www.nps.gov/orgs/1050/index.htm

____.2022a. National Historic Landmarks. National Park Service. Accessed 11 December 2024 from https://home.nps.gov/subjects/nationalhistoriclandmarks/index.htm

____. 2022b. Air Quality Conditions and Trends. National Park Service. Accessed 06 Dec 2024 from https://www.nps.gov/subjects/air/park-conditions-trends.htm

____. 2022c. Final Air Tour Management Plan. Glacier National Park, West Glacier, Montana.

____. 2023. Administrative flights (May 2023 – October 2027), Programmatic biological assessment. Glacier National Park. Glacier National Park, West Glacier, Montana.

____. 2024. Sustainability. National Park Service. Accessed 06 Dec 2024 from https://www.nps.gov/glac/getinvolved/sustainability.htm

Nature Conservancy. 2018. Putting bison back on the prairie in North and South Dakota. Accessed 05 Dec 2024 from https://www.nature.org/en-us/about-us/where-we-work/united-states/north-dakota/stories-in-north-dakota/putting-bison-back-on-the-prairie/

Norris, L.A. and W.L. Webb. 1989. Effects of fire retardant on water quality. In: Berg, Neil H. tech. coord. *Proceedings of the Symposium on Fire and Watershed Management*: October 26-28, 1988, Sacramento, California. Gen. Tech. Rep. PSW-109. Berkeley, Calif.: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 79-86.

Parks, S. A., and J.T. Abatzoglou. 2020. Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985 to 2017. Geophysical Research Letters, 47, e2020GL089858. https://doi. org/10.1029/2020GL089858

Pederson, G. T., Gray, S. T., Ault, T., Marsh, W., Fagre, D. B., Bunn, A. G., Woodhouse, C. A., & Graumlich, L. J. 2011. Climatic controls on the snowmelt hydrology of the northern Rocky Mountains. Journal of Climate, 24(6), 1666-1687. https://doi.org/10.1175/2010JCLI3729.1

Peterson, K.T. 1999. Whitebark pine (*Pinus albicaulis*) decline and restoration in Glacier National Park. Thesis. University of North Dakota, Grand Forks.

Rieman, B. E., and J. D. McIntyre. 1993. Demographic and habitat requirements of bull trout Salvelinus confiuentus. U.S. Forest Service General Technical Report INT-302

Rockman, M., Morgan, M., Ziaja, S., Hambrecht, G., and Meadow, A. 2016. Cultural Resources Climate Change Strategy. Washington, DC: Cultural Resources, Partnerships, and Science and Climate Change Response Program, National Park Service.

Ruediger, B., Claar, J., Gniadek, S., Hol,t B., Lewis, L., Mighton, S., Naney, B., Patton, G., Rinaldi, T., Trick, J.,Vandehey, A., Wahl, F., Warren, N., Wenger, D., and Williamson, A. 2000. Canada lynx conservation assessment and strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT

Ruggiero, L.F., K. B. Aubry, S.W. Buskrik, G.M Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires. 1999. Ecology and Conservation of Lynx in the United States. US Forest Service, General Technical Repot; Rocky Mountain Research Station. Accessed 06 Jan 2025 from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.fs.usda.gov/rm/pubs/rmrs_gtr030.pdf

Ryan, Kevin C., J.A. Trinkle, C.L. Koerner. K.M. Lee, tech. eds. 2012. Wildland fire in ecosystems: effects of fire on cultural resources and archaeology. Gen. Tech. Rep. RMRS-GTR-42-vol. 3. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 224 p

Sexauer, H.M., and P.W. James. 1997. A comparison of the microhabitat use by juvenile bull trout in four stream located in the eastern Cascades, Washington. Pages 361-370 in W.C. Mackay, M.K. Brewin, and M. Monita, editors. *Trout Unlimited Canada*, Bull Trout Task Force, Calgary, Alberta.

Shannon G., M.F. McKenna, L.M. Angeloni, K.R. Crooks, K.M. Fristrup, E. Brown, K.A. Warner, M.D. Nelson, C, White, J. Briggs, S. McFarland, and G. Wittemyer. 2015. A synthesis of two decades of research documenting the effects of noise on wildlife. Biol Rev Camb Philos Soc. 2016 Nov;91(4):982-1005. doi: 10.1111/brv.12207. Epub 2015 Jun 26. PMID: 26118691.

Squires, J. R., M. K. Schwartz, J. P. Copeland, L. F. Ruggiero, and T. J. Ulizio. 2007. Sources and patterns of wolverine mortality in western Montana. Journal of Wildlife Management 71:2213–2220.

Stephens, Scott L., J.J. Moghaddas, C. Edminster, C.E. Fiedler, S. Hasse, M. Harrington, J.E. Keeley, E.E. Knapp, J.D. McIver, K. Metlen, C.N. Skinner, A. Youngblood. 2009. Fire treatment effects on vegetation structure, fuels, and potential fire severity in western US Forests. Ecological Consequences of Fire Fuel Reduction Methods. 19:2; 305-320.

Thompson S. 2015. Flathead Headwaters Ethnographic Resources Review and Assessment. Unpublished Report prepared for Glacier National Park.

Tiedemann, A.R., J.O. Klemmedson, E.L. Bull. 2000. Solution of forest health problems with prescribed fire: are forest productivity and wildlife at risk? Forest Ecology and Management 127:1-18.

Tomback, D.F., Arno, S.F., and R.E. Keane. 2001. The compelling case for management intervention. In Tomback, D.F., S.F. Arno, and R.E. Keane (eds.). Whitebark Pine Communities: Ecology and Restoration. *Island Press*. Washington, D.C. 440 pp.

US Department of Transportation (US DOT). 2009. Baseline ambient sound levels in Glacier National Park. U.S. Department of Transportation, Research and Innovative Technology Administration, John A. Volpe National Transportation Systems Center, Environmental Measurement and Modeling Division, RTV-4F Acoustics Facility, Cambridge, MA. 213 pages.

US Forest Service (USFS). 1986. Interagency Grizzly Bear Management Guidelines. Missoula, Montana.

____. 2013a. Canada lynx conservation assessment and strategy. 3rd edition. Interagency Lynx Biology Team. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp.

____. 2013b. Conservation Strategy for Bull Trout on USFS Lands in Western Montana. USDA Forest Service, Northern Region and USFWS, Montana Field Office. PDF.

US Fish and Wildlife Service (USFWS). 1993. Grizzly Bear Recovery Plan. Missoula, Montana.

____. 1999. *Federal Register*, *Vol. 64, No. 210*. Monday, November 1, 1999.

____. 2008. Bull Trout Recovery: Monitoring and Evaluation Guidance. Report prepared for the U.S. Fish and Wildlife Service by the Bull Trout Recovery and Monitoring Technical Group (RMEG). Portland, Oregon. Version 1 - 74 pp.

____. 2014a. *Federal Register*, *Vol. 79, No. 177*. Friday, September 12, 2014.

____. 2014b. Species Assessment and Listing Priority Assignment Form (Whitebark Pine). US Fish and Wildlife Service, Region 6.

____. 2017. DRAFT Species Status Assessment for the North American Wolverine (*Gulo gulo luscus*). USFWS, Washington, D.C., USA.

____. 2023. Species Status Assessment Addendum for the Canada lynx (Lynx canadensis) Contiguous United States Distinct Population Segment. December 2023. Denver, Colorado. 122 pp

___. 2024a. *Monarch (Danaus plexippus)*. Accessed 19 Dec 2024 from https://www.fws.gov/species/monarch-danaus-plexippus

___. 2024b. S*ervice Proposes to List Suckley's Cuckoo Bumble Bee as Endangered, Seeks Public Comment.* Press Release. Accessed 19 Dec 2024 from https://www.fws.gov/press-release/2024-12/monarch-butterfly-proposed-endangered-species-act-protection

Watson, G., & Hillman, T. 1997. Factors Affecting the Distribution and Abundance of Bull Trout: An Investigation at Hierarchical Scales. *North American Journal of Fisheries Management, 17*, 237-252.

Whelan, R.J. 1995. The Ecology of Fire. Cambridge University Press, Cambridge, United Kingdom. 346 pp.

Yu, AC, Reinhart, M., Hunter, R., Lu, K., Maikawa, C.L., Rajakaruna, N., Acosta, J.D., Stubler, C., Appel, C., Appel, E.A. Seasonal Impact of Phosphate-Based Fire Retardants on Soil Chemistry Following the Prophylactic Treatment of Vegetation. *Environmental Science Technology.* 2021 Feb 16;55(4):2316-2323. doi: 10.1021/acs.est.0c05472. Epub 2021 Feb 2. PMID: 33529000.

Zager, P.E. 1980. The influence of logging and wildfire on grizzly bear habitat in northwestern Montana. Dissertation.

Zeller, K.A., M.A. Ditmer, J.R. Squires, W.L. Rice, J. Wilder, D. DeLong, A. Egan, N. Pennington, C.A. Wang, J. Plucinski, and J.R. Barber. 2024, Current Biology 34, 2997–3004 July 8, 2024 Published by Elsevier Inc. https://doi.org/10.1016/j.cub.2024.05.030

Appendix B – Best Management Practices

Parkwide Management Requirements

- Minimum Impact Strategies and Tactics (MIST) would be used for all fire management actions. MIST can be found in Exhibit 1 of RM-18 Chapter 2 and by following the link above. MIST directs that fire management activities be conducted to cause the least impact to park resources and least alteration of the landscape while safeguarding human lives and accomplishing objectives.
    - As part of the park's initial response procedures, notifications would be made to the Chief of Science and Resource Management and the Environmental Compliance Program Manager to identify appropriate emergency environmental protection measures, assign Resource Advisors (READs), and notify consultation parties, including Tribes, Montana SHPO and the US Fish and Wildlife Service for necessary consultation.
- Park resource specialists would be involved during prescribed burn and non-fire fuel treatment planning to ensure that treatments do not conflict with objectives for resource protection.
- No vehicle use off road (including bulldozers, ATV'S, UTV's, heavy equipment) unless approved in writing by the Superintendent.
- Application of chemical fire retardants or foams would require written approval by the park Superintendent except to mitigate imminent risk to human life and property.
- Water would be used in lieu of fire retardant whenever possible; if retardant must be used, a 300 feet buffer around all water bodies would be employed. Other avoidance zones would be identified as necessary in consultation with resource advisors.
- Use best management practices for prevention of invasive species spread (aquatic and terrestrial) as described in the Interagency Standards for Fire and Fire Aviation Operations (Red Book), Chapter 11.
- Strengthen fuel reduction treatments as needed and implement structure protection plans (where available) around potentially threatened developed areas, historic sites, and values of concern.
- Locations for camps, staging areas, helispots, etc. would be identified in consultation with a READ and/or the park's ID team to avoid or minimize impacts to vegetation, wildlife, wilderness character, water resources, and cultural resources.
- Use a READ on wildfires whenever necessary and possible in coordination with the Incident Commander and/or park FMO and Chief of Science and Resources Management. For Incident Management Teams (IMT), identifying the need for a READ would be included in the Superintendent's delegation of authority.
- The following BMPs would be in place during fuels treatments (prescribed fire and mechanical):
    - All fuels management projects and subsequent site-specific treatment prescriptions would be monitored by the Glacier Fire Management office.
    - Resource sensitivity, including aesthetics, would be considered in all treatment prescriptions and plans.

- The borders of treatment areas would be feathered in an irregular pattern and with increasing fuel density (with distance from the value to be protected) to improve the visual quality of the treatment.
- During the treatment, clumps of trees would be left for aesthetic purposes, depending upon their potential to contribute to adverse fire behavior. Irregular spacing of trees that are left would be encouraged to maintain a random appearance.
- Some standing dead, diseased, or insect-infested trees, when not a safety hazard, would be left for wildlife habitat snags.
- Tree limbs would be pruned to reduce ladder fuels from the ground to the forest canopy. Pruning would occur at variable heights to prevent an unnatural appearance to the forest.
- Ground disturbance would be minimized during fuel reduction treatments. Burn piles, dragging of material, and the use of wheeled or tracked equipment are mechanisms of ground disturbance that would be monitored and mitigated.
- All stumps from thinned trees would be cut as close to ground level as possible. Stump grinding (grinding the stump to ground level to remove it without excavation) could be an option in developed areas.
- Efforts would be made to leave an appropriate species composition that reflects the natural succession of the forest.
- Disturbance to employees and the public would be minimized as much as possible during fuel treatments.
- The Minimum Requirement Analysis process would be applied to fuel treatments proposed within recommended wilderness.
- An air curtain burner would be used to burn slash from non-fire fuel treatments if practical and feasible and consistent with resource management objectives.
- Glacier would obtain necessary burn and/or air quality permits from the State of Montana prior to implementation of any prescribed burning. All prescribed fire plans would include appropriate consideration of smoke production, duration, and impacts.

In addition to parkwide requirements listed above, the following resource specific BMPs would be in place:

Vegetation

- Before initiating prescribed burning or fuel reduction projects, non-native invasive plant species that are present or likely to invade the disturbed areas would be identified and documented. The burn or fuel reduction project scope would include post-project monitoring and a treatment plan as needed.
- Areas of disturbance would be rehabilitated and restored as necessary through consultation with the park's Vegetation Management Specialist.
    - Only seeds and plants originating from the park or from approved sources would be used in restoration activities.

    - Excavated vegetated layer and topsoil would be conserved for replacement of soil layers in the stratigraphic horizons from which they were excavated, i.e., topsoil would be placed at the top layer.
    - Disturbed areas would be monitored and treated as necessary for non-native invasive plants.
- Erosion-control devices on steep slopes would be used and bare soil would be covered to prevent soil movement and promote rapid revegetation of a site following suppression actions.
- The on-site dispersal of wood chips from chipping fuels would occur in consultation with the park's ID team.
- All equipment and materials would be cleaned and inspected prior to entering the park to prevent the spread of non-native invasive plants. Pre-determined areas may be avoided entirely during fuels treatments.
- Access routes to treatment sites would be selected to minimize vegetation trampling and soil compaction.
- Prescribed burn and non-fire fuel treatment areas would be surveyed for rare plants prior to treatment in consultation with the park's Vegetation Management Specialist. If found, rare plants would be marked and avoided as feasible or salvaged.
- If found in fuels treatment areas (prescribed burns and mechanical treatments), whitebark pine would be marked and avoided.
    - Fire management personnel would be trained in the identification of whitebark pine.
- All whitebark pine PLUS trees and restoration sites would be considered for protection during wildfire incidents. The park's Vegetation Management Specialist would be consulted for protection measures and any work that may impact mature, naturally regenerating, and restored whitebark pine and to provide a map of these locations.
- Removal of trees in fuels treatment areas would follow a project specific plan in consultation with the park's ID Team and Vegetation Management Specialist.
- For all wildland fires and prescribed fires, natural barriers (i.e., rock outcroppings, surface water, open meadows, barren areas, ice, etc.) and/or human-made features (roads, trails, rights-of-way, etc.) would be considered in identifying control lines or general management boundaries. A resource advisor from the park would assist in cases where sensitive vegetation habitat exists or is suspected.

Water Quality

- Park resource management staff would be consulted on appropriate locations for ignition (i.e., burn outs and backfiring), mixing of fuels, helicopter bucket dipping, and water drafting operations from streams and lakes.
- Wildfire management activities, including temporary fire facilities (e.g., camps) should be excluded within a minimum of 300 feet of riparian areas, water bodies, areas of peatlands, fens, and other groundwater dependent ecosystems to avoid disturbing or compacting soil, damaging riparian vegetation, and potential sediment input into streams.
    - When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian dependent resources would be used in consultation

with the park's Vegetation Management Specialist and/or Aquatic Program Manager. Any such impacted riparian areas would be restored to pre-fire conditions.

- Fire lines would be rehabilitated to previous, natural conditions to reduce erosion and sedimentation risks to streams and other waterbodies. Fire lines would be restored to natural slope grade to prevent water-channeling and the creation of new stream channels.
- A spill plan would be developed and followed in case of a fuel or hazardous material leak. The plan would be reviewed by the Glacier's Safety Office.
    - Personnel would inspect engines, fuel lines, and fittings as well as other equipment for leaks prior to beginning project activities each day.
    - Appropriate spill containment supplies would be on site to address a spill on shore and on the water.
    - Petroleum products would be properly stored, to include the use of spill-proof and bear-proof containers.
- Protocols to prevent aquatic invasive species (AIS) would be followed in accordance with Glacier's AIS Action Plan (NPS 2018a).
    - Prior to use in a waterbody or when moving between watersheds, equipment (including boats, rafts, drafting equipment, water tenders, and helicopter buckets) must be inspected and cleaned to reduce the potential for the introduction of AIS. The *Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations* (PMS 444) would be adhered to.
- Sediment control (e.g., silt fences, waddles, etc.) should be installed prior to the initiation of fire management activities along waterbodies where natural vegetation is not sufficient to filter out sediment between the work area and any nearby waterbodies and prevent runoff from reaching waterbodies.

Wetlands

- Wetlands disturbed from wildfire suppression activities would be restored in consultation with the park's Vegetation Management Specialist.
- Prescribed burn and non-fire fuel treatment areas would be surveyed for wetland resources before the treatment begins to identify the presence and extent of wetlands; sensitive wetland resources would be marked and avoided.

Wildlife

- The USFWS would be contacted as soon as reasonably possible in the event of an unplanned wildfire incident where suppression activities may impact federally listed species.
- The park would involve the USFWS in the Burned Area Emergency Rehabilitation (BAER) team to minimize impacts to federally listed species during rehabilitation activities following a wildfire.
- Food and garbage must be securely stored in accordance with park regulations to avoid attracting bears and other wildlife or providing wildlife with food rewards. Bear resistant containers must be used for food and garbage storage.
- Project personnel would be trained on appropriate behavior in the presence of bears and other wildlife.

- Temporary toilets must be installed so that they are secure from wind and bears and other wildlife.
- Prior to prescribed burns or removing trees, shrubs, or other vegetation during non-fire fuel treatments, the park's wildlife program would be consulted regarding the presence of nesting birds and/or roosting bats. A survey for nesting birds and/or bats may be required. If the species are present, vegetation removal would not occur until after they have left or before they arrive and would be scheduled in consultation with the park's wildlife program. (In general, nesting season occurs between June 1 and July 15 on the west side of the park, and June 1 and July 22 on the east side. These dates could change depending on species, location and weather conditions.)
- Sensitive wildlife areas, such as bald and golden eagle and common loon nesting locations, would be avoided if feasible in consultation with a READ to minimize the potential for disturbance, including during aircraft and uncrewed aircraft systems (UAS) operations.
- The following conservation measures as agreed to with the USFWS in Glacier's programmatic BA for administrative flights (NPS 2023) are required for all park administrative flights and would be followed for any non-emergency flights associated with this plan:
    - Flights would follow suggested flight paths away from sensitive areas. Where possible, flight paths would follow road corridors and occur over developed areas. The flight manager would be responsible for coordinating with the park biologist to identify sensitive sites prior to the flight.
    - Flights would occur one hour after sunrise and one hour before sunset from 1 May to 1 October to minimize impacts to grizzly bears. Grizzly bear denning activity peaks during den emergence from 15 March to 15 May and during den construction from 15 October to 15 November. No flights would occur over known dens or potential den habitat during den emergence and den construction. In order to conserve prey species, flights would avoid ungulate winter range from 15 January to 1 May when wintering ungulates are most vulnerable.
    - Restricting flights to the 1 May to 1 October period, or minimizing them outside that period, would eliminate or minimize impacts to sensitive wildlife.
    - The helicopter would fly at a minimum of 2000 feet AGL over the park whenever possible, depending on mountainous topography, weather, and except when it is landing or taking off or when it is delivering supplies via long line.
    - To minimize impacts on denning Canada lynx, no flights would be permitted over known den sites from 1 May to 30 Aug.
    - Flight paths would be designated so as to avoid open alpine meadows, talus slopes, or other areas where grizzly bears congregate but do not have access to cover. If a low-level flight or landing is needed in an alpine area and a bear is seen, the flight would be postponed. If the flight cannot be postponed, the flight would keep a maximum distance from the bear(s).
- Sediment producing actions upstream of known or potential spawning areas are to be avoided during the native fish spawning/rearing period of September 1 through May 15; the park's Aquatic Program Manager would be consulted regarding sensitive locations.

- If water pumps are needed, they must be screened to prevent capture of fish. During the spawning season for native fish, pumping sites should be located away from spawning gravels and known native fish spawning locations.
- Wildland fire management activities would be avoided whenever feasible in the upper-most extent of high-elevation streams that originate from glacial meltwater and could be inhabited by the western glacier stonefly. Sensitive locations would be identified in consultation with the park's Aquatics Program Manager.
- When working in or near stonefly stream habitat (as identified in consultation with the park's Aquatics Program Manager), personnel would use rocky or hardened surfaces as much as possible for walking and equipment staging and avoid walking or working in streamside vegetation. Personnel would work from existing stream crossings whenever feasible and avoid the creation of multiple paths or social trails.

Air Quality

- All fire management activities other than suppression of unwanted wildland fires would follow Montana/Idaho Airshed Group guidelines for best management practices and ensure that particulate concentrations do not exceed standards that may result in reduced air quality or impact visibility and public health.
- Design of prescribed burns would include scheduling prescribed burns during periods and seasons of good ventilation, limiting the amount of burning to be performed during any one time, using ignition and burning techniques that minimize smoke production, and selecting fuel preparation methods that minimize dirt and moisture content to control smoke levels.
- When smoke dispersion forecasts are unfavorable, or smoke impacts cannot be minimized, promote alternative treatments of materials to be burned.

Recommended Wilderness

- The minimum requirements analysis framework would be applied for any planned actions and, whenever feasible, during emergency responses when working in recommended wilderness, using the least impactful methods while still meeting protection and resource objectives.
- Helicopter and fixed-wing operations and the use of UAS would be avoided in recommended wilderness whenever feasible while still meeting protection and resource objectives.
    - Flight paths would avoid wilderness and other sensitive areas as feasible, depending on risk management considerations.
    - Launching and landing aircraft from outside of the recommended wilderness boundary is preferred,
    - To minimize administrative flights over recommended wilderness, the park would make every effort to include routine helicopter flights for fire management within the 50-flight limit on administrative flights. Flights would be considered with other proposed administrative flights, coordinated with other projects, and combined with other hauling needs whenever possible.
- The use of motorized equipment would be minimized and hand tools would be used whenever feasible within recommended wilderness while still meeting protection and resource objectives.
- Installations would be avoided in recommended wilderness whenever feasible while still meeting protection and resource objectives. If necessary:

- Installations would remain in place only for the minimum amount of time needed (i.e., installations would be removed when no longer operationally necessary).
- Installations would be discrete, hidden from public view, and designed to blend with natural surroundings as much as possible.

- Fire management personnel would practice principles of "Leave No Trace" outdoor ethics.

Natural Soundscapes

- Motorized equipment would be selected for the lowest possible noise production while still using equipment that would meet project objectives.
- To reduce noise and pollution emissions, equipment would not idle any longer than is necessary.

Cultural Resources

Measures would be developed in consultation with the park's Cultural Resources Specialist and Tribes to avoid ethnographic features, such as plants harvested for traditional purposes.

- To ensure that the NPS avoids adversely affecting the integrity of ethnographic resources during fire management program activities, the following laws and policies would be complied with:
  - Executive Order 13007 on American Indian Sacred Sites, NPS Management Policies, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 8000, and Presidential Memorandum of April 29, 1994, on Government-to-Government Relations with Tribal Governments.
- If known cultural resources are threatened by an unplanned wildfire and associated suppression strategies, a cultural resource specialist or advisor would be consulted to identify strategies to minimize impacts.
- Staples (or other means) used for affixing fire-resistant wrapping to historic structures would be completely removed when no longer needed.
- The use of chemical fire retardants would be prohibited in the vicinity of historic structures unless there is imminent threat from wildfire to the structure.
- Tribal officials would be contacted well in advance of planned fire management projects to determine if traditional use areas are included in the planning area.
- Fuels management projects (prescribed fire and non-fire fuels treatments) would include cultural resource monitoring as needed in consultation with the park's Cultural Resources Specialist.
- If cultural material is found during ground disturbing activities, ground disturbance would stop immediately, and the park's Cultural Resources Specialist notified. If archeological resources are identified, work would not resume until resources are recorded.
- Wildland fire or fire management activities that pose a potential threat to cultural resources may require specific on-site protection strategies and monitoring. A qualified cultural resource specialist would provide guidance on implementing the following BMPs as conditions warrant.
  - Locate, identify, and isolate sites that are vulnerable to fire effects or fire management activities.
  - Conduct cultural resource surveys as needed in consultation with the park's Cultural Resources Specialist in areas where prescribed fire and/or non-fire fuels treatments are proposed.

- Remove fuel concentrations from close proximity to known cultural sites.
    - Educate fire personnel about the need to protect cultural resources.
    - Minimize ground disturbance wherever possible.
    - Conduct post-fire cultural resource surveys to identify, evaluate, and document impacts.

Visitor Use and Experience

- Public engagement, education, and interpretation of wildland fire management in the park would continue.
- The public would be informed of any closures or restrictions by means of media releases and postings on the park's website, backcountry permit offices, and visitor centers, as applicable. Signs informing visitors of temporary area closures would be posted at trailheads and roads as necessary.

Appendix C – Alternatives and Alternative Elements Considered but Dismissed from Detailed Analysis

Three alternative elements were identified but eliminated from further analysis. The following is a brief description, including reasons for dismissal.

Allow all wildfires to burn without human intervention. To employ this strategy across the park would result in an undesirable potential for risk to human life, property, and park resources. Because this alternative element would result in too great of an environmental impact, it has been dismissed.

Omit the use of prescribed fire in the park. This alternative would require management to only utilize manual, mechanical fuel reduction and restrict the flexibility of using prescribed fire as a tool to manage fuel buildup and protect values. To remove this critical tool would not be consistent with objectives stated in the Purpose and Need of this EA (Chapter 1) to: manage wildland fuels associated with resources and assets to reduce risk of unwanted fire effects (Goal 2); use fuels treatments to simulate the desired effects of wildfires (Goal 3); and use current science to guide an adaptive and innovative fire management program (Goal 4). Fuels management goals and objectives (Chapter 2 of the EA) include restoring fire to the landscape where opportunities are limited for wildfire to meet resource objectives and maintaining, restoring, and promoting fire resilience in diverse habitats and cultural landscapes. Therefore, this alternative was dismissed because it is not consistent with the purpose and need of the plan.

Thin lodgepole pine that has regenerated after previous burns. Lodgepole pine, and other fuels, would be managed in accordance with plan goals and objectives. Thinning lodgepole pine would be done as needed to meet protection objectives and would depend on proximity and risks to park infrastructure, resources, and values. Widespread thinning of regenerated lodgepole pine stands throughout multiple previously burned acres in the park would not be technically or economically feasible, and is not compatible with goals and objectives listed in the Purpose and Need of the EA (Chapter 1), specifically the identification and prioritization of values at risk to inform protection and mitigation strategies (Goal 2), minimizing negative impacts to values caused by fire management activities (Goal 2), and management of wildfires to allow natural processes to function unimpaired by human activity where successful risk mitigation is probable (Goal 3). Thinning vast areas of lodgepole pine would adversely impact vegetation and wildlife habitat, natural soundscapes (depending on equipment used), and wilderness character, including the untrammeled quality, natural condition, undeveloped quality if motorized equipment is used, and opportunities for solitude. Therefore, this suggested element has been dismissed because it does not meet the purpose and need of the plan, is not technically or economically feasible, and would result in too great an environmental impact.

Appendix D – Issues and Impact Topics Dismissed from Detailed Analysis

The following impact topics have not been analyzed in detail because the issues associated with these resources are not pivotal or central to the proposal, a detailed analysis of impacts to these resources is not necessary to make a reasoned choice between alternatives, these topics are not contentious among the public or other agencies, and/or there would be no potentially significant impacts to these resources.

Water Quality

The Clean Water Act requires the NPS to "comply with all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution" (33 U.S. Code 1251 et seq., Section 313). Glacier National Park contains many water resources, including lakes, rivers, streams, and ephemeral drainages.

Water quality could be negatively impacted by runoff during wildfire management operations or following a wildfire due to loss of ground cover, since runoff can carry sediment into nearby waterways or water bodies. The potential for erosion and sedimentation during wildfire management would be minimized by MIST and best management practices developed to protect water resources (Appendix B), including sediment control, avoiding sensitive riparian areas, and restoration. These measures would also result in little to no impacts to water resources from prescribed fires.

Aviation resources are used to assist in the suppression of wildfires and may dip or scoop water from approved water bodies. Equipment entering waterbodies has the potential to spread aquatic invasive species (AIS) if contaminated; however, tanked aircraft and helicopter buckets would be required to be decontaminated for AIS prior to the first use in any water source in the park unless there is imminent threat to human life or property. The park would adhere to the Interagency Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations during all aircraft/water operations. Glacier has provided the local helibase with a hot-water power washer to decontaminate equipment and tanks after every use. With these measures in place, dipping/scooping aircraft would not introduce AIS, cause sedimentation or erosion, or pollute the water.

If it occurs, the application of chemical fire retardant during wildfire suppression would likely be very infrequent (chemical retardant would typically only be used in an emergency and has only been applied in the park once in the last 17 years, with the last application occurring in 2007). A current list of qualified products including gels, foams, and additives and their approved uses can be found on the Wildland Fire Chemical Systems (WFCS) website (https://www.fs.usda.gov/rm/fire/wfcs/). Fire retardants contain ammonium salts which, if entering surface water, can lead to nutrient loading and potential eutrophication (occurs when excess nutrients cause excessive plant or algae growth). Ammonium, phosphate, and nitrate concentrations typically increase for short durations and decrease with aeration and dilution (British Columbia Wildfire Service 2023). Norris and Web (1989) studied the fate of chemical retardant in five streams and documented rapidly decreased concentrations downstream within a few hours of application. Runoff events could transport retardant from aerial drops downslope to streams, lakes, or other surface water, or aerial retardant could reach surface water through drift. But the risks to water quality resulting from the potential impacts of a severe wildfire (e.g., runoff and erosion, increasing total suspended solids and turbidity, large quantities of ash, increased water temperature, etc.) would likely be higher than the potential risks posed by the prescribed use of fire retardants. When precautions and guidelines for retardant use are followed correctly there is minimal risk to the environment. Chemical retardant would not be applied directly to surface water. The interagency policy for aerial and ground delivery of wildland fire chemicals near waterways also includes avoiding aerial and terrestrial application of all wildland fire chemicals within 300 feet of waterways (DOI 2024). Given the low likelihood of retardant use and the best management practices and precautions that would be implemented if it is used, it is highly unlikely that retardants would enter surface water.

Non-fire fuel treatment and mechanical fuel reduction would not adversely affect water quality because treatments would not occur in riparian areas and the MIST framework and best management practices would be implemented, including erosion and sediment control, spill control plans, and restoration (Appendix B). The park's Aquatics Program Manager would be consulted prior to activities that could affect water resources to identify site-specific measures to minimize potential impacts.

Management actions proposed under the updated FMP would have beneficial impacts to water quality because prescribed fire, non-fire fuel treatments, and strategies that do not fully suppress wildfire would reduce the potential for high severity fires outside of normal ranges. This would minimize the potential for impacts from such fires, which can damage water resources through hardened soils and increased erosion and widespread loss of riparian vegetation.

With the implementation of protocols under MIST and best management practices described above, the impacts on water resources would be reduced or eliminated. Therefore, water quality has been dismissed from detailed analysis.

Floodplains and Wetlands

Best management practices and MIST protocols that minimize or prevent impacts to water resources and vegetation would also protect wetlands and floodplains. These include avoidance of riparian areas, procedures to prevent AIS transport, sediment and erosion control, spill plans, post-activity restoration, keeping retardant a minimum of 300 feet away from water sources, and consultation with resource specialists for site-specific actions. Wetlands would be avoided during suppression actions whenever possible, and prescribed burns and non-fire fuels treatments would not take place in wetlands. Actions under the updated FMP would not construct structures in floodplains. If suppression activities result in disturbance or degradation to wetlands, impacts would be short-term because disturbed areas would be restored. Because wetlands and floodplains would be avoided and/or best management practices would prevent long-term impacts and preserve essential wetland and floodplain processes and values, impacts to floodplains and wetlands have been dismissed from detailed analysis.

Ground Water

There are no municipal drinking water sources in the park. None of the planned actions in the proposed updated FMP would impact groundwater-fed drinking water or sources. This topic has therefore been dismissed from detailed analysis.

Wild and Scenic Rivers

The three forks of the Flathead River are designated as part of the National Wild and Scenic River (WSR) system. The North Fork of the Flathead River is designated "scenic" from the international boundary downstream to Camas Creek and "recreational" from Camas Creek to the confluence with the Middle Fork. The Middle Fork is designated "recreational" for the entire length bordering Glacier National Park. Congress directed that the U.S. Forest Service be the primary management agency for the Flathead Wild and Scenic River, giving the NPS secondary responsibility.

Wildfire suppression operations, prescribed fire, and non-fire fuel treatments could occur within the WSR corridors for the North Fork and the Middle Fork of the Flathead (the WSR boundaries are, on average, about one-quarter mile from both sides of the riverbanks). Wildfire management activities could negatively affect certain outstandingly remarkable values (ORVs) for the North and Middle Forks, including the recreational and scenic ORVs from operational noise and visibility of fire management equipment, the botany ORV if vegetation within the WSR corridor is disturbed or removed, and the wildlife ORV if wildlife are disturbed or displaced by fire management activities. Wildfire management would benefit historic ORVs of each river by protecting cultural resource values that may be at risk. Prescribed fire would benefit the botany and wildlife ORVs by maintaining native vegetation communities and wildlife habitat, such as grasslands and ponderosa pine stands in the North Fork.

Adverse impacts from noise and visibility of equipment would be temporary, ending once wildfire management activities are complete. Negative impacts to the wildlife ORV would also likely be temporary, as any disturbed or displaced wildlife would be expected to resume use of the corridor once operations are over. Impacts to the botany ORV from the removal of vegetation would be temporary where disturbed areas are restored and vegetation recovers, and longer term if trees are removed (see also analysis of impacts to Vegetation, Chapter 3 of the EA). There would be no changes to the rivers' free-flowing condition or water quality (see dismissal of water quality, above). With the possible exception of using the rivers as a water source during wildfire suppression operations (water for bucket drops, for example), fire management operations (such as fireline construction, establishment of camps, use of vehicles, etc.) would generally not occur within the bed and banks of either river. Since actions under the updated FMP would not impact the WSR designations of the rivers, this topic has been dismissed from detailed analysis.

Viewsheds

Scenery is discussed as another feature of value contributing to wilderness character in "Chapter 3, Recommended Wilderness" above.

Viewsheds in the park could be affected by visible smoke and haze from wildfires and prescribed fires. Suppression activities and non-fire fuel treatments could also negatively affect local viewshed due to the visual presence of fire management camps, equipment, and personnel. These types of impacts would be temporary, ending once a fire is either suppressed or naturally extinguished by rain or snow, and when fire management operations are over and personnel and equipment are no longer onsite. In areas where wildfire management strategies do not fully suppress a fire, there could be long-term or permanent changes to both distant and immediate viewsheds from the visual presence of a burned landscape, the loss of trees and other vegetation, and the eventual regeneration of a burn. These effects would be a result of natural events, contributing to the dynamic visual quality of the park's natural condition. Because long-term changes to viewsheds would be the result of natural events, and since any impacts to viewsheds from wildfire management operations would be temporary, this topic has been dismissed from detailed analysis.

Night Skies

There may be impacts to night skies from the use of lighting at fire camps or spike camps, or during wildfire suppression operations that occur at night. Impacts would be localized to camps and work areas, and would be temporary, ending once wildfire management activities are over. Wildfires produces light, which may lighten dark skies and be visible from a distance, but this would be a natural occurrence. Because any impacts from wildfire management operations would be temporary and would not affect the vast majority of dark skies in the park, this topic has been dismissed from further analysis.

Visitor Use and Experience

Noise and visible operational activity during wildfire management could disturb visitors, and area closures could restrict access. These impacts would be temporary, ending once wildfire management activities conclude and operations are over or a closed area is re-opened. Impacts would be localized to suppression or treatment areas and would not affect visitors' overall ability to use and experience other areas of the park. Wildfire management would have an overall long-term benefit to visitor use and experience by protecting park values, resources, and infrastructure that visitors seek to experience at Glacier. For these reasons, this topic has been dismissed from detailed analysis.

Human Health and Safety

For all fire management activities, risk management to employees and the public is given the highest priority (see Goal 1 under Goals and Objectives in Chapter 1, Purpose and Need of the EA). The FMP would include measures to protect visitors, park neighbors, park employees, and fire personnel, and would be in accordance with safety measures built into multiple federal fire management policies. Area closures would be utilized as needed for public safety during fire events and fuel treatments. Implementation of the FMP would benefit human health and safety by protecting infrastructure and managing risks presented during a wildfire event. Because the updated FMP would benefit human health and safety and has no potential to increase risks to human health and safety, this topic has been dismissed from detailed analysis.

Socioeconomics and Environmental Justice

Glacier National Park would strive to be inclusive in its fire prevention and incident information efforts by employing strategies and tactics that would reach the entire community, to include non-English speaking, deaf or hard of hearing, and other significant populations. Glacier would also strive to involve the surrounding communities in agency fire management activities in a positive manner economically, politically, and socially. Wildfire management activities under the updated FMP would not alter spending, income, or employment in the local or regional economy. The FMP would benefit socioeconomics by protecting infrastructure and developed areas from wildfire risk, including areas where private businesses and concessioner operated facilities are located. The FMP would also minimize wildfire risks to surrounding communities and would have no potential to cause disproportionately high and adverse effects on low-income and minority communities. For these reasons, socioeconomics and environmental justice would not be adversely affected and these topics have been dismissed.

References

British Columbia Wildfire Service. 2023. Water Quality: Fire Retardants Used to Fight Wildfires. Brochure. Accessed 05 Dec 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/fire_retardants_and_water_quality_brochure.pdf

Department of the Interior (DOI). 2024. Interagency Standards for Fire and Fire Aviation Operations. Interagency Standards for Fire and Fire Aviation Operations Group, National Interagency Fire Center, Boise, ID.

Norris, L.A.; Webb, W.L. 1989. Effects of fire retardant on water quality. In: Berg, Neil H. tech. coord. *Proceedings of the Symposium on Fire and Watershed Management*: October 26-28, 1988, Sacramento, California. Gen. Tech. Rep. PSW-109. Berkeley, Calif.: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 79-86