



# **GOING-TO-THE-SUN ROAD CORRIDOR MANAGEMENT PLAN ENVIRONMENTAL ASSESSMENT**



**September 2019**





# CONTENTS

<b>CHAPTER 1: PURPOSE AND NEED .....</b>	<b>1</b>
Purpose and Need for Action.....	1
Description of Going-To-The-Sun Road Corridor.....	1
Planning Issues within the Going-to-the-Sun Road Corridor.....	1
Visitation Increases .....	1
Congestion from Vehicles.....	2
Alternative Transportation .....	2
Natural Resources.....	6
Trail Use .....	6
Historical Significance.....	6
Visitor Use Planning.....	6
The Planning Process .....	7
Desired Conditions .....	7
<b>CHAPTER 2: ALTERNATIVES .....</b>	<b>11</b>
Introduction .....	11
No-Action Alternative: Continue Current Management of Going-to-the-Sun Road.....	11
Alternative Transportation .....	11
Access by Private Vehicle Including Traffic Management and Parking .....	12
Trails and Trailhead Facilities.....	12
Bicycle Use .....	12
Visitor, Experience, Interpretation, and Education .....	12
Technology.....	15
Partner Opportunities .....	15
Resource Protection.....	15
Natural Soundscape Monitoring .....	15
Preferred/Proposed Alternative: Adaptive Management Approach to Address Visitation Levels.....	15
Indicators and Thresholds .....	16
Visitor Capacity .....	17
Alternative Transportation—Expanded Shuttle System and Related Projects .....	18
Access by Private Vehicle Including Traffic Management and Parking .....	19
Trails and Trailhead Facilities.....	23
Bicycle Use .....	27
Visitor Use, Experience, Interpretation, and Education .....	27
Technology.....	27
Partner Opportunities .....	28
Resource Protection.....	28
Natural Soundscape Protection .....	29

Mitigation Measures.....	29
Proposed Actions by Location .....	29
<b>CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES.....</b>	<b>33</b>
Introduction .....	33
Visitor Use and Experience.....	33
Affected Environment.....	33
Impacts on Visitor Use Analysis .....	39
Vegetation .....	44
Affected Environment.....	44
Impacts on Vegetation.....	45
Species of Special Management Concern .....	48
Affected Environment.....	48
Impacts on Species of Special Management Concern .....	53
Character of Recommended Wilderness .....	58
Affected Environment.....	58
Impacts on Character of Recommended Wilderness .....	60
Cultural Resources.....	62
Affected Environment.....	62
Historic Structures and Districts, Cultural Landscape, and Visual Resources.....	62
Impacts on Cultural Resources.....	64
<b>CHAPTER 4: CONSULTATION AND COORDINATION .....</b>	<b>67</b>
Elected Officials .....	67
Federal Agencies .....	67
Canadian Federal Government Agencies .....	67
Montana State Agencies and Tribal Offices.....	67
Organizations and Businesses .....	68
<b>APPENDIXES .....</b>	<b>69</b>
<b>APPENDIX A: REFERENCES .....</b>	<b>A-1</b>
<b>APPENDIX B: ACRONYMS AND ABBREVIATIONS .....</b>	<b>B-1</b>
<b>APPENDIX C: PREPARERS, PLANNING TEAM MEMBERS, CONSULTANTS, AND CONTRIBUTORS ....</b>	<b>C-1</b>
<b>APPENDIX D: INDICATORS, THRESHOLDS, AND CAPACITY.....</b>	<b>D-1</b>
<b>APPENDIX E: MITIGATION MEASURES .....</b>	<b>E-1</b>
<b>APPENDIX F: OTHER PAST, ONGOING, AND REASONABLY FORESEEABLE FUTURE ACTIONS .....</b>	<b>F-1</b>
<b>APPENDIX G: STRATEGIES AND ALTERNATIVES CONSIDERED BUT DISMISSED .....</b>	<b>G-1</b>
<b>APPENDIX H: IMPACT TOPICS CONSIDERED BUT DISMISSED .....</b>	<b>H-1</b>



**APPENDIX I: HISTORY OF CIVIC ENGAGEMENT, AGENCY CONSULTATION, AND COORDINATION . I-1**

**APPENDIX J: PLANT SPECIES OF CONCERN WITH THE POTENTIAL TO OCCUR NEAR PROPOSED AND  
POTENTIAL NEW TRAIL SEGMENTS UNDER THE PREFERRED/PROPOSED ALTERNATIVE.....J-1**

**APPENDIX K: TRAFFIC COUNTS AND LEVEL OF SERVICE ON GOING-TO-THE-SUN ROAD REPORT K-1**

**Tables**

Table 1. Visitor Use Management and the Planning Process.....	7
Table 2. Visitor Capacity, as defined by People At One Time (PAOT) Delivered to these Locations.....	18
Table 3. Preferred/Proposed Alternative Elements by Location .....	29
Table 4. Land Cover in the GTSR Management Area .....	44
Table 5. Species of Special Management Concern Potentially Occurring in GTSR Management Area .....	49

**Figures**

Figure 1. Glacier National Park “Hot Spots” .....	3
Figure 2. Glacier National Park Vicinity Map.....	5
Figure 3. No-Action Alternative: Continue Current Management of Going-to-the-Sun Road Map .....	13
Figure 4. Glacier National Park Preferred/Proposed Action .....	21
Figure 5. Avalanche Development Concept Plan .....	25
Figure 6. Recommended Wilderness within Glacier National Park .....	59

*This page intentionally left blank.*



# **CHAPTER 1: PURPOSE AND NEED**

## **PURPOSE AND NEED FOR ACTION**

The purpose of the Going-to-the-Sun Road (GTSR) Corridor Management Plan is to identify a suite of strategies and actions for managing transportation, visitation and visitor use, trail use, and access throughout the corridor, including at developed areas, to meet desired conditions established for the park's fundamental resources and values, including providing high-quality visitor experiences.

The plan is needed to address a range of changing conditions and challenges within the GTSR corridor associated with unprecedented visitation levels and dynamic use patterns, including roadway gridlock and parking lot congestion; visitor safety issues; natural and cultural resource impacts; and heavy stress on park facilities, services, and operations.

## **DESCRIPTION OF GOING-TO-THE-SUN ROAD CORRIDOR**

The GTSR is a spectacular scenic road that spans the Continental Divide and links the east and west sides of the 1.1-million-acre Glacier National Park. The 50-mile-long, two-lane (10–11-foot width), two-way GTSR is the only road transecting the park in its entirety. The GTSR holds the highest historic significance recognition as a national historic landmark (NHL), a program administered by the National Park Service. It is also designated a national historic civil engineering landmark by the American Society of Civil Engineers. In 2019, the park completed the 12-year, \$160 million road rehabilitation project. This was the largest rehabilitation efforts since GTSR was built in 1932. The posted maximum speed limit between Apgar Visitor Center and The Loop, and Siyeh Bend to St. Mary Visitor Center, is 40 miles per hour (mph), although some road sections have lower speed limits around curves and other difficult to navigate areas. The alpine section of the road from The Loop to Siyeh Bend has grades as high as 6% and sections with hairpin turns warranting a lower posted speed limit of 25 mph. There are intermittent passing opportunities (a dashed centerline) and slow vehicle turnouts to facilitate travel along the road. GTSR has 20 parking lots with at least 20 parking spaces each along the road, as well as approximately 170 pullouts. A pullout is defined as an area with fewer than 20 parking spaces, whereas a parking lot has 20 or more spaces for a total of approximately 2,100 parking spaces along the entire corridor. The road also features 23 trailheads, five campgrounds, and many scenic views. The GTSR management area, as defined in the 1999 General Management Plan, is depicted in the chapter 2 alternatives figures and consists of approximately 183,860 acres. It contains approximately 173 miles of trails, Granite Park, and the Sperry Chalets.

## **PLANNING ISSUES WITHIN THE GOING-TO-THE-SUN ROAD CORRIDOR**

### **Visitation Increases**

Overall visitation to Glacier National Park serves as a proxy for visitation to the GTSR corridor because 68% of visitors to the park travel through the corridor (Volpe 2016). Since the GTSR opened in 1932, annual visitation to the park has increased from 53,000 visitors to approximately 3.3 million in 2017. Visitation increased by almost a million between 2015 and 2017, equaling a 40% increase. In 2018, monthly record visitor numbers included the busiest May on record and the second busiest June and July, only surpassed by 2017 in which 1 million visitors came to Glacier in July; more than any park has ever received in a single month. August 2018 was the fifth busiest and September 2018 was the second busiest ever. Visitation has increased 82% since 1988 and 124% since 1980. Though significantly lower than peak season totals, shoulder season visitation increased 32% between 1988

and 2014, as measured using the months April to June and September to November (NPS 2014a; NPS 2014b; NPS 2014c).

## **Congestion from Vehicles**

In surveys of visitors driving the GTSR, parking shortfalls and generalized congestion while driving, including at entrance stations and popular destinations along the GTSR, were frequently cited. The West Entrance Station becomes so congested during high-use times in the summer months that the park is periodically forced to wave all cars through to avoid hazardous backups to Highway 2, though this method often results in simply moving congestion to the next bottleneck point (i.e., parking lots and/or pullouts along the GTSR). During peak season, parking lots at places such as Logan Pass and Avalanche Creek frequently fill to capacity between 8:00 a.m. and 9:00 a.m. most days, requiring drivers arriving after that time interval to wait for lengthy periods or drive to an alternate destination (Miller and Freimund 2014). In 2017 and 2018, Logan Pass began filling as early as 7:30 a.m. and now closes three or four times a day for short periods of time during peak season. Research shows that approximately 50 of the 234 visitor spaces are filled for six or more hours a day during peak season. (Miller and Freimund 2014).

During a planning meeting in August 2012, park staff categorized various congestion hot spots along the corridor as poor or worse; this listing was updated in February 2014. The designations were based on research and qualitative observations about the areas. The majority of the hot spots are associated with parking areas and shuttle stops (see figure 1 below).

## **Alternative Transportation**

A voluntary shuttle system was launched in 2007 to mitigate the impacts of delays during the rehabilitation and to reduce congestion along the GTSR, its parking areas, and pullouts. By 2012, ridership on the park's shuttle system had increased 61% as measured against 2008 levels. In 2017, the shuttle system reported 227,707 shuttle boardings. Despite the shuttle's popularity, the road, parking areas, and pullouts are still congested. Studies estimate that the shuttle system eliminates approximately 5% of private vehicle round trips from the road corridor (NPS 2012).

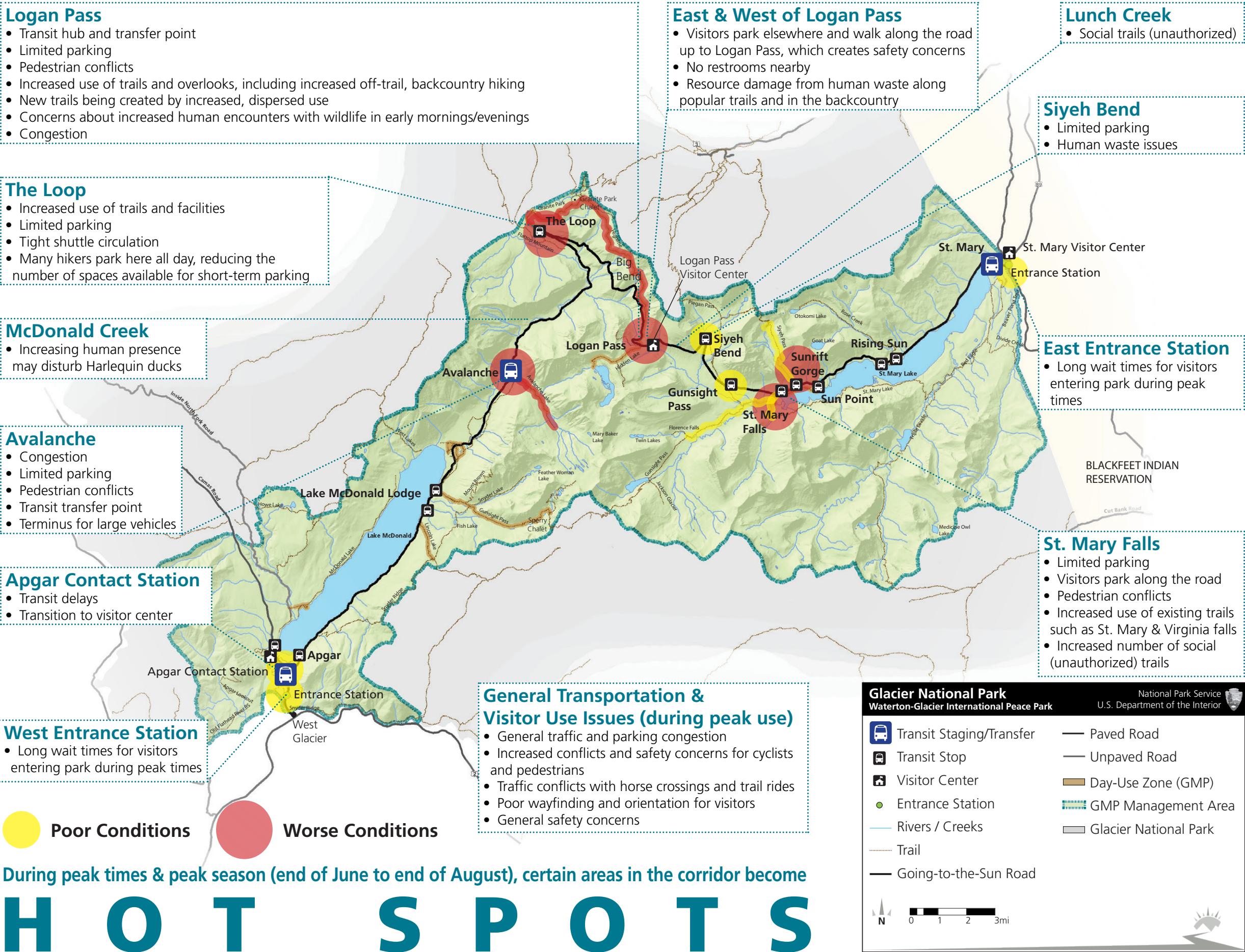
The park's shuttle system is funded by a transportation fee, which is included in the park's \$35 entrance fee. Currently, the transportation "set aside" is \$10 and goes directly to fund the shuttle system. A "pro forma" analysis is completed annually to ensure the system's future financial sustainability. This analysis includes review of current expenses for operations, maintenance, and capital needs and determines how to project those expenses into the future based on current and local trends. If needed, the park's transportation fee can be amended to cover rising costs, but increasing the fee decreases available funding for other park projects that use entrance fee revenues.

Bicycling is a prevalent activity along the GTSR. Conflicts between motorized vehicles and bicyclists have been documented, including road-sharing issues associated with multiple bicyclists riding abreast and long lines of motorized vehicle traffic backed up behind bicyclists, particularly on uphill terrain.



Figure 1. Glacier National Park  
“Hot Spots”

GOING-TO-THE-SUN ROAD CORRIDOR MANAGEMENT PLAN



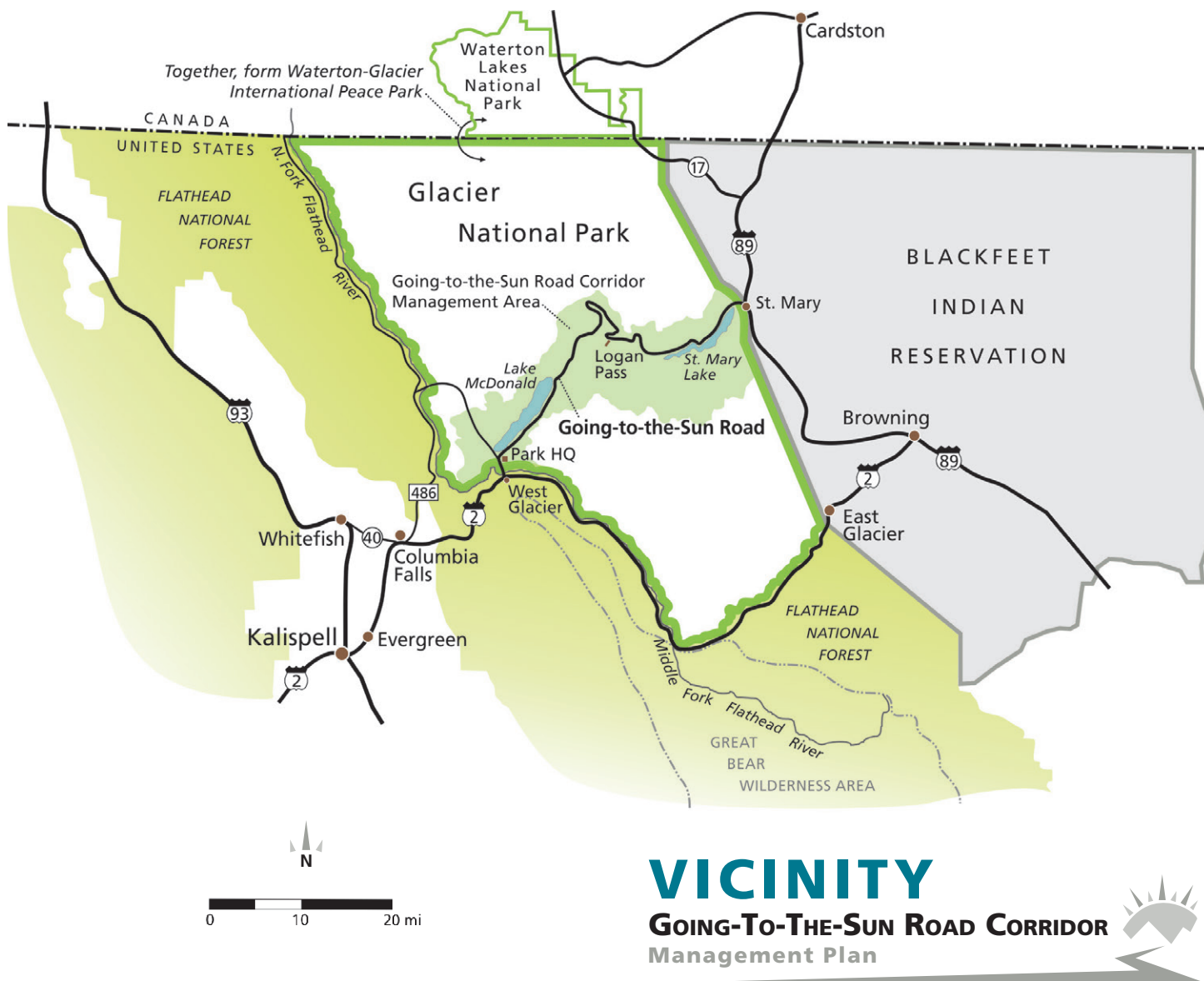
During peak times & peak season (end of June to end of August), certain areas in the corridor become

**H O T S P O T S**

*This page intentionally left blank.*



Figure 2. Glacier National Park Vicinity Map



## **Natural Resources**

Natural resources (vegetation and wildlife) are showing the impacts of increasing visitation on the road and trails and at trail overlooks. Trail conditions reflect path widening, erosion, vegetation trampling, increased informal trails, and the presence of litter and human waste. Wildlife habituation is also increasing with mountain goats, deer, and small mammals. Encounters with bears continue.

## **Trail Use**

The GTSR provides access to 26 trails. Many trails along the corridor have experienced significant increases in use, including the Avalanche Lake Trail, which has seen a 250% increase in use since 1988. Similarly, The Loop increased from 1,800 hikers in 1988 to 29,779 in 2015. Hidden Lake Overlook and Avalanche Lake are the busiest trails (1,364 and 1,482 on average in 2018, respectively). Up to an 18% increase was shown on these two trails from 2017. The Highline Trail in 2018 had on average 714 daily hikers. As a result, trails do not always provide the wilderness experience that some hikers seek. The additional use also negatively impacts vegetation, wildlife, and water quality.

## **Historical Significance**

The GTSR holds the highest historic significance recognition as a national historic landmark, a program administered by the National Park Service. GTSR is also designated as a national historic civil engineering landmark by the American Society of Civil Engineers. National historic register trails in the management area also hold important historic significance. As modern infrastructure is added to these areas, the historic significance is eroded. Present-day safety requirements and adequate visitor services must be balanced with the additional concern of preserving these significant historic resources.

## **VISITOR USE PLANNING**

The National Park Service strives to maximize opportunities and benefits for visitors while achieving and maintaining desired conditions for resources and visitor experience. Doing so is inherently complex. It requires that NPS managers analyze the number of visitors, where they go, what they do, their impacts on resources and visitor experience, and the underlying causes of those impacts. The dynamic nature of visitor use and the vulnerabilities of natural and cultural resources requires that managers be responsive to changing conditions and to implement a proactive and adaptive process of planning for and managing characteristics of visitor use and its physical and social setting and using a variety of strategies and tools to sustain desired resource conditions and visitor experience.

Proactively planning for visitor use maximizes the ability of agencies to encourage access, address safety concerns, assess infrastructure capacity, and protect resources and values. In this GTSR Corridor Management Plan, visitor use refers to human presence in an area for recreational purposes including education, interpretation, inspiration, and physical and mental health. Visitor use refers to the types of activities that people engage in during a park visit and also includes the amount, timing, and distribution of visitor activities and behaviors.

Visitor capacity must be identified for those areas connected to decisions in this plan to meet the requirements of the National Parks and Recreation Act of 1978 (Public Law 95-625, Section 604), which mandates that all parks address visitor capacity. These visitor capacities will define the maximum allowable types and amount of use for key areas along the road corridor that still support



attainment of desired resource conditions and visitor experience consistent with the park’s purposes. The indicators and thresholds established in this plan also help with the long-term monitoring and management of the desired conditions and visitor capacities in this plan. The indicators, thresholds, and visitor capacities can be found in appendix D.

## The Planning Process

The process used to develop this plan is outlined below and is consistent with guidance provided by the Interagency Visitor Use Management Council (IVUMC) ([www.visitorusemanagement.nps.gov](http://www.visitorusemanagement.nps.gov)). Studies conducted by multiple sources related to visitor use, the condition of natural resources related to visitor use, and visitor preferences in the park also informed development of the alternatives.

**TABLE 1. VISITOR USE MANAGEMENT AND THE PLANNING PROCESS**

Visitor Use Management Framework Elements	Framework Steps and Alignment with the Planning Process and Corresponding Chapter Location
<p>Element 1: Build the Foundation</p> <p><i>Building the foundation is the first of the four elements of the visitor use management framework. The purpose of this element is to help managers understand what needs to be done, how to organize the plan, and how to define the resources needed to complete the plan.</i></p>	<ol style="list-style-type: none"> <li>1. Clarify the plan purpose and need (chapter 1).</li> <li>2. Review the area’s purpose and applicable legislation, agency policies, and other management direction (chapter 1).</li> <li>3. Assess and summarize existing information and current conditions (e.g., current conditions of natural, cultural, and recreational resources and visitor experience opportunities in the area) (chapter 3).</li> <li>4. Develop a plan strategy (chapter 1).</li> </ol>
<p>Element 2: Define Visitor Use Management Direction</p> <p><i>The purpose of this element is to answer critical questions about what the planning effort is trying to achieve and the acceptable levels of impacts from visitor use.</i></p>	<ol style="list-style-type: none"> <li>5. Define desired conditions for the planning area (chapter 1).</li> <li>6. Define appropriate visitor activities, facilities, and services (chapter 2).</li> <li>7. Select indicators and establish thresholds (chapter 2; appendix D).</li> </ol>
<p>Element 3: Identify Management Strategies</p> <p><i>This element is intended to help managers identify management strategies and actions to achieve and maintain the desired conditions of the plan area. This element also identifies visitor capacity. The goal of element 3 is to define how visitor use would be managed to achieve desired conditions.</i></p>	<ol style="list-style-type: none"> <li>8. Compare and document the differences between existing and desired conditions, and for visitor use-related impacts; clarify the specific links with visitor use characteristics (chapter 3).</li> <li>9. Identify visitor use management strategies and actions to achieve desired conditions (chapter 2).</li> <li>10. Where necessary, identify visitor capacities and strategies to manage use levels within capacities (appendix D).</li> <li>11. Develop a monitoring strategy (chapter 2; appendix D).</li> </ol>
<p>Element 4: Implement, Monitor, Evaluate, and Adjust</p> <p><i>This element focuses on implementing management actions, monitoring, evaluating monitoring results, and adjusting management strategies and actions based on monitoring results. This phase of the planning process focuses on making progress toward meeting desired conditions as well as evaluating potential unintended consequences of the actions for visitors or resources.</i></p>	<ol style="list-style-type: none"> <li>12. Implement management actions.</li> <li>13. Conduct and document ongoing monitoring and evaluate the effectiveness of management actions in achieving desired conditions.</li> <li>14. Adjust management actions if needed to achieve desired conditions and document rationale.</li> </ol>

## Desired Conditions

Desired conditions are aspirational statements that articulate what areas of the park would look, feel, sound, and function like in the future. Desired conditions are defined for resources, visitor experience and opportunities, park operations, and facilities and services that the park strives to achieve and maintain. Subsequently, desired conditions also provide basic criteria to evaluate the appropriate types and levels of management, development, and access needed to achieve those conditions. In this

planning process, desired conditions guide the development of alternatives, indicators, and thresholds needed for monitoring and adaptive management within the GTSR corridor.

Desired conditions are defined as “a park’s natural and cultural resource conditions that the National Park Service aspires to achieve and maintain over time, and the conditions necessary for visitors to understand, enjoy, and appreciate those resources.”

*NPS Management Policies 2006*

Desired conditions for experiences and resources in the GTSR corridor were informed by NPS policies and guidance and the park planning portfolio. Zoning language in the general management plan, fundamental resources and values and significance statements in the foundation document, and relevant studies and institutional knowledge that inform the understanding of park resources and management direction were referred to during their development (NPS 1999; NPS 2016). Additionally, some desired conditions grew from the goals and objectives of this planning effort. Fundamental resources and values (FRVs) are those features, systems, processes, experiences, stories, scenes, sounds, smells, or other attributes determined to merit primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. Other resources and values that may not be fundamental to the purpose and significance of the park, but are important to consider in management and planning decisions are referred to as other important resources and values (OIRVs). Both FRVs and OIRVs for the park were identified during previous planning efforts and are referenced in the desired conditions below.

Desired conditions are listed below under the categories of visitor use and experience, natural resources, cultural resources, and park operations. Some are corridor-wide in scope and others speak to specific types of resources or experiences. These desired conditions do not replace desired conditions from other plans or policies; rather, they provide additional guidance for the corridor regarding visitor use management. The desired conditions categorized and listed below apply to all management zones in the GTSR corridor unless otherwise noted.

**Visitor Use and Experience.** The following desired conditions were identified for visitor use and experience.

- Manage the corridor to maximize safety for all users.
- Manage traffic, access, and parking on the GTSR for all appropriate transportation modes to reduce congestion and protect resources. Encourage seamless and convenient transportation connections inside and outside the park.
- Operate and maintain transportation vehicles and assets such as buses, shuttle stops, parking areas, roads, trails, and signs to promote uniformity and efficiency.
- Incorporate innovative technology and techniques to minimize ecological impacts and the park’s carbon footprint.
- Create and improve opportunities for orientation, interpretation, and education using a mix of traditional and cutting-edge technologies and methods, where appropriate.
- Provide visitor services and associated infrastructure such as restrooms, potable water, and signage to support visitor needs (and experience). Leverage partnership and outreach opportunities to maintain and enhance transportation systems and manage visitor use.
- Provide visitor access to high-quality, seasonally appropriate recreational opportunities such as hiking, horseback riding, camping, backpacking, boating, fishing, viewing star-filled night skies, experiencing the natural soundscape, photography, and experiencing the only historic chalets in the national park system.
- Provide high-quality experiences in settings with a range of visitor densities (high to low) that are not dominated or degraded by crowding or congestion of vehicles or visitors. These

settings are characterized by high-quality, natural and cultural resources, natural soundscapes, and dark night skies. Manage the number of visitors to key park attractions to prevent conflicts over available parking spaces and among different user groups, as well as provide access for a variety of activities.

**Natural Resources.** The following desired conditions were identified for natural resources:

- Protect natural processes, conditions, and values. Maintain the GTSR corridor's scenic and natural conditions and ecosystem integrity.
- Ensure that use of the roadway does not interfere with the protection and enhancement of the diverse habitats of iconic wildlife.
- Adapt to and/or mitigate climate change and related impacts where possible.
- Protect the processes and components of the park's natural ecosystems such as flora and fauna, habitat, natural soundscapes, and night skies.
- Protect wilderness character, wilderness resource values, and wilderness recreational opportunities.
- Maintain and improve clean water and air.
- Protect the tremendous biological diversity found in this corridor, which encompasses all five park ecoregions, to ensure its overall integrity.
- Minimize negative human-wildlife interactions and impacts and continue to provide diverse habitats that support iconic wildlife.
- Ensure that visitors have the opportunity to understand the importance of the park's natural ecosystems, processes, and unique and diverse wildlife.
- Minimize visitor-created trails (informal trails) and widening or braiding of trails, including related impacts such as trampled vegetation and the spread of invasive species.

**Cultural Resources.** The following desired conditions were identified for cultural resources:

- Preserve and maintain character-defining features of the GTSR corridor as identified in the NHL nomination.
- Ensure that visitors have the opportunity to experience the unique aesthetic and engineering characteristics of the national historic landmark and the national historic civil engineering landmark-designated GTSR.
- Educate the public about the historic significance of the GTSR and related elements of the cultural landscape including trails, structures, viewsheds, and ethnographic resources.
- Preserve historically and culturally significant transportation tours and services such as the Red Bus and Sun Tours.
- Ensure that visitors have the opportunity to experience and understand the significance of the NHL hotels and chalets in the GTSR management area.

**Park Operations.** The following desired conditions were identified for park operations:

- Ensure the ability of the park to sustainably maintain and operate park infrastructure with the GTSR management area including water systems, wastewater treatment, lift stations, visitor centers, restrooms, chalets, hotels, and all support facilities.
- Ensure the ability of the park to have the critical staffing necessary to preserve resources, basic operations of facilities and infrastructure, and provide emergency services and law enforcement response commensurate with visitation levels to ensure visitor and employee safety and resource protection.

**Desired Conditions for Selected Fundamental Resources and Values and Other**

**Important Resources and Values.** The following FRVs and OIRVs are integral to the GTSR and

how the corridor facilitates the visitor's ability to experience those resources and share in those values. As part of this comprehensive planning effort, desired conditions were defined for the following FRVs and OIRVs to guide the development of alternatives presented in chapter 2 of this environmental assessment.

*Tribal Connections*— The Blackfeet Tribe of the Blackfeet Indian Reservation, Confederated Salish and Kootenai Tribes of the Flathead Reservation, and other American Indian tribes have a relationship with this land that goes back thousands of years.

Desired condition for this FRV:

- Preserve and protect areas that are culturally significant to tribes because tribal connections are vital to the future of Glacier National Park and are also an FRV. Visitors have the opportunity to understand the importance of the connections among tribes and the areas along the GTSR.

*Variety of Recreational Opportunities*— Visitors from all over the world to discover that the park has something for everyone.

Desired conditions for this FRV:

- Visitors have access to high-quality, seasonally appropriate recreational opportunities such as hiking, horseback riding, camping, backpacking, boating, fishing, viewing star-filled night skies, listening to natural sounds, photography, and staying in the only historic chalets in the national park system.
- Visitors have a variety of options to access areas along the GTSR corridor by private automobile, bus, bicycle, horseback, or by foot.
- High-quality experiences are provided in settings with a range of visitor densities (high to low) that are not dominated or degraded by crowding or congestion of vehicles or visitors. These settings are characterized by high-quality, natural and cultural resources, natural soundscapes, and dark night skies. The number of visitors to key park attractions is managed to prevent conflicts over available parking spaces and among different activity participants, as well as providing access for a variety of activities.

*Going-to-the-Sun Road*— No other road combines the historic associations, the landscape design aesthetic and engineering significance, and the excellent state of preservation as the GTSR.

Desired conditions for this OIRV:

- Traffic is predominantly free flowing with occasional congestion at acceptable levels that would usually abate on its own and does not compromise safety and emergency response. Visitors in private vehicles are able to find parking space at destinations most of the time but with acceptable delays. The historic Red Bus and GTSR shuttle service can easily circulate on the GTSR and throughout the park.

*Diverse Habitats that Support Iconic Wildlife*— Glacier is a refuge for species on a continental scale.

Desired conditions for this FRV:

- Use of the roadway does not interfere with the protection and enhancement of the diverse habitats of iconic wildlife.

## **CHAPTER 2: ALTERNATIVES**

### **INTRODUCTION**

This chapter includes a description of the no-action and the preferred/proposed alternatives for transportation and visitor use management in the GTSR corridor management area of Glacier National Park. Under the no-action alternative, current direction of transportation and visitor use management would continue, whereas the preferred/proposed alternative presents various approaches to managing park resources and values, including a spectrum of visitor opportunities, amenities, and transportation system solutions. The analysis of the no-action alternative (in chapter 3) allows the National Park Service to compare how conditions would change by implementing different management strategies. The development of the preferred/proposed alternative was informed by research conducted by the University of Montana (UMT) on visitor use levels and level of service traffic models (Baker et al. 2007; Bedoya 2012a; Bedoya 2012b; Bedoya 2013). These models were first developed by the Federal Highway Administration and were then updated by the University of Montana. Additionally, input was solicited from park staff, stakeholders, other government agencies, and the public on key issues and potential management strategies. A history of civic engagement efforts, agency consultation, and coordination for the project is summarized in appendix I.

### **NO-ACTION ALTERNATIVE: CONTINUE CURRENT MANAGEMENT OF GOING-TO-THE-SUN ROAD**

Under the no-action alternative, park management would continue the management direction set forth in previous park planning efforts such as the 1999 General Management Plan. Based on 2017 visitation levels, this alternative assumes the trend of substantial increases in visitation would continue. Response to increased visitation, changes in transportation technology, or other events would be reactionary on a case-by-case basis, rather than as part of an integrated and long-term strategy. The following sections describe the actions the park would continue under this alternative.

#### **Alternative Transportation**

- Continue to operate the park shuttle system under the current cooperative agreement, modified as needed to respond to funding, weather events, and road opening and closing dates.
- Continue to manage fleet size based on available funding. In 2019, there were 35 buses consisting of both smaller passenger vans and larger buses.
- Continue to operate the shuttle seasonally depending on snow removal operations (roughly between July and September) from approximately 7:00 a.m. to 7:00 p.m. Maintain average headways (average time between shuttles running in the same direction on the same route) for west side shuttles of approximately 15–30 minutes and average headways of approximately 40 minutes for east side shuttles. Continue Express shuttles from Apgar Visitor Center to Logan Pass each morning.
- Maintain the 16 shuttle stops at their current locations (figure 3).
- Continue to operate large buses between Apgar and Avalanche with a mandatory transfer point at Avalanche for all riders to transfer to smaller passenger vans. Continue to operate these smaller vehicles between Avalanche and Logan Pass.
- Continue to allow guided driving tours through concessioners and other businesses with commercial use authorizations.



## **Access by Private Vehicle Including Traffic Management and Parking**

- Continue to allow private vehicles 21 feet and less access to the entire length of the GTSR.
- Continue to use traffic metering on the GTSR corridor before Logan Pass coming from the west side during emergency events or extreme congestion. Continue to temporarily close the Logan Pass parking lot on an intermittent and unplanned basis when it fills during peak season.
- Maintain the approximately 2,000 parking spaces within the GTSR corridor.
- Maintain the existing West Entrance Station and continue to provide rangers and other staff for orientation and information. Continue to wave through vehicle queues at the West Entrance Station if they extend into the town of West Glacier.
- Continue formal and informal ride sharing on an ad hoc basis.

## **Trails and Trailhead Facilities**

- Maintain current hiking trails within and accessible from the GTSR corridor.
- Respond to and mitigate informal trails when possible.
- Allow guided hiking tours through concessioners and/or commercial use authorizations with no restriction to daily visits or group sizes.

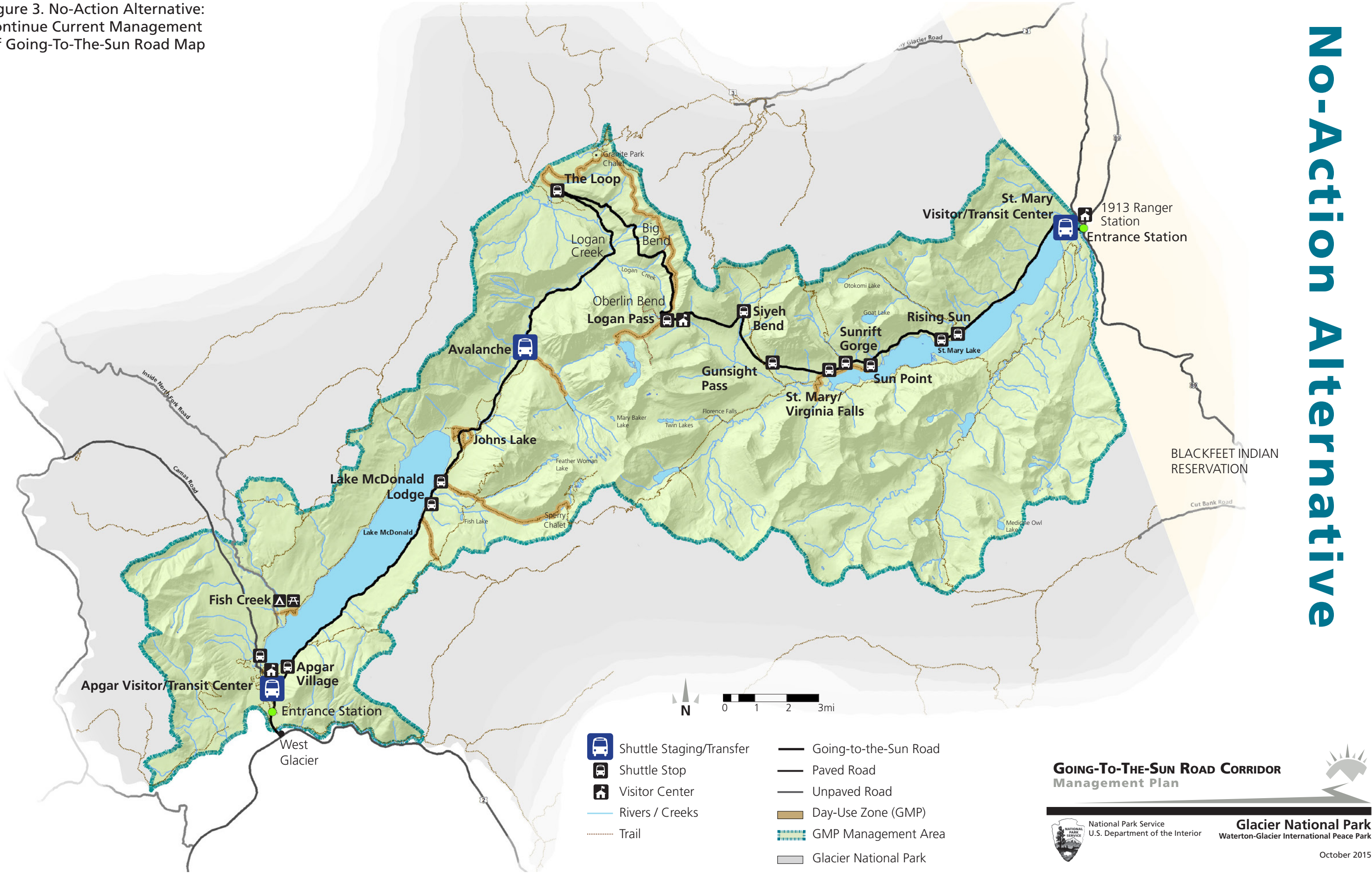
## **Bicycle Use**

- Continue to allow access by hikers and bicyclists to the GTSR every spring before it is fully open to cars for an opportunity to enjoy a more relaxed pace on this national historic landmark. As the plowing crews make their way up Logan Pass, the plowed sections behind them would remain available for a car-free experience. Crews would mark the closure of the hiker-biker section of the road with a sign. Visitors would not be permitted beyond this point while the crews are plowing. After work hours or on days the crews are not plowing, visitors would be free to go as far as they like, depending on conditions.
- Maintain the use of daily timed bicycle restrictions after the road opens each season, generally June 15 through Labor Day, prohibiting bicyclists traveling uphill on the GTSR between Apgar Campground and Sprague Creek Campground and Logan Creek to Logan Pass. Continue to confine bicycles to roadways, designated bike trails, and parking areas.

## **Visitor, Experience, Interpretation, and Education**

- Maintain current visitor center daily operating hours with extended hours in the peak of summer.
- The Apgar Visitor Center would be open daily from mid-May through September and remain open on winter weekends.
- The Logan Pass Visitor Center would remain open only in the summer, generally from June through September.
- The St. Mary Visitor Center would remain open daily from mid-May through September.
- Rangers and other staff would continue to provide orientation and information to visitors at visitor centers.
- Maintain trip planning information, including access to brochures, newspapers, websites, and social media.
- Evaluate and install new wayfinding and other visitor information signage, as needed.

Figure 3. No-Action Alternative:  
Continue Current Management  
Of Going-To-The-Sun Road Map



No-Action Alternative

*This page intentionally left blank.*

## **Technology**

- Continue to provide information on seasonal road closures and information regarding the park shuttle on the park's website.
- Continue to post the status of parking lots and campgrounds, as available, on social media and some roadside LED signs during the peak summer season.
- Maintain detailed signs and information about traveling throughout the park at the Apgar, St. Mary, and Logan Pass Stations.
- Maintain display of real-time information for all campgrounds at the St. Mary Entrance Station.
- Continue to evaluate and apply new technology as it evolves and when and where appropriate.

## **Partner Opportunities**

- Continue to build partnerships with local businesses and nonprofits related to visitor experience and resource protection in the GTSR corridor.
- Continue to cultivate partnerships as part of a larger strategy that could include collaboration to facilitate more transportation connections between the park and gateway communities.

## **Resource Protection**

- Continue wildlife aversive conditioning on a case-by-case basis to manage human-wildlife interactions in frontcountry and backcountry locations.
- Continue to rely on established grizzly bear management zones to guide wildlife protection actions.
- Continue visitor education on resource issues at current levels.
- Continue to learn new resource management techniques and apply such knowledge.

## **Natural Soundscape Monitoring**

- Continue monitoring noise levels depending on funding and availability of equipment.

## **PREFERRED/PROPOSED ALTERNATIVE: ADAPTIVE MANAGEMENT APPROACH TO ADDRESS VISITATION LEVELS**

The preferred/proposed alternative offers a suite of strategies and actions intended to achieve and maintain desired conditions described in chapter 1, as represented by thresholds for indicators, and/or visitor capacities established during the planning process as described below. This alternative also includes a suite of adaptive management actions the National Park Service would implement if monitoring indicates these initial management actions do not result in the desired conditions, as represented by thresholds for indicators and/or visitor capacities established during the planning process. These actions would support the park's ability to respond to future events, trends, risks, and threats, including those that are unknown or uncertain. These adaptive management actions are described below and/or are listed in appendix D.



This alternative would continue to provide a variety of visitor experiences throughout the GTSR corridor, including solitary, social, family friendly, and physically rigorous recreation while managing existing transportation infrastructure (with a few exceptions noted in this alternative).

Upon implementing the plan, the National Park Service would take the following initial management actions: expand the shuttle system to include new stops and associated parking/trail projects, increase ridership, and expand hours; implement a timed entry parking permit system to manage congestion at Logan Pass and St. Mary and Virginia Falls Trailheads; and implement changes to the circulation and parking availability in the Avalanche Developed Area. Chapter 3 of this environmental assessment includes an analysis of the environmental impacts of these actions because they could have notable impacts on natural resources, cultural resources, and/or visitor use and experience.

The National Park Service would also implement a number of actions that are operational in nature to help manage transportation and visitor use. This chapter includes these actions in the descriptions below and marked with an asterisk [\*]) because they are important to understanding the full scope of the proposed corridor management plan. However, because of their operational nature, these actions have little or no potential to cause meaningful environmental impacts that would inform the decision-making process. Therefore, consistent with Council on Environmental Quality's National Environmental Policy Act (NEPA) regulations and the 2015 NPS NEPA Handbook, the National Park Service has not analyzed impacts associated with these actions in chapter 3.

As described in *Adaptive Management: The Department of the Interior Technical Guide*, “adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders” (Williams et al. 2009).

In the event that implementation of this plan is not successful in managing desired conditions for the GTSR corridor, the National Park Service may consider a reservation system for the entire corridor. The National Park Service would complete additional analyses and compliance, as appropriate, before implementing such a system.

## Indicators and Thresholds

The National Park Service developed the indicators and thresholds for this plan using the framework created by the Interagency Visitor Use Management Council (the council) (see appendix D). Indicators measure conditions related to visitor use and resources that the National Park Service would monitor to track those conditions over time. Thresholds represent the minimum acceptable condition for each indicator. Although defined as “minimally acceptable,” thresholds still represent acceptable conditions. For some indicators, the National Park Service has developed triggers that reflect a condition of sufficient concern for an indicator to prompt a management response to ensure the maintenance of desired conditions before the threshold is crossed. The National Park Service would monitor these indicators, thresholds, and triggers to inform whether desired conditions are being met and to inform strategies to be used by park managers so that desired conditions are met. This iterative practice of monitoring, implementing potential management strategies, and then continuing to monitor to gauge the effectiveness of those actions allows park managers to maximize



benefits for visitors while achieving and maintaining desired conditions for resources and visitor experiences in a dynamic setting.

Under this alternative, the National Park Service would monitor the following indicators for trails, transportation, water use and availability, and backcountry soundscapes related to management of the GTSR corridor. Thresholds for these indicators are also described in appendix D.

Indicators for trails include:

- trail use
- trail conditions
- informal trails
- human waste near trails

Indicators for transportation include:

- vehicles at one time (VAOT) at key destinations
- roadway level of service
- shuttle wait time for visitors
- preservation of historic road features

Indicators for water use and availability include:

- Average number of gallons used per day during July and August at Logan Pass

Indicators for soundscapes in the backcountry include:

- the number of noise events with a maximum one-second average A-weighted sound level above 40 decibel (dB)
- the percent of time that noise is audible over natural ambient
- the cumulative increase of median daytime sound pressure levels over natural ambient

The park would also continue to monitor the number of visitors per year entering the park as well as hiking on trails including during shoulder seasons and two components of the shuttle system: financial sustainability and ridership costs. Human-wildlife encounters and changes in visitor activity trends would also continue to be observed and documented.

Initially, data from 2012 informed the development of indicators and thresholds. The condition of the indicators with respect to thresholds remain mostly acceptable, although some of the thresholds have been exceeded in recent years (see appendix D). Continued monitoring of these indicators would show whether thresholds for trail use levels, closures and traffic slowdowns, potential increases in user conflicts, crowding at key sites, and natural and cultural resource degradation (e.g., formation of visitor-created trails) are being exceeded, which would be indicative of a condition that is not consistent with the desired conditions of the transportation system, fundamental resources and values, or other desired conditions for the GTSR corridor. If monitoring indicates conditions are approaching their respective triggers or thresholds, the National Park Service would implement adaptive management strategies, as described below and in appendix D.

## **Visitor Capacity**

The park would use visitor capacity identified for the GTSR corridor to inform implementation of the management strategies selected as part of this GTSR Corridor Management Plan / Environmental

Assessment. Visitor capacity is the maximum amount and types of visitor use that an area can accommodate while sustaining desired resource conditions (i.e., goals and objectives for this plan) and visitor experience consistent with the purpose for which the area was established. By establishing and implementing visitor capacities, the National Park Service can help protect resources and provide visitors with the opportunity for a range of high-quality experiences. Doing so also helps the National Park Service meet mandates contained in the 1978 National Parks and Recreation Act.

Appendix D details the considerations and process used to identify visitor capacities for each analysis area and how they inform management actions. The table below highlights visitor capacities by area. People at one time (PAOT) refers to the total number of people that are present at a site at any given point in time. To determine the appropriate amount and types of use at key areas, a variety of data was reviewed to understand current conditions compared to goals and objectives for the area. Visitor capacity identification also considers the amount and types of visitor use, including the timing and distribution of visitor activities and behaviors as they relate to desired conditions. It also takes into consideration management objectives, desired conditions (chapter 1), and the types of management actions and strategies being considered for an area (chapter 2).

**TABLE 2. VISITOR CAPACITY, AS DEFINED BY PEOPLE AT ONE TIME DELIVERED TO THESE LOCATIONS**

Location on Figure 4	Location / Shuttle Stop Area	Identified Visitor Capacity
6	Avalanche	975 PAOT
7	The Loop	130 PAOT
8	Big Bend	145 PAOT
10	Logan Pass	1,390 PAOT
11	Lunch Creek	85 PAOT
12	Siyeh Bend	190 PAOT
13	Gunsight Pass and Jackson Glacier Overlook	140 PAOT
14	St. Mary Falls	160 PAOT
15	Sunrift Gorge	190 PAOT

## Alternative Transportation—Expanded Shuttle System and Related Projects

Under this alternative, visitors would continue to have free access to the shuttle after entering the park. However, the National Park Service would expand the system as follows:

- Manage the size of the shuttle fleet to meet desired conditions based on available funding.\*
- Continue to operate the system seasonally depending on snow removal operations each year. Continue to run shuttles in both directions between local West Glacier businesses and local St. Mary businesses and expand hours to 6:30 a.m. to 9:00 p.m. daily. Average headways (average time between shuttles running in the same direction on the same route) would be 15-40 minutes. Continue express shuttles from Apgar Visitor Center to Logan Pass each morning.\*
- All existing shuttle stops would remain. New shuttle stops would be added at the following locations (figure 4):
  - West Side Construction Staging Area: Add a shuttle stop with an approximately 200-square-foot concrete pad waiting area, a shelter, related signage, and a vault or backcountry toilet.
  - Fish Creek Campground: Add a shuttle stop with signage.

- Johns Lake Trail: Add a new shuttle stop consisting of a roughly 800-square-foot waiting area and related signage. The exact location and any necessary compliance would be completed in the future.
- Big Bend: Adaptive Management Option: Add a shuttle stop with an approximately 800-square-foot concrete pad waiting area if the new trail is constructed (see below).
- 1913 Ranger Station: Adaptive Management Option: Add a shuttle stop with an approximately 1,200-square-foot concrete pad waiting area, if conditions exceed thresholds and/or capacity.
- Additional shuttle stops may be added outside the park on the east and west sides as partnerships develop.\*
- Siyeh Bend. Modify the shuttle dropoff schedule to distribute use levels on this trail. Drop-offs would only occur once or twice in the morning and once or twice in the afternoon.\*
- Sun Point. Adaptive Management Option: The National Park Service would consider establishing a new transfer point at Sun Point on the east side so that larger buses would operate between St. Mary’s Visitor Center and Sun Point; then visitors would transfer to smaller passenger vans that can navigate the narrow mountainous corridor. These passenger vans would operate from Sun Point to Logan Pass.\*
- GTSR Corridor. Adaptive Management Option: Consider allowing alternative commercial transportation services that would solely provide transport to various locations along the corridor without a guided tour element. The park could allow for this use under a commercial use agreement or similar avenue.

Design and construction of the proposed shuttle stops described above would vary depending on the location and magnitude of the proposed action, and additional compliance could be required. The use of construction equipment and machinery would be required. For each project, the National Park Service would identify construction staging areas within the specific work zone for each project or existing areas of disturbance. The length of construction would vary by location, but would likely take place during a four to six month construction season over one to several years, depending on the length and site conditions of each trail. Efforts would be made to avoid construction or temporary closures during peak season.

## **Access by Private Vehicle Including Traffic Management and Parking**

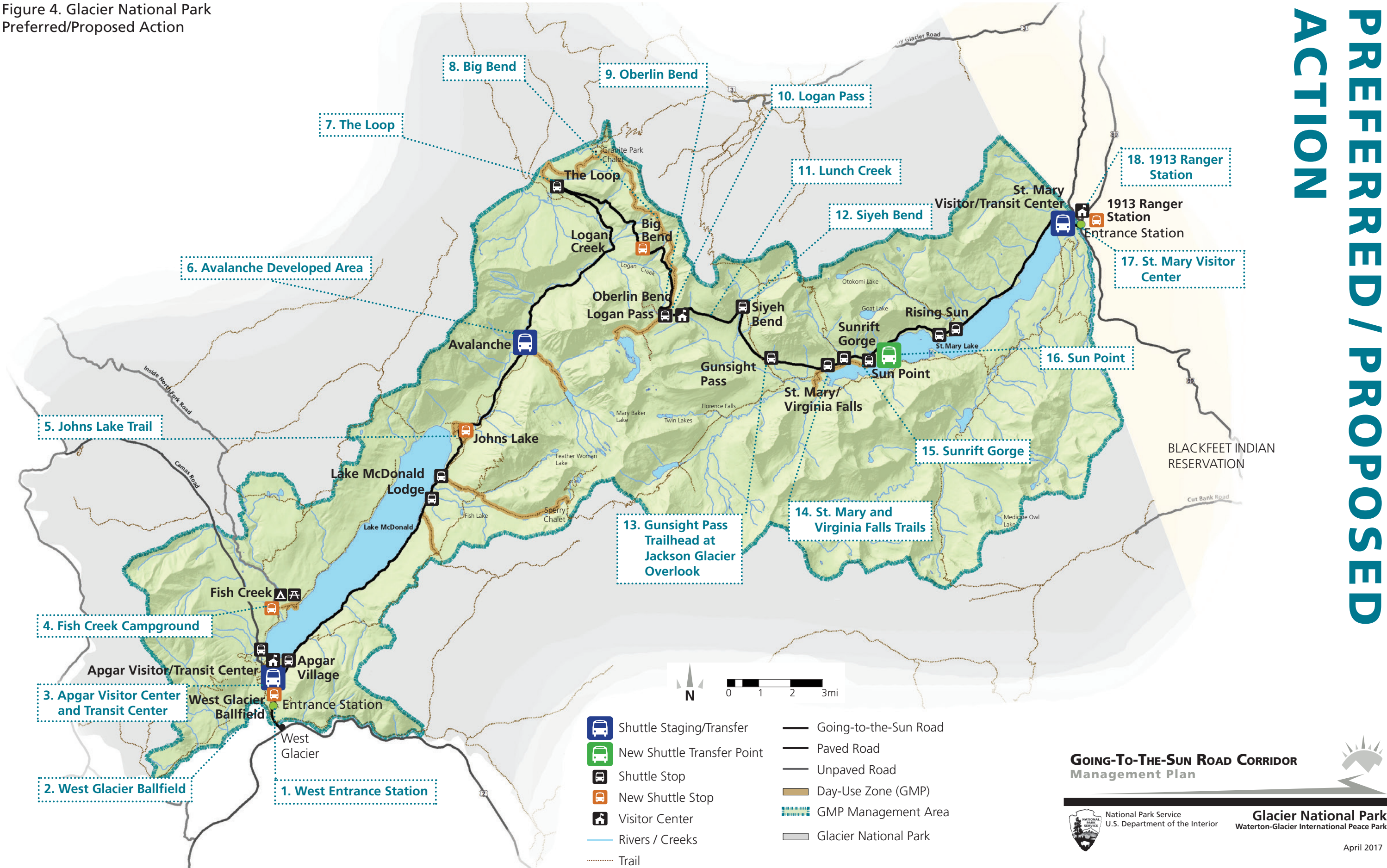
Under the proposed alternative, the following actions related to private vehicle management in the GTSR corridor would occur:

- Allow private vehicles 21 feet in length and less to access the entire length of the GTSR corridor.\*
- Staff a travel information center daily in an existing building during peak season providing traffic, parking, and trail information and real-time updates on park conditions. This would assist visitors navigating traffic volumes and intermittent closures.\*
- Restripe the Apgar Visitor Center and Logan Pass parking lots for compact vehicles.\*
- Continue traffic metering described in the no-action alternative in several locations in addition to strategies described below.\*
- Maintain oversized and regular vehicle parking and a turnaround site at Sun Point.\*
- Restrict overnight parking in the corridor during peak season.
- During peak season, all parking lots in the corridor would be designated for day use parking only with signage.

- Implement a phased day use parking permit system beginning with Logan Pass and St. Mary and Virginia Falls Trailhead using the following design parameters:
  - Hold a percentage of permits aside for short-term purchase (i.e., day of, day before, week of). Add leftover advance reservations and no-shows to the short-term reservation pool.
  - Provide opportunities to obtain permits online and in locations throughout the park and local community.
  - Timed-entry permits would only be valid for entering during a specified time and when accompanied by an entrance pass. Provide opportunities to purchase entrance passes in tandem with parking permits, separately online, and at locations including visitor information centers.
  - Fund operation of the parking permit system through a fee associated with the reservation. The fee would be tied to the cost of operating the reservation system.
  - Adaptive Management Option: Monitor vehicles numbers at other sites such as Avalanche, Big Bend, and St. Mary Visitor Center to ensure these areas are meeting desired conditions. If conditions exceed thresholds and/or capacity, implement a parking permit system at these locations as the second phase.
  - Adaptive Management Option: After initial implementation of the day use parking permit system, monitor the number of permits, allocations of permits (between types of users), or the length of time a parking permit is valid. Adjust these up or down to ensure the highest possible use of the existing available parking while achieving and maintaining desired conditions.
- West Side Construction Staging Area. Widen the 0.25-mile segment of Quarter Circle Bridge Road to the Ball Field approximately 8 feet to accommodate increased traffic. Convert the site to a 100-space parking area for passengers and oversized vehicles and install two electric vehicle solar powered charging stations.
- Apgar Visitor Center and Transit Center Developed Area. Add two hard-wired electric vehicle charging stations.
- Avalanche Developed Area. As mentioned under the purpose and need section in chapter 1, visitation increases at the park have resulted in considerable traffic congestion in the GTSR corridor and portions of the road are failing in their level of service (see appendix K). Over the course of the planning process, the park has had to consider where there is potential to accommodate additional visitor parking while minimizing impacts to natural and cultural resources. As an existing developed area, the Avalanche area was analyzed in detail due to its capacity to accommodate additional parking capacity without the need for large areas of new disturbance. As a result, the following proposed actions were developed after considering multiple factors and considerations.
  - Do not allow parking along the campground entrance road. To facilitate better traffic flow, make the current entrance one way and restore the historic exit just west of the entrance road.



Figure 4. Glacier National Park Preferred/Proposed Action





*This page intentionally left blank.*

- Adaptive Management Option: To allow the park to respond to changes in visitation levels and the need for additional parking, the following dynamic parking configurations and uses would be implemented seasonally, resulting in a range of 128–269 available parking spaces (see figure 5):
  - Maintain 10 existing spaces for oversized vehicle parking and turnaround.
  - Maintain picnicking in the existing area as either walk-in or drive-in, dependent on the level of visitation. As parking demand increases, move picnicking to the middle of loop A and use the existing picnicking area for parking (adding approximately 35 to 40 parking spaces for both regular and oversized vehicles).
  - If parking demand warrants during peak season, temporarily close a portion of campground loop A to accommodate approximately 125 vehicles.
  - If parking demand during peak season increases, close the campground to camping during peak season only and use all the sites for parking. Use the currently abandoned campground loop for parking and construct a secondary road segment to connect the abandoned loop to loop A. This would provide approximately 57 parking spaces in the abandoned loop; an additional approximately 100 parking spaces in the remainder of campground loop A; and approximately 120 parking spaces in loop B. Parking in these loops would only occur within the existing footprint.
- Big Bend. Reorganize and stripe the pullout areas within the current footprint to increase the efficiency of this space. \*
- Logan Pass. Add two solar powered electric vehicle charging stations.
- St. Mary Visitor Center. Add 10 additional parking spaces on undisturbed flat ground.
- 1913 Ranger Station. Widen the 1-mile-long approach road by approximately 20 feet and expand the parking lot by approximately 40 spaces for compact and oversized vehicles.

Collectively, these proposed actions would add up to approximately 400 additional parking spaces in the corridor, for a total of approximately 2,400 spaces.

Design and construction for the physical changes to parking opportunities described above would vary depending on the location and magnitude of the proposed action; additional compliance could be required for some of the proposed actions. The use of construction equipment and machinery, such as heavy grading equipment, could be required in some locations. For each project, the National Park Service would identify construction staging areas in the specific work zone for each project or existing areas of disturbance. Length of construction would vary by location, but would likely take place during a four to six month construction season over one to several years, depending on weather and site conditions of each location. Efforts would be made to avoid construction or temporary closures during peak season, but would likely include temporary delays not to exceed 30 minutes.

The National Park Service would monitor indicators for transportation as described in appendix D. If, after implementation of these proposed actions, desired conditions were still not being met, additional adaptive management strategies would be considered, as described in appendix D.

## **Trails and Trailhead Facilities**

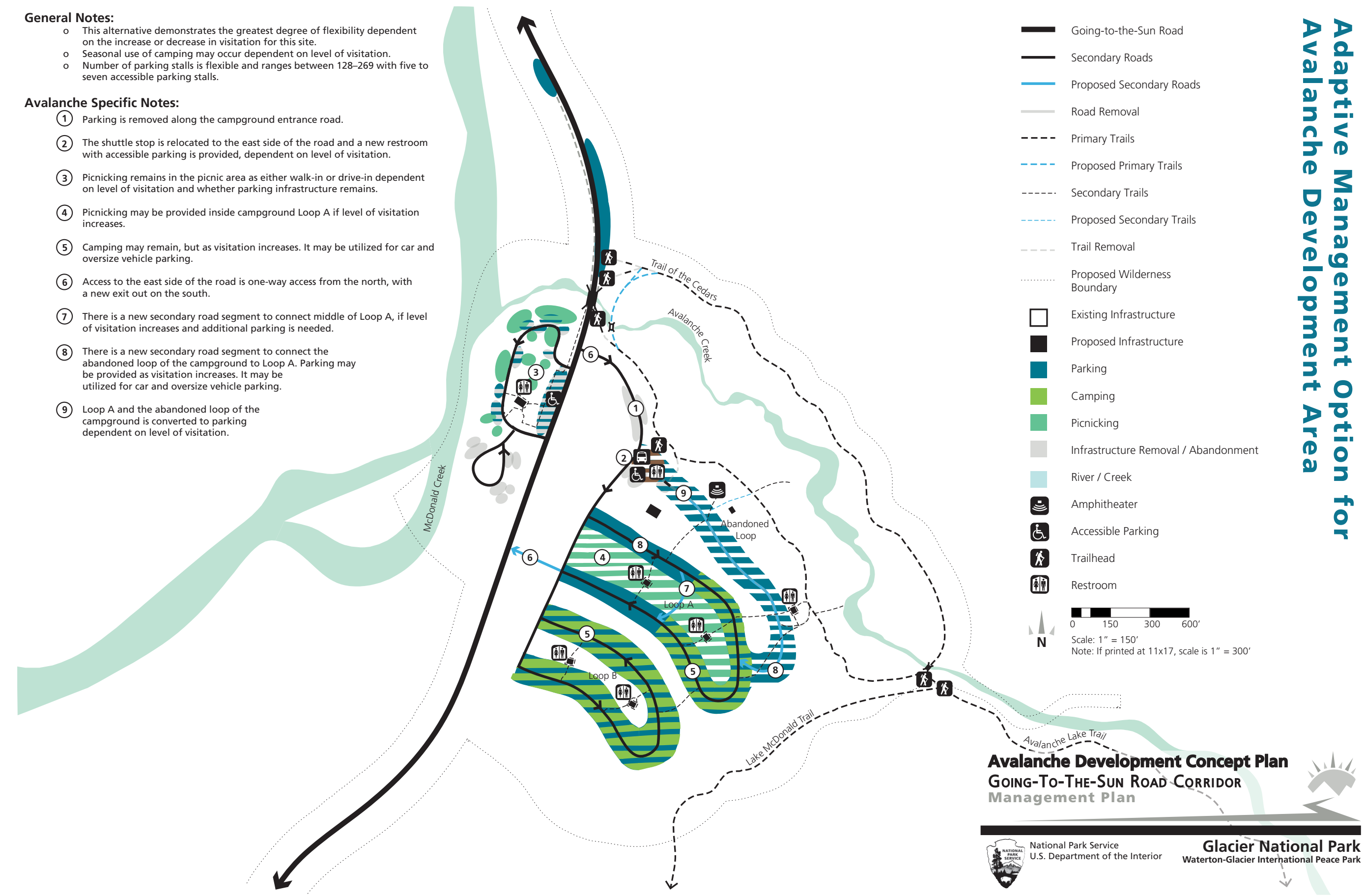
Collectively, the proposed actions include up to 7.5 miles of new trail, as follows:

- Avalanche Developed Area. Construct a vault toilet near the new shuttle shelter. Do not allow commercially guided hikes during peak season (currently July and August), and limit them to two trips per day and 25 people per trip per operator during other seasons. Harden 2.5-miles

of the trail in appropriate locations to accommodate high-use levels. Formalize trail extension for 0.5 mile around a portion of the lake.

- Big Bend. Add a removable vault or backcountry toilet during peak season. Adaptive Management Option: If conditions exceed thresholds and/or capacity, designate one-way travel along the Highline Trail (from Logan Pass to the Big Bend cutoff) during peak season. Construct an approximately 3-foot-wide and 3-mile-long exposed soil footpath from Big Bend to the Highline Trail for two-way travel during peak season. Due to wildlife concerns, upon further design of this trail, consultation under the Endangered Species Act would be required and a determination would be made regarding the need for any additional environmental compliance.
- Logan Pass. Assign volunteers during peak season to conduct foot traffic control at the cliff area on the Highline Trail. Designate one-way travel on the Highline Trail to Big Bend and implement a timed-entry permit system for hiking this trail to manage use levels. Establish a group size of 25 people for commercially guided hikes and a maximum of two trips per day per operator along the Highline Trail (exempt concessioner-guided hikes from this hiking permit requirement). Construct a backcountry toilet near Hidden Lake Overlook and another at Haystack Butte on the Highline Trail. Enlarge Hidden Lake Overlook by approximately 15 square feet.
- Lunch Creek. Adaptive Management Option: If conditions exceed thresholds and/or capacity, reestablish an approximately one-mile-long footpath from Lunch Creek to Logan Pass along a historic construction road used to build the GTSR corridor. Due to wildlife concerns, consultation under the Endangered Species Act would be required and a determination would be made regarding the need for any additional environmental compliance.
- Siyeh Bend. Construct a backcountry toilet in the first mile of the trail and another at Preston Park. Adaptive Management Option: If conditions exceed thresholds and/or capacity, construct a one-mile trail from Siyeh Bend to Lunch Creek (4-foot-wide soil footpath) using an existing unmaintained horse trail. Due to wildlife concerns, consultation under the Endangered Species Act would be required and a determination would be made regarding the need for any additional environmental compliance.
- Gunsight Pass Trailhead at Jackson Glacier Overlook. Manage the trail for a lower level of use to offer opportunities for solitude in the corridor. Promote use of the trail from Jackson Glacier Overlook to Sun Point during peak season and consider implementing a day hike permit system.
- Sun Point. Promote and maintain trailhead to Three Falls hike and Sun Point Nature Trail.
- St. Mary and Virginia Falls Trail. Construct a backcountry toilet along the trail about 0.5 mile from the trailhead. Establish a group size of 25 people for commercially guided hikes and a maximum of two trips per day per operator along the St. Mary Falls Trail.
- St. Mary Visitor Center. Construct a 12-foot-wide, under-road crossing for pedestrians and bicycles. The crossing would also be designed to provide floodwater passage during high-water events. Upon further design of this element, consultation under the National Historic Preservation Act would be required and a determination regarding the need for any additional environmental compliance would be made.
- 1913 Ranger Station. Construct a 1.5-mile-long and up to 12-foot-wide asphalt bicycle trail from the 1913 Ranger Station to St. Mary Campground and St. Mary town site. This would require additional documentation and public notification in accordance with 36 *Code of Federal Regulations* (CFR) 4.30.

Figure 5. Avalanche Development Concept Plan



*This page intentionally left blank.*



Trail design for the areas described above would vary depending on topography and adjacent resources, but trails would generally be approximately 3 to 8 feet in width. Depending on the location and site conditions, construction equipment could include both hand tools and mechanized equipment such as chainsaws, rock drills, generators, possible rock blasting, and use of helicopters for material delivery. Length of construction would vary by location but would likely take place during a four to six month construction season over one to several years, depending on the length and site conditions of each trail. Efforts would be made to avoid temporary closures during peak season.

At all trail locations, the National Park Service would monitor indicators and capacity as described in appendix D. If, after implementation of these proposed actions, desired conditions were still not being met, additional adaptive management strategies would be considered as described in appendix D.

## **Bicycle Use**

Access to current bicycling opportunities and regulations during peak season would continue as described in the no-action alternative. Other proposed actions related to bicycle use include:

- Consider expanded opportunities for bicyclists to use the shuttle system by including some shuttles with bicycle trailers.\*
- Install bicycle racks at various locations, including Apgar Visitor and Transit Center, Avalanche Developed Area, The Loop, Big Bend, Oberlin Bend, Logan Pass, Siyeh Bend, Gunsight Pass Trailhead at Jackson Glacier Overlook, St. Mary and Virginia Falls Trail, Sun Point, St. Mary Visitor Center, and the 1913 Ranger Station to support increased bicycle.\*
- Consider additional bicycle-only events (i.e., “car-free mornings”) in the event of decreasing parkwide visitation.\*

## **Visitor Use, Experience, Interpretation, and Education**

The National Park Service would take the following actions under this alternative:

- At Apgar and St. Mary Visitor Centers, extend daily operating hours and the open season into the spring and fall shoulder seasons.\*
- Provide better access to brochures, newspapers, websites, and social media to improve trip planning. Promote visiting the park during a nonpeak season.\*
- Evaluate and install new wayfinding and other visitor information signage as a coordinated strategy.\*
- At Logan Pass, a site manager would be re-established at Logan Pass to provide additional area oversight.\*
- At Avalanche Developed Area, improve visitor orientation by moving the shuttle stop sign and site orientation to the south side of the road.\*
- Manage use levels on trails to provide a range of experiences in the GTSR corridor.

## **Technology**

Technology being applied in the park would continue as described in the no-action alternative. In addition, the National Park Service would explore the following actions under this alternative:

- As available, use emerging technology to connect visitors with in-car information systems to find available parking, identify congested areas, shuttle stops, and orientation information. Encourage emerging transportation and communication technology such as connected

vehicles, driverless vehicles, and electric vehicles to the extent they would meet desired conditions.\*

- Develop a congestion app and mobile device-friendly website using real-time data.\*
- Add device charging stations at select service areas to enable visitors to use personal devices to access park information.\*
- Equip entrance stations with updated technology to expedite park entry including handheld park pass readers and other automated controls. West and East Entrance Station efficiencies identified in a 2014 business operation analysis would occur, including an automated entrance gate in the current administrative bypass lane, roving fee collection using tablet devices, and use of cameras.\*
- At the West Entrance Station, redesign the station within its current footprint to include automated technology and the addition of two or more kiosks in each lane to enable one lane to provide entry for two or more cars. This action would be subject to additional compliance.
- At Logan Pass, add technology improvements to continue to communicate parking conditions with entrance stations (e.g., real-time information).

## **Partner Opportunities**

The National Park Service would take the following actions under this alternative:

- Make park entrance passes available for sale at partner satellite locations.\*
- Encourage regional transit connections in gateway communities and work with local agencies to develop remote intercept parking and transit stops outside the park, including the West Glacier Train Station, provide links to in-park shuttle services, and disperse visitors to other locations and experiences outside the park.\*
- Seek partnerships with other organizations that provide visitor and tourism information to encourage visitation during off-peak times.\*
- Seek meaningful partnerships with agencies and community services and resources to build capacity, maximize resource sharing, and provide levels of service that neither the park nor community or other agencies could accomplish alone.\*

## **Resource Protection**

Current activities for resource protection described in the no-action alternative would continue. Other actions the National Park Service would take in this alternative would include:

- Station additional temporary ranger staff at popular locations to provide education about appropriate wildlife interactions and other resource protection initiatives.\*
- Create a volunteer group to educate visitors about wildlife safety topics and manage routine visitor-wildlife encounters at busy locations such as Logan Pass.\*
- Develop a mountain goat safety video.\*
- Monitor and respond to use levels on trails to reduce encounters between wildlife and hikers.
- Implement water conservation measures at Logan Pass if visitation and water use exceeds capacity of the system and threatens federally listed stonefly species.

## Natural Soundscape Protection

The National Park Service would take the following actions under this alternative:

- Perform noise monitoring as described in appendix D.\*
- Continue education and outreach to visitors and implement best management practices to reduce the effects of traffic noise on park resources in the corridor. To reduce the duration and intensity of noise in the corridor, motorists would be encouraged to do the following—turn off engines while parked, minimize idling, avoid revving engines, limit the use of horns and vehicle radios, reduce speeds, and avoid the use of aftermarket mufflers. As further guidance is provided at the national level, take additional actions to manage noise levels.\*

## MITIGATION MEASURES

Mitigation measures are delineated in appendix E.

## PROPOSED ACTIONS BY LOCATION

Table 3 summarizes all of the proposed actions the National Park Service would take under the preferred/proposed action by location, as numbered on figure 4.

**TABLE 3. PREFERRED/PROPOSED ALTERNATIVE ELEMENTS BY LOCATION**

<b>Location on Figure 4</b>	<b>Location</b>	<b>Proposed Actions</b>
1	West Entrance Station	Redesign the entrance within its current footprint to include automated technology. Add two or more kiosks in each lane to enable one lane to provide entry for two or more cars. This action would be subject to additional compliance.
2	West Side Construction Staging Area	Widen the 0.25-mile segment of Quarter Circle Bridge Road to the Ball Field to 8 feet to accommodate increased traffic. Add one shuttle stop with an approximately 200-square-foot waiting area with shelter and related signage and a vault or backcountry toilet. Convert the Ball Field to a 100-space parking area for passengers and oversized vehicles. Install two electric vehicle solar-powered charging stations in the new paved lot.
3	Apgar Visitor Center and Transit Center	Add two hard-wired electric vehicle charging stations. Install bicycle racks.
4	Fish Creek Campground	Add a shuttle stop.
5	Johns Lake Trail	Add a shuttle stop consisting of a roughly 800-square-foot waiting area and related signage. The exact location and related compliance would be determined in the future.

Location on Figure 4	Location	Proposed Actions
6	Avalanche Developed Area	<p>Improve visitor orientation by moving the shuttle stop sign and site orientation to the south side of the road. Construct a vault toilet near the shuttle shelter and install bicycle racks to support increased bicycle use in the shoulder season.</p> <p>Do not allow parking along the campground entrance road. To facilitate better traffic flow, make the current entrance one way and restore the historic exit just west of the current entrance. To allow the park to respond to changes in visitation levels and the need for additional parking, the following dynamic parking configurations and uses would be implemented, as needed, resulting in a range of 128 to 269 available parking spaces. Maintain 10 spaces for oversized vehicle parking and turnaround. Maintain picnicking in the existing area as either walk-in or drive-in, dependent on the level of visitation. As parking demand increases, move picnicking to the middle of loop A and use the existing picnicking area for parking (adding approximately 35–40 parking spaces for both regular and oversized vehicles). If parking demand warrants during peak season, close a portion of campground loop A to accommodate approximately 125 vehicles. If parking demand during peak season increases, close the campground to camping during peak season and use all the sites for parking. Use the currently abandoned campground loop for parking and construct a secondary road segment to connect the abandoned loop to loop A, providing approximately 57 parking spaces. Provide approximately 100 additional parking spaces in the remainder of campground loop A and approximately 120 parking spaces in loop B. Parking in these loops would only occur within the existing footprint.</p> <p>Monitor vehicle numbers at Avalanche to ensure desired conditions were being maintained. If the thresholds were exceeded, implement a parking permit system in this location.</p> <p>Do not allow commercially guided hikes during peak season (currently July and August), and establish a group size of 25 people per trip per operator during other seasons. Harden 2.5 miles of the Avalanche Lake Trail in appropriate locations to accommodate high-use levels. Formalize trail extension for 0.5 mile around a portion of the lake.</p>
7	The Loop	Install bicycle racks to support increased bicycle use.
8	Big Bend	<p>Add signs to designate the area as a shuttle stop and install bicycle racks to support increased bicycle use.</p> <p>Reorganize and stripe the pullout at Big Bend within the current footprint to mitigate traffic congestion and increase parking efficiency.</p> <p>Monitor vehicle numbers at Big Bend to ensure desired conditions are being maintained (see appendix D). If the thresholds were exceeded, implement a parking permit system in this location.</p> <p>Install a removable vault toilet during peak season.</p> <p>Adaptive Management Option: If conditions exceed thresholds and/or capacity, designate one-way travel along the Highline Trail (from Logan Pass to the Big Bend cutoff) during peak season. Construct an approximately 3-foot-wide and 3-mile-long exposed soil footpath from Big Bend to the Highline Trail for two-way travel during peak season. Install signage to designate the parking lot for day use parking only during the peak season.</p>
9	Oberlin Bend	Install bicycle racks to support increased bicycle use.

Location on Figure 4	Location	Proposed Actions
10	Logan Pass	<p>Install bicycle racks to support increased bicycle use.</p> <p>Restripe parking lots for compact vehicles and install two electric vehicle solar-powered charging stations.</p> <p>During the peak season, designate the parking lot for day use parking only and implement a day use parking permit system (described above) to more effectively manage use in the desired resource and experiential conditions of the site.</p> <p>Add technology improvements to communicate parking conditions at the entrance stations (e.g., real-time information).</p> <p>Create a volunteer group to educate visitors about wildlife safety topics and to manage routine visitor-wildlife encounters in this location. Consider providing an NPS site manager to provide additional area oversight. During peak season, assign volunteers to conduct foot traffic control at the cliff area on the Highline Trail. Establish a group size limit of 25 people and two trips per day per operator for commercially guided hikes along the Highline Trail (exempt concessioner-guided hikes from this hiking permit requirement). Construct a backcountry toilet near Hidden Lake Overlook and another at Haystack Butte on the Highline Trail. In addition, enlarge and harden Hidden Lake Overlook by approximately 15 square feet.</p> <p>Adaptive Management Option: If conditions exceed thresholds and/or capacity, designate one-way travel on the Highline Trail to Big Bend and implement a timed-entry permit system for hiking this trail to manage use levels.</p>
11	Lunch Creek	<p>Adaptive Management Option: If conditions exceed thresholds and/or capacity, reestablish an approximately one-mile-long footpath from Lunch Creek to Logan Pass along a historic construction road used to build the GTSR.</p>
12	Siyeh Bend	<p>Modify the shuttle drop-off schedule to distribute use levels on the trail. Drop-offs at this location would only occur once or twice in the morning and once or twice in the afternoon. Install bicycle racks to support increased bicycle use.</p> <p>Adaptive Management Option: If conditions exceed thresholds and/or capacity, construct a one-mile trail from Siyeh Bend to Lunch Creek (4-foot-wide soil footpath) using an existing unmaintained horse trail. Construct a backcountry toilet in the first mile of the trail and another at Preston Park.</p>
13	Gunsight Pass Trailhead at Jackson Glacier Overlook	<p>During peak season, designate the parking lot for day use parking only. Install bicycle racks to support increased bicycle use.</p> <p>Manage the trail for a lower level of use to offer opportunities for solitude in the corridor. During peak season, promote hikes from the Jackson Glacier Overlook to Sun Point.</p>
14	St Mary and Virginia Falls Trail	<p>During peak season, designate the parking lot for day use parking only and implement a day use parking permit system (described above) to more effectively manage use in the desired resource and experiential conditions of the site. Install bicycle racks to support increased bicycle use. Construct a backcountry toilet along the trail about 0.5 mile from the trailhead. Establish a group size limit of 25 people per group and two trips per day per operator for commercially guided hikes along the St. Mary Falls Trail.</p>
15	Sunrft Gorge	There are no proposed changes at this location.
16	Sun Point	<p>Maintain oversized and regular vehicle parking and a turnaround site. Install bicycle racks to support increased bicycle use. Promote and maintain trailhead to Three Falls hike and Sun Point Nature Trail.</p>



Location on Figure 4	Location	Proposed Actions
17	St. Mary Visitor Center	<p>Add 10 additional parking spaces on undisturbed flat ground. Install bicycle racks to support increased use.</p> <p>Monitor St. Mary Visitor Center to ensure desired conditions are being maintained (see appendix D). If the thresholds are exceeded, implement a parking permit system in this location.</p> <p>Extend daily operating hours and extend the open season into the spring and fall shoulder seasons.</p> <p>Construct approximately a 12-foot-wide, under-road crossing for pedestrians and bicycles. The crossing would also be designed to provide floodwater passage during high-water events.</p>
18	1913 Ranger Station	<p>Widen the one-mile-long approach road by 20 feet and expand the parking lot by approximately 40 spaces including oversized vehicles.</p> <p>Install bicycle racks to support increased bicycle use.</p> <p>Construct a 1.5-mile-long and up to 12-foot-wide asphalt bike trail from the 1913 Ranger Station to St. Mary Campground and St. Mary town site.</p>

## CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

### INTRODUCTION

This chapter provides baseline information on the potentially affected resources including visitor use and experience, natural resources, and cultural resources. It also includes an analysis of the potential beneficial and adverse direct, indirect, and cumulative impacts of each alternative described in chapter 2. A discussion of impact topics dismissed from further analysis can be found in appendix H. Direct impacts occur as a result of the proposed action, at the same time and place of implementation (40 CFR 1508.8). Indirect impacts occur as a result of the proposed action but later in time or farther in distance from the action (40 CFR 1508.8). Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such actions” (40 CFR 1508.7). Cumulative impacts are determined for each impact topic by combining the impacts of the alternative being analyzed and other past, present, and reasonably foreseeable actions that also would result in beneficial or adverse impacts. Other past, present, and reasonably foreseeable actions occurring within or in proximity to GTSR were identified through the internal and external project scoping process and are listed in appendix F. For purposes of the cumulative effects analysis, the temporal scope considered past actions that occurred one decade before present and future actions that could occur one decade after present.

### VISITOR USE AND EXPERIENCE

#### Affected Environment

Visitor use and experience is linked to both road access and associated recreational amenities along the road including hiking, bicycling, camping, driving, and other visitor activities such as riding the shuttle in the GTSR corridor. The affected environment for visitor use and experience includes the GTSR corridor, including the roadway itself, and the larger management area that encompasses some portions of the park’s trail system and recommended wilderness areas proximate to the roadway.

In the last 30 years, park annual visitation has ranged from a low of 1.8 million in 1988 to a record high of 3.3 million in 2017. Visitation has fluctuated throughout the years; however, visitation has been increasing overall since the park’s opening in 1911. Park visitation is seasonal due to the short summers and the limited length of time the entire GTSR is open to vehicle traffic. Shoulder season visitation is increasing at a faster rate than peak season visitation. May, June, and September have had the highest recorded visitation on record during three of the last five years.

**Visitor Characteristics.** Over the past 25 years, there have been numerous studies of park visitors that have gathered social and economic data about the visiting parties and their households (e.g., Littlejohn 1991; WIS 2001; Nickerson 2002). Oschell, Tanner, and Nickerson (2009) conducted the most current study in 2008. The demographic and trip characteristics of park visitors presented here draws primarily from that research.

Visitors to Glacier National Park come from all over the world, but primarily from the United States and Canada. Montana residents are the most frequent visitors to the park (8% of all visitors). The Midwest has been a traditional origin of park visitors over the years. In 2009, Minnesota, Wisconsin, Illinois, Michigan, and Ohio comprised 19% of annual visitation. Residents of California, Oregon, and Washington accounted for another 17% of all visitors. Alberta, Canada, residents represented 6% of

total park visitors in 2009. A 2001 survey found that 44% of people coming to the park were first-time visitors; a slight downturn from 59% and 62% for similar studies performed in 1991 and 1996, respectively (Littlejohn 1991; Miller, Freimund, McCool 1997; NPS 2001a).

Results from a 2016 summer visitor survey revealed that visiting the park was the primary trip purpose for 46% of visitors, one of several equally important destinations for 51% of visitors, and an incidental stop for 3% of visitors (RSG 2019). More than 86% of survey respondents stayed overnight in the nearby area during their trip to the park (Cullinane et al. 2019). Of these overnight visitors, 56% stayed in lodging outside the park, 16% camped outside the park, 8% camped in the park, 3% lodged in the park, and 4% stayed with friends or family living in the local area. Time spent in the local area ranged from 4 days for visitors staying in lodging outside the park and up to 6 days for visitors camping inside the park (Cullinane et al. 2019). Average local area spending per visitor group ranged from \$54 per day for local area day visitors to \$400 per day for visitors lodging outside the park.

**Trip Planning and Technology.** The park website offers information to visitors. Many non-NPS websites, some that are maintained by service providers, provide information that can be useful for arranging lodging and activities. There are also several software applications for smartphones and tablets that are helpful for planning visits to Glacier National Park. In addition, more visitors are using smartphones and other devices, in addition to traditional methods, such as toll-free phone numbers and signage throughout the park, to monitor campground and road status.

A recreation access display was developed and made available to the public in 2019 on the website and at all visitor centers and contact stations. The display provides daily information on weather, parking lots, and campground availability. Intelligent transportation systems use various technologies to monitor, evaluate, and manage transportation in real-time or near real-time. For example, intelligent transportation systems might monitor rehabilitation or traffic and accident delays, weather conditions, and arrival times, and display information on roadside LED signs.

Visitors to the park arrive through a variety of transportation methods. There are multiple airports nearby, and train and bus stations, regional tour services, local shuttles, taxis, and tours, etc., also offer service to the park. On arrival, cars are by far the most common transportation mode along the GTSR. In 2013, 88% of travelers used a car on the west side of the park and 85% of travelers used a car on the east side (Volpe 2014).

The East and West Entrance Stations are an important opportunity for park staff to provide visitors with a range of information in a short period of time. Unfortunately, when the West Entrance Station queue extends to Highway 2 and vehicles are waved through to clear congestion, the opportunity to share information is lost.

Cell phone service is limited past Apgar on the west and Rising Sun on the east and visitors cannot rely on cell phones for contacting park staff, real-time traveler information, or other information on park resources once they are in the interior of the park. Radio communication is limited to specific sites along the road. However, radio communications are constantly being improved along the GTSR. Park data can be downloaded for use in advance of arriving or at park entrances.

**Travel Patterns.** Visitation to the park during the peak season is fairly balanced across the days of the week. Weekend visitation is slightly higher than weekdays only by one or two percentage points (NPS traffic count data by lane at West Glacier and St. Mary Entrance Station). The nonpeak season has greater variation across the week. Weekday and weekend visitation to the park numbers start to rise in the spring and then peak during July and August. The time of day that visitors arrive at the park also varies by weekend and weekday.

In terms of general traffic patterns along the GTSR, eastbound traffic has more spikes in volume than westbound traffic. The data show that the West Entrance Station peaks at 10:00 a.m., and steadily increases at other points throughout the day. A number of eastbound visitors stop at Apgar Visitor Center where they may take a shuttle to travel the GTSR or obtain trip planning and interpretive information. A portion of West Glacier visitors enter the park through the west entrance and travel to St. Mary Visitor Center, and then return to the West Entrance Station later in the day, rather than exiting the park on the east side or remaining in the park for multiple days. St. Mary Visitor Center entries are more spread out throughout the day and do not exhibit the same dramatic entry peaks that the West Entrance Station experiences.

**Visitor Opportunities.** Diverse recreational opportunities and experiences are available for visitors at the park. Visitors can drive the GTSR in their own vehicles, use the park shuttle system, or take advantage of commercially operated tour vehicles. They can stay in the park's grand historic lodging facilities or choose from campgrounds and motor inns. Other activities include snowshoeing, cross-country skiing, horseback riding, canoeing, fishing, or participating in a boat tour. Visitors can hike on an estimated 148 miles of designated trails in the GTSR management area, most in recommended wilderness, and access primitive campsites and backcountry overnight chalets. Day hikes and multiple-day backpacking trips are all popular recreational activities during peak season. In 2007, the three most popular visitor activities were driving/auto-touring, wildlife watching, and stopping at the park's various visitor centers (Baker and Freimund 2007).

From 2010 to 2013, the GTSR corridor received approximately 1.3 million visitors per year (NPS PUSO 2010–13). While the GTSR corridor contains by far the most popular points of interest, the proportion of total recreational visitors who only visit the corridor is less during summer months as other areas of the park become accessible after road plowing and snow melt.

During the winter months (December to March), almost 95% of visits to the park are to the GTSR corridor; however, those visitors accessing the GTSR corridor do so in a limited way during the winter months. Vehicles on the west side may only drive as far as Lake McDonald Lodge, and on the east side only the first 1.5 miles of the GTSR is maintained for winter driving. Visitors do take advantage of skiing and other winter recreation opportunities from parking areas like Lake McDonald Lodge. There is camping available year round at Apgar and St. Mary Campgrounds and the Apgar Visitor Center is open on the weekends during the winter.

*Hiking*— Glacier National Park is well-known for its outstanding hiking opportunities in a mountainous, alpine environment. Trails in the GTSR corridor provide access to five ecoregions. The GTSR corridor offers a wide range of different recreational hiking experiences for visitors, including different levels of trail use, other social conditions, wildlife experiences, soundscape quality, and natural/pristine conditions. Hikes along the GTSR corridor include short, accessible trails like the Trail of the Cedars, mid-distance hikes like Avalanche Lake or Hidden Lake, and longer-distance hikes like the Highline to The Loop Trail or Siyeh Pass. Additionally, many overnight backcountry trips begin or end at a trailhead in the GTSR corridor.

Currently, many trails along the corridor have experienced significant increases in visitor use, including the Avalanche Lake Trail, which has seen a 250% increase since 1988. Similarly, The Loop increased from 1,800 hikers in 1988 to 29,779 in 2015. As a result, trails do not always provide the visitor experience that some hikers seek. Because of increases in visitation, visitors to the GTSR corridor do not always have the ability to choose a hiking experience to meet their preferences.

There are 26 trails accessible from the GTSR by 18 trailheads. For hikers, the three most popular destinations are Hidden Lake Overlook (Logan Pass), Avalanche Lake (west side), and the Highline Trail (Logan Pass). The St. Mary Virginia Falls Trail use levels are rapidly increasing as well. The peak

season for trail use is generally from mid-July to mid-August. Many higher-elevation trails do not open until July when the snow cover melts. Lower-elevation trails become accessible to hikers in late April or early May. Recreational hikers can have a substantial impact on the availability of parking as they are likely to stay longer than visitors stopping for a quick photograph or to use a restroom.

The Highline Trail on the west side and the trail network between Siyeh Bend and Sun Point on the east side are considered loop hikes because they allow a hiker to traverse along the GTSR corridor. The shuttle service has enhanced visitors' ability to use these trails for one-way hikes and then take a shuttle back to where their private vehicle is parked.

A number of trails, including those at Avalanche, The Loop, and Logan Pass, require visitors to cross the GTSR to access the trailhead from either a parking area or transit stop. The accessible location of these trails results in high use levels.

Hiker surveys indicate that ecological experiences like wildlife viewing and enjoying pristine natural areas are the most highly rated components of the hiking experience (Miller and Freimund 2014). Finding true solitude while hiking in the corridor can be challenging. Approximately 20% of hikers in the corridor have been displaced from areas in the park because they believe recreational use is too high in certain locations (Miller and Freimund 2014). Displaced hikers are those who choose to go elsewhere or not go at all to avoid a probable park experience like an extremely crowded or ecologically impacted trail.

*Bicycling*— Bicycling along the GTSR is popular. Eastbound (uphill) cycling along the road is restricted to certain hours of the day from June 15 to Labor Day between Apgar Campground and Sprague Creek Campground, and from Logan Creek to Logan Pass. It is roughly a 45-minute bike ride from Sprague Creek to Logan Creek and about three hours from Logan Creek to Logan Pass. In addition, there is a network of bike paths in the West Glacier, Headquarters, and Apgar areas. If visitors access the trail in West Glacier just across the Middle Fork of the Flathead, the trail skirts the West Entrance Station.

Guided bicycle tours are authorized under commercial use authorizations. Private companies apply for and are issued noncompetitive permits each year to provide this service. While each company structures its itinerary differently, most groups ride the GTSR and some market this as a highlight of their tour.

*Camping*— Frontcountry camping is a popular activity in the GTSR corridor, and campgrounds fill frequently during peak season. During the peak season, campgrounds are full between 74% and 96% of the days depending on location. During July and August in the years of 2012 through 2014 the Apgar and Avalanche Campgrounds filled during 75% of the available dates. Sprague Creek, Rising Sun, and St. Mary Campgrounds filled 95% of those days. The majority fill before 4:00 p.m., although some campgrounds typically fill before noon. Even during the peak season, visitors have a relatively good chance of finding an open campsite somewhere in the GTSR corridor on most days. St. Mary Campground has a reservation system in place, as do approximately half of the large group sites at Apgar. The rest of the campgrounds along the GTSR corridor are managed on a first-come, first-served basis.

*Driving*— Information regarding the driving experience was informed by visitor research collected from drivers in 2014 at the highest use areas in the GTSR corridor: Avalanche, Logan Pass, and The Loop (Miller and Freimund 2014). Drivers report high levels of satisfaction with the natural environment, experiencing solitude, encountering wildlife, and the ability to find information about what to do along the road. They generally report that seeing a lot of other cars and human-caused

noise detracted from their driving experience. Since 2014, visitation has increased further and as a result, it is likely these visitor issues have also increased in magnitude.

Avalanche is the most congested and crowded area in the GTSR corridor. It is a popular spot because it offers more recreation amenities than any other location, including an accessible trail, multiple hikes, camping, fishing, and picnicking opportunities, shuttle access, oversized vehicle parking, and restrooms. Drivers rated the number of other cars on the roadway as having a greater negative impact on their experience at Avalanche than other survey locations (Miller and Freimund 2014). Pedestrians on the roadway (crossing from the parking area to the hiking area) also cause additional roadway congestion, although 83% of drivers felt neutral about pedestrians detracting from their experience (Miller and Freimund 2014).

The 1990 Transportation Plan for Glacier National Park included a Level of Service Analysis for the GTSR. Level of service is a measure of traffic movement on a roadway. While it is generally used for intersections and city traffic, it offers a comparison for the traffic on the GTSR. Although the level of service numbers reported in the 1990 plan were based on 1985 methodology, the numbers still give a reasonably good estimate of level of service. And given the historical nature of the road, only minimal physical changes have been made to the road. According to the 1990 plan, the level of service for the GTSR was rated at D and E. Level of Service D is defined as approaching unstable flow with tolerable operating speeds. Drivers have little freedom to maneuver or pass other vehicles. Level of Service E is defined as operating at even lower speeds than level D with volumes near capacity of the road. The highest volume under E defines the capacity of the roadway. Flows are unstable and momentary stops may occur. Level of Service F is defined as forced or breakdown flow operation at low speeds where volume exceeds capacity. The University of Montana prepared a Level of Service analysis using 2012 data. Most locations were continuing to operate at Level of Service D; however, at Logan Pass, traffic was well into Level of Service E (Appendix K: Traffic Counts and Level of Service on GTSR [Dalenberg et al. 2017]). Since 2012, visitation has increased 53%. If visitation to the GTSR continues to increase during the summer months as it has since 2012, it's projected that all roadway segments monitored for level of service would be below their threshold (in failing status more than 1% of the time for June–August) by 2020.

Currently, congestion occurs at park entrance stations, particularly at West Glacier. Long lines of traffic are sometimes waved through to clear the congestion. In 2013, park employees stated that at least once per day between mid-July and mid-August, vehicles at West Glacier were waved through without paying due to traffic backing up all the way to State Highway 2 (Volpe 2014), although that practice currently occurs less than in previous years due to operational efficiency improvements. The St. Mary Entrance Station also experiences delays but not as severely. It is rare for vehicles to be waved through at the St. Mary Entrance Station.

Congestion points along the GTSR beyond the entrances are directly related to parking areas. Congested parking areas contribute to congestion on the road. Parking areas and pullouts are spread throughout the corridor, with capacity for more than 2,000 parked vehicles overall. However, parking capacity does not always match demand. Conditions vary by parking area, with some locations having greater activity than others. Lack of parking availability or heavy congestion in certain areas may cause visitors to change their intended plans. The demand for parking across the corridor leads to vehicles circling to wait for spaces, particularly at Logan Pass, where peak wait times can reach an excess of 25–30 minutes, or illegally parking at shuttle stops. The latter situation causes shuttles to load and unload from the travel lane, causing further backups on the road. Additionally, visitors sometimes park along or in the road when parking lots fill, leading to additional pedestrian traffic along narrow roadways, road hazards from parked vehicles, and unsafe conditions.

Although parking availability was not rated as low as the number of other vehicles on the roadway, parking issues did detract from the driving experience for 40% of drivers on the GTSR (Miller and Freimund 2014). Parking experiences are tied to time of day (peak/nonpeak), which explains why surveyed drivers were divided on their ability to find parking in relation to their experience. Parking experiences at select locations are noted below.

The mean response of drivers suggests that the ability to find parking detracts more at Logan Pass than other locations. Parking at Logan Pass during peak times of day is challenging (between 8:00 a.m. and 3:00 p.m.). Many drivers are able to park, but some exit the parking lot without finding a parking space. At 12:00 p.m. and 1:00 p.m., nearly half of all cars exit the parking lot without parking. The higher percentage of drivers at Logan Pass found the ability to park detracted more than at other surveyed locations. Some visitors waited over 30 minutes before successfully finding a parking space. Due to the nature of the research, the survey data from 2014 (Miller and Freimund 2014) only contacted drivers who had successfully found a parking space. This biased the results of the study as researchers only surveyed those who succeeded in parking. For this reason, it is likely that satisfaction with the ability to park is lower overall than what is reflected in the surveyed responses.

Congestion is also caused when vehicles slow down or stop to look at wildlife visible from the road. Congestion caused by viewing wildlife is difficult to predict or mitigate.

**Shuttle System.** The shuttle system has provided an alternative to driving private vehicles since it began in 2007. Shuttle operation has been adapted to ridership trends and needs over the last 13 years. New bus shelters and crosswalks have been added as part of rehabilitation activity to improve the comfort and safety of shuttle riders.

The shuttle system in the GTSR corridor provides access to visitor centers, scenic vistas, campgrounds, and trailheads (see the no-action alternative map in “Chapter 2: Alternatives”). Most visitors ride the shuttle for transportation and are unlikely to ride it for recreational value because it is not designed for interpretation or other recreational activities such as photography and wildlife viewing; however, the shuttle system has become an important part of visitor experience in the corridor. Many hikers use the shuttle to access recreational opportunities such as trailheads, and many shuttle riders also drive the road at some point (Miller and Freimund 2014). The shuttle schedule changes slightly from year to year to make improvements and anticipate interest in certain park locations and is published on the park’s website.

In 2012, it was calculated that people who rode the shuttle during their visit to the GTSR ended up boarding the shuttle an average of 2.4 times due to transfers, multiple stops, etc. (Volpe Center 2014). The express shuttles on the west side were full 68% of the time. Other small shuttle runs on the west side were filled approximately 20% of the time. Shuttles on the east side are seldom at capacity and can absorb increased use levels. According to visitor surveys, wait time was occasionally an issue for visitors; 16% of visitors found time waiting in line unacceptable and 42% felt that the transfer stations were crowded. However, the overall value of the shuttle experience remained high and 68% of visitors felt the service was worth the inconveniences of waiting and crowding. Nearly 90% of visitors were satisfied with the number of people encountered in the shuttle system (Miller and Freimund 2014).

On average, in 2018, approximately 2,712 visitors per day rode the shuttles during peak season; in 2017, 3,308 visitors per day rode the shuttles; and in 2016, 2,929 visitors per day rode the shuttles. Between 2015 and 2018, the shuttle season expanded by almost 17 days. Ridership has increased by 30% daily since 2012 and 70% overall. Currently, the shuttles are operating at capacity more often. Early morning shuttle riders at Apgar form long lines to wait for shuttles to take them east along the GTSR, and in the afternoon at the Loop; however, actions are being taken to address these long wait times.



Like drivers, shuttle riders have fairly similar experiences regardless of location on the GTSR. Visitors at Logan Pass and Avalanche were asked a variety of questions about their shuttle system experiences. Responses indicate that the shuttle offers a unique way to experience the park with high levels of safety, freedom, and access to different areas of the GTSR (Miller and Freimund 2014). Shuttle riders cited shuttle wait time and crowding as negative aspects of their experience.

Shuttle riders commented, “it is hard to get a place on the shuttle” and “the transfer stations seemed crowded” the lowest rating. At Avalanche, shuttle riders generally rated these topics lower than at Logan Pass. Shuttle riders at Avalanche were more neutral or showed more agreement that the transfer stations seemed crowded. Shuttle riders at Avalanche were more likely to strongly agree with the statement “it is hard to find a place on the shuttle” (Miller and Freimund 2014). Shuttle riders at Avalanche rated most negative experience topics lower than shuttle riders at Logan Pass. This was particularly true for the amount of time waiting to access shuttle service (Miller and Freimund 2014).

The different perceptions at Avalanche and Logan Pass are likely due to a variety of factors. Avalanche is a mandatory transfer station. Large buses from Apgar deliver groups of people who typically wait several cycles for a seat on one of the smaller buses capable of driving above Avalanche and into the alpine section of the park. The transfer point tends to create large groups of people and long queues, which could explain why shuttle riders at Avalanche cite more crowding concerns.

Shuttle riders at both Logan Pass and Avalanche indicated that their expectations were being met for a variety of different shuttle experience components (Miller and Freimund 2014). However, the number of other people on the shuttle and access to information materials were rated higher than road construction impacts and access to shuttle service / time waiting in line. These results indicate that crowding (the number of other people on the shuttle) was less of an issue for shuttle riders than the amount of time spent waiting for a shuttle.

Overall, shuttle riders appear satisfied with their shuttle experience (Miller and Freimund 2014). When surveyed, riders generally noted positive experiences with other visitors and shuttle drivers and the level of shuttle etiquette exercised by other visitors. Riders were less satisfied with the amount of space on shuttles and the amount of wait time between shuttles.

**Tour Options.** In addition to bicycling and driving the GTSR, there are also tours available to visitors including the Red Jammer Buses and Sun Tours.

## **Impacts on Visitor Use Analysis**

The effects of the alternatives on visitor use and experience in the project area were analyzed based on impacts resulting from changed opportunities for access to recreation opportunities and key visitor experience. In addition, impacts on current visitor experience resulting from changes to visitor use patterns and visitor demand and expectations at popular destinations was also analyzed. These are important distinctions to recognize given the actions in the alternatives. Where one action may change how visitors can access a site it would, at the same time, affect the quality of the experience for the visitors once they arrive at the site. Understanding and exploring this distinction through this analysis is important to understanding the relative benefits and trade-offs.

**No-Action Alternative.** The no-action alternative represents the continuation of current management practices. This alternative assumes that current visitation levels would likely continue to increase. Under this alternative, demand for parking would remain high and the park would continue to direct visitors to the shuttle service. Visitors would continue to have access to the GTSR; however, they would also continue to experience a loss of solitude; high levels of congestion; and crowding in parking areas, at visitor centers, and on trails. There would also be uncertainty about different

recreational opportunities such as camping and access to specific trails or areas resulting in an adverse impact to visitor use and experience. Visitors would continue to have opportunities to access the GTSR through concessioners and other businesses with commercial use authorizations and bicycling opportunities.

Under the no-action alternative, park management would struggle to adapt to increasing visitation. For example, the park would not be able to provide increased shuttle service to keep pace with the increased demand due to unsustainable operating costs and the need to manage for desired conditions in the area. The most popular travel times would have long wait times and the number of visitors who felt the service was worth the trade-off of leaving their car would likely decline. The no-action alternative would have adverse impacts to those using the shuttle service because of increased wait time.

Current visitor access to parking affects the visitor's driving, hiking, and shuttle riding experience. With increasing visitation, lack of certainty about parking would continue to result in increasing frustration for visitors and adversely impact visitor use and experience. Parking lots would be full into the late afternoon or evening. The Logan Pass parking area would continue to fill to capacity at approximately 7:30 a.m. and remain full until 4:00 p.m. Smaller parking areas would also be at capacity and competition for parking in the corridor would remain high. Reduced ability to park would detract from the visitor experience of those wishing to drive the GTSR in a private vehicle because they may be directed to ride the shuttle or experience increased congestion levels.

Because of a lack of parking during peak times, visitors would likely arrive earlier and later to find parking and parking challenges would extend into nonpeak times of the day. Currently, over 75% of hikers are destination oriented and 65% learned about their hike before arriving at the park. As visitation increases, hikers would have to alter plans when they are unable to locate a parking space. When trails are inaccessible, hikers would likely select another trail in the corridor. This would lead to a continued displacement of hikers during peak times. Satisfaction levels for the hiking experience are currently very high. However, nearly 17% of the visitors evaluated their ability to find solitude as unacceptable. With an increase in visitor use on low use trails, different types of hiking experience that previously included opportunities for solitude would disappear from the corridor during peak season and peak use times. Overall, the lack of diverse recreational opportunities and perceived crowding would have an adverse impact on the majority of hikers; however, some visitors who feel safer hiking with people may see a beneficial impact as more people are on trails that previously saw less visitor use.

Visitors on busy days would continue to experience bottlenecks at the entrance gates, along GTSR, in parking areas, and on trails. Visitors would continue to see many cars on the road, which detracts from the quality of their driving experience. In recent years, visitation has been increasing at a higher rate during the summer months and roadway volumes follow a similar pattern. It is likely that without any management actions, the level of service would be mostly in the F range (in failing status more than 1% of the time for June–August) for all roadway segments monitored for level of service by 2020.

Campground usage would be expected to maintain current levels or continue to increase. The campgrounds are popular but not currently operating at capacity at all times. In the future, it is likely that visitors would still be able to find a place to camp. If use levels continue to increase, it is likely that access to camping in the corridor would be at or above capacity for most campgrounds and competition for late day camping would be intense. This demand would result in some visitors being unable to find camping spaces.

Trip planning information, including current orientation information, would continue to be provided at visitor centers and entrance stations. The continuation of these opportunities and access to information would have a beneficial impact on visitor use and experience.

**Preferred/Proposed Alternative.** Extending the shuttle system's daily operation times, including both earlier and later in the day, and extending the operation season would increase some visitors' ability to access locations and hikes during times of day that were previously not easily available, including earlier in the morning, later in the evening, and during nonpeak times (i.e., June and September). This would have a beneficial impact on visitor use and experience by providing increased opportunities to access the GTSR corridor and also distribute use throughout the day. Adding additional shuttle stops and relocating some others would have beneficial impacts by increasing visitor access to new locations, which would allow visitors riding the shuttle to choose from a greater variety of experiences. In addition, the installation of shuttle stop shelters in some locations would improve visitor safety and provide weather protection while waiting for a shuttle.

If warranted, the park could implement adaptive management options to add a shuttle transfer (similar to the one at Avalanche) at Sun Point and consider alternative commercial transportation services (without a tour element) to various locations along the corridor. If implemented, both of these actions would enhance visitor access for those using them. Conversely, increased alternative transportation access would likely result in increased visitors being delivered to certain areas that were previously constrained by the number of parking spaces. The increase in visitors to certain areas could increase crowding on trails and result in an adverse impact for those seeking opportunities for solitude.

Under the preferred/proposed alternative, phase I of a parking permit system would be implemented, resulting in direct management of a portion of parking lot use at Logan Pass and at the St. Mary and Virginia Falls Trailheads. Implementation of the parking permit system during peak season would provide some visitors with a predictable, quality experience at some parking areas resulting in a beneficial impact to visitor use and experience. For example, visitors with an advanced parking permit would be able to enter the parking area, park, and begin their hike without circling the parking area waiting for a parking space. Because the parking permit system would only apply to a percentage of parking areas, it would not require all visitors to participate in pre-trip planning for parking. A portion of visitors could still enter and find a first come, first served parking space while others could obtain a permit ahead of time. Some visitors may feel constrained by this targeted parking lot permit system; others would appreciate knowing they have a time to visit the park and be assured access. Other sites, including Avalanche, Big Bend, and the St. Mary Visitor Center would be monitored to ensure desired conditions are maintained. If thresholds were exceeded, the adaptive management option would be applied and phase II of the parking permit system would be implemented at these locations, which would have similar impacts. The proposed parking permit system would improve the visitor experience in parking areas for some, while others would still experience an adverse impact if they need to circulate through the parking area to find a parking space or are unable to find a parking space.

Constructing a new parking area at the West Side Construction Staging Area, restriping the pullout area at Big Bend, and expanding the parking lots at St. Mary Visitor Center and the 1913 Ranger Station would increase the number of available parking spaces available to visitors and improve their accessibility to ride the shuttle in some locations.

At the Avalanche Developed Area, prohibiting parking along the entrance road to the campground and reconfiguring circulation in the area to one-way would result in short-term adverse impacts to return visitors who would have to adjust to these changes. If thresholds were exceeded and adaptive management options at the Avalanche Developed Area were implemented, the seasonal conversion of

picnic and camping areas to day use parking would decrease visitors' ability to find a campsite. The dynamic parking configurations would reduce and could completely eliminate the availability of campsites at Avalanche Campground. Visitors would then be less likely to find a first come, first served campsite in the park because the decreased number of available campsites would likely fill earlier in the day. Campsites would also likely be full during more days of the peak season. If implemented, these adaptive management options would result in an adverse impact to some campers but would provide a beneficial impact for day users as a result of expanded parking areas, increased parking opportunities, increased access, and reduced congestion in other parking areas.

Restricting overnight parking in the GTSR corridor and restriping for compact cars would provide additional parking through increased lot efficiency. These management actions would have beneficial impacts on visitor use and experience as more spaces would open at shorter intervals providing increased opportunities for visitors to park. Visitors using locations such as Logan Pass to access the backcountry for overnight camping (or to access the Granite Park Chalet) would have to take the shuttle to these locations, restricting their ability to drive and resulting in an inconvenience to those backcountry campers.

The addition of new vault or backcountry toilets at Avalanche, Big Bend, Siyeh Bend, and the St. Mary and Virginia Falls Trails would have a beneficial impact to visitors by reducing human waste and providing convenience. Limiting the group size and daily number of commercially guided hikes at sites such as Avalanche and the Highline Trail would reduce a small number of people hiking the trail overall, but would also reduce the likelihood of encountering large groups along the trail, which would result in beneficial impacts on visitor experience. Implementing a parking permit system at Logan Pass, designating one-way travel on the Highline Trail to Big Bend, and managing the Gunsight Pass Trail for a lower level of use would result in beneficial and adverse impacts because visitors would have an improved experience with less congestion while on the trail; however, some visitors may not be able to visit at their desired time or on their desired day.

Hardening the Avalanche Lake Trail and formalizing the extension part way around Avalanche Lake, the construction of an under-road crossing for pedestrians and bicycles at the St. Mary Visitor Center, and the construction of a 1.5-mile-long bike trail from the 1913 Ranger Station to St. Mary Campground and St. Mary town site would result in beneficial impacts to visitors by providing additional trail options and improved safety.

If conditions exceed thresholds and/or capacity, implementation of adaptive management options to further designate travel directions on the Highline Trail and the construction of three new sections of trail totaling approximately 5 miles in length at Big Bend, Lunch Creek, and Siyeh Bend would result in beneficial impacts to visitors by improving visitor experience and safety while on the Highline Trail by prohibiting two-way travel on the cliff section during peak season and increasing trail options. For returning visitors who are familiar with the Highline Trail, there could be some short-term adverse impacts while they adjust to the changes in designated travel directions.

During construction and implementation of the proposed actions and, if warranted, adaptive management options, there would be temporary impacts to visitor use and experience as a result of construction-related activity and noise and the potential for temporary closures or alternative access points in locations where construction activity was occurring. Efforts would be made to avoid construction or temporary closures during peak season to minimize these impacts. In addition, avoidance and minimization measures (see appendix E) would be implemented during construction activities to reduce the potential for, and magnitude of, temporary adverse effects on visitor use and experience.

The total number of cars entering the GTSR corridor would not be managed under the preferred/proposed alternative, and the amount of vehicle noise on the road could increase and detract from visitors' driving experience, depending on the type of vehicle traffic. If visitation to the GTSR continues to increase during the summer months as it has since 2012, it is projected that all roadway segments monitored for level of service would be below their threshold (in failing status more than 1% of the time for June–August) by 2020. Implementation of the preferred/proposed alternative and the ability to adaptively apply management options would aim to improve the quality of visitor experience and resolve some crowding-related issues in the corridor. This would include improving visitor access at the East and West Entrance Stations by installing automated technology that would increase the efficiency of cars entering the park. Under the preferred/proposed alternative, there would still be crowded conditions during peak times; however, open access to the GTSR corridor would be maintained and visitor experience would be improved with increased services and opportunities, certainty of access, and an increased range of experiences for some visitors. However, as visitation and congestion increase, the park would undertake emergency measures predicated on life, health, and safety, which is currently being done throughout the park during peak season.

As described above, monitoring indicators and thresholds would continue to provide feedback to park staff, ensuring that desired conditions are maintained and to inform future adaptive management direction. The adaptive strategies in the preferred/proposed alternative should allow the park staff to respond to conditions and more effectively maintain these benefits into the foreseeable future.

**Cumulative Effects.** Past actions that have impacted visitor use and experience include infrastructure improvements in the park and changes to visitor services and facilities. Past improvements at the West Glacier Entrance Station enhanced traffic flow and visitor experience. Ongoing construction of the Gateway to Glacier Bike Trail has beneficial impacts to visitor use and experience by providing new and safe opportunities for visitors to access the park from nearby communities. Other examples of present and future actions listed in appendix F with beneficial impacts to visitor use and experience include the Apgar Circulation Management Plan to improve visitor circulation through Apgar Village; the Bark Ranger Program that uses a canine ranger to enhance visitor understanding about human-wildlife encounters; and development of additional overnight housing for visitors in surrounding communities. Collectively, the actions included in the cumulative impacts scenario have beneficial impacts on visitor use and experience by improving traffic flow, increasing overnight opportunities, and improving how visitors access the park from nearby communities.

The no-action alternative would contribute a fairly substantial adverse impact due to congestion on the road and crowding on hiking trails. This would detract from effects of past, present, and reasonably foreseeable actions; however, cumulative effects under the no-action alternative would remain beneficial.

The direct and indirect impacts of the preferred/proposed alternative on visitor use and experience would be beneficial because the proposed actions would result in increased certainty of access to services and facilities; a diverse range of recreational opportunities; and improved experiences on trails, at overlooks, and in visitor centers. Collectively, the actions included in the cumulative impacts scenario have beneficial impacts on visitor use and experience by improving traffic flow, increasing overnight opportunities, and improving how visitors access the park from nearby communities. Despite some adverse impacts, the preferred/proposed alternative would contribute a sizeable beneficial increment to the impacts that are already occurring and therefore enhance the beneficial impacts of the cumulative effects scenario. In summary, when the effects of the preferred/proposed alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on visitor use and experience would continue to be beneficial.

## VEGETATION

### Affected Environment

The park 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. Much of the upper St. Mary River drainage, located largely within the park, has been nominated as the Logan Pass Important Plant Area (IPA) under the Montana Native Plant Society's Important Plant Areas Program (MNPS 2018). The Logan Pass area includes mostly alpine and high subalpine plant communities that harbor an exceptional number of peripheral and disjunctive arctic-alpine plants at the southern edge of their geographic range (Carolin, Menicke, and Lesica 2010). The general trend predicted for alpine vegetation in the park due to climatic warming is for alpine lower-elevation species to expand their range, while species restricted to the highest elevations would decline in abundance (Lesica 2014).

Fire is the dominant ecological disturbance throughout the park and has undoubtedly influenced the diversity and heterogeneity of the community types and landscape. Other major natural disturbances that contribute to the complex mosaic of vegetation across the park and management area include avalanches and forest pathogens.

The US Geological Survey (USGS) and National Park Service cooperated to classify, describe, and map vegetation in the park (Hop et al. 2007). The agencies mapped park vegetation based on the National Vegetation Classification (NVC) Standard (FGDC 1997). The following table lists land cover types in the GTSR management area. See US Geological Survey-NPS Vegetation Mapping Program Waterton-Glacier International Peace Park (Hop et al. 2007) for detailed descriptions of the different vegetation communities. The acres and percent of each vegetation group in the 183,860-acre GTSR management area were measured and are presented below. The 2003 Robert Fire and 2006 Red Eagle Fire burned almost 42,000 acres of mostly forest or woodland areas in the GTSR management area. In addition, the Howe Ridge Fire in West Glacier burned over 14,500 acres on the northwestern shore of Lake McDonald in 2018, a large portion of which was in the management area. Because vegetation mapping was completed before these fires, most of the high-intensity burn areas with dead trees could be reclassified as successional vegetation. The vegetation group percentages in table 4 are for pre-2003 conditions.

**TABLE 4. LAND COVER IN THE GTSR MANAGEMENT AREA**

<b>Vegetation Class</b>	<b>Acres</b>	<b>Percent</b>
<b>Western North America Freshwater Shrub, Marsh, and Wet Meadow</b>	<b>7,388</b>	<b>4.0%</b>
Rocky Mountain Shoreline Vegetation	320	0.2%
Rocky Mountain Subalpine and Montane Riparian Shrubland	751	0.4%
Rocky Mountain Wet Meadow and Snowbed	6,105	3.3%
Western North America Emergent Marsh	212	0.1%
<b>Rocky Mountain and Great Basin Wet Forest</b>	<b>2,844</b>	<b>1.6%</b>
Northern Rocky Mountain Conifer Swamp and Riparian Forest	478	0.3%
Northern Rocky Mountain Montane Riparian Forest	857	0.5%
Rocky Mountain Conifer Swamp and Riparian Forest	1509	0.8%
<b>Rocky Mountain Lower Montane Forest and Woodland</b>	<b>36,060</b>	<b>19.6%</b>
Rocky Mountain Cedar – Hemlock Rainforest	17,765	9.7%
Rocky Mountain Mesic Montane Conifer Forest	18,291	9.9%

<b>Vegetation Class</b>	<b>Acres</b>	<b>Percent</b>
Northern Rocky Mountain Ponderosa Pine Woodland	3	<0.1%
Rocky Mountain Montane Limber Pine – Juniper Woodland	1	<0.1%
<b>Northern Rocky Mountain – Vancouverian Montane Shrubland and Grassland</b>	<b>12,335</b>	<b>6.7%</b>
Northern Rocky Mountain Avalanche Chute Shrubland	10,559	5.7%
Northern Rocky Mountain Lower Montane Deciduous Shrubland	992	0.5%
Rocky Mountain Montane Grassland	784	0.4%
<b>Rocky Mountain Subalpine and High Montane Forest and Woodland</b>	<b>73,903</b>	<b>40.2%</b>
Rocky Mountain Subalpine (Cool) Deciduous Broadleaf and Mixed Forest	6,017	3.3%
Rocky Mountain Subalpine Mesic Conifer Forest and Woodland	53,808	29.3%
Rocky Mountain Subalpine Whitebark Pine and Subalpine Larch Woodland	8,696	4.7%
Rocky Mountain Subboreal and Montane Conifer Forest	5,382	2.9%
<b>Rocky Mountain Alpine Scrub, Forb Meadow, and Grassland; Rock Vegetation</b>	<b>19,848</b>	<b>17.8%</b>
Rocky Mountain Alpine Dry Scrub and Fell-field	656	0.4%
Rocky Mountain Alpine Meadow	19,192	10.4%
Rocky Mountain Cliff, Scree, Talus, and Other Rock Vegetation	12,800	7.0%
<b>Rocky Mountain Successional Vegetation</b>	<b>n/a</b>	<b>n/a</b>
Rocky Mountain Early Successional Forest, Shrubland, and Forb Meadow	*	*
<b>Unvegetated Areas</b>	<b>18,620</b>	<b>10.1%</b>
Mountain Perennial Glacier and Snowfield	5,296	2.9%
Open Water Stream/River and Lake/Pond	12,586	6.9%
Developed Area or Other Cultural Areas	738	0.4%

\* The 2003 Robert Fire and 2006 Red Eagle Fire burned almost 42,000 acres of mostly forest or woodland areas in the GTSR management area. Because vegetation mapping was completed before these fires, most of the high-intensity burn areas with dead trees could be reclassified as successional vegetation.

## Impacts on Vegetation

**No-Action Alternative.** Roadside parking of privately owned vehicles outside designated parking areas would continue to cause removal of vegetation, erosion, and sedimentation that buries plants and contributes to the loss of native vegetation. Within the GTSR management area, vegetation in the alpine and subalpine zones is generally considered sensitive and fragile to disturbance and slow to recover due to low productivity, a short growing season, and a harsh environment, in combination with poor soil conditions (Jägerbrand and Altalo 2015). Long-term, unassisted regeneration of severely degraded alpine sites could take more than a century (Willard, Cooper, and Forbes 2007). Trampling of vegetation by visitors would continue to occur along informal trails and adjacent to existing heavily used trails. Trampling of vegetation can damage individual plants, cause soil compaction, and reduce flowering potential and species composition. Sensitive plant habitat that may occur near hiking trails may be subject to hiker trampling in spot locations, but the probability of damage to rare plant habitat is considered quite low (Carolyn, Menicke, and Lesica 2010). Many of these species are limited to the alpine zone and moist or wet habitats and those occurring near heavily used areas would be most susceptible. Despite their susceptibility, rare plant surveys conducted in the park in recent years have not shown a measurable decline in the populations most vulnerable to trampling. Regardless, trampling and continued use of braided informal trails and over-widened trail sections would continue to prevent the regrowth of vegetation needed to stabilize surface soils. In addition, sediment erosion on informal trails would continue to bury adjacent vegetation. These



actions would result in the localized loss of individual native plants in alpine, subalpine, and montane zones and near heavily used areas, especially in moist and wet areas.

Invasive and nonnative vegetation has the ability to dominate or disrupt natural communities or restoration projects. They spread rapidly and are difficult to eradicate from an area once established. Any identified future noxious weed infestations would be managed in accordance with the park's Invasive Exotic Plant Management Plan (NPS 1991).

Impacts to specific rare plant species are described under the "Species of Special Management Concern" section.

**Preferred/Proposed Alternative.** The preferred/proposed alternative would permanently remove up to 6.18 acres of vegetation as a result of constructing new shuttle stops, widening 1.25 miles of road, adding or expanding three parking lots in high visitor use areas, adding a bike path, and improving one trail. These proposed activities would predominantly impact montane grassland vegetation. Additional temporary impacts to vegetation would occur during construction. To minimize temporary impacts to vegetation, staging areas would occur in previously developed areas or in the immediate project area—best management practices would be implemented (see appendix E).

Construction of the shuttle stops in frontcountry locations would have minimal direct effects on vegetation because they would occur in previously disturbed areas or in immediately adjacent areas that would minimize removal of sensitive vegetation. In addition, each of these elements have a minimal footprint of disturbance in the context of the landscape. It is assumed that less than 0.1 acre of concrete pad would be installed for the five shuttle stops, all of which would be placed in or immediately adjacent to previously developed areas.

The new parking lots at the old West Side Construction Staging Area, 1913 Ranger Station, and expansion of the St. Mary Visitor Center parking lot would be mostly built on unvegetated developed areas. At the West Side Construction Staging Area, approximately 0.58 acre of mesic montane conifer forest would be permanently removed. At the 1913 Ranger Station, approximately 0.42 acre of montane grassland would be permanently removed. At the St. Mary Visitor Center parking lot, approximately 0.16 acre of montane grassland would be permanently removed.

Widening 0.25 mile of Quarter Circle Bridge Road and 1.0 mile of the 1913 Ranger Station Road (Red Eagle Road) by up to 20 feet would permanently remove approximately 2.7 acres of adjacent vegetation. The 1.25 miles of widened road segments would predominantly intersect montane grassland and to a lesser extent mesic montane conifer forest.

Preventing parking at the Avalanche Campground entrance road and implementation of a phased parking permit system would reduce trampling and compression of vegetation adjacent to the road and parking lots.

Construction of five restroom facilities at two frontcountry and three backcountry locations would have minimal direct effects on vegetation because they would occur in previously disturbed areas or areas that would minimize removal of sensitive vegetation. Assuming each facility would not exceed approximately 150 square feet, the total acreage of disturbance for the five vault or backcountry toilets is estimated to be less than 0.02 acre. Types of vegetation impacted would depend on the exact placement of the vault or backcountry toilets, but they would be placed to minimize impacts to vegetation. An indirect benefit of the new comfort stations would be a reduction in hikers needing to leave the trails, resulting in less trampling and disturbance of sensitive vegetation.

Hardening 2.5 miles of the Avalanche Lake Trail and formalizing 0.5 mile of the heavily used informal portion of the trail would stabilize surface soil conditions, reduce over-widening and the development

of braided trail sections, and allow existing braided or over-widened trail sections to naturally stabilize and revegetate. Improvements to this segment of trail would intersect cedar-hemlock rainforest and a small area of subalpine mesic conifer forest and woodland. Efforts would be made to minimize the removal of trees.

Construction of an approximate 1.5-mile, up to 12-foot-wide asphalt bike trail from the 1913 Ranger Station to St. Mary Campground and St. Mary town site would require permanent vegetation removal in areas. Acreages are approximate pending further design, but it is estimated that construction of the linear bike trail would result in the permanent removal of up to 2.2 acres of vegetation. Approximately 75% of the trail length would be constructed in montane grassland. Small portions of the trail (each less than 5% of the trail length) would also intersect montane deciduous shrubland, montane conifer forest, shoreline vegetation, subalpine deciduous broadleaf and mixed forest, and montane riparian shrubland. The remainder of the trail would traverse unvegetated areas.

If implemented under adaptive management options, the construction and reestablishment of three additional new trails totaling approximately 5.0 miles would require additional permanent vegetation removal for the new trail segments. Trail widths are anticipated to be approximately 3 to 8 feet, plus additional cut and fill depending on the cross slope, but compliance based on additional design would be undertaken if these actions are implemented. Based on these assumptions, up to approximately 4.85 acres of vegetation would be permanently removed. Vegetation types that would be impacted are described below. Along the approximate 3.0-mile Big Bend to Highline Trail, the majority of the trail would traverse mixed conifer and avalanche chute deciduous shrubland. A small portion of the trail would traverse conifer (Engelmann spruce) woodland and an even smaller portion through dwarf-shrub herbaceous complex. Along the approximate 1.0-mile Lunch Creek to Logan Pass Trail, the majority of the trail would traverse dry mesic herbaceous shrubland. Much of the remainder would traverse conifer (Engelmann Spruce) woodland. Along the approximate 1.0-mile Siyeh Bend to Lunch Creek Trail, the majority of the trail would traverse mixed conifer woodland and avalanche chute deciduous shrubland. Two of the proposed trails from Lunch Creek to Logan Pass and Lunch Creek to Siyeh Bend (totaling 2.0 miles) would use previously disturbed areas along a historic construction road and unmaintained horse trail; the trail from Big Bend to the Highline is already an informal climbers trail. Therefore, formalization and development of these 5.0 miles of trail would require less disturbance to vegetation than those sections of trail in previously undisturbed areas. In all locations, design efforts would be made to minimize the removal of individual trees.

Trail improvements, establishing a group size for commercially guided hikers, the use of permits on some trails, and education would encourage and allow hikers to stay on the single trail alignments and allow the nearby braided informal trails to naturally stabilize and revegetate. This would have the greatest beneficial impact in the alpine and subalpine zones where, as described in the affected environment, vegetation is generally considered sensitive and fragile to disturbance.

The redesign of the West Entrance Station to include automated technology would occur within the existing footprint of the facility. While there could be temporary impacts to vegetation in spot locations during construction, there would be no permanent vegetation removal.

Under this alternative, proposed construction activities that disturb vegetation could lead to increasing populations of nonnative invasive plants by removing established native plants that compete with noxious weeds, exposing mineral soil as a substrate for weed germination and dispersing existing or new weed seeds or plants carried by construction equipment and trail users. To prevent the spread of invasive and nonnative vegetation, the National Park Service would manage weed infestations in accordance with the park's Invasive Exotic Plant Management Plan (NPS 1991) and other measures discussed in "Appendix E: Mitigation Measures."

**Cumulative Effects.** Past, present, and reasonably foreseeable future actions that could have cumulative adverse effects on vegetation in the GTSR management area include periodic road and trail maintenance activities such as shoulder repairs, hazard tree removal, herbicide applications, and culvert cleaning and repair; commercial services improvements; past and ongoing rehabilitation of the GTSR; and past improvements at West Glacier Entrance Station, including expansion of the Apgar Transit Center parking lot and water improvements to meet demand such as adding a water tank at Granite and rehabilitating water diversions at Sperry and Logan Pass. Most of these activities have caused or would cause a minimal loss of vegetation because they have occurred or would occur on or near developed areas where vegetation has been previously disturbed. The park's ongoing nonnative vegetation management would continue to have a beneficial cumulative effect on native vegetation and rare plants. Overall, cumulative effects on vegetation from these past, present, and reasonably foreseeable future actions are minimally adverse. The effects of the no-action or preferred/proposed alternatives would have a very small adverse and beneficial incremental contribution to the minimally adverse impacts of these other actions and would not substantially change the overall cumulative effects already occurring now or in the future.

## **SPECIES OF SPECIAL MANAGEMENT CONCERN**

### **Affected Environment**

Species lists from the US Fish and Wildlife Service, National Park Service, and State of Montana databases were reviewed to determine which species of concern had the potential to occur in the GTSR management area. Species of concern include those protected under the Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act, Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," and native species of concern by the State of Montana. The following table summarizes the species status, distribution, and habitat in the GTSR management area.

**TABLE 5. SPECIES OF SPECIAL MANAGEMENT CONCERN POTENTIALLY OCCURRING IN GTSR MANAGEMENT AREA**

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Grizzly Bear <sup>1,2,3</sup> <i>Ursus arctos</i> <i>horribilis</i> (mammal)	FT SGCN2 SGCN3	<p>Glacier is part of the core recovery area for the threatened grizzly bear in the Northern Continental Divide Ecosystem and has the highest known density in the recovery area (USFWS 2013). Preliminary results from a 2000 study indicate there is a minimum of 222 individual grizzly bears inhabiting the park with an estimated mean density of 30 bears per ~385 square miles (Kendall et al. 2008). There is a long history of grizzly bear use of the GTSR management area (Secrest 2006). Grizzly bears require large areas of undeveloped habitat (including a mixture of forests, moist meadows, grasslands, and riparian habitats) and have home ranges of 50 to 500 square miles (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). McDonald Creek Valley riparian areas are highly suitable spring grizzly bear habitat. During the summer, bears move to higher elevations in search of glacier lilies and other roots, berries, and army cutworm moths (White, Kendall, and Picton 1998). During the huckleberry season in late summer and early autumn, bears forage at upper elevation sites, including avalanche chutes east and west of Logan Pass. During the winter, grizzly bears hibernate in dens away from human disturbance, typically at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow (Mace and Waller 1997). In addition to diverse foraging habitat, grizzly bears require natural habitat that provides secure cover for travel between foraging sites. Examples of these travel corridors are in the Logan Creek area, the McDonald Valley near Apgar, and at the head and foot of Lake McDonald. Grizzlies are wide-ranging and require a substantial amount of solitude from human interactions. Climate change may result in changes to grizzly bear habitat, including a reduction in snowpack levels, shifts in denning times, shifts in abundance and distribution of some food sources, and changes in fire regimes. Most grizzly bear biologists do not expect habitat changes predicted under climate change scenarios to directly threaten grizzly bears (Servheen and Cross 2010).</p>

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Canada Lynx <sup>1,2,3</sup> <i>Lynx canadensis</i> (mammal)	FT CH SGCN3	<p>Canada lynx generally occurs in climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Advanced successional stages of forests and dense conifer stands often are preferred habitats for denning and foraging, respectively. Large amounts of woody debris and minimal human disturbance are important features of denning sites. Lynx generally forage in dense young conifer forests or mature forests in more open stands where their primary prey, snowshoe hare, is abundant. Travel corridors are an important factor in lynx habitat because of their large and variable home ranges, generally 3 to 285 square miles (Ruediger et al. 2000). Travel cover includes contiguous vegetation cover over 6 feet tall—lynx generally do not cross openings greater than 300 feet wide (Koehler 1990). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May–August) (Joslin and Youmans 1999). Historically, Canada lynx may have been more common throughout the park; documented sightings have declined since the 1960s but appear to be increasing in recent years. Systematic surveys since 1994 detected lynx in many of the park drainages, including the St. Mary and McDonald Valleys. Winter snow track surveys in 1998–99 and 1999–2000 revealed Canada lynx tracks in the McDonald Creek drainage. DNA sampling for lynx documented at least six individuals in 2000 (Edmonds 2002). The only Canada lynx sighting recorded in the GTSR corridor in 2002 was at Logan Pass (Elze 2002). Twenty-eight lynx sightings were outside the road corridor in 2002, with 22 lynx tracks detected in the Middle Fork of the Flathead River drainage. The number of lynx currently present in the park is not known.</p> <p>Most of the GTSR management area is in designated critical habitat (Unit 3: Northern Rocky Mountains) for the Canada lynx (USFWS 2014a). A zone surrounding Lake McDonald and McDonald Creek is not designated critical habitat. In this unit, climate change is expected to result in loss of snow conditions suitable for lynx by the end of this century (Gonzalez et al. 2007). Therefore, climate change represents a potential habitat-related threat to lynx in this unit. The primary constituent elements for Canada lynx critical habitat are: (1) presence of snowshoe hares and their preferred habitat (boreal forest), (2) generally deep and fluffy snow for extended periods during winter, (3) sites for denning with abundant coarse woody debris such as downed trees and root wads, and (4) matrix habitat (e.g., hardwood forest, dry forest, nonforest, or other habitat types not supporting snowshoe hares) that occurs between patches of boreal forest and support lynx travel (USFWS 2014a).</p>
North American Wolverine <sup>1,2,3</sup> <i>Gulo gulo luscus</i> (mammal)	PT SGCN3	<p>Major threats to wolverine include climate change, human use and disturbance, dispersed recreational activities, infrastructure development, transportation corridors, and land management (USFWS 2016). Wolverine is a rarely seen resident of coniferous forests and alpine meadows on both sides of the Continental Divide. Wolverines occur in low densities and have large home ranges. They use a range of habitats including alpine areas, mature forests, ecotonal areas, and riparian areas. The park has high-quality wolverine habitat due to extensive alpine areas, rugged topography, and remoteness (Copeland and Yates 2008). Wolverines move to lower elevations during the winter where they search for carrion in ungulate winter ranges. Den sites are typically under deep snow on high elevation talus slopes in sparsely forested areas with boulders, rock caves, and downed woody debris. Recent population monitoring in the park resulted in a parkwide density estimate of 13/~385 square miles and a model-averaged population estimate of 33 individuals. The data also indicated an increasing population, a result also obtained by Squires et al. (2007). Average home ranges for wolverines in Glacier National Park are ~200 square miles for males and ~55 square miles for females (Copeland and Yates 2008). Wolverine tracks and sightings are frequently reported in the park by visitors and staff (park files). Numerous sightings and track observations have come from the GTSR corridor.</p>

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Bald Eagle <sup>2,3,4,5,6,7</sup> <i>Haliaeetus leucocephalus</i> Golden Eagle <sup>2,3,4,5,6</sup> <i>Aquila chrysaetos</i> (birds)	BGEPA MBTA BCC SGCN3	The management area contains feeding and nesting habitat for bald and golden eagles. During the autumn of 1996, over 3,000 raptors were observed from a single location in the McDonald Valley (Yates et al. 2001). About 92% of the observations were golden eagles and the remainder were bald eagles. The migration of golden eagles through the park may be one of the largest eagle migrations in North America. Bald eagles are a bird of conservation concern. Golden eagles are a Montana Species of Greatest Conservation Need (SGCN).
Other Migratory Birds and Birds of Conservation Concern (BCC) <sup>2,3,4,5,6,7</sup> (birds)	MBTA BCC SGCN	The project area is in the Northern Rockies Bird Conservation Region (BCR 10). Besides the two BCCs listed above, other migratory BCCs that could occur in or near the project area and include Cassin's finch, Clark's grebe, lesser yellowlegs, long-billed curlew, marbled godwit, olive-sided flycatcher, rufous hummingbird, and willet. The management area provides habitat for a variety of other birds not on the BCC such as osprey, Cooper's hawk, northern goshawk, pileated woodpeckers, barred owls, white-tailed ptarmigan, harlequin ducks, common loons, and numerous other waterfowl. Many of these birds are Species of Greatest Conservation Need (MFWP 2015).
Bull Trout <sup>1,2,3</sup> <i>Salvelinus confluentus</i> (aquatic species)	FT CH SGCN2	Bull trout have declined in the park due to competition and hybridization with nonnative lake trout and brook trout. There is low likelihood of bull trout occupying any of the Lake McDonald tributaries (Dux and Guy 2004). In the St. Mary drainage, bull trout have been documented in St. Mary Lake, Red Eagle Lake, and Slide Lakes, and in Boulder, Kennedy, Otatso, lower Swiftcurrent, Lee, and Wild Creeks (Downs, Woody, and McKeon 2013). However, the observations of bull trout in Rose and Wild Creeks have been infrequent and it does not appear as though these streams support reproducing populations. Habitat requirements include cold water, deep pools, overhanging banks and large woody debris, and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitats (USFWS 2014b). Riparian vegetation is an important component of the primary constituent elements of designated bull trout critical habitat (USFWS 2010b). Bull trout are a sensitive indicator of climate change, especially where loss of late-season snowfield and glacial meltwater could jeopardize bull trout reproduction (Fredenberg, Meeuwig, and Guy 2007). Spawning occurs in third and fourth order streams between late summer and early fall. Eggs and fry typically overwinter in spawning streams until the following spring (USFWS 2014b). Designated bull trout critical habitat in the management area includes Lake McDonald and McDonald Creek 4.0 miles upstream and 4.0 miles downstream of the lake, St. Mary Lake and St. Mary River downstream of the lake, Divide Creek, and Red Eagle Lake and Red Eagle Creek 2.9 miles upstream (USFWS 2010a).
Westslope <sup>2,3,6</sup> Cutthroat Trout <i>Oncorhynchus clarkia lewisi</i>	S2	The westslope cutthroat trout is one of several native salmonid species in Glacier National Park. It is a state-listed species of concern and Montana's official state fish. The distribution and abundance of genetically pure populations of westslope cutthroat trout has declined drastically from its historic range over the past 150 years (Liknes and Graham 1988). Native westslope cutthroat trout are currently found in all four 5th-order drainages in the park (North Fork Flathead, Middle Fork Flathead, Upper Missouri, and S. Saskatchewan). Many of the streams bisected by the GTSR support westslope cutthroat trout. Dux and Guy (2004) surveyed streams intersected by the GTSR and documented westslope cutthroat in Avalanche, Baring, Jackson, Logan, Rose, Snyder, Sprague, and Two Dog Creeks. Genetic status of westslope cutthroat trout along the GTSR corridor on the west side of the park follows a general pattern of low-level hybridization with rainbow and/or Yellowstone cutthroat trout in streams downstream of the barrier falls on upper McDonald Creek, and genetically pure populations of westslope cutthroat trout in the McDonald Creek drainage upstream of the barrier falls. These populations are of high conservation value because they are protected from invasive fishes by the barrier falls and the upper McDonald Creek drainage provides a relatively large stream network compared to other stream networks with pure westslope cutthroat trout in the park. On the east side of the GTSR corridor, recent genetic data indicates almost pure westslope cutthroat trout occupying both Rose and Two Dog Creeks (>97% westslope cutthroat trout). Both of these streams are of high conservation value because they represent what remains of the native westslope cutthroat trout genome in the St. Mary River drainage.

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Meltwater Lednian Stonefly <sup>1,2</sup> <i>Lednian tumana</i> Western Glacier Stonefly <sup>3</sup> <i>Zapada glacier</i> (aquatic species)	PT S1	The meltwater lednian stonefly and western glacier stonefly are at risk because of climate change-induced melting glaciers in the park. These stoneflies occupy the upper reaches of alpine streams, typically occurring in the first 0.5-mile of a stream, starting at the meltwater source. Because they are sensitive to temperature changes, these two species are considered a barometer for the effects of climate change in the alpine environment. In the park, the western glacier stonefly is known to occur in six streams and the meltwater lednian stonefly in 109 streams (Giersch et al. 2016).
Spalding's Catchfly <i>Silene spaldingii</i>	FT	Spalding's catchfly prefer habitats that include bunchgrass grassland, sagebrush-steppe, and less frequently, stands of open-canopy pine. Potential habitat for the species has not been identified in the GTSR corridor. A study of east side grasslands, which included 155 vegetation plots in a wide variety of grasslands under 5,500 ft (1,676 m) elevation did not locate the species. In addition, the catchfly has not been found in fire effects plots in North Fork grasslands, park flora inventories, or in vegetation mapping plots anywhere in the park. As a result, the proposed actions presented in this plan would have no effect on this species and it was dismissed from further analysis.
Water Howellia <i>Howellia aquatilis</i>	FT	Water howellia prefer shallow ponds often associated with glacial potholes and former river oxbows that dry up in the late portion of the growing season. In Montana, this species is known to occur in the Swan Valley located in both Missoula and Lake Counties. Habitat for the wetland-dependent species might be present within the park boundary, but there have been no recorded observations and no identification of the species in multiple recent surveys throughout the park. As a result, the proposed actions presented in this plan would have no effect on this species and it was dismissed from further analysis.
Whitebark Pine <sup>1,2,6</sup> <i>Pinus albicaulis</i> (rare plants)	FC S3	Whitebark pine is a common component of subalpine forests and a dominant species of tree line and krummholtz habitats. Whitebark pines have declined across large areas of its range because of past mountain pine beetle outbreaks and white pine blister rust. Whitebark pine is typically found in cold, windy, high elevations in western North America and many stands are geographically isolated. It is a hardy stress-tolerant tree that grows where other conifer species cannot. Whitebark pine is ecologically significant in maintaining snow pack and regulating runoff, initiating succession after fire or other disturbances, and producing seeds that are a high-energy food source for wildlife.



Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Plant Species of Concern <sup>2,6</sup> (rare plants)	SOC	<p>A list of rare plants in the management area was compiled in the Montana Natural Heritage Program database of plant species of concern. Designation as a species of concern is not a statutory or regulatory classification. There are 52 plant species of concern known to occur in the GTSR management area, including 36 vascular plants, 11 bryophytes (mosses), and five lichens. These rare plants are found in most of the habitats present in the management area. Many of the rare plants are found in wetland and riparian areas. The steep rocky slopes at higher elevations support a variety of rare vascular plants and mosses adapted to wet rocks and limestone outcrops. Of the 52 plant species of concern, 29 have the potential to occur near proposed and potential new trail segments under the preferred/proposed alternative. These species are listed below; more information about them can be found in appendix J.</p> <ul style="list-style-type: none"> <li>▪ Alpine glacier poppy</li> <li>▪ Arctic buttercup</li> <li>▪ Arctic eyebright</li> <li>▪ Banff bluegrass</li> <li>▪ Barratt's willow</li> <li>▪ Coastal sand sedge</li> <li>▪ Dense-leaf draba</li> <li>▪ Five-leaf cinquefoil</li> <li>▪ Glaucous gentian</li> <li>▪ Goose-grass sedge</li> <li>▪ Hudson's Bay bulrush</li> <li>▪ Macoun's draba</li> <li>▪ Moonwort species (several)</li> <li>▪ Northern beechfern</li> <li>▪ Northern buttercup</li> <li>▪ Rock sedge</li> <li>▪ Rocky Mountain twinpod</li> <li>▪ Running-pine</li> <li>▪ Simple kobresia</li> <li>▪ Small tofieldia</li> <li>▪ Stalk-leaved monkeyflower</li> <li>▪ Three-flowered rush</li> <li>▪ Tufted club-rush</li> <li>▪ Meesia moss</li> <li>▪ Myurella moss</li> <li>▪ Norwegian twist moss</li> <li>▪ Paraleucobryum moss</li> <li>▪ Schleicher's bryum moss</li> <li>▪ Chocolate chip lichen</li> </ul>

**Status Code<sup>a</sup>:** **FE** = federally listed endangered; **FT** = federally listed threatened; **PT** = Proposed **BGEPA** = Species protected under the Bald and Golden Eagle Protection Act; **MBTA** = Species protected under the Migratory Bird Treaty Act; **BCC** = Birds of Conservation Concern in the Northern Rockies Bird Conservation Region (BCR 10); **SGCN** = Species of Greatest Conservation Need Species under MT Wildlife Action Plan; **Montana Natural Heritage Program Rankings – S1** = At high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state; **S2 or SGCN2** = At risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state; **S3 or SGCN3** = Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas; **SOC** = Species of Concern. **Data Sources:** <sup>1</sup>USFWS Official List of Threatened and Endangered Species for the Going-to-the-Sun Corridor Management Plan (USFWS 2018a); <sup>2</sup>NPS GLAC Species Checklist (NPS 2018); <sup>3</sup>Montana's State Wildlife Action Plan (MFVP 2015); <sup>4</sup>USFWS IPac Resource List for the Going-to-the-Sun Corridor Management Plan (USFWS 2018b); <sup>5</sup>Glacier Bird Checklist (NPS 2015); <sup>6</sup>Montana Natural Heritage Databases (MNHP 2012a, 2012b, 2018a, 2018b); <sup>7</sup>Birds of Conservation Concern 2008 (USFWS 2008)

## Impacts on Species of Special Management Concern

**No-Action Alternative.** Due to the similarities of impacts, several species of special management concern have been analyzed collectively as described below.

*Federally Listed Mammals*— Grizzly bear, Canada lynx, and wolverines are all highly mobile species found in the corridor. During the peak summer season, high traffic volumes and high use levels on roads and trails in the GTSR corridor produce noise and act as a barrier to safe travel across the corridor for these species. In addition, the potential for vehicle collisions would continue to increase with rising visitation.

Visitor education and wildlife management to address human-wildlife interactions would strive to protect these species of concern and their habitat by discouraging off-trail use and thereby confining areas of noise disturbance and limiting associated erosion and impacts to adjacent habitat. During the peak summer season, grizzly bear, Canada lynx, and wolverines traveling through or residing in or near the GTSR would continue to be disturbed and/or displaced by the high levels of visitor activities, including trail hikers and pedestrian traffic, parking outside designated areas, off-trail travel, increasing noise, human presence, and habitat degradation associated with these activities. These disturbances would continue to disrupt foraging patterns, migration dynamics, and breeding behavior for grizzly bears, Canada lynx, and wolverine, as well as other wildlife species. This increasing pressure on corridor resources, especially in popular areas, would result in an increased potential for habituation to human activity, an increased potential for human-animal interactions, and the degradation of these species' habitats through vegetation loss, erosion, and sedimentation impacts that harm native plants and foster the spread of invasive species. These impacts would occur at the local level and would likely increase as overcrowding in the GTSR corridor intensifies under the no-action alternative.

*Birds of Special Management Concern*— As described for federally listed mammals during the peak summer months, migratory birds, including birds of conservation concern that could occur in the vicinity of the road corridor, would be displaced and/or disturbed as a result of increasing noise, human presence, and habitat degradation associated with high and increasing levels of visitor activities. There would be no loss of bald or golden eagle nesting or feeding habitat. Human activity in the GTSR corridor could affect their foraging and movement; however, flight allows them to safely cross and easily avoid areas of the corridor.

*Aquatic Species of Special Management Concern*— The no-action alternative would not require any new in-water work in any streams and would not directly affect bull trout, bull trout critical habitat, westslope cutthroat trout, or stoneflies. Sediment delivery from existing disturbed areas that have a hydrologic connection to streams could increase with increased visitation and subsequent increase in hikers on the nearby braided informal trails. Sediment in excess of normal conditions can result in gill trauma to adult bull trout, adversely impact embryo survival and subsequent fry emergence success, and change the abundance or type of food organisms (Muck 2010). However, the increased sediment delivery from hikers on nearby informal trails would be anticipated to remain minimal in comparison to natural sediment levels experienced during spring runoff in the management area. Therefore, the anticipated continued impacts of the no-action alternative would be so small that it would not be of any new measurable or perceptible consequence to stoneflies westslope cutthroat trout, bull trout, or designated bull trout critical habitat.

*Rare Plants*— There would be no impact to threatened whitebark pine under the no-action alternative because there are no proposed actions near whitebark pine woodland communities in the GTSR management area. The linearleaf moonwort (*Botrychium lineare*) population, a rare plant species of concern, occurs on road shoulders and is also vulnerable to roadside parking, disturbance

by road maintenance activities, and visitor trampling (Carolyn, Menicke, and Lesica 2010). Other populations of state-listed species of concern occur near hiking trails or climbing routes and may be subject to increased hiker trampling as visitor use increases along the trails. Many of these species are limited to the alpine zone and moist or wet habitats and those occurring near heavily used areas would be most susceptible. Despite their susceptibility, rare plant surveys conducted in the park in recent years have not shown a measurable decline in the populations most vulnerable to trampling. Regardless, trampling and continued use of braided informal trails and over-widened trail sections would continue to threaten rare plants growing in these areas and prevent their regrowth.

**Preferred/Proposed Alternative.** Due to the similarities of impacts, several species of special management concern have been analyzed collectively as described below.

*Federally Listed Mammals*— Impacts under the preferred/proposed alternative would include disturbance and displacement of grizzly bears, Canada lynx, and wolverines. Implementation of shuttle improvements, including changes to schedules, additional stops, and increased rider parking, combined with implementation of a phased day use parking permit system would aim to disperse visitor use and activities along the corridor. In addition, established group sizes and numbers of commercially guided hikes along the Avalanche and Highline Trails and use of a timed-entry permit system on the Highline Trail would also aim to reduce the number of PAOT in these high use areas. While the dispersal of visitor use would result in a slight benefit to these species in high use areas during the peak summer season, individuals residing in or near the corridor would continue to be locally affected by high traffic volumes in the GTSR corridor as a result of noise levels, visitor activity, impacts to safe movement across the road, and an increased potential for vehicle collisions. In addition, individual bears, lynx or wolverines residing in or near current low-use areas that could see increased visitation could experience an increase in adverse impacts as described above.

Under the preferred/proposed alternative, construction and modifications of trails, overlooks, restrooms, roads, and parking lots would occur. Most of these actions would occur in highly developed, frontcountry areas where these species are less likely to reside or den, while several would occur in previously undisturbed backcountry areas (three backcountry toilets and three potential new trails). While the design and placement of these facilities would be done to minimize impacts, several acres (estimated to be less than 4.85 backcountry acres and up to 6.18 more frontcountry acres) of potential foraging habitat would be temporarily disturbed or permanently removed. While marginal in comparison to the approximate 183,860-acre corridor management area, the increased displacement would result in adverse impacts to these sensitive species. These impacts would be greater in backcountry areas where new trails and facilities are proposed in areas where they are currently absent. Grizzly bears, Canada lynx, and wolverines are accustomed to noise and human activity in the corridor, but construction-related activity and noise from the temporary operation of heavy equipment and power tools would differ from other daily and seasonal customary activities and sounds. Avoidance and minimization measures (see appendix E) would be implemented during construction activities to reduce the potential for and magnitude of temporary adverse effects on protected mammals and habitat. The use of new trails, future implementation of adaptive management actions, and the associated temporary and increased levels of noise, in combination with continued high traffic volume and human activity, including increased use during the shoulder seasons, may alter the behavior of bears, Canada lynx, and wolverine causing increased levels of displacement or habituation of individual animals, increased risk of vehicle-animal collisions, and additional impacts to foraging habitat. If thresholds were exceeded and the three trails proposed as potential adaptive management options were initiated, there would be new areas of disturbance to these species and the impacts noted above would extend further into their habitat. Prior to construction of these trails, additional consultation with the US Fish and Wildlife Service would be necessary due to their

potential to adversely impact grizzly bear, Canada lynx, Canada lynx critical habitat, and wolverines (see appendix I).

In addition, because species such as grizzly bears and Canada lynx require solitude, increased shoulder season visitation may also displace some individuals from potential spring, summer, and fall habitats due to wildlife tendencies to avoid areas where humans and loud machinery are present.

*Birds of Special Management Concern*— Migratory birds, including birds of conservation concern that occur in the vicinity of the various construction zones, could be temporarily displaced from the immediate vicinity due to noise, human presence, and removal of a total of approximately 11 acres of vegetation. However, most but not all, project activities would occur in existing developed and disturbed areas that do not provide high-quality nesting habitat, partly because most birds tend to avoid disturbed high-use areas. Conservation/mitigation measures (see appendix E) to protect birds during the breeding season would be implemented to avoid adverse impacts. For example, to ensure that any migratory birds that may nest near active construction areas are not disturbed, construction would be timed outside of nesting periods, and any necessary removal of vegetation with the potential to provide nesting habitat would take place outside of nesting periods. During further design of proposed actions, efforts would be made to limit the removal of vegetation suitable for bird nesting. Human activity in the GTSR corridor could continue to affect their foraging and movement; however, flight allows birds to safely cross and easily avoid areas of the corridor. As described under the federally listed mammals section above, dispersing visitors and implementation of adaptive management actions that would introduce visitors to low-use or previously unused areas could further contribute to impacts caused by human activity.

*Aquatic Species of Special Management Concern*— Preferred/proposed alternative construction activities would not require in-water work in any streams and would therefore not directly affect bull trout, bull trout critical habitat, westslope cutthroat trout, or stoneflies. Construction and modification of trails, restrooms, roads, and parking areas would remove vegetation and expose soil that would temporarily increase the potential for erosion, sedimentation, and subsequent habitat alterations. However, most work in riparian areas with hydrologic connections to streams would occur in recommended wilderness and be done with hand tools, which would limit the amount of ground disturbance, soil exposure, and sedimentation. In addition, erosion control best management practices would be implemented during construction to capture sediment. Because riparian vegetation is an important component of the primary constituent elements of designated bull trout critical habitat (USFWS 2010b), the Johns Lake shuttle stop near McDonald Creek would be located at least 100 feet from the stream channel outside the riparian area to avoid adversely modifying bull trout critical habitat.

The impacts of sediment delivery from existing disturbed areas that have a hydrologic connection to streams would be reduced by keeping hikers on the single trail alignments and allowing the nearby braided informal trails to naturally stabilize and revegetate. If warranted, the National Park Service would also implement water conservation measures to compensate for increased visitor numbers at Logan Pass Visitor Center to ensure no net increase in water depletion from Logan Creek, which is habitat for protected stoneflies.

*Rare Plants*— Under the preferred/proposed alternative, the National Park Service would examine potential rare plant habitat in and near all construction areas that have not been previously surveyed for the presence of rare plants. Known occurrences of rare plants in the vicinity of the proposed parking lot additions and improvements, new trails, and vault or backcountry toilets would be delineated and protected during construction. In addition, erosion and sediment controls and other best management practices would be used during construction to reduce soil erosion and prevent sediment from leaving the construction site and entering nearby vegetated habitat.

Managing parking under the parking permit system and additional parking at either end of the shuttle system, would encourage visitors to shift from privately owned vehicles to shuttles and buses, and lower peak traffic numbers. This would potentially have a beneficial effect on rare plants, such as linearleaf moonwort, that may be present along road shoulders by reducing traffic congestion and the potential for parking privately owned vehicles outside designated areas that could lead to trampling and vegetation loss associated with shoulder parking. Some populations of rare plants occur near hiking trails or climbing routes and would continue to be subject to hiker trampling, which can damage individual plants, cause soil compaction, and reduce flowering potential. Increased visitor use along new or improved trails has the potential to increase trampling. There would be no impacts to the threatened whitebark pine because no trails, roads, or parking areas are in or near whitebark pine woodland communities in the GTSR management area and the backcountry toilet in the Preston Park area would be placed to avoid impacts to whitebark pine.

If thresholds are exceeded and the trails proposed as potential adaptive management options near Siyeh Bend were initiated, there could be potential for impacts to whitebark pine in the Preston Park area although the trails would be designed to minimize these impacts and avoid tree removal if possible. Several other plants listed by the State of Montana as species of concern (see table 5 and appendix J) could occur near the trail segments proposed as potential adaptive management options between Lunch Creek and Logan Pass and between Big Bend parking and the Highline Trail. These rare plants are mostly limited to the alpine and subalpine zones. While many of them are limited to moist or wet habitats in tundra or fen environments, several, such as the alpine glacier poppy, require stony soils on exposed slopes and ridgetops. During trail design and construction, efforts would be made to avoid routing the trail through these sensitive vegetation types. If implemented, use of these trails could subject adjacent plant communities to increased hiker trampling along the new trails. However, as mentioned under the no-action alternative, despite their susceptibility, rare plant surveys conducted in the park in recent years have not shown a measurable decline in the populations most vulnerable to trampling and therefore impacts are expected to be minimal.

A biological assessment was prepared and shall be sent to the US Fish and Wildlife Service for actions that would be taken upon implementation of the plan. Consultation is ongoing. If implemented, adaptive management options triggered by future conditions (including the three new trails) would require separate consultation with the US Fish and Wildlife Service prior to construction. Additional biological assessments would be prepared and submitted to the US Fish and Wildlife Service, as appropriate.

**Cumulative Effects.** Past, present, and reasonably foreseeable future actions that could have cumulative effects on species of concern in the GTSR management area include shuttle system implementation, Apgar Transit Center parking lot construction, past and ongoing rehabilitation of the GTSR and improvements to the West Glacier Entrance Station. These previous actions modified relatively small areas of habitat and intermittently disturbed and/or displaced species of concern. Conservation measures and best management practices associated with past construction projects continue to be implemented to avoid or minimize impacts on sensitive species and their habitat. Future construction projects have the potential to disturb prime habitat for grizzly bears, rare plants, and other sensitive species as well as result in the long-term displacement of these species as a result of habitat fragmentation and increasing visitor numbers in areas where visitors previously did not venture.

Past facilities improvement projects indirectly increased visitation levels that elevated the potential for disturbing or interacting with sensitive species and fragmenting their habitat. Disturbance associated with visitor use has and would continue to disrupt foraging patterns, migration dynamics, and breeding behavior of several species at the local level. Park staff continues to ensure that mitigation measures are enforced to minimize impacts to listed species such that the cumulative effects from

other actions have not affected wildlife at the population level or measurably changed overall species distribution and abundance. The collective effects of past construction activities are negligible because a relatively small area of habitat has been affected. In addition, the National Park Service would continue to carry out avoidance and minimization measures to protect sensitive species. The no-action alternative would contribute an adverse increment to the overall low level of adverse cumulative effects as a result of increasing use of informal trails, over-used trails, and the associated disturbance. When the effects of the no-action alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on species of special management concern would continue to be minimally adverse. The preferred/proposed alternative would contribute relatively small increments of beneficial and adverse impacts on the overall low level of adverse cumulative effects, until trigger points are reached that would initiate management actions such as new construction of trails. When these trigger points are met and construction projects are initiated, additional undisturbed areas of sensitive wildlife habitat would be disturbed, animals displaced, and long-term adverse impacts would result in a greater adverse contribution. In summary, when the effects of the preferred/proposed alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on species of special management concern would continue to be minimally adverse.

## CHARACTER OF RECOMMENDED WILDERNESS

### Affected Environment

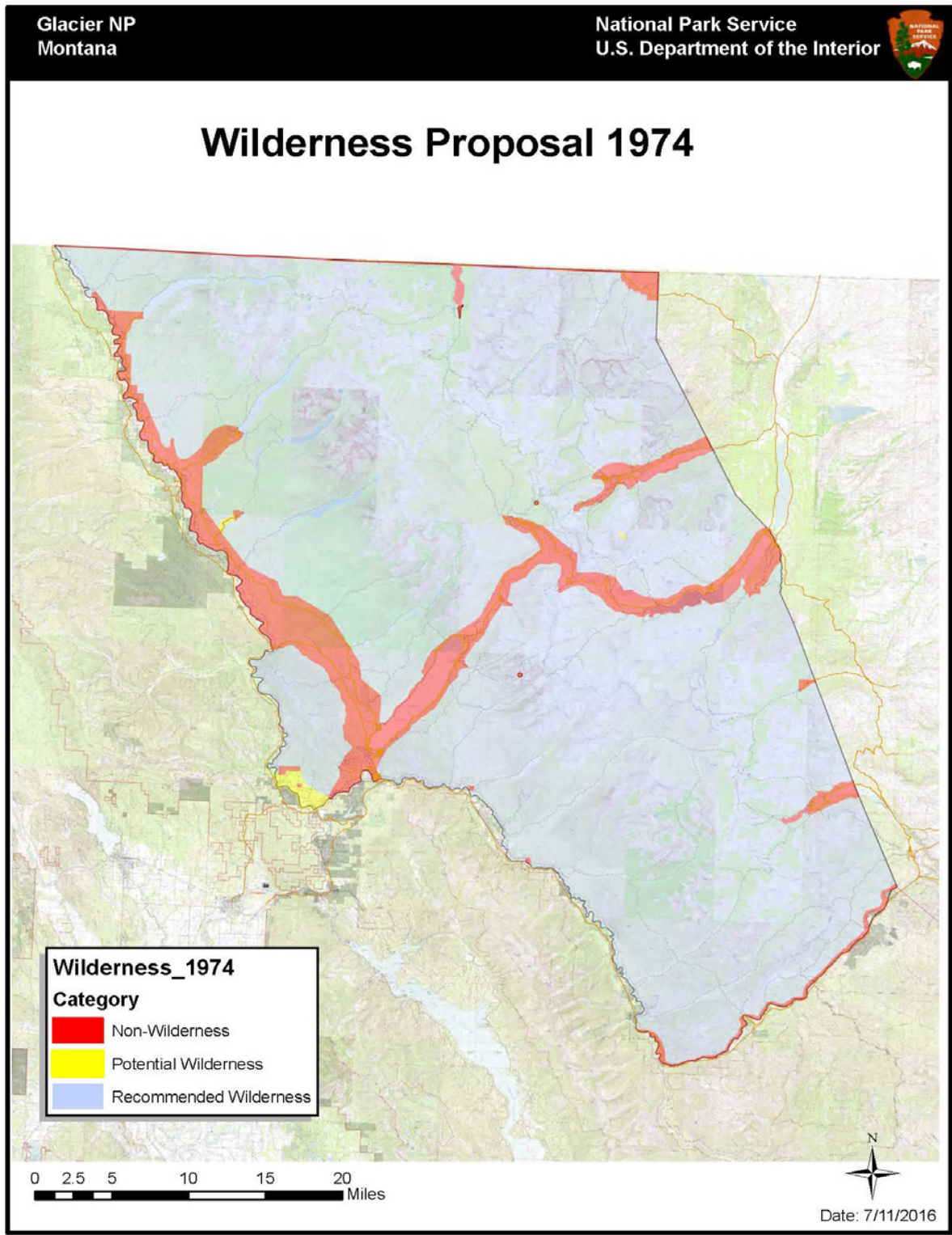
Glacier National Park completed a study and environmental impact statement in 1973 to comply with the Wilderness Act. As a result, over 90% of the park, totaling 9663,155 acres, was recommended by the president through Congress to be formally designated wilderness (see figure 6).

Recommended wilderness in the park is characterized by rugged peaks, glacial valleys, and 200 stunning lakes with horseback and foot trails that weave among many areas. Glacier National Park is the core of the Crown of the Continent ecosystem, one of the most ecologically intact areas remaining in the temperate regions of the world. It is one of the few places in the contiguous 48 states that continue to support natural populations of all indigenous carnivores and most of their prey species (Douglas 2012). Visitors enjoy hiking an estimated 148 miles of designated trails in the GTSR management area, most within recommended wilderness.

Keeping It Wild 2, An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System produced by the Department of Agriculture provides a tangible definition of wilderness character and identifies four qualities of wilderness character that apply uniquely to every wilderness: untrammeled, natural, undeveloped, and solitude or primitive and unconfined recreation. These qualities are based on the wilderness definition from the Wilderness Act (section 2(c)). In addition to these four qualities, a fifth quality—other features of value—was also identified in the Wilderness Act: a wilderness “may also contain ecological, geological, or other features of scientific, educational, scenic or historical value” (Landres et al. 2012; Landres et al. 2015).

The *untrammeled quality* focuses on the degree to which wilderness is unhindered and free from modern human control or manipulation. The untrammeled quality is degraded by actions that intentionally manipulate or control ecological systems (in contrast to the natural quality, which is degraded by the effects of modern civilization). Fire management, invasive species management, as well as wildlife research and hazing degrade the untrammeled quality, if/when they are implemented in areas of recommended wilderness in the GTSR management area.

FIGURE 6. RECOMMENDED WILDERNESS WITHIN GLACIER NATIONAL PARK





The *natural quality* centers on the idea that wilderness contains ecological systems that are substantially free from the effects of modern civilization. This quality is degraded by the intended or unintended effects of modern people on ecological systems inside wilderness. Loss of native fish species, spread of nonnative species, livestock trespass, and climate change effects on the park's ecosystems have degraded the natural quality in portions of recommended wilderness in the GTSR management area.

The *undeveloped quality* centers on the idea that wilderness is without permanent improvements or modern human occupation. This quality is degraded by the presence of structures and installations, as well as the use of motor vehicles, motorized equipment, and mechanical transport because these increase people's ability to occupy or modify the environment. Remote patrol cabins, ranger stations, fire lookouts, scientific instrumentation, chalets, dams, and other administrative structures in the GTSR management area diminish the undeveloped quality of recommended wilderness. While there are many administrative and scientific structures in recommended wilderness, the majority of the vast expanses of the park's recommended wilderness exemplify the undeveloped quality (Douglas 2012).

The *solitude or primitive and unconfined recreation quality* focuses on the outstanding opportunities that exist in wilderness to experience solitude, remoteness, and primitive recreation free from the constraints of modern society. This quality is degraded by tangible attributes of the setting that reduce these opportunities such as visitor encounters, signs of modern civilization, recreation facilities, and management restriction on visitor behavior. The park provides a variety of opportunities for visitors to find solitude. The craggy topography with its deep valleys provides the remoteness from occupied and modified areas outside the recommended wilderness (Douglas 2012). Increasing visitation levels, noise from overflights, vehicle traffic noise, and mechanized tools for research and maintenance activities degrade the character of this recommended wilderness quality.

The *other features of value quality* centers on unique and tangible features of a wilderness that are integral to the wilderness character of that place. These features may include cultural resource sites, paleontological sites, or any other features not included under the other four qualities that have ecological, geological, scientific, educational, scenic, or historical value. Human influence in the park has created a wide range of cultural resources including American Indian ceremonial sites, ethnographic places of importance, and historic park administration structures (Douglas 2012). This quality is degraded by loss or damage to features integral to the character of recommended wilderness because of increasing visitor use and routine maintenance needs.

## Impacts on Character of Recommended Wilderness

**No-Action Alternative.** Under the no-action alternative, visitor use of informal and over-widened trails would continue, increasing the potential for accelerated erosion and damage to unstable areas. Additional informal trails could also develop over time as visitation increases. This would degrade the natural quality of recommended wilderness. Minor trail maintenance and improvements would reduce adverse human disturbance to trails, but if and when implemented, would also add an element of human control and the potential use of motorized equipment that would degrade the untrammelled and undeveloped qualities of the recommended wilderness. In addition, growing visitation would increase the number of visitors on trails within the recommended wilderness surrounding the GTSR corridor. This increase could degrade the solitude or primitive and unconfined recreation quality of wilderness by hindering a visitor's ability to experience solitude, depending on the time of year and the trail being hiked. In general, these impacts would be greatest on popular trails in proximity to the road corridor. In addition, with an increase in visitor use on low use trails, different types of hiking experience that previously included opportunities for solitude would disappear from the corridor during peak season and peak use times.

Under the no-action alternative, impacts to each of the wilderness qualities would continue to be greatest along popular trails in proximity to the GTSR road corridor since access to other parts of recommended wilderness is more difficult and time consuming. Given that the GTSR corridor management area in its entirety includes less than 20% of the recommended wilderness in the park, and that these impacts are generally limited to a smaller portion of the management area concentrated around the road corridor, the impacts would continue to be localized and minimal when compared to the overall amount of recommended wilderness in the park.

**Preferred/Proposed Alternative.** The proposed trail work would entail human manipulation in recommended wilderness, with the objective of reestablishing and/or maintaining sustainable ecological conditions. This would result in impacts to the untrammeled wilderness quality in these locations. During the four- to six-month construction period, improvements to the Avalanche Lake Trail, installation of three backcountry toilets, and, if implemented, construction of 5.0 miles of new trails proposed as adaptive management options, would degrade the undeveloped wilderness quality and opportunities for solitude due to the continued presence of work crews and new ground and human disturbance. If implemented, adding approximately 5.0 miles of new trails in, or immediately adjacent to wilderness would increase the total wilderness trail miles by 3.4% in the GTSR management area, which would have the potential to degrade the natural quality of wilderness by introducing nonnative plants, introducing noise, and displacing wildlife; however, best management practices would be implemented to minimize this potential. Because most trail and restroom work in recommended wilderness would be conducted with hand tools, construction noise would be limited and disturbance would mostly be contained to the narrow trail corridor. Exceptions include use of mechanized equipment such as small hand tools, chainsaws, rock drills, generators, possible rock blasting, and use of helicopters for material delivery. Use of this equipment would be subject to minimum requirements analysis and is expected to be infrequent, limited to short durations, and used in compliance with the park's wilderness requirements. The noise from these actions would be heard and seen by visitors in adjacent wilderness areas, which diminishes opportunities for solitude or primitive and unconfined recreation and adversely impacts the undeveloped wilderness quality. The area affected by the sights and sounds of construction would vary depending on topography, vegetation, and other site conditions. The effects would diminish as one moves away from the construction site. Sound from using mechanized equipment may be noticeable several miles or more from the site. The wilderness viewsheds from where visitors could discern construction activities could also extend many miles from the construction sites. These adverse effects on wilderness qualities would typically occur during a three- to four-month construction season occurring over several years.

Following construction, the use and presence of the improved trails and restrooms, and new trails, if implemented, would have an adverse impact on natural and undeveloped wilderness qualities. Regular maintenance and weed control activities on the new trails and at restrooms would degrade the undeveloped and solitude qualities of wilderness character. The continued adverse effects on the natural wilderness quality viewshed could extend many miles from the new trails and restrooms. Hardening of the Avalanche Lake Trail would occur primarily in the footprint of the existing trail, although some earthwork may be necessary outside the footprint to meet trail design standards. Native materials would be used for constructed trail sections to protect the natural qualities of wilderness character. Imported tread material or structural material may be needed at some locations.

Outside recommended wilderness, the preferred/proposed alternative also involves improving roads and trails, expanding parking areas, and installing restroom facilities that would generate noise and visual intrusions from construction activities that may carry into wilderness and degrade natural qualities and opportunities for solitude during the few weeks involved for each location's short construction period.

Improving or adding trails and adding new restroom facilities in heavily used areas would have beneficial effects on recommended wilderness by limiting off-trail use and helping to reduce the footprint of informal trails. These beneficial effects would promote recovery of native vegetation on disturbed areas and eventually improve the natural quality of wilderness (see vegetation section above).

**Cumulative Effects.** Past, present, and reasonably foreseeable future actions that could have cumulative adverse effects on recommended wilderness in the GTSR management area have primarily occurred as a result of visitor use, overflights, and park operations such as trail, road, and facility maintenance. Impacts on wilderness qualities from these activities include soil erosion and loss of vegetation, introduced noise and visual disturbance from commercial air tours, administrative aircraft use, vehicles traveling on adjacent park roads, and reduced water flows caused by existing water uses. Activities associated with the park's ongoing efforts to protect natural resources, such as efforts to prevent and control nonnative invasive species and future projects such as the proposed comprehensive fisheries management, would also adversely affect the untrammeled quality of wilderness but benefit natural qualities. Collectively, all these uses and activities have had, and would continue to have, adverse impacts on recommended wilderness. Adding the effects of the no-action or preferred/proposed alternatives would have a slight localized, adverse, and beneficial incremental contribution to the adverse impacts of these other actions and would not substantially change the overall adverse cumulative effects already occurring now or in the future.

## **CULTURAL RESOURCES**

### **Affected Environment**

For the purposes of this analysis, cultural resources are defined as buildings, structures, objects, sites, or districts that display significant associations to US history, architecture, archeology, engineering, or culture, and are listed, or eligible for listing in the National Register of Historic Places (NRHP). Research and fieldwork have been conducted in the park, and most of the cultural resources likely to be affected by activities related to implementation of the corridor management plan are documented. However, some types of resources with potential historic significance include intersecting roads and trails, historic communications systems, former road alignments, and others that may not have been evaluated. Federal regulations mandate the completion of a cultural resource survey prior to the beginning of any undertakings along the GTSR corridor that may impact undisturbed land or previously undocumented resources.

### **Historic Structures and Districts, Cultural Landscape, and Visual Resources**

A number of historic structures and cultural landscape features along the GTSR corridor are already listed in, or are eligible for listing in, the national register, including the road itself. The GTSR was listed in the national register in 1983; was documented by the Historic American Engineering Record in 1990; and was designated a national historic landmark by the Secretary of the Interior in 1997. The national historic landmark distinction is the most noteworthy and restrictive and affords the road and its cultural resources the highest possible level of federal protection. The road is considered significant for its history, as well as for its engineering and landscape. As an early example of a major NPS roadway, it represents a pioneering federal attempt to design and construct an automobile road that both harmonized with its environment and showcased its natural surroundings. The engineering and landscape architecture techniques used in construction of the road further reflected this design philosophy, featuring well-crafted stonework and gently curving walls that blend with the spectacular

natural setting. Both the national register and NHL nominations include the length of the road from the T-intersection at the foot of Lake McDonald to the park boundary at St. Mary.

The important historic engineering and landscape features of GTSR include the roadbed, bridges, culverts, and overpasses; retaining walls and guard walls; two tunnels; and other structural and design elements. Most of these features were constructed of native stone and display high-quality craftsmanship. Broader elements of the road's design are also considered significant such as its alignment and width. The road has long been recognized for its careful and uniquely designed spatial relationship with its surrounding geography.

The GTSR Historic District was documented as a cultural landscape (RTI 2002). The cultural landscape concept has a direct bearing on planning actions related to future road rehabilitation and other changes in the GTSR corridor. Scenic viewsheds from the road are also considered important elements of the cultural landscape.

In addition to the road itself and its associated contributing features, a number of other resources exist along the road that are listed in, or are eligible for listing in the national register; most are buildings or groups of buildings (districts). Resources within approximately 0.25 mile of the current roadway corridor that may be directly or indirectly impacted by the proposed action are described below. Proposed actions predominantly occur within this 0.25 mile-distance from the road, and depending on the topography, vegetation, and siting of structures, the viewshed from these resources could include the GTSR corridor.

The West Entrance Station is a stone and log structure erected in 1940, slightly enlarged in the 1960s, and totally rehabilitated in 2010. An excellent example of NPS rustic architecture. The facility continues to serve as the primary initial contact point for park visitors arriving from the west. The building is eligible for inclusion in the national register because of its contribution to the major pattern of US history and its distinctive architectural characteristics. Lake McDonald Lodge is a handsome, rustic hotel dating from 1913–14. The building is a national historic landmark. The lodge, known originally as Lewis Glacier Hotel, has long been the focal point of visitor activity on the west side of the park.

The Lake McDonald Lodge Historic District that surrounds the hotel includes a number of log guest cabins and ancillary buildings and a 1960s Mission 66 coffee shop. The Lake McDonald Lodge is significant for its architecture. The Mission 66 era is an important NPS-wide development and improvement program (1956–66). While the current road alignment bypasses the historic district to the east, some of its buildings are briefly visible to travelers on the road. In addition, a former alignment of the road (now a loop road) passes through the district.

The Logan Creek Cabin is a single-room log cabin used primarily for winter backcountry patrols. It is a well-preserved example of NPS rustic architecture. Built in 1924, it was originally constructed for surveyors who laid out the road's western approach to Logan Pass.

The Logan Pass and St. Mary Visitor Centers, both dating from the mid-1960s, are the largest NPS visitor contact facilities along the road. The buildings are listed in the national register and are highly visible from the road. The St. Mary Visitor Center is immediately adjacent to the road and incorporates entrance station kiosks for park visitors. While not a historic feature, a medicine wheel created in 2009 is of cultural importance to the tribes.

Many of the trails in the GTSR management area are listed in the National Register of Historic Places. The 1913 Ranger Station and barn was the original ranger station in St. Mary and built prior to the construction of the GTSR.

Rising Sun Auto Camp Historic District is a small facility with buildings dating from 1940 and beyond. The property is considered significant as a well-preserved example of a park tourist facility geared toward automobile travelers, although only the store building is readily visible from the road. It is assigned to the park concessioner and a 1960s coffee shop dominates the view of Rising Sun for road travelers and two 1960s motels are located with the guest cabins. All these buildings may be eligible for listing in the national register, but are currently unevaluated.

Avalanche Campground Historic District is approximately 15 miles northeast of the park entrance at West Glacier and has been determined eligible for listing in the national register. It includes a three-loop campground on the east side of the road; one loop dating from 1927 has been abandoned and the two other loops date from the Mission 66 era. The picnic area across the road and two nearby trails (Trail of the Cedars and Avalanche Lake Trail) are unevaluated for NRHP eligibility.

## Impacts on Cultural Resources

**No-Action Alternative.** Under the no-action alternative, there would be no changes to existing park facilities and only routine maintenance activities would be performed. There would be no noticeable impacts to the Headquarters Historic District, West Entrance Station, the Lake McDonald Lodge Historic District, Logan Creek Cabin, South Circle Trail, Rising Sun Auto Camp Historic District, and St. Mary Visitor Center because no changes are anticipated that would directly or indirectly impact the historic settings or viewsheds associated with these historic resources. However, increased visitor use of some facilities in recent years, particularly at “hot spots” such as Avalanche Creek and Logan Pass, have and would continue to result in impacts to the setting of historic structures, such as the Logan Pass Visitor Center, and degradation of cultural landscape features in the Avalanche Campground Historic District and the GTSR corridor. These impacts consist primarily of new informal trails, eroded soils, and trampled vegetation that result in deterioration of the vegetation composition and design features of the cultural landscape and increased wear and tear of the historic structures. The duration of these impacts would be expected to continue until landscape rehabilitation actions could be completed by park staff.

**Preferred/Proposed Alternative.** Under the preferred/proposed alternative, new infrastructure and services would be implemented to accommodate increased visitation. Adaptive management approaches may be implemented to respond to monitored conditions. An increase in infrastructure would mean introducing nonhistoric materials, adding a structure or feature where none historically existed, or altering the historic circulation pattern in some locations.

At the Avalanche Developed Area, restoring the exit and converting the current entrance to the exit, converting the east side to one way would restore the historic design and circulation pattern in the Avalanche Campground Historic District and would be beneficial. If the dynamic parking configurations proposed as potential adaptive management options in the Avalanche Developed Area were seasonally implemented for parking, the dynamic conversion of the picnic area, loop A, loop B, and the abandoned loop would alter the historic use of the campground. However, the proposed changes would be designed and implemented to ensure they would not permanently alter the location, design, setting, and workmanship of the historic district; the campground would revert back to its historical seasonal use prior to and following peak season parking demand. In order to allow temporary additional parking in the campground loops, new aggregate would be placed in the original campground loop configuration. This material is both removable and in keeping with existing materials in the campground. However; if implemented, the construction of a secondary road segment to connect the abandoned loop to loop A would change the historic design and circulation pattern in the district. Hardening the Avalanche Lake Trail and formalizing a trail partially around Avalanche Lake would not have an adverse impact to the historic setting of the Avalanche Campground and

Picnic Area Historic District because it would not alter the design, location, or setting of the district. While this action could have an impact to the trail itself, the trail has not been assessed for eligibility, and the details of that potential impact would not be known until further design and the completion of a cultural resource assessment. Upon further design, consultation with the Montana State Historic Office (SHPO) and the Tribal Historic Preservation Officer (THPO) would be initiated and the National Park Service would work with the SHPO and the Advisory Council Historic Preservation (ACHP) according to section 106 procedures to determine mitigation requirements for any unavoidable adverse impacts at the Avalanche Developed Area. The type and level of mitigation required would vary depending on the resource involved and the level of damage. Historic documentation, public interpretation, and restoration of related historic resources are among potential mitigation steps.

Expanding parking at the St. Mary Visitor Center and Entrance Station would not have an adverse impact on the historic setting because the parking area does not contribute to the national register eligibility of the St. Mary Visitor Center and Entrance Station. The addition of 10 parking spaces would increase the capacity of the parking lot by less than 10%, which would have a minimal impact to the character of the overall landscape on which this facility is located. The new parking spaces would be sited in consultation with the Blackfeet Tribe to avoid any direct and indirect impacts to the medicine wheel created by the tribe in 2009. A cultural resource survey would be conducted prior to the beginning of any construction if the design could impact undisturbed land or previously undocumented resources.

Construction of an under-road crossing for pedestrians and bicycles and adding an asphalt bike trail to the 1913 Ranger Station would add a modern element to the historic setting of the St. Mary Visitor Center. Depending on the location, design, and presence of contributing road features, the under-road crossing could have an adverse impact on the historic GTSR and GTSR Historic District, archeological resources, and/or the cultural landscape. All efforts would be made to avoid an adverse effect. A cultural resource survey would be conducted prior to the beginning of any construction if the design could impact undisturbed land or previously undocumented resources. Upon further design, consultation with the SHPO would be initiated and, if necessary, mitigation for any adverse impacts would be formalized in a memorandum of agreement.

The addition of a removable vault toilet at Big Bend would be placed to avoid an adverse effect on the cultural landscape of the GTSR Historic District at that location. The addition of vault and backcountry toilets at the Avalanche shuttle shelter, Hidden Lake Overlook, along the Highline Trail, the Siyeh Bend Trail, and the St. Mary and Virginia Falls Trails would be placed to avoid an adverse effect on the eligibility of the historic trail routes or the GTSR Historic District.

The addition of two or more kiosks at the West Entrance Station could adversely impact the setting of this historic building due to the addition of these nonhistoric elements. Prior to construction, consultation with the SHPO would be initiated and mitigation for any adverse impacts would be agreed upon.

There would be no noticeable impacts to the Headquarters Historic District, the Lake McDonald Lodge Historic District, Logan Creek Cabin, South Circle Trail, or the Rising Sun Auto Camp Historic District because there are no proposed actions in proximity of these resources that would directly or indirectly impact the historic settings or viewsheds associated with these resources.

The changes as described above would diminish the integrity of an individual contributing resource but are not likely to render any of the resources ineligible for listing in the national register. The adverse impacts would be both localized and direct, mainly due to the physical addition of nonhistoric elements to historic settings. Indirect impacts, primarily due to visual impacts associated with these

intrusive elements, would be confined mainly to the West Entrance and St. Mary Visitor Center areas. These impacts are localized, site specific, and permanent. Careful siting and design of these new additions in consultation with the SHPO would be used to minimize adverse impacts; however, any adverse impacts would be mitigated in consultation with the SHPO.

**Cumulative Effects.** Past, present, and reasonably foreseeable future projects that could have cumulative adverse or beneficial effects on cultural resources include the GTSR rehabilitation project, which consisted of extensive repairs to the roadway, retaining walls, guard walls, drainage features, and tunnels. Although some individual historic features of the road needed to be modified or reconstructed due to their deteriorated condition; overall, the project had a beneficial impact on the GTSR because it improved the condition of the road and its associated historic features and will preserve it for future use. A Lake McDonald properties management plan, currently underway, will provide guidance to the park in the preservation and maintenance of these historic properties. Improvements completed at the West Glacier Entrance Station improved the condition of this resource. Collectively, these projects have provided beneficial impacts to the park's cultural resources. The no-action alternative would not contribute a meaningful incremental change to the overall beneficial cumulative impacts on cultural resources because the associated impacts would be negligible and localized and not likely to render any of the resources ineligible for listing. When the effects of the no-action alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on cultural resources would continue to be beneficial. The preferred/proposed alternative would add a small adverse incremental change to the overall beneficial cumulative impacts due to the associated impacts of altering the setting of historic structures and adding new visually intrusive elements to the cultural landscape. When the effects of the preferred/proposed alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impact on cultural resources would continue to be beneficial.

## **CHAPTER 4: CONSULTATION AND COORDINATION**

Agency consultation and coordination began early in the planning process and is ongoing to ensure that all relevant agencies are informed of any NPS planning actions. Agencies, elected officials, tribal offices, and organizations that were consulted and coordinated with during the planning process are listed below. Additional information regarding the history of civic engagement and agency consultation and coordination is included in appendix I.

### **Elected Officials**

- Blackfeet Tribal Business Council
- Browning Town Mayor
- Steve Bullock, Governor of Montana
- Columbia Falls City Mayor and City Council
- Confederated Salish-Kootenai Tribal Council
- Flathead County Commissioners
- Glacier County Commissioners
- Kalispell City Mayor and City Council
- Jason Kenney, Premier of Alberta, Canada
- US Senator Steve Daines
- US Senator Jon Tester
- US Congressman Greg Gianforte
- Whitefish City Mayor and City Council

### **Federal Agencies**

- Advisory Council on Historic Preservation
- Federal Highway Administration – Western Lands Division
- National Park Service, Intermountain Regional Office
- National Trust for Historic Preservation – Western Field Services
- US Army Corps of Engineers, Helena Regulatory Office
- US Department of the Interior, Office of the Solicitor
- US Environmental Protection Agency
- US Fish and Wildlife Service
- US Forest Service: Flathead National Forest and Lewis and Clark National Forest
- US Geological Survey, Federal Documents Librarian

### **Canadian Federal Government Agencies**

- Waterton Lakes National Park

### **Montana State Agencies and Tribal Offices**

- Blackfeet Environmental Office, Blackfeet Tribal Historic Preservation Officer
- Confederated Salish-Kootenai Tribal Preservation Office
- Eagle Transit
- Flathead Basin Commission, Flathead County Commissioners, Flathead County Planning and Zoning Board



- Kalispell Chamber of Commerce / Convention and Visitor Bureau
- Montana Department of Environmental Quality
- Montana Department of Fish, Wildlife and Parks
- Montana Department of Natural Resources and Conservation
- Montana State Historic Preservation Office
- Stillwater State Forest

## **Organizations and Businesses**

- Adventure Cycling Association, Backcountry Horsemen, Belton Chalets
- Bike Walk Montana Crossbow Corporation, Friends of the Wild Swan, Glacier Raft Company, Glacier Institute
- Glacier National Park Conservancy, Glacier National Park Volunteer Associates
- Glacier Park Boat Company, Glacier Park Incorporated
- Great Northern Whitewater Resort, Montana Preservation Alliance, Montana Raft Company
- Montana Wilderness Association National Parks Conservation Association Sun Tours
- Pursuit-Glacier Park Incorporated
- Swan Mountain Outfitters, Swan View Coalition, West Glacier Mercantile, Wilderness Watch
- Wild Rivers Adventures, Xanterra

## **APPENDIXES**

Appendix A: References

Appendix B: Acronyms and Abbreviations

Appendix C: Preparers, Planning Team Members, Consultants, and Contributors

Appendix D: Indicators, Thresholds, and Capacity

Appendix E: Mitigation Measures

Appendix F: Other Past, Ongoing, and Reasonably Foreseeable Future Actions

Appendix G: Strategies and Alternatives Considered But Dismissed

Appendix H: Impact Topics Considered But Dismissed

Appendix I: History of Civic Engagement, Agency Consultation, and Coordination

Appendix J: Plant Species of Concern with the Potential to Occur Near Proposed and Potential New Trail Segments Under the Preferred/Proposed Alternative

Appendix K: Traffic Counts and Level of Service on Going-to-the-Sun Road Report

*This page intentionally left blank.*

## APPENDIX A: REFERENCES

- Baker, Melissa and Wayne Freimund  
2007 "Initial Season of the Going-to-the Sun Road Shuttle System at Glacier National Park: Stakeholder Evaluation." University of Montana, Department of Society and Conservation. Missoula, MT.
- Barber, J. R., K. R. Crooks, and K. M. Fristrup  
2010 The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution*, 25(3), 180–189.
- Bedoya, D. M., W. Freimund  
2012a Use of Selected Trails and Parking Areas on the Going-to-the-Sun Road: Interim Report (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Bedoya, D., W. Freimund  
2012b Visitor Use of the Going-to-the-Sun Road Corridor: A Survey of Shuttle Riders, Non-shuttle Riders and Hikers (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Bedoya, Gomez, D. M.  
2013 "Exploring Detracting Elements and Coping Mechanisms Reported on Four Trails Along the Going-to-the-Sun Road Corridor in Glacier National Park." University of Montana, Missoula, MT.
- Beeco, J. A. and A. R. Pipkin  
2018 Hawai'i Volcanoes National Park: Acoustic monitoring report 2013. Natural Resource Report NPS/NRSS/NSNS/NRR—2018/1578. National Park Service, Fort Collins, CO.
- Carolin, T., R. Menicke and P. Lesica  
2010 "Important Plant Area Nomination Form – Montana for Logan Pass." Submitted to the Montana Native Plant Society's Important Plant Areas Program on January 4, 2010.
- Clow, D. W., R. G. Striegl, L. Nanus, M. A. Mast, D. H. Campbell, D. P. Krabbenhoft  
2002 "Chemistry of Selected High-Elevation Lakes in Seven National Parks in the Western United States." *Water, Air, and Soil Pollution: Focus* 2:139–164.
- Copeland, J. P. and R. E. Yates  
2008 "Wolverine Population Assessment in Glacier National Park, Comprehensive Summary Update (Preliminary Results)."

- Cullinane, Thomas C., E. Cornachione, L. Koontz, and C. Keyes  
 2019 National Park Service Socioeconomic Pilot Survey: Visitor Spending Analysis. Natural Resource Report NPS/NRSS/EQD/NRR\_\_2019/1924. National Park Service, Fort Collins, CO.
- Dalenberg, Douglas, Elena Nikolaeva, Wayne Freimund, Jennifer Thomsen  
 2017 "Glacier National Park: 2017 Trail and Road Monitoring Report." W. A. Frank College of Forestry and Conservation, Department of Society and Conservation. University of Montana, Missoula, MT.
- DeBolt, A. and B. McCune  
 1993 "Lichens of Glacier National Park, Montana." *The Bryologist* 96:192-204.
- Douglas, M.  
 2012 "Keeping it Wild in the Crown Jewel, Wilderness Building Blocks for Glacier National Park." Final report to National Park Service. Interagency Wilderness Fellows Program. West Glacier, MT.
- Downs, C. C., M. Woody and B. McKeon  
 2013 "Glacier National Park Fisheries Inventory and Monitoring Report, 2010–2012." National Park Service, Glacier National Park, West Glacier, MT.
- Dutton, B., J. Hadlock, M. Arthur, D. Marrett, A. Goldin, and A. Zhu  
 2001 "Soils of Glacier National Park." Prepared for Glacier National Park by Land & Water Consulting, Inc., Missoula, MT.
- Dux, A. M. and C. S. Guy  
 2004 "Evaluation of Fish Assemblages and Habitat Variables in Streams Bisecting the Going-to-the-Sun Road and Peripheral Roads in Glacier National Park, Final Report." Montana Cooperative Fishery Research Unit, Department of Ecology, Montana State University, Bozeman, MT.
- Edmonds, A.  
 2002 "Gray Wolf Monitoring Observations in Glacier National Park." Division of Natural Resources, Glacier National Park, West Glacier, MT.
- Elliott, J. C.  
 1987 "Preliminary report on the ecology and distribution of mosses in Glacier National Park, Montana." West Glacier, MT.: Glacier National Park Library.
- Ellis, B. K., J. A. Stanford, J. A. Craft, D. W. Chess, G. R. Gregory, and L. F. Marnell  
 1992 "Monitoring of Water Quality of Selected Lakes in Glacier National Park, Montana: Analysis of Data Collected, 1984–1990." Open File Report 129-92 in conformance with Cooperative Agreement CA 1268-0-9001, Work Order 6, National Park Service, Glacier National Park, West Glacier, Montana. Flathead Lake Biological Station, the University of Montana, Polson.

- Elze, L.  
2002 "Threatened, Endangered, and Species of Concern Wildlife Sightings Within the Going-to-the-Sun Road Corridor." Division of Resource Management. Glacier National Park, West Glacier, MT.
- Environmental Protection Agency (EPA)  
2014 "Motor Vehicle Emissions Model for SIPs and Transportation Conformity." *Federal Register* 79: 60343-60347.
- Federal Geographic Data Committee (FGDC)  
1997 Vegetation Classification Standard. Document No. FGDC-STD-005.
- Federal Highway Administration (FHWA)  
2011 Highway Traffic Noise: Analysis and Abatement Guidance. Report No. FHWA-HEP-10-025.
- Federal Register  
2013 Notice of Intent: Going-to-the-Sun Road Corridor Management Plan, Environmental Impact Statement, Glacier National Park, Montana. 78 FR 43226 (July 19, 2013). Accessed 4/16/2015. <http://www.gpo.gov/fdsys/pkg/FR-2013-07-19/html/2013-17375.htm>.
- Ford, A., T. Nguyen, A. Beall  
2012 Modeling Support for National Park Planning: Initial Results from Glacier National Park. School of the Environment, Washington State University. Pullman, WA.
- Fredenberg, W. A., M. H. Meeuwig, and C. S. Guy  
2007 Action Plan to Conserve Bull Trout in Glacier National Park, Montana. US Fish and Wildlife Service, Kalispell, MT.
- Freimund, W., D. Dalenberg, C. Mills, A. Weinberg, S. Markegrd, T. Warner, and Z. Miller  
2013 Glacier National Park Site History (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Freimund, W., D. Dalenberg, C. Mills, A. Weinberg, S. Markegrd, T. Warner, and Z. Miller  
2014 Glacier National Park Site History: Logan Pass (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Freimund, W., D. Dalenberg, E. Nikolaeva  
2016 Bicycle/Vehicle Counter 2016 at Avalanche, Apgar, and Camas Road (unpublished). University of Montana, Missoula, MT.
- Freimund, W., S. F. McCool, J. Adams  
2006 Recreational Use of Selected Viewpoints on Going-to-the-Sun Road, 2005, Glacier National Park (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.

- Giersch, J. J., S. Hoatling, R. P. Kovach, L. A. Jones, C. C. Muhlfeld  
 2016 "Climate-Induced Glacier and Snow Loss Imperils Alpine Stream Insects." *Global Change Biology*. doi:10.1111/gcb.13565.
- Giordano, R. N.  
 2002 "Exploring Visitor Experiences on Going-to-the-Sun Road in Glacier National Park," University of Montana, Missoula, MT.
- Glacier National Park (GNP)  
 2014 "Trip Report: Motorcycle Outreach." National Park Service, Department of the Interior, Natural Science and Stewardship Directorate, Natural Sounds Program.
- 2014a "Glacier National Park Business Plan." Glacier National Park, West Glacier, MT. On file at Glacier National Park.
- 2014b Glacier National Park Annual Park Recreation Visitation (1904–2014). Natural Resource Stewardship and Science Division, Fort Collins, CO. Accessed on 4/15/2015 at: <https://irma.nps.gov/Stats/Reports/Park/GLAC>.
- 2014c Glacier National Park Recreation Visitors by Month (1979–2014). Natural Resource Stewardship and Science Division. Fort Collins, CO. Accessed on 4/15/2015 at: <https://irma.nps.gov/Stats/Reports/Park/GLAC>.
- 2014d Climate Change Scenario Planning Summary. Climate Change Response Program. Missoula, MT. Accessed on 4/15/2015 at: [http://crownmanagers.org/storage/CMP-Forum-2014\\_Scenario-Planning-Report\\_FINAL201407171.pdf](http://crownmanagers.org/storage/CMP-Forum-2014_Scenario-Planning-Report_FINAL201407171.pdf).
- Gonzalez, Patrick, R. P. Neilson, K. S. McKelvey, J. M. Lenihan, and R. J. Drapek  
 2007 "Potential Impacts of Climate Change on Habitat and Conservation Priority Areas for Canada lynx (*Lynx canadensis*).” Report to: USDA Forest Service and NatureServe.
- Hageman, K. J., Simonich, S. L., Campbell, D. H., Wilson, G. R., Landers, D. H.  
 2006 Atmospheric deposition of current-use and historic-use pesticides in snow at national parks in the Western United States. *Environmental Science & Technology* 40: 3174–3180.
- Haybeck, J. R.  
 1963 "Lichen Distribution in the Lake McDonald Forest Communities in Glacier National Park." *Montana Academy of Science* 23:34-37.
- Hermann, F. J.  
 1969 "The Bryophytes of Glacier National Park, Montana." *The Bryologist* 72:358376.
- Highway Capacity Manual (HCM)  
 2010 Highway Capacity Manual. Transportation Research Board, Washington, D.C. 2000. ISBN 0-309-06681-6.

- Hop, K., M. Reid, J. Dieck, S. Lubinski, and S. Cooper  
 2007 "U.S. Geological Survey-National Park Service Vegetation Mapping Program: Waterton-Glacier International Peace Park." US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.
- Interagency Visitor Use Management Council (IVUMC)  
 2016 "Visitor Use Management Framework, A Guide to Providing Sustainable Outdoor Recreation, Edition One." July.
- Intergovernmental Panel on Climate Change (IPCC)  
 2007 Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller [eds.]). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Jägerbrand, Annika K. and Juha M. Alatalo  
 2015 Effects of human trampling on abundance and diversity of vascular plants, bryophytes and lichens in alpine heath vegetation, Northern Sweden. *SpringerPlus* 4:95. DOI 10.1186/s40064-015-0876-z.
- Johnson, M., A. Dimond, W. Freimund  
 2010 Going-to-the-Sun Road Shuttle System and Visitor Study Synthesis Report (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Joslin, G. and H. Youmans  
 1999 "Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana." Committee on Effects of Recreation on Wildlife, Montana Chapter of the Wildlife Society.
- 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):1693–1705.
- Koehler, G. M  
 1990 "Population and Habitat Characteristics of Lynx and Snowshoe Hares in North Central Washington." *Canadian Journal of Zoology* 68: 845-851.
- Kohut, R. J.  
 2007 "Ozone Risk Assessment for Vital Signs Monitoring Networks, Appalachian National Scenic Trail, and Natchez Trace National Scenic Trail. "NPS/NRPC/ARD/NRTR—2007/001. National Park Service, Fort Collins, CO. Available at:  
[https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=152846&file=OzoneRiskAssessment\\_NRTR2\\_007\\_001.pdf](https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=152846&file=OzoneRiskAssessment_NRTR2_007_001.pdf).



- 2004 "Ozone Risk Assessment for Rocky Mountain Network." National Park Service. Fort Collins, CO. Available at: <https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=442215&file=romnO3RiskOct04.pdf>.
- Landers, D. H., S. L. Simonich, D. A. Jaffe, L. H. Geiser, D. H. Campbell, A. R. Schwindt, C. B. Schreck, M. L. Kent, W. D. Hafner, H. E. Taylor, K. J. Hageman, S. Usenko, L. K. Ackerman, J. E. Schrlau, N. L. Rose, T. F. Blett, and M. M. Erway  
 2008 "The Fate, Transport, and Ecological Impacts of Airborne Contaminants in Western National Parks (USA)." EPA/600/R-07/138. U.S. Environmental Protection Agency, Office of Research and Development, NHEERL, Western Ecology Division, Corvallis, OR. Available at: [http://www.nature.nps.gov/air/studies/air\\_toxics/WACAPreport.cfm](http://www.nature.nps.gov/air/studies/air_toxics/WACAPreport.cfm).
- Landres, P., W. M. Vagias, and S. Stutzman  
 2012 "Using Wilderness Character to Improve Wilderness Stewardship." *Park Science* 28(3):44-48.
- Landres, P., C. Barns, S. Boutcher, T. Devine, P. Dratch, A. Lindholm, L. Merigliano, N. Roeper, and E. Simpson  
 2015 Keeping it Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System. US Forest Service, Fort Collins, CO. Gen. Tech. Rep. RMRS-GTR-340.
- Lau, M. C., C. S. Y. Lee, J. L. Rochat, E. R. Boeker, G. G. Fleming, K. L. Cummins, and J. Ruggiero  
 2004a FHWA Traffic Noise Model, version 2.5 Look-Up Tables User's Guide. Report Nos. FHWA-HEP-05-008 and DOT-VNTSC-FHWA-0406, Cambridge, MA: John A. Volpe National Transportation Systems Center.  
 2004b FHWA Traffic Noise Model (FHWA TNM) User's Guide (Version 2.5 Addendum). Report No. FHWA-PD-96-009, Washington, D.C.: Federal Highway Administration, April 2004.
- Lawson, S. R., P. Newman, and C. Monz  
 2017 A systems-based approach to address unintended consequences of demand-driven transportation planning in national parks and public lands. *International Journal of Sustainable Transportation*. Vol. 0, No. 0, 1-11.  
<http://dx.doi.org/10.1080/15568318.2016.1194504>
- Lee, C., J. MacDonald, C. Scarpone, A. Rapoza, and G. Fleming  
 2016 Glacier National Park: Baseline Ambient Sounds Level 2004. Report Nos. DOT-VNTSC-FAA-16-13 and DOT/FAA/AEE/2016-02, Cambridge, MA: John A. Volpe National Transportation Systems Center.
- Lesica, P.  
 2002 "The Flora of Glacier National Park." Oregon State University Press. Corvallis, OR.

- 2014 "Arctic-Alpine Plants Decline Over Two Decades in Glacier National Park, Montana, U.S.A." *Arctic, Antarctic, and Alpine Research*, 46:2, 327-332, DOI: 10.1657/1938-4246-46.2.327.
- Liknes, G. A. and P. J. Graham  
1988 Westslope cutthroat trout in Montana: Life history, Status, and Management. *American Fisheries Society Symposium* 4:53-60.
- Littlejohn, Margaret  
1991 "Visitor Services Project, Glacier National Park, Report 35," Cooperative Park Studies Unit, University of Idaho.
- Mace, R. D., and J. S. Waller  
1997 "Grizzly Bear Ecology in the Swan Mountains." *Montana Fish, Wildlife and Parks*, Helena, MT.
- Mace, B., P. Bell, and R. Loomis  
1999 Aesthetic, affective, and cognitive effects of noise on natural landscape assessment. *Society of Natural Resources*, 12, 225-242. DOI: 10.1080/089419299279713.
- Markegard, S.  
2014 Understanding the Nature of Interactions Between Visitors and Mountain Goats (*Oreamnos americanus*) on the Hidden Lake Trail, Glacier National Park. University of Montana, Missoula, MT.
- Martinka, C.  
1972 "Habitat Relationships of Grizzly Bears in Glacier National Park. Progress Report." On file at Glacier National Park.
- McCool, S. F., A. Braithwaite  
1989 An Estimate of Backcountry Day Use of Glacier National Park (unpublished). Institute for Tourism and Recreation Research, School of Forestry, University of Montana, Missoula, MT.
- McKenna, M., B. Lignell, A. Rapoza, C. Lee, V. Ward, and J. Rocchio  
2016 A framework to assess the effects of commercial air tour noise on wilderness. *Journal of Forestry*, 114(3), 365-372.
- Menge, C. W., C. F. Rossano, G. S. Anderson, and C. J. Bajdek  
1998 FHWA Traffic Noise Model, Version 1.0: Technical Manual. Report Nos. FHWA-PD-96-010 and DOT-VNTSC-FHWA-98-2, Cambridge, MA: John A. Volpe National Transportation Systems Center.
- Miller, Zachary D. and Dr. Wayne Freimund  
2014 Going-to-the-Sun Road Corridor Visitor Experience and Support for Management Actions Survey Report (unpublished). University of Montana, Department of Society and Conservation. Missoula, MT.

- Miller, Zachary D., Dr. Wayne Freimund, and Stephen F. McCool  
 1997 Glacier National Park 1996 Visitor Study. University of Montana, School of Forestry. July 1997. Missoula, MT.
- Mills, C., W. Freimund  
 2013 Informal Trail Monitoring Glacier National Park (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Montana Department of Environmental Quality (MDEQ)  
 2007 “Montana Greenhouse Gas Inventory and Reference Case Projections 1990–2020.” Center for Climate Strategies.  
 2016 “2016 Water Quality Information for Divide Creek.” MDEQ Clean Water Act Information Center. Accessed February 12, 2018.  
[http://svc.mt.gov/deq/dst/#/app/cwaic/report/cycle/2016/auid/MT40T002\\_010](http://svc.mt.gov/deq/dst/#/app/cwaic/report/cycle/2016/auid/MT40T002_010).
- Montana Fish, Wildlife & Parks (MFWP)  
 2015 “Montana’s State Wildlife Action Plan.”
- Montana Native Plant Society (MNPS)  
 2018 “Montana Native Plant Society’s Important Plant Areas Program.” Accessed 2018.  
<http://www.mtnativeplants.org/ImportantPlantAreas>.
- Montana Natural Heritage Program (MNHP)  
 2012a “Species Occurrence Data for Animal Species of Concern in Montana.” GIS data retrieved 2014 from: <http://mtnhp.org/animal/>.  
 2012b “Species Occurrence Data for Plant Species of Concern in Montana.” GIS data retrieved 2014 from: <http://mtnhp.org/plants/>.  
 2018a “Montana Natural Heritage – SOC Report.” Accessed 2018.  
<http://mtnhp.org/SpeciesOfConcern/>.  
 2018b “Montana Field Guides.” Accessed 2018. <http://fieldguide.mt.gov/default.aspx>.
- Muck, Jim.  
 2010 Biological Effects of Sediment on Bull Trout and their Habitat – Guidance for Evaluating Effects. U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office, Lacey, WA. July 13. Accessed 2019 from:  
<https://www.fws.gov/wafwo/documents/2010FinalSedimentDoc.pdf>.
- Nanus, L., M. W. Williams, D. H. Campbell, K. A. Tonnessen, T. Blett, and D. W. Clow  
 2009 “Assessment of Lake Sensitivity to Acidic Deposition National Parks of the Rocky Mountains.” *Ecological Applications* 19(4): 961–973.
- National Park Service (NPS)  
 n.d. Visitor Use Statistics, <https://irma.nps.gov/Stats/Reports/Park/GLACNPS>, 2004 Final Commercial Services Plan and Final Environmental Impact Statement.

- 1990 Transportation Plan. Glacier National Park, West Glacier, MT.
- 1991 Exotic Vegetation Management Plan. Glacier National Park, West Glacier, MT.
- 1999 General Management Plan. Glacier National Park, West Glacier, MT.
- 2001a “Visitor Use and Transportation Study.” Glacier National Park, West Glacier, MT. On file at Glacier National Park. Prepared by Washington Infrastructure Services, Inc. “Going-to-the-Sun Road Transportation and Visitor Use Study. August 2001. Glenwood Springs, CO.
- 2001b West Entrance Station Environmental Assessment. Glacier National Park, West Glacier, MT.
- 2003 Going-to-the-Sun Road Rehabilitation Plan / Environmental Impact Statement. Glacier National Park. West Glacier, MT.
- 2004 Final Commercial Services Plan / Environmental Impact Statement. Glacier National Park, West Glacier, MT.
- 2006 *Management Policies 2006*. The Guide to Managing the National Park Service, Washington, D.C.
- 2007 West Entrance Station Improvements Environmental Assessment. Glacier National Park, West Glacier, MT.
- 2010 Climate Change Response Strategy. National Park Service Climate Change Response Program, Fort Collins, CO.
- 2012 Transit System Summary Report. Glacier National Park, West Glacier, MT.
- 2013 “Excessive Noise from Motorcycles and Soundscape Restoration Pilot Program.” Presented at Going-to-the-Sun Road Existing Conditions Workshop, Glacier National Park, MT.
- 2014a “Glacier National Park Business Plan.” Glacier National Park, West Glacier, MT. On file at Glacier National Park.
- 2014b Glacier National Park Annual Park Recreation Visitation (1904–2014). Natural Resource Science and Stewardship Directorate. Fort Collins, CO. Accessed on April 15, 2015 at: <https://irma.nps.gov/Stats/Reports/Park/GLAC>.
- 2014c Glacier National Park Recreation Visitors by Month (1979–2014). Natural Resource Science and Stewardship Division. Fort Collins, CO. Accessed on April 15, 2015 at: <https://irma.nps.gov/Stats/Reports/Park/GLAC>.
- 2014d Climate Change Scenario Planning Summary. Climate Change Response Program. Missoula, MT.

- 2015 “Glacier Bird Checklist.” List compiled by David S. Shea. Accessed at: <https://www.nps.gov/glac/learn/nature/upload/Bird-Checklist-2016-web.pdf>.
- 2016 Foundation Document, Glacier National Park, Montana. Waterton-Glacier International Peace Park, Biosphere Reserve, World Heritage Site. October.
- 2017 National Park Visitor Spending Effects: Economic Contributions to Local Communities, States, and the Nation. Natural Resource Report NPS/NRSS/EQD/NRR—2018/1616. [https://www.nps.gov/nature/customcf/NPS\\_Data\\_Visualization/docs/NPS\\_2017\\_Visitor\\_Spending\\_Effects.pdf](https://www.nps.gov/nature/customcf/NPS_Data_Visualization/docs/NPS_2017_Visitor_Spending_Effects.pdf).
- 2018 “Glacier National Park “Species Full List with Details.” Accessed January 29, 2018. <https://irma.nps.gov/NPSpecies/Search/SpeciesList/GLAC>.
- NFI, Inc.
- 2014 “Affected Environment Report: Visitor Use and Transportation Management Plan.” Glacier National Park. April.
- Nickerson
- 2002 Institute for Tourism and Recreation Research. Montana Vision, Non-Resident Summer Visitor Profile.
- Nguyen, T.
- 2012 System Dynamics Simulation for Park Management: A Case Study of Glacier National Park, Montana. School of the Environment, Washington State University. Pullman, WA.
- Oschell, Tanner, and Nickerson
- 2009 “Glacier National Park Visitors: A Seasonal Analysis.” Institute for Tourism and Recreation. April 2009.
- Pederson, G. T., L. J. Graumlich, D. R. Fagre, T. Kipfer, C. C. Muhlfeld
- 2010 “A Century of Climate and Ecosystem Change in Western Montana: What do Temperature Trends Portend?” *Climate Change* 98(1):133–154.
- Peterson, D. L., T. J. Sullivan, J. M. Eilers, S. Brace, D. Horner, K. Savig, and D. Morse
- 1998 “Assessment of Air Quality and Air Pollutant Impacts in National Parks of the Rocky Mountains and Northern Great Plains.” Report NPS/CCSOUW/NRTR—98/19. National Park Service, Air Resources Division, Denver, CO. Chapter 6: Glacier National Park. Available at <http://www.nature.nps.gov/air/Pubs/pdf/reviews/rm/RM6glac.pdf>.
- Proppe, D. S., C. B. Sturdy, and C. C. St. Clair
- 2013 Anthropogenic noise decreases urban songbird diversity and may contribute to homogenization. *Global Change Biology* 19: 1075–1084.

- Rauscher, S. A., J. S. Pal, N. S. Diffenbaugh, M. M. Benedetti  
 2008 "Future Changes in Snowmelt-Driven Runoff Timing over the Western US." *Geophysical Research Letters* 35(16):L16703. DOI:10.1029/2008gl034424.
- Renewable Technologies, Inc. (RTI)  
 2002 Glacier National Park Going-to-the-Sun Road Draft Cultural Landscape Report. Butte, MT.
- Resource Systems Group (RSG)  
 2019 Glacier National Park Socioeconomic Monitoring: Summer 2016. Natural Resource Report NPS/GLAC/NRR-2019/1944. National Park Service, Fort Collins, CO.
- Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Nancy, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williamson  
 2000 "Canada Lynx Conservation Assessment and Strategy." US Forest Service, US Fish and Wildlife Service, Bureau of Land Management, and National Park Service. Missoula, MT.
- Sarmento, Wesley and Mark J. Biel  
 2014 Glacier National Park Mountain Goat Capture Report. Glacier National Park and University of Montana. On file at Glacier National Park.
- Saros, J.  
 2009 "Inferring Critical Nitrogen Deposition Loads to Alpine Lakes of Western National Parks and Diatom Fossil Records. National Park Service: Final Report." Available at [http://www.nature.nps.gov/air/permits/docs/2009\\_Saros\\_diatomsSEKI\\_YELL\\_GLAC.pdf](http://www.nature.nps.gov/air/permits/docs/2009_Saros_diatomsSEKI_YELL_GLAC.pdf).
- Saunders, Stephen, Tom Easley, and Suzanne Farver  
 2009 National Parks in Peril: The Threats of Climate Disruption. Denver, CO: The Rocky Mountain Climate Organization and Natural Resource Defenses Defense Council. Available on the Internet at <http://rockymountainclimate.org/website%20pictures/National-Parks-In-Peril-final.pdf>.
- Secret, A.  
 2006 "Grizzly Bear Monitoring in the Going-to-the-Sun Road Corridor during Road Rehabilitation, 2006 Annual Monitoring Report." National Park Service.
- Servheen, C., and M. Cross  
 2010 "Climate Change Impacts on Grizzly Bears and Wolverines in the Northern U.S. and Transboundary Rockies: Strategies for Conservation." Report on a workshop held September 13-15, 2010, in Fernie, British Columbia, Canada.
- Shannon, G., M. McKenna, L. Angeloni, K. Crooks, K. Fristrup, E. Brown, K. Warner, M. Nelson, C. White, J. Briggs, S. McFarland, and G. Wittemyer  
 2016 A synthesis of two decades of research documenting the effects of noise on wildlife. *Biological Reviews* 91(4):982–1005.

- Spencer, C. N.  
 1991 "Evaluation of historic sediment deposition related to land use through analysis of lake sediments." Flathead Basin Commission, Kalispell, MT.
- Squires, J. R., J. P. Copeland, T. J. Ulizio, M. K. Schwartz, L. F. Ruggiero  
 2007 "Sources and Patterns of Wolverine Mortality in Western Montana." *Journal of Wildlife Management* 71(7):2213-2220.
- Stafford, C. P., C. C. Downs, and H. W. Langner  
 2016 "Mercury Hazard Assessment for Piscivorous Wildlife in Glacier National Park." *Northwest Science* 90:(4):450-469.
- Sullivan, T. J., G. T. McPherson, T. C. McDonnell, S. D. Mackey, D. Moore  
 2011a "Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition: Main Report." Natural Resource Report NPS/NRPC/ARD/NRR—2011/349. National Park Service, Denver, CO. Available at: <http://www.nature.nps.gov/air/permits/aris/networks/acidification-eval.cfm>.
- 2011b "Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition: Rocky Mountain Network (ROMN)." Natural Resource Report NPS/NRPC/ARD/NRR—2011/371. National Park Service, Denver, Colorado. Available at: [https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=428451&file=romn\\_acidification-eval\\_2011-05.pdf](https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=428451&file=romn_acidification-eval_2011-05.pdf).
- Transportation Research Board  
 2010 Highway Capacity Manual. Washington, D.C. Transportation Research Board, print.
- US Department of the Interior (USDI)  
 1997 National Register Bulletin: How to Apply the National Register Criteria for Evaluation. National Park Service Cultural Resources, National Register, History, and Education. Washington, D.C.
- US Fish and Wildlife Service (USFWS)  
 1993 "Grizzly Bear Recovery Plan." US Fish and Wildlife Service, Denver, CO.
- 2008 "Birds of Conservation Concern 2008." US Department of the Interior, US Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. Accessed October 12, 2017. <http://www.fws.gov/migratorybirds>.
- 2010a "Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States; Final Rule." *Federal Register* 75:63898 – 64070.
- 2010b "Biological Effects of Sediment on Bull Trout and their Habitat – Guidance for Evaluating Effects." Prepared by Jim Muck, US Fish and Wildlife Service, Washington Fish and Wildlife Office, Lacey, WA.

- 2013 “Draft NCDE Grizzly Bear Conservation Strategy.”
- 2014a “Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary; Final Rule.” *Federal Register* 79: 54782-54846.
- 2014b “Revised Draft Recovery Plan for the Coterminous United States Population of Bull Trout (*Salvelinus confluentus*).” Portland, OR.
- 2016 “Proposed Rule for the North American Wolverine: Proposed rule; Reopening of Comment Period.” *Federal Register* 81(201):71670-71671.
- 2018a “List of Threatened and Endangered Species for the Going-to-the-Sun Road Corridor Management Plan, Glacier National Park.” Montana Ecological Services Field Office. Consultation Code: 06E11000-2018-SLI-0165; Event Code: 06E11000-2018-E-00250.
- 2018b “IPaC Resource List for the Going-to-the-Sun Road Corridor Management Plan, Glacier National Park.” Accessed January 19, 2018.  
<https://ecos.fws.gov/ipac/project/PCHBSSTFIVCR5LVHJKINXRN5HI/resources>.

US Geological Survey (USGS)

- 2013 Northern Rocky Mountain Science Center. “Climate Change in Mountain Ecosystems,” last modified in May 2013.  
<http://www.nrmsc.usgs.gov/research/global.htm>.
- 2017 “Glaciers Rapidly Shrinking and Disappearing: 50 Year of Glacier Change in Montana.” Accessed February 9, 2018. <https://www.usgs.gov/news/glaciers-rapidly-shrinking-and-disappearing-50-years-glacier-change-montana>.

Volpe Natural Transportation Systems Center (Volpe)

- 2014 “Going-to-the-Sun Corridor Management Plan – Existing Conditions of the Transportation System.” U.S. Department of Transportation. June
- 2016 Glacier National Park Going-to-the-Sun Road Corridor Management Plan Draft Transportation Analysis.” U.S. Department of Transportation. January.
- 2017 “Going-to-the-sun Corridor Management Plan – Transportation Analysis.”

Washington Infrastructure Services, Inc. (WIS)

- 2001 “Going-to-the-Sun Road Transportation and Visitor Use Study. August 2001. Glenwood Springs, CO.

Weinberg, A. B.

- 2014 An Empirical Test of the Effectiveness of an Indirect Management Tool in Increasing Optional Shuttle Use at Glacier National Park. University of Montana, Missoula, MT.



- Weinberg, A., W. Freimund, D. Dalenberg  
 2014 Going-to-the-Sun Road Corridor Vehicle and Trail Counter Report (unpublished). Department of Society and Conservation (unpublished). Department of Society and Conservation, University of Montana, Missoula, MT.
- Weinzimmer, D., P. Newman, D. Taff, J. Benfield, E. Lynch, P. Bell  
 2014 Human responses to simulated motorized noise in national parks. *Leis. Sci.* 36 251–267.
- Westerling, A. L., H. D. Hidalgo, D. R. Cayan, and T. W. Swetnam  
 2006 “Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity.” *Science* 313-5789:940–943.
- White, D. Jr., K. C. Kendall, and H. C. Picton  
 1998 “Grizzly Bear Feeding Activity at Alpine Army Cutworm Moth Aggregation Sites in Northwest Montana.” *Canadian Journal of Zoo* 76(2): 221-227.
- Willard, B. E., D. J. Cooper and B. C. Forbes  
 2007 “Natural Regeneration of Alpine Vegetation after Human Trampling: A 42-Year Data Set from Rocky Mountain National Park, Colorado, U.S.A.” *Arctic, Antarctic, and Alpine Research*, 39(1) 177–183.
- Williams, Byron K., Robert C. Szaro and Carl D. Shapiro  
 2009 Adaptive Management The U.S. Department of the Interior Technical Guide. Developed by the Adaptive Management Working Group.
- Wood, L.  
 2015 “Acoustic Environment and Soundscape Resource Summary, Glacier National Park.” Natural Sounds & Night Skies Division, National Park Service.
- Yates, R. E., B. R. McClelland, P. T. McClelland, C. H. Key, and R. E. Bennetts  
 2001 “The Influence of Weather on Golden Eagle Migration in Northwestern Montana.” *Journal of Raptor Research* 35(2):81-90.

## **APPENDIX B: ACRONYMS AND ABBREVIATIONS**

ACHP	Advisory Council on Historic Preservation	NVC	National Vegetation Classification
CFR	Code of Federal Regulations	OIRV	Other Important Resources and Values
dB	Decibel	PAOT	People at One Time
EPA	Environmental Protection Agency	PEPC	Planning, Environment and Public Comment
FHWA	Federal Highway Administration	POV	Privately Owned Vehicles
FRV	Fundamental Resources and Values	PPVh	Persons-Per-Vehicle
GMP	General Management Plan	PUSO	Public Use Statistics Office
GIS	Geographic Information System	SHPO	State Historic Preservation Office
GNP	Glacier National Park	THPO	Tribal Historic Preservation Officer
GTSR	Going-to-the-Sun Road	TNM	Traffic Noise Model
HPD	Hikes per Day	UMT	University of Montana
IPA	Important Plant Area	USDI	US Department of the Interior
IVUMC	Interagency Visitor Use Management Council	USFWS	US Fish and Wildlife Service
mph	Miles per Hour	USGS	US Geological Survey
NEPA	National Environmental Policy Act	VAOT	Vehicles at One Time
NHL	National Historic Landmark	VSA	Visitor Service Assistant
NPS	National Park Service		
NRHP	National Register of Historic Places		

*This page intentionally left blank.*

## **APPENDIX C: PREPARERS, PLANNING TEAM MEMBERS, CONSULTANTS, AND CONTRIBUTORS**

**Table C-1. Glacier National Park Planning Team Members**

<b>Name and Title</b>	<b>Contribution</b>	<b>Education</b>	<b>Experience</b>
Lauren N. Alley, Writer/Editor (former)	Plan/Environmental Assessment (EA) Production	M. Public Affairs	7 years
Mark J. Biel, Natural Resources Program Manager	EA Document Review	MS Animal Nutrition & Animal Science	22 years
Bill Brooks, Transportation Specialist (former)	Alternatives Development	n/a	n/a
Katie Eaton, Env. Protection Specialist (former)	Wildlife Impacts, T&E, Document Production	MS Wildlife Biology	5 years
James E. Foster II, PE, Chief of Facilities Mgmt.	Transportation & EA Development & Review	BS Civil Engineering	19 years
Jack Gordon, Landscape Architect (retired)	Alternatives Development, EA Review	BS Landscape Architecture	31 years
Kym A. Hall, Deputy Superintendent (former)	EA Review	Kennedy School of Gov., Sr. Executive Fellows Program	30 years
Kassandra Hardy, Mgmt. Assistant, NRSS/BRD	Document Production	MS Env. Law, BS Env. Science	15 years
Kyle Johnson, Park Ranger (Backcountry Mgr.) (retired)	Wilderness, Alternatives Development	BS Resource Mgmt. & Range Science	25 years
Jan Knox, Chief of Concessions (retired)	Alternatives Development	BS Business Administration	33 years
Marc Neidig, Supervisory Park Ranger	Alt. Development, Interpretation, Visitor Experience	n/a	n/a
Mary Riddle, Chief of Planning & Environmental Compliance	Project Leader, Planning/ EA	BS Environmental Studies	31 years
Dona Rutherford, Supervisory Park Ranger (retired)	Alts. Development, Visitor Experience, Law Enforcement	BS Recreation Resource Mgmt.	28 years
Stephen Smith, Transportation Specialist (former)	Transportation, Alts. Development	HS Grad., 2 yrs. College	15 years
Jean Tabbert, Concessions Mgmt. Specialist (former)	Concessions & Alts. Development	BA	13 years

**Table C-2. NPS Denver Service Center Planning Team Members**

<b>Name and Title</b>	<b>Contribution</b>	<b>Education</b>	<b>Experience</b>
Treff Alexander, Landscape Architect (former)	Avalanche Site Design	M. Env. Policy & Regional Planning	n/a
Megan Braunschweig, Landscape Architect	Avalanche Site Design	M. Env. Policy & Regional Planning	7 years
Rachel H. Collins, Visitor Use Mgmt. Specialist	Visitor Use Mgmt. Analysis	PhD Parks, Rec. & Tourism MS Experimental Education BS Rec. & Leisure Studies, Outdoor Recreation	6 years
Steven R. Culver, Natural Resource Specialist	EA Natural Resources	BS Fishery Biology	31 years
Wanda Gray Lafferty, Senior Editor, Contractor	Editing, Document Composition	2 yrs. Undergrad in Communications	35 years
Linda MacIntyre, Project Manager (former)	Project Mgmt., Transportation, Planning, Alts. Development	M. Urban & Regional Planning	27 years
Chris Osgood, Cost Estimator	Cost Estimator	BS Construction Mgmt.	37 years
Aleksandra Pitt, Visitor Use Mgmt. Specialist	Visitor Use Management Analysis	MS Forest Sciences BS Resource Conservation	4 years
Lee Terzis, Cultural Resource Specialist	EA Cultural Resources	MA Anthropology	22 years
Eric Thuerk, Project Mgr., Technical Specialist	Project Mgmt., Transportation, & Planning	M. Architecture	27 years
Deryn Wagner, Community Planner, Landscape Architect (former)	Transportation, Planning, & Alts. Development	M. Urban & Regional Planning, Landscape Architecture	10 years

**Table C-4. NPS Intermountain Regional Office Planning Team Member**

<b>Name and Title</b>	<b>Contribution</b>	<b>Education</b>	<b>Experience</b>
Erica F. Cole, Transportation Planner	Transportation, Planning, & Compliance Support	M. Business	5 years

**Table C-5. National Park Service Contributors**

<b>Name and Title</b>	<b>NPS Sector</b>
Micah Alley, Supervisory Park Ranger	Glacier National Park
Paul Austin, Chief Ranger	Glacier National Park
Brad Blickham, Park Ranger	Glacier National Park
Kerri Cahill, Branch Chief, Planning	Denver Service Center
Tara Carolin, Crown of Continental Research Learning Center Director	Glacier National Park
Chas Cartwright, Superintendent (retired)	Glacier National Park
Mark Foust, Chief Ranger (former)	Glacier National Park
Debra Frye, Landscape Architect / Alternative Transportation Coordinator (retired)	Intermountain Regional Office
Eric Gabriel, Branch Chief of Ranger Activities (former)	Glacier National Park

<b>Name and Title</b>	<b>NPS Sector</b>
Denise Germann, Management Assistant (former)	Glacier National Park
Dan Jacobs, Trails and Backcountry Campgrounds Supervisor	Glacier National Park
Lon Johnson, Cultural Resource Specialist/Historical Architect (retired)	Glacier National Park
Lynne Koontz, Economist	NPS, NRSS
Dawn LaFleur, Restoration Biologist	Glacier National Park
Sierra Mandelko, Cultural Resource Specialist	Glacier National Park
Richard Menicke, Geographer/GIS Coordinator	Glacier National Park
Jeff Mow, Superintendent	Glacier National Park
Charles Notzon, Economist	Denver Service Center
Ericka Pilcher, Research Associate	Denver Service Center
Amy Secrest, Natural Resource Specialist	Glacier National Park
Laura Segars, Revenue & Fee Program Manager (former)	Glacier National Park
Deirdre Shaw, Museum Curator (retired)	Glacier National Park
Eric Smith, Deputy Superintendent (former)	Glacier National Park
Frank Turina, Program Manager	Natural Sounds & Night Skies Div.
John Waller, Wildlife Biologist	Glacier National Park
Phil Wilson, Chief of Science and Resources Management	Glacier National Park

**Table C-6. Other Consultants and Contributors**

<b>Name and Title</b>	<b>Entity</b>
Sharon Bengston, Transit Coordinator Supervisor (former)	Flathead County Eagle Transit
Joel Berger, PhD	John C. Craighead Chair and Professor of Wildlife Conservation
Jim Boyd, Transportation Manager (former)	Flathead County Eagle Transit
Douglas Dalenberg, PhD	Department of Economics
Frances Fisher, Deputy Chief of Transportation and Planning	Volpe, Department of Transportation
Wayne Freimund, PhD	Arkwright Professor of Protected Area Management
Susan Law, Planning Team Leader Alternative Transportation	Western Federal Highways Division, Federal Highway Administration
Lloyd E. Levy, Socioeconomist	NFI. Inc.
Sarah Markegard, Zachary Miller, Christina Mills, Wesley Sarmiento, Tyler Warner, Alex Weinberg	Graduate Students
Dale Novak, Shuttle Operations Supervisor	Flathead County Eagle Transit
Mike Retzlaff, Socioeconomist	NFI, Inc.
Heather Richardson, Community Planner, Transportation Planning Division	Volpe, Department of Transportation

*This page intentionally left blank.*

## **APPENDIX D: INDICATORS, THRESHOLDS, AND CAPACITY**

The visitor use management framework created by the Interagency Visitor Use Management Council (the council) includes a series of elements by which planning decisions are made concerning visitor use management. Establishing indicators and thresholds and determining visitor capacity are key components of this framework as applied by the National Park Service. Indicators measure conditions that are related to visitor use, and monitoring is conducted to track those conditions over time. The results of monitoring are used to inform and select strategies to be used by park managers in order to not exceed the maximum amount of visitor use that can be accommodated for a site (i.e., visitor capacity determination). In this section, potential management strategies are described for each indicator and would be applied together with the actions and intents of the alternatives presented in this plan. This iterative practice of monitoring, implementing corrective strategies, and then continuing to monitor to gauge the effectiveness of those actions allows park managers to maximize benefits for visitors while achieving and maintaining desired conditions for resources and visitor experiences in a dynamic setting. In this section, the indicators to be monitored at Glacier National Park are presented, and the associated thresholds and strategies included below are used to inform the visitor capacity determination.

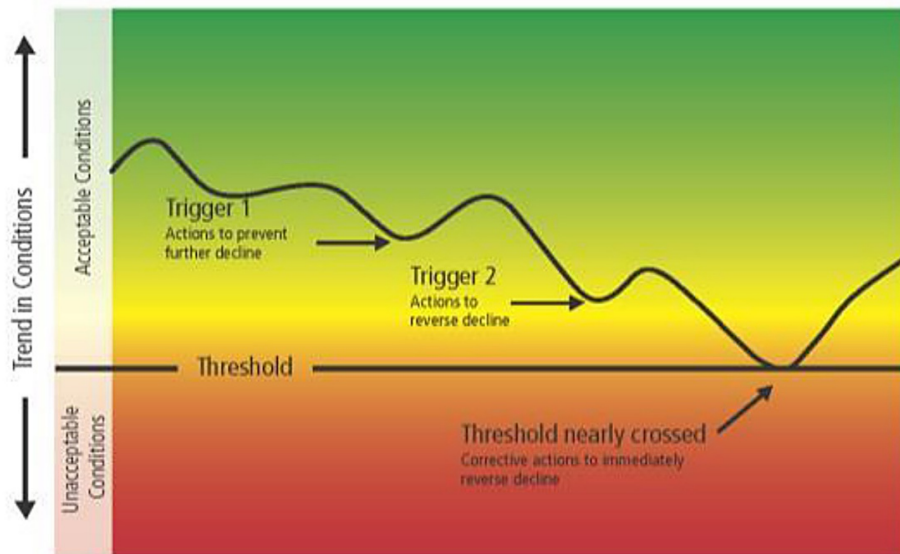
### **INDICATORS AND THRESHOLDS**

Indicators translate the broad description of desired conditions into measurable attributes (e.g., people at one time at key locations, number of visitor-created trails) that can be tracked over time to evaluate change in resources or conditions that relate to visitor experience. They are a critical component of the visitor use management framework. The planning team considered many potential issues and related indicators that would identify impacts of concern, but those described in this section are considered the most noteworthy, given the importance and vulnerability of the resources or visitor experiences affected by visitor use. In identifying meaningful indicators, the planning team also reviewed the experiences of other park units with similar issues.

Thresholds that represent the minimum acceptable condition for each indicator were then assigned, taking into consideration the qualitative descriptions of the desired conditions, data on existing conditions, relevant research studies, and staff management experience. Although defined as “minimally acceptable,” thresholds still represent acceptable conditions. Also, establishing thresholds does not imply that no action would be taken prior to reaching the threshold. One goal of visitor use management is to strive to make progress toward desired conditions. Thresholds identify when conditions are about to become unacceptable and accordingly serve as a “line in the sand,” letting managers and the public know that corrective action must be taken to keep conditions acceptable so that progress toward desired conditions can be achieved over time. For some indicators, triggers have been developed. A trigger reflects a condition of sufficient concern for an indicator to prompt a management response to ensure that desired conditions continue to be maintained before the threshold is crossed.

Indicators, thresholds, triggers (when identified), and associated adaptive management strategies (see figure D-1) that would be implemented as a result of this planning effort are described below.





**Figure D-1. Management Triggers and Thresholds in Relation to Trend in Conditions**

The implications of indicators, thresholds, adaptive management strategies, and visitor capacity determinations are considered as part of the proposed action and therefore, if warranted under relevant laws and regulations, are analyzed as part of the alternatives in chapter 3. If additional strategies are needed as outlined in the adaptive management strategies, details of their application would be developed as thresholds are exceeded or approached and would be informed by monitoring results. If necessary, additional environmental compliance would be conducted to implement those strategies.

Visitor use management is an iterative process in which management decisions are continuously informed and improved through monitoring to determine the most effective way to manage visitor use to attain desired visitor experience and resource conditions. Initially, data from 2012 informed the development of indicators and thresholds. The condition of the indicators with respect to thresholds remain mostly acceptable, although some of the thresholds have been exceeded in recent years. Management actions outlined in chapter 2 would help achieve desired conditions (which means at or below threshold levels) and in the future ensure thresholds are not exceeded. As monitoring of conditions continues, managers may decide to modify or add indicators if better ways are found to measure important changes in resource and experiential conditions. For the purposes of this document, the rationale, indicator, threshold, and adaptive management actions have been listed. For more information on monitoring protocol (e.g., data collection, analysis, frequency, etc.) see the full monitoring report from the University of Montana on the Planning, Environment and Public Comment (PEPC) page.

If monitoring detects changes in conditions trending toward the trigger and threshold for any indicator, managers would use this as an indication to begin to implement management actions in the area as specified by the GTSR Plan on a site by site basis (see “Chapter 2: Alternatives”). Monitoring these thresholds would begin with the data collection efforts that occurred in 2017.

If monitoring an indicator suggests a change in the same direction across a majority of locations being monitored, this likely indicates a systemwide change in visitor use in the GTSR corridor. In this situation, a larger scale approach to managing and monitoring in the GTSR corridor would be undertaken. Adaptive management actions vary by indicator and are identified under each indicator.

## TRAILS

To understand if desired conditions along trails are being achieved, the park identified four different indicators to understand changes that are occurring on trails in the GTSR corridor. This includes trail use, trail conditions, informal trails, and human waste near trails.

### Trail Use

Seven different trails are used as indicator places for trail use conditions across the GTSR corridor (table D-1 below). This includes trails classified as higher use (Avalanche Lake and Hidden Lake), medium use (Highline and St. Mary Falls), and lower use (The Loop, Siyeh Pass, and Gunsight). The indicator monitors the average number of hikers per day during the peak season (July 1 to August 15), for three consecutive years. Table D-1 below infers a variety of conditions at each location as inferred by the indicator. The baseline condition for these indicators is 2017. These conditions have been calculated by examining use in 2012 and increasing that baseline use by 25% established the threshold, and finding a middle ground between the two conditions (trigger). An increase of 25% would still be protective of the desired conditions and resources on trails. Also included in this table is the number of hikers per day in 2017.

**Table D-1. Monitoring for Trail Use in the GTSR Corridor\***

Location	2012	2017	Trigger	Threshold
Avalanche Lake – Higher Use	≤864	1,298	972	≥1080
Hidden Lake – Higher Use	≤1145	1,604	1289	≥1432
Highline – Medium Use	≤616	832	694	≥772
St. Mary Falls – Medium Use	≤601	782	677	≥752
The Loop – Lower Use	≤258	362	291	≥323
Siyeh Pass – Lower Use	≤113	128	127	≥142
Gunsight Pass – Lower Use	≤27	90	30	≥34

\*Average number of hikers per day during the peak season (July 1 to August 15) for three consecutive years

### Adaptive management actions:

- Begin monitoring other trail locations (not just the specified indicators).
- Explore trail systemwide changes to visitor use.
- Implement hiking party size limits for some or all trails.
- Implement day hike permits for additional trails beyond currently identified trails (see “Chapter 2: Alternatives”).
- Modify use levels or characteristics of parking areas (see “Chapter 2: Alternatives”).
- Manage number of shuttle drop-offs to reduce hiking numbers.
- Construct an approximately 3-foot-wide and 3-mile-long exposed soil footpath that connects with the Highline Trail and add a sign to designate Big Bend as a shuttle stop.
- Designate one-way travel along the Highline Trail and connecting trails (from Logan Pass to the Big Bend cutoff) and two-way travel between Granite Park and Big Bend. Designate the existing parking lot with signs for day use only.
- Reestablish an approximately one-mile-long footpath from Lunch Creek to Logan Pass along an historic construction road used to build the GTSR.

- Construct a one-mile trail from Siyeh Bend to Lunch Creek (4-foot-wide soil footpath) using an existing unmaintained horse trail.

## Trail Conditions

Similar to trail use, trail conditions use the same seven indicator places to understand trail conditions in the GTSR corridor (table D-2). The indicator monitored is the average trail width on each of the trails. Trail width standards in Glacier National Park are between 18 inches and 30 inches in width on average. Table D-2 describes a variety of trail conditions as inferred by the indicator.

**Table D-2. Monitoring for Trail Conditions in the GTSR Corridor**

Location*	2013	Trigger	Threshold
Avalanche Lake – Higher Use	≤30"	36"	≥48"
Hidden Lake – Higher Use	≤30"	36"	≥48"
Highline – Medium Use	≤30"	36"	≥48"
St. Mary Falls – Medium Use	≤30"	36"	≥48"
The Loop – Lower Use	≤30"	36"	≥48"
Siyeh Pass – Lower Use	≤30"	36"	≥48"
Gunsight Pass – Lower Use	≤30"	36"	≥48"

\* Average trail width over the entire length of trail

## Adaptive management actions:

- Expand monitoring of trail conditions to include vegetation health, wet areas, and other factors.
- Increase frequency of monitoring.
- Implement vehicle checks for invasive weeds.
- Harden surfaces as appropriate in first 300–500 yards of trail.
- Enhance trail delineation.
- Widen boardwalks.
- Modify the types and amounts of visitor use on various trails.

## Informal Trails

The informal trail use indicator uses three locations to track trail conditions in the GTSR corridor (see table D-3 below). The indicator monitors the linear extent of informal trails in identified areas. In the near future, St Mary, Siyeh, and The Loop would be evaluated for baseline informal trail conditions. At this time the linear extent of informal trails in these areas is not known, therefore, thresholds would be identified for these areas after baseline information is collected.

**Table D-3. Monitoring for Informal Trails in the GTSR Corridor\***

Use level	Location	2013	Trigger	Threshold
Higher use	Logan Pass	1632	+10%	≥25%
Medium use	Haystack	2317	+10%	≥25%
Lower use	Preston Park	991	+10%	≥25%

\*Number of linear feet of informal trails leaving a formal trail

If monitoring indicates a change in the same direction across a majority of locations, this likely indicates a systemwide change in the number of linear feet of informal trails in the GTSR corridor. In this situation, a larger scale approach to managing and monitoring informal trails in the GTSR corridor should be undertaken. This includes expanding the scope of formal trails monitored to be more inclusive of other locations. Managers would use data from previous monitoring efforts of the indicator places to inform expanded monitoring. For instance, if use is increasing only on the medium-use formal trails, expanded monitoring efforts should focus on other medium-use formal trails in the GTSR corridor.

Adaptive management actions:

- Increased monitoring of informal trails (e.g., documenting width and depth of informal trails).
- Increase visitor education (e.g., signs).
- Increase roving rangers in certain areas.
- Restoration of informal trails.
- Install barriers (rock, logs, etc.).
- Install additional infrastructure for increased use levels using native materials as much as possible, and in accordance with NPS wilderness management policies.

## Human Waste Near Trails

Human waste monitoring near trails uses the same seven indicator places as other trail monitoring components (see table D-4 below). The indicator monitored is the total number of human waste sites near the trail over the entire length of the trail. Human waste consists of human feces, visible urine, and toilet paper associated with waste disposal. “Near the trail” means human waste deposited in areas out of sight of the main trail, but still relatively close to the main trail. Many of the sites identified had informal data collection in 2013 and those levels were mostly acceptable at the seven locations at that time with the exception of the Highline. Therefore, they have been used below as baseline conditions that are acceptable. To resolve the two areas of concern, two additional backcountry toilets have been identified in “Chapter 2: Alternatives” for Haystack Butte on the Highline and Hidden Lake Overlook. Of the seven sites informally monitored, Highline had the highest number of human waste sites and had unacceptable conditions of 20 documented human waste sites. With the addition of the privy at Haystack Butte, the threshold of five documented sites.

**Table D-4. Monitoring for Human Waste Sites Near the Trail in the GTSR Corridor\***

Location	2013	Trigger	Threshold
Avalanche Lake – Higher Use	5	+10%	≥15%
Hidden Lake – Higher Use	5	+10%	≥15%
Highline – Medium Use	20	+10%	≥15%
St. Mary Falls – Medium Use	10	+10%	≥15%
The Loop – Lower Use	5	+10%	≥15%
Siyeh Pass – Lower Use	5	+10%	≥15%
Gunsight Pass – Lower Use	5	+10%	≥15%

\*Total number of human waste sites near the trail over the entire length of the trail

Adaptive management actions:

- Educate visitors about available facilities and proper waste disposal.

- Add restroom facilities at additional locations, explore additional facilities beyond those identified in site area descriptions.
- Reduce the number of shuttle stops and parking spaces.
- Recommend the use of solid human waste disposal system and encourage visitors to carry out waste.
- Require the use of solid human waste disposal system and require visitors to carry out waste.

## **TRANSPORTATION (INCLUDING VEHICLES, ROADS, AND THE SHUTTLE SYSTEM)**

### **Vehicles at One Time at Key Destinations**

Monitoring and managing visitor use according to this indicator helps ensure that visitors have safe and stress-free access to popular visitor destinations at key areas on the GTSR corridor by reducing vehicle congestion and conflicts in parking lots. Vehicles at one time (VAOT) is a measure commonly used by park managers and researchers to quantify vehicle congestion in parking lots. It provides an important measure of parking lot conditions in relation to visitor access to popular destinations as well as potential park resource impacts as a result of parked vehicles in unauthorized areas when lots are full.

Parking lot capacities provide an ideal threshold on which to base monitoring efforts for VAOT. Instances in which parking lot capacities are exceeded are often indicative of vehicle congestion, potential safety concerns, and possible park resource impacts stemming from vehicles parking in unauthorized areas (Lawson, Newman, and Monz 2017). This indicator helps ensure that the reservation systems for parking lots are appropriately allocated to ensure that visitors with reservations can reach their intended destinations as allocated. The VAOT thresholds are determined so that the reservation system for parking lots in alternative C can be fully utilized without approaching the threshold.

Vehicles at one time in parking lots along the GTSR corridor would be used as an indicator of transportation and access conditions at popular visitor destinations. Parking lots at these destinations provide visitors with access to important park resources and experiences. Monitoring VAOT at one or more of these locations provides a reasonable basis on which overall transportation and access conditions at visitor destinations can be inferred.

### **Threshold**

VAOT does not exceed the design capacity of parking lots at the visitor destinations more than 25% of the time (about 2 hours per day or 14 hours per week) during the peak hours of the day (6:00 a.m. to 8:00 p.m.).

### **Triggers and Corrective Actions**

Under the preferred/proposed alternative, phase I of a site specific reservation system would be implemented at Logan Pass and St. Mary and Virginia Falls Trailhead. If thresholds are met for two years in a row, then phase II would be implemented at other sites such as Avalanche, Big Bend, and St. Mary Visitor Center, as needed.

- **Trigger for Phase I: Lots not on Reservation Systems.** VAOT does not exceed the design capacity of the parking lot at each visitor destination for more than 20% of the time per day during peak hours of the day (6:00 a.m. to 8:00 p.m.) for two consecutive years.

- Adaptive Management Action for Trigger. Implement phase II to actively manage vehicle demand at other lots in the corridor. Continue using trigger for phase 1 for additional lots that enter the reservation system.
- Rationale for Trigger. There may come a point where changes in visitation numbers or patterns are such that managing these lots is problematic for both visitors and for park managers, and a systems management approach may be more effective for managing vehicle volume in the park.

#### Adaptive management:

- Enforce parking and access restrictions, as well as site-management (signage, curbing, paving, revegetation) to resolve issues related to parking.
- Provide visitors with information on status of parking lots (i.e., Logan Pass Visitor Center is full—park at Apgar Visitor Center and take the shuttle). This information would be conveyed to visitors prior to and/or on entry to the corridor to facilitate seeking alternative experiences, including those outside the corridor.
- Increase extent of shuttle service to areas outside the park.
- Increase enforcement of endorsed parking only.
- Require park and ride from Apgar Visitor Center lot when GTSR parking areas reach capacity.
- Periodic road closure as issued by the superintendent.
- Implement a timed entry parking permit system for day users to park for a portion of Avalanche, Big Bend, and St. Mary Visitor Center during peak season.

## Roadway Level of Service

**Rationale for Indicator and Thresholds.** GTSR offers sweeping views of the Crown of the Continent ecosystem and access to many of the park’s most popular visitor destinations and, as a result, is very popular for scenic driving. Roadway level of service is a qualitative measure used to determine the quality of traffic service. It uses measures like speed, density, delay to determine the performance or level of service of roads. Transportation professionals rate levels of service from A to F, with level A being the best and least congested and level F being gridlock. The 1990 Glacier National Park Transportation Plan includes a definition of the levels that states (pg. 20):

Level of Service D: Approaching unstable flow with tolerable operating speeds although considerably affected by changes in operating conditions. Drivers have little freedom to maneuver and pass other vehicles; comfort and convenience are low. According to the *Highway Capacity Manual* (HCM 2010), in level D 70%–85% of the time is spent following another vehicle.

Level of Service E: Represents operations at even lower speeds than level D, with volumes near the capacity of the highway. The highest volume attainable under E defines the capacity of the roadway. Flows are unstable and momentary stops may occur. In Level E, more than 85% of the time on the road is spent following another vehicle (HCM 2010).

Level of Service F: Forced or breakdown flow operation at low speeds where volumes exceed capacity. Speeds are reduced substantially and stops may occur for short or long periods of time because of down-road congestion.

The 1990 Transportation Plan does contain the Level of Service E range of volumes along with 1984 peak hour volume and the associated 1984 Level of Service. In 2018, the 2016 data was compared against the data collected in 2012–14. A complete data set did not exist for 2017 or 2018 at the time of

this analysis. Table D-5 shows road segments and the related data from 1984 and the 2012–14 counter locations as well as 2016.

**Table D-5. Level of Service – Volume and Threshold Data**

Road Section	1984 Peak Hour Volume	Maximum 2012 Peak Hour Volume 2012	Peak Hour Volume for 2016	LOS F Threshold	Number of Hours at LOS F in 2016
Avalanche Creek Campground to Logan Creek	460	592	975	1030	0
West Portal, West Side Tunnel to Logan Pass	460	561	747	685	6
Logan Pass to St. Mary Falls Trailhead	450	517	688	895	0
St. Mary Falls Trailhead to Rising Sun (data collected in 2013)	N/A	414	513	880	0

## Thresholds

- Between 6:00 a.m. and 8:00 p.m., any segment shouldn't have more than 10 hours violating Level of Service F. This means, during the months of June, July, and August the condition of GTSR cannot decline to failing more than 1% of the time.
- Rationale: in 2016, between 6:00 a.m. and 8:00 p.m. the condition of GTSR from West Side Tunnel to Logan Pass declined to Level of Service F in 6 hours.

### Adaptive management actions:

- Provide visitors with information on status of parking lots (i.e., Logan Pass is full—park at Avalanche). This information would be conveyed to visitors prior to and/or on entry to the corridor to facilitate seeking alternative experiences, including those outside the corridor.
- Increase frequency of shuttle service in park.
- Increase extent of shuttle service in communities leading to park.
- Adjust parking permit system parameters (timing, number, duration) to reduce roadway congestion.
- Understand relationship between bicycle use and traffic flow to inform future management of bicyclists on GTSR. The average number of bicyclists pre-vehicle access for both east and west bound traffic in 2016 was 150. The average number of bicyclists for both east and west bound traffic in 2016 post-vehicle access was 23.
- Expand site specific parking lot reservation systems.

## Shuttle Wait Time for Visitors

There is currently little data on the average number of shuttles or amount of time a visitor waits before boarding, and no standard operating procedures exist to collect the data (shuttle bus drivers have kept track of numbers of people waiting when they leave and arrive, but not wait times). Primary data collection, likely in the form of cameras and people counting software, would be necessary to establish a baseline of existing conditions and sense shifts in shuttle wait time for visitors in the GTSR corridor. Similar to the trails section, this indicator relies on a variety of locations to serve as indicator places.

These include main hubs, transfer locations, and one-way hike shuttles on both the east and west sides of the GTSR.

Initially, cameras would be set up at the Apgar Transit Center and St. Mary. These cameras would take a photo of shuttle lines. The ground would have different marks to indicate the typical length of time associated with the length of the line. Privacy of visitors is important and these photos would be deleted after visitor counts are documented. Data collected for this indicator would inform park management how the system is operating. In the future, if more intensive monitoring was needed volunteers, seasonal staff, or shuttle bus drivers could be tasked with counting the number of people at shuttle stops at different times throughout the day or the number of people left behind after a shuttle departs. A visitor counting software such as Timelapse2 could be used to analyze this data. Currently, wait times have wide variation throughout the day ranging from 15 minutes to 2-hour wait times.

The first two locations for cameras would be the Apgar Transit Center and the St. Mary Transit Center. In the future, the park would also include Logan Pass, Avalanche, The Loop, and Sunrift Gorge. Thresholds have not been determined at this time but the park would work to understand visitor preferences related to thresholds in the near future.

The park currently does not have the data or capacity to make micro-adjustments throughout the hour, day or season. This data would be analyzed at the end of the peak season and could result in adaptive management actions such as expanding the shuttle season or operating hours, increasing the number of shuttles, or exploring opportunities for visitors to reserve shuttle spaces online or in advance.

**Preservation of Historic Road Features**

Although there are many historical features along the GTSR itself, the approximately 11 miles of guard wall is used to monitor changes regarding preservation of historic road features. Jersey rail is put in place for safety reasons when the historic guard wall is damaged. The indicator monitored is the number of continuous Jersey rail sections along the approximately 11 miles of guard wall on the GTSR. Table D-6 infers a variety of conditions as inferred by the indicator. These conditions have been established by considering both visitor experience and the cost of hiring contractors to repair the guard wall.

**Table D-6. Monitoring for Preservation of Historic Road Features in the GTSR Corridor**

Indicator	Current	Trigger	Threshold
Number of Jersey rail sections along the guard wall	≤1 section	2 to 4 sections	≥5 sections

Adaptive management actions:

- Increase attention to other historic features along the GTSR.

**WATER USE AND AVAILABILITY**

The average number of gallons used per day at Logan Pass during July and August is the indicator used to measure water use and availability. Similar to parking, use of water at Logan Pass is a good indicator



of water usage and availability throughout the GTSR corridor. Due to the high visitor use at Logan Pass, it is likely that monitoring water use and availability there would detect changing conditions before large impacts occur in other locations such as Avalanche. The table below is used to infer a variety of conditions related to water use and availability. In 2014, the average number of gallons used per day in July and August at Logan Pass was 5,829 (personal communication with Christopher Walker, HBD utilities supervisor at Glacier National Park). Average water usage for 2016 was also reported and determined to be approximately 9,000 gallons per day. Each additional threshold represents a 10% and 25% increase in average water use. In 2017, the park replaced plumbing in the facility to improve efficiency in water use. The park continues to document the number of gallons used daily.

**Table D-7. Monitoring Water Use and Availability in the GTSR Corridor**

Indicator	Current	2016	Trigger	Threshold
Average number of gallons used per day at Logan Pass during July and August	≤5,829	9,000	6,412	≥7,286

Adaptive management actions:

- Implement monitoring water use and availability at other locations outside Logan Pass.
- Implement site specific reservation system to allow only the number of visitors to access the site that the water system can serve. Likely areas could be Logan Pass and Sperry and Granite Chalets.

## SOUNDSCAPES IN BACKCOUNTRY

The desired conditions for backcountry in the GTSR corridor is that visitors have the opportunity for solitude and experience mostly natural sounds with few intrusions of non-natural sounds. Acoustic conditions should also allow wildlife to perceive acoustic stimuli and not interfere with critical ecological processes.

Sound pressure level data would be collected at two sites meant to represent different environmental conditions (e.g., vegetation, terrain, proximity to GTSR, traffic volumes) on each side of the GTSR corridor—Sperry Campground and Grinnell Glacier Overlook. All elements in this plan would complement building block components related to Glacier National Park’s wilderness planning.

### Site Descriptions

Sperry Campground is on the western side of the Continental Divide. This area is popular with visitors due to its access to alpine lakes, glaciers, and relative proximity to the GTSR. The Sperry Chalet was also a popular attraction before it was destroyed in the 2017 fire. Sperry Campground is in a subalpine zone (table D-8).

Grinnell Glacier Overlook is located on the Continental Divide and can be accessed easily by trails from the GTSR. Grinnell Glacier Overlook is similar to Sperry Campground (table D-8) with respect to acoustic zone and elevation, but is much closer in distance to the GTSR.

**Table D-8. Site Descriptions**

Site	Acoustic Zone	Distance from GTSR	Elevation	Latitude, Longitude
Sperry Campground	Alpine/Subalpine	4.0 miles	2,036 meters	48.6024, 113.7872
Grinnell Glacier Overlook	Alpine/Subalpine	1.5 miles	2,330 meters	48.763333, 113.743611

## Existing Conditions

Existing conditions are derived from two sources—a baseline ambient sound levels report from 2004 and an air tour modeling exercise.

**Baseline Ambient Sound Level.** In 2004, baseline ambient sound levels were collected at Glacier National Park at eight sites (Lee et al. 2016) that represented different park areas, vegetation types, and environmental conditions. This study quantified many different aspects of the soundscape at the park and informs the indicators and thresholds listed below. The results of this study included both existing and natural ambient conditions at these eight specific sites and modeled ambient conditions across the park (figures D-1 and D-2). Natural ambient was estimated by removing human-caused noise, including roadway noise. The acoustical data collected included continuous, one-second average, A-weighted sound levels ( $LA_{eq, 1s}$ ) and their associated one-third octave band unweighted spectrum from 20 to 20,000 Hz. Generally, the study found that existing ambient conditions (represented by the median sound level,  $LA_{50}$ ) directly around GTSR ranged from 35–40 decibel (dB), dropping to 30–35 dB farther from the road. These general findings are the median sound pressure levels ( $LA_{50}$ ); therefore, a single noise event such as a passing car or aircraft is likely to produce a much higher noise level.

The baseline acoustic report also presented site specific data for Sperry Campground. As table D-9 indicates, the Sperry Campground site was subject to continuous waterfall sounds, and it experienced a fairly small increase in sound pressure levels (less than a decibel) due to anthropogenic noise.

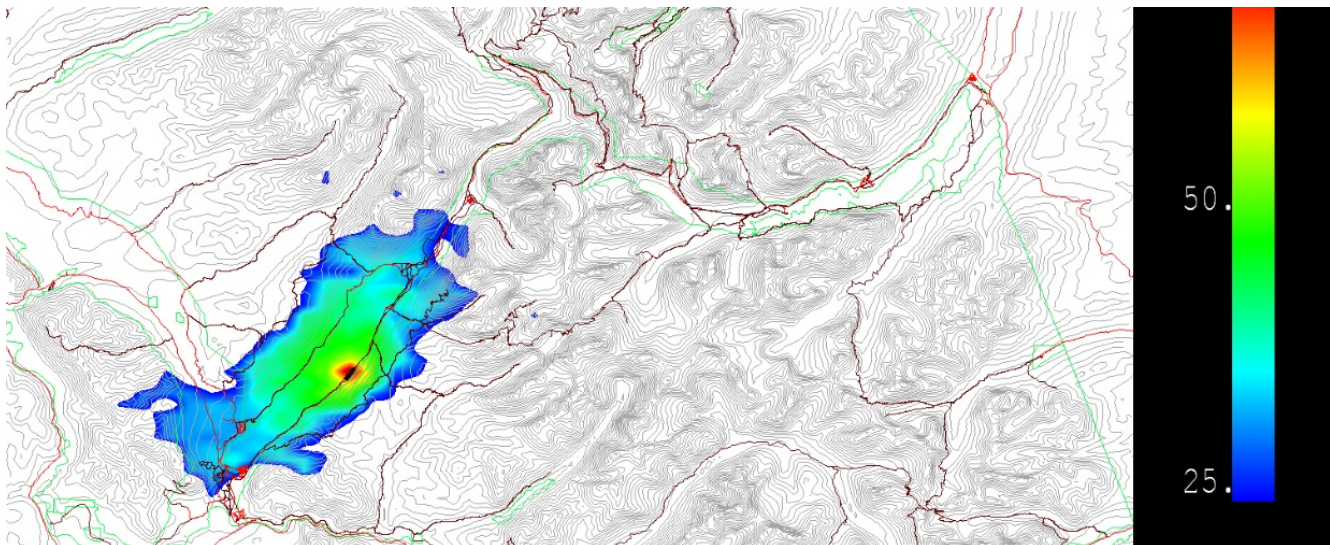
Site specific data was not collected at Grinnell Glacier Overlook during the 2004 study. A similar site in terms of location, elevation, and vegetation to have data collected was Logan Pass. However, the Logan Pass site is not suitable as a long-term monitoring site for this plan because the original site is too close to the road and visitor center to represent the backcountry experience. The site measurements taken at the Logan Pass site do serve well as a proxy for estimating conditions at Grinnell Glacier Overlook because (1) while Logan Pass experiences a higher traffic volume than Grinnell Glacier Overlook, the overlook is much farther from the road, and (2) the sites are only 5 miles apart (as measured by Euclidean distance). Table D-9 also identifies the sound pressure levels of existing and natural ambient conditions of Logan Pass measured in 2004. The metric  $LA_{50}$  is the median sound pressure level.

**Table D-9. Existing and Natural Ambient Conditions**

Site Name	Existing Ambient, All Data: LA <sub>50</sub> (dB)	Existing Ambient, 7:00 a.m. to 7:00 p.m. LA <sub>50</sub> (dB)	Existing Ambient Without All Aircraft: LA <sub>50</sub> (dB)	Natural Ambient: LA <sub>50</sub> (dB)	% Time Audible
Sperry Campground	34.2	34.1	34.0	34.0	3%
Logan Pass (proxy for Grinnell Glacier Overlook)	31.9	30.5	30.3	29.6	20%

The 2004 report included modeled noise levels from traffic on GTSR. Figure D-10 shows the results from the model roadway and railway ambient map. The model used nine localized sound sources, including Going-to-the-Sun Road; Camas Road; Outside North Fork Road; Inside North Fork Road; Routes 2, 49, 89, and 17; and the Burlington Northern and Santa Fe Railway. A number of assumptions were made in the report about traffic volumes and directionality. Traffic volumes were derived from 2004 data from an average day during peak season. All road traffic was presumed to occur during a 12-hour day (7:00 a.m.–7:00 p.m.). The GTSR traffic included all visitors entering the West Entrance Station.

The report notes that vehicle traffic was audible at Logan Pass, including occasional motorcycle noise. The Sperry Campground location did not report vehicle traffic noise. Aircraft noise was reported at both sites.

**Figure D-2. Glacier National Park Motorcycle Study**

**Air Tour Modeling.** Since the baseline ambient report was published in 2004, visitor use patterns, traffic patterns, and air tour activity (all factors that influence the acoustic environment) have all likely changed to some extent since 2004. In the 2004 report, aircraft were identified as the primary source of noise at both the Sperry Campground and Logan Pass sites. As a result, analyzing changes in noise generated by air tours provides a useful approximation of noise levels in recent years. This section provides updated information related to changes in air tour operations as reported by air tour

operators.<sup>1</sup> The Natural Sounds and Night Skies Division has modeled the noise from air tours using up-to-date information on air tour routes and number of air tours provided by operators in 2017. These modeling results include site specific information at Sperry Campground. Grinnell Glacier Overlook was not a modeled point, but Granite Park Chalet provides a good proxy.

The number of reported flights by all operators was 767 for 2016. Table D-10 represents the model results of air tour noise generated on the day with the highest number of air tours (peak day) based on reporting data for 2016. The most flights to occur on any single day in 2016 was 21. The percent time audible is the percentage of time that air tours could be heard during a 12-hour period on the peak day. The time above 35 dB and 52 dB is the percentage of time over a 12-hour period that air tour noise was above 35 dB and 52 dB. These noise levels are associated with increases in blood pressure and interpretive program speech interference respectively.  $LA_{max}$  is the maximum sound pressure level of an overflight event as calculated by the model. Figure 6 displays the routes provided by each operator.

**Table D-10. Modeled Air Tour Noise Results for a Peak Operations Day in 2016 (21 flights)**

Site Name	% Time Audible (12 hr)	% Time Above 35 dB (12 hr)	% Time Above 52 dB (12 hr)	Maximum Noise Level dB ( $LA_{max}$ )
Sperry Campground	11%	8%	0%	53 dB*
Granite Park Chalet (as proxy for Grinnell Glacier Overlook)	7%	0%	0%	46 dB

\*Note: The discrepancy between the  $LA_{max}$  of 53 dB and the time above 52 dB. Because the time above 52 dB was so slight, it was rounded down to 0.

There are three characteristics of air tour noise that, considered together, give a holistic perspective of the acoustic influence of air tours, (1) the spatial extent, (2) the duration of noise, and (3) the magnitude of noise (McKenna et al. 2016). Generally, for Glacier National Park (not just the GTSR corridor) based on 2016 reporting data for a peak reported day (21 flights) and a 90th percentile day (13 flights) air tour noise was pervasive throughout the spatial extent of the park and also exceeded the daytime-average noise level ( $L_{Aeq, 12hr}$ ) of 35 dB or greater. However, for days representing a 50th percentile day (six flights), air tour noise would have the same spatial extent but for shorter durations and at lower levels.

## Indicators<sup>2</sup>

Soundscape monitoring would be used to measure the conditions that visitors experience while in the backcountry of the GTSR corridor and three indicators of quality would be used:

1. the number of noise events with a maximum one-second average A-weighted sound level ( $LA_{eq, 1s}$ ) above 40 dB
2. the percent of time that noise is audible over natural ambient

<sup>1</sup> Reporting by commercial air tours is required as part of *United States Code (USC)* – Overflights of National Parks (49 USC § 40128(d)) and operators submit quarterly reports.

<sup>2</sup> Sound levels measured over 1 second intervals are used to calculate summary statistics or percent of the time a sound level of interest is exceeded. Sound level in this document refers to broadband (12.5 Hz - 1 kHz) ANS-weighted 1-second time-averaged sound level ( $LA_{eq, 1s}$ , NS). Sound levels are on a logarithmic scale and reported as decibels (dB) relative to the reference sound pressure for atmospheric sources, 20  $\mu$ Pa. The decibel scale is a useful way to express the wide range of sound pressures, but has no absolute value. An A-weighting function is applied to sound pressure levels in order to resemble the response of the human ear. To approximate human hearing sensitivity, A-weighting discounts sounds below 1 kHz and above 6 kHz. Elimination of the high-frequency sound (wind noise, equipment noise, and biologic sounds) improves measurements in quiet environments and allows for more accurate comparisons of ambient sound across environments, for example urban vs. natural areas (ANSI S3/SC1.100, 2014).

### 3. the cumulative increase of median daytime sound pressure levels over natural ambient

These three indicators are appropriate measures for the desired management conditions. Visitors who hear many noise events or who hear noise during large portions of their visit may not feel a sense of solitude in the backcountry. Further, when noise increases sound pressure levels above natural or existing conditions, the “listening area” of visitors and wildlife alike is reduced due to masking (Barber, Crooks, and Fristrup 2010; Beeco and Pipkin 2018). For example, if the natural ambient sound pressure level is 30 dB, and transportation noise raises the background sound pressure level by 3 dB, the listening area for humans (and many birds and mammals) is reduced by 50%. Increasing the background sound pressure level an additional 3 dB would reduce the listening area by half again, to 25% of the initial area. An effective approach to considering the human experience of noise is to conceptualize noise by its duration, intensity, and occurrences (number of events). Therefore, these three measures combined capture these different dimensions of noise.

The first indicator, number of noise events above a maximum one-second average A-weighted noise level ( $L_{Aeq, 1s}$ ) of 40 dB, is used to capture the number of unique events that a visitor may hear above a specific sound pressure level. (Note: 40 dB is not a threshold. The threshold is the number of events.) The sound pressure level of 40 dB was selected for a number of reasons. First, the existing daytime ambient sound level ( $LA_{50}$ ) of the GTSR corridor generally ranged from 30–35 dB when not directly adjacent to the road. Thus, events above 40 dB are very likely to be heard. Study results have suggested that noise, even at a relatively quiet 40 dB ( $L_{Aeq, 1s}$ ), interferes with many important visitor experience attributes and affects the perceived aesthetic quality of landscapes (Mace et al. 1999; Weinzimmer et al. 2014). Also, the Wilderness Tier Framework (McKenna et al. 2016) uses an average noise level ( $L_{Aeq}$ ) of 35 dB to represent a level of noise that may influence visitor experience, suggesting that values higher than 35 dB are needed for single events. In other words, visitors do not experience the average, but both noise events above and below the average. Finally, long-term noise levels above 40 dB have been shown to adversely impact wildlife, specifically species diversity (Proppe et al. 2013; Shannon et al. 2016).  $LA_{max}$  should be used to determine if an event exceed 40 dB.

The second indicator, percent time audible, is used to capture the percent of time (over a 12-hour period) that noise is audible. This indicator was selected because it considers the existing ambient and is well-suited to characterizing noise that varies daily or seasonally, such as traffic. This measure can be completed for the entire 12-hour period overall or segmented hourly. For example, a 12-hour period is equal to 720 minutes; therefore, if noise was audible a total of 1 hour during the 12-hour period, the percent time audible would be 8%.

The third indicator, increase in sound pressure levels over natural ambient, is a more broad metric that complements the two specific metrics above. This deviation from natural ambient is the difference between the measured existing conditions and the natural ambient condition. It represents the extent to which human-caused sounds raise the natural ambient background levels. This metric does not provide information on event duration or timing, nor does it mean that human-caused sound levels cannot be heard at or below the ambient. It means that the sound levels produced by human sources are above the natural ambient. Deviation from natural ambient can be used to identify reductions in listening area and alerting distance. Reduction in listening area quantifies the loss of hearing ability to humans and animals as a result of an increase in ambient noise level. Under natural ambient conditions a sound is audible within a certain area around a visitor or animal. If the ambient level is increased due to a noise event, the area in which the sound is audible decreases. By comparing the  $LA_{50}$ , this indicator gives a robust measure (a median) that is representative of broad changes in conditions. Additionally, this measure also aligns well with NPS policy direction. Specifically, NPS *Management Policies 2006* section 8.2.3 states “The natural ambient sound level—that is, the environment of sound that exists in the absence of human-caused noise—is the baseline conditions, and the standard against which current conditions in a soundscape will be measured and evaluated.”

Understanding the existing condition is also important for measuring trends and success of management actions.

## Thresholds

The most likely noise sources for the GTSR corridor, including both Sperry Campground and Grinnell Glacier Overlook, are loud mechanized noises. It is understood that noise nearer the road would be more pronounced than noise farther from the road. The locations of focus here are well away from the road and emphasize backcountry conditions.

The threshold for number of events with a maximum one-second average noise level ( $LA_{eq}$ , 1s) above 40 dB should be set at four per day for 95% of days per year. The air tour noise modeling exercise revealed that many air tour events would exceed a  $LA_{max}$  of 40 dB at the monitoring locations. (Note: Granite Park is used here as proxy for Grinnell Glacier Overlook.) Specifically, two of the three fixed-wing air tour route / aircraft / altitude combinations would have a maximum noise level ( $LA_{max}$ ) above 40 dB at both Sperry Campground and Granite Park. One of six helicopter route / aircraft / altitude combinations would have a maximum noise level ( $LA_{max}$ ) that would exceed 40 dB at Granite Park, while all six helicopter route / aircraft / altitude combinations would exceed 40 dB at Sperry Campground. Again, referencing 2016 air tour reporting data, 13 flights per day would represent a 90th percentile day—there were 17 days during the air tour season with 13 or more flights (which generally aligns with peak visitation season). With the additional consideration of loud vehicular traffic in the GTSR corridor, four events per day represents a realistic threshold based on existing data. Further, this threshold results in one event every 3 hours, on average. Visitors in the backcountry experiencing one noise event over 40 dB in 3 hours is consistent with the desired acoustic conditions for backcountry along the GTSR corridor.

The threshold for percent time audible for human-caused noise should be set at no more than 15% of daytime hours (12-hour day, 7:00 a.m.–7:00 p.m.) for 95% of days. This threshold was informed by the Wilderness Tier Framework, which set a threshold of 25% time audible as a level that would likely interfere with visitors' ability to hear natural sounds (McKenna et al. 2016). Also, the air tour modeling exercise revealed that 2016 peak day conditions would result in a percent time audible of 11% at Sperry Campground and 7% at Grinnell Glacier Overlook. Additionally, the existing conditions from the 2004 study reveal that percent time audible at Sperry Campground was 3% and Logan Pass (proxy for Grinnell Glacier Overlook) was 20%. With the addition of loud vehicular traffic in the GTSR corridor, no more than 15% time audible for 95% of days represents a realistic threshold. Further, hearing noise less than 15% of the time is aligned with the desired conditions the park is trying to provide.

The threshold for cumulative increase in A-weighted sound pressure level over natural ambient should be set for no more than 2 dB as measured by the difference between the 2004 natural ambient and current  $LA_{50}$  as measured over the entire monitoring period, averaged over a 12-hour period (7:00 a.m.–7:00 p.m.). The 2004 data suggested deviations from natural and existing ambient at both Sperry Campground and Logan Pass (proxy for Grinnell Glacier Overlook) were relatively small (table D-11). An increase in 2 dB over natural ambient could represent a meaningful change in a visitor's ability to hear natural sounds in affected frequency bands. Based on existing data, these thresholds are believed to be realistic.

**Table D-11. Indicators and Thresholds for Sound**

Site	Number of Events Above 40 dB <sup>1</sup>	% Time Audible	Cumulative Increase of SPL over Natural Ambient
Sperry Campground	95% of the days may have up to four events above 40 dB	No more than 15% of a 12-hour day (7:00 a.m.–7:00 p.m.) for 95% of days	No more than an increase of 2 dB <sup>2</sup> over 2004 natural ambient of 34 dB (7:00 a.m.–7:00 p.m.)
Grinnell Glacier Overlook	95% of the days may have up to four events above 40 dB	No more than 15% of a 12-hour day (7:00 a.m.–7:00 p.m.) for 95% of days	No more than an increase of 2 dB <sup>2</sup> over 2004 natural ambient of 29.6 dB (7:00 a.m.–7:00 p.m.)

<sup>1</sup>Based on the maximum of one-second average noise levels (LAeq, 1s) during 7:00 a.m.–7:00 p.m.

<sup>2</sup>An increase of 2 dB represents a 37% reduction in listening area.

## Monitoring

The thresholds established for Grinnell Glacier Overlook were based on existing data at Logan Pass. Updated measurements are needed for current existing conditions for both Grinnell Glacier Overlook and Sperry Campground. Adjustments of thresholds for Grinnell Glacier Overlook may be needed if existing conditions are inordinately different from the Logan Pass data. Additionally, the exact location of Grinnell Glacier Overlook may need to be adjusted to remove it from visitor sight and reduce wind interference.

It is believed at this time that all the proposed thresholds are currently not being exceeded. However, monitoring is needed to ensure that desired conditions would persist. Therefore, monitoring sound pressure level at both Grinnell Glacier Overlook and Sperry Campground should be conducted the year following the implementation of this plan. If thresholds are met, monitoring could occur on a five-year rotation. Monitoring should take place during the high season (July or August) when the majority of noise would occur. If thresholds are not exceeded during the high season, it is likely that thresholds are also not exceeded during the shoulder and low seasons. Monitoring should occur for at least 30 days.

## Adaptive Management Actions

The thresholds established above must be realistic, and sensitive to management action. The management actions listed below are all likely to improve the natural soundscape at the park. Once regular monitoring is occurring, trends in the conditions of soundscape should also drive management actions—especially if the trend is downward but has not crossed the thresholds set above.

- Focus education and outreach on ways to reduce noise-producing visitor behaviors.
- Install quiet pavement in key areas.
- Effectively manage traffic conditions in corridor.



Figure D-3. Baseline Composite Ambient Map – Natural Ambient: LA<sub>50</sub>

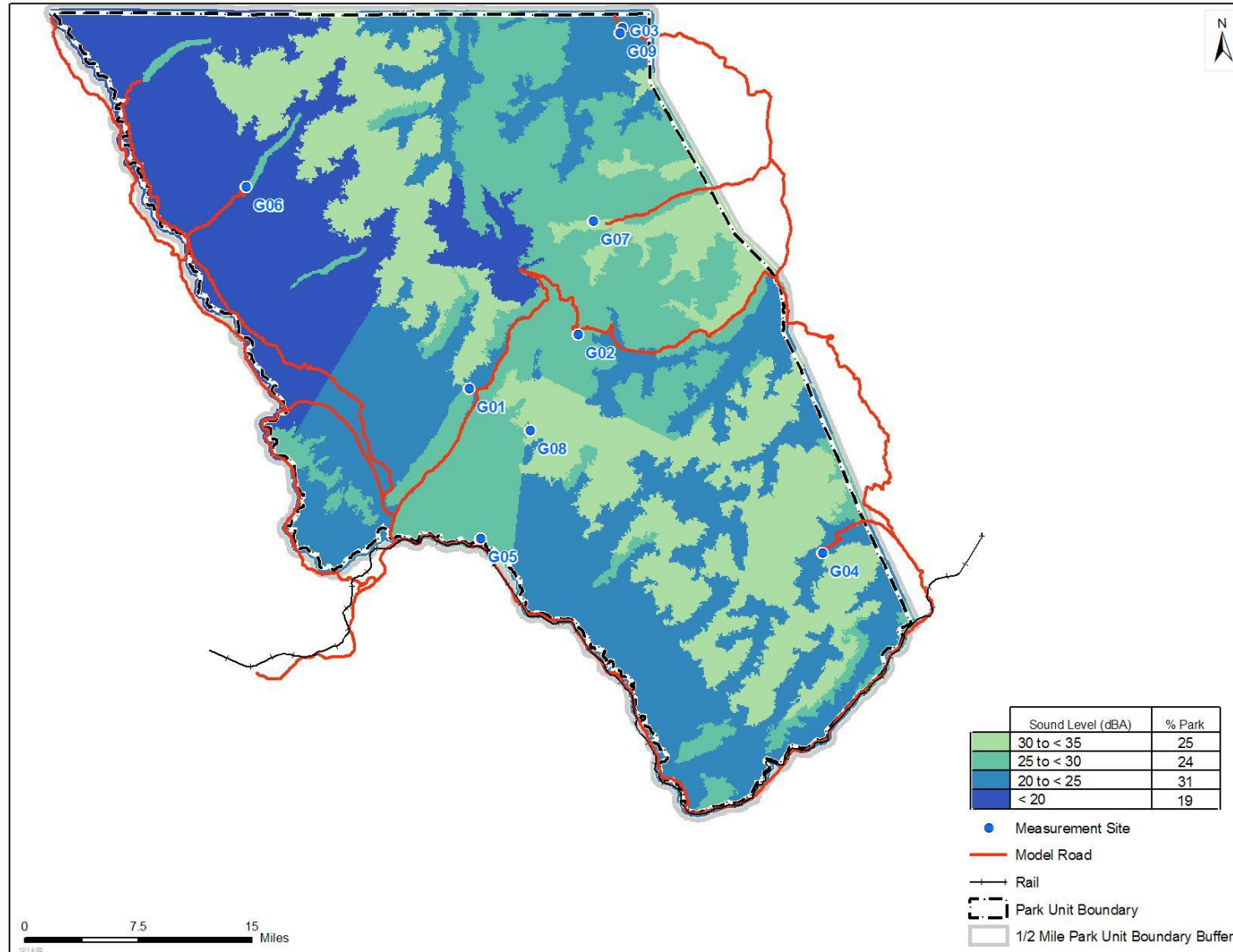




Figure D-4. Baseline Composite Ambient Map – Existing Ambient: LA50

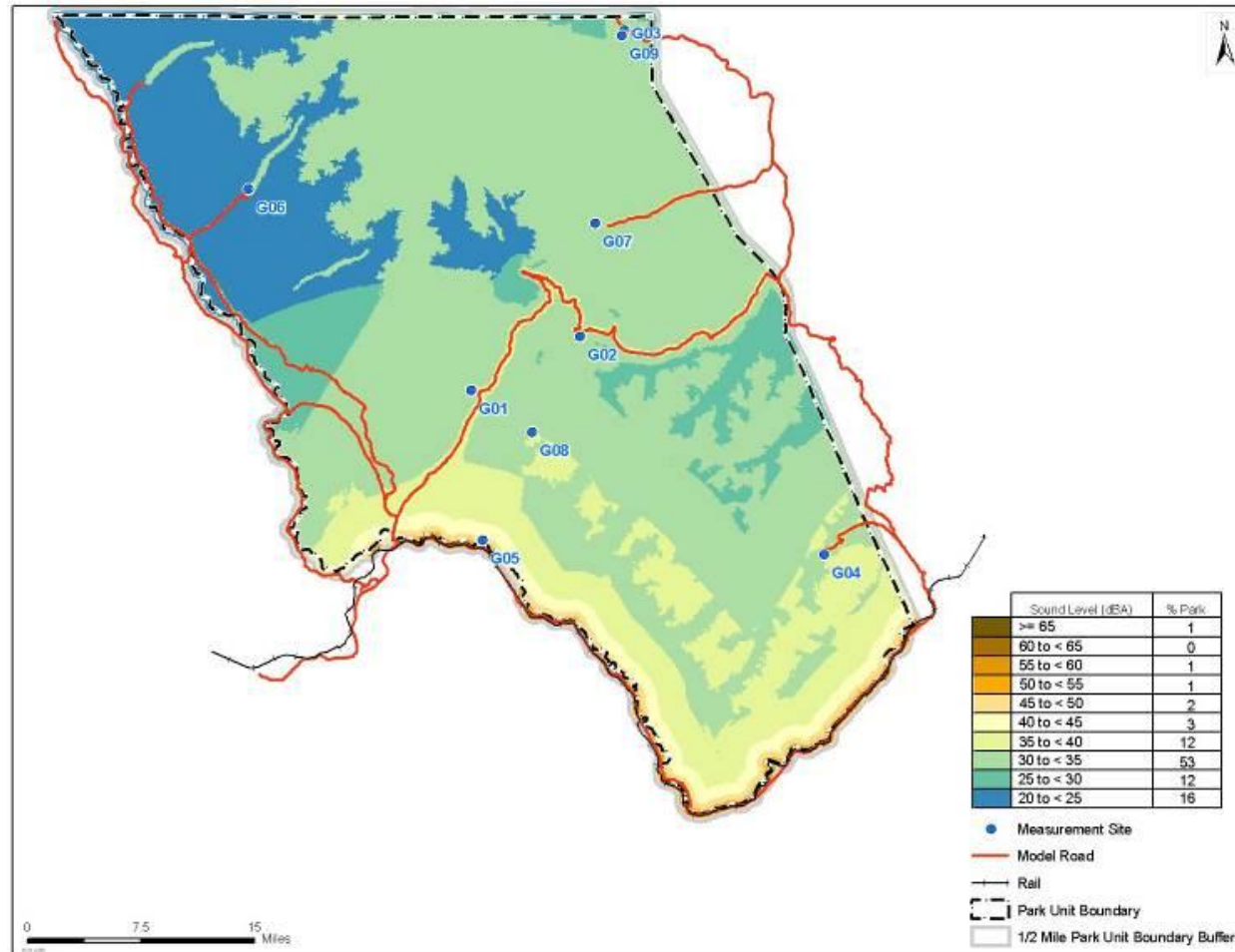


Figure D-5. Modeled Roadway and Railway Ambient Map

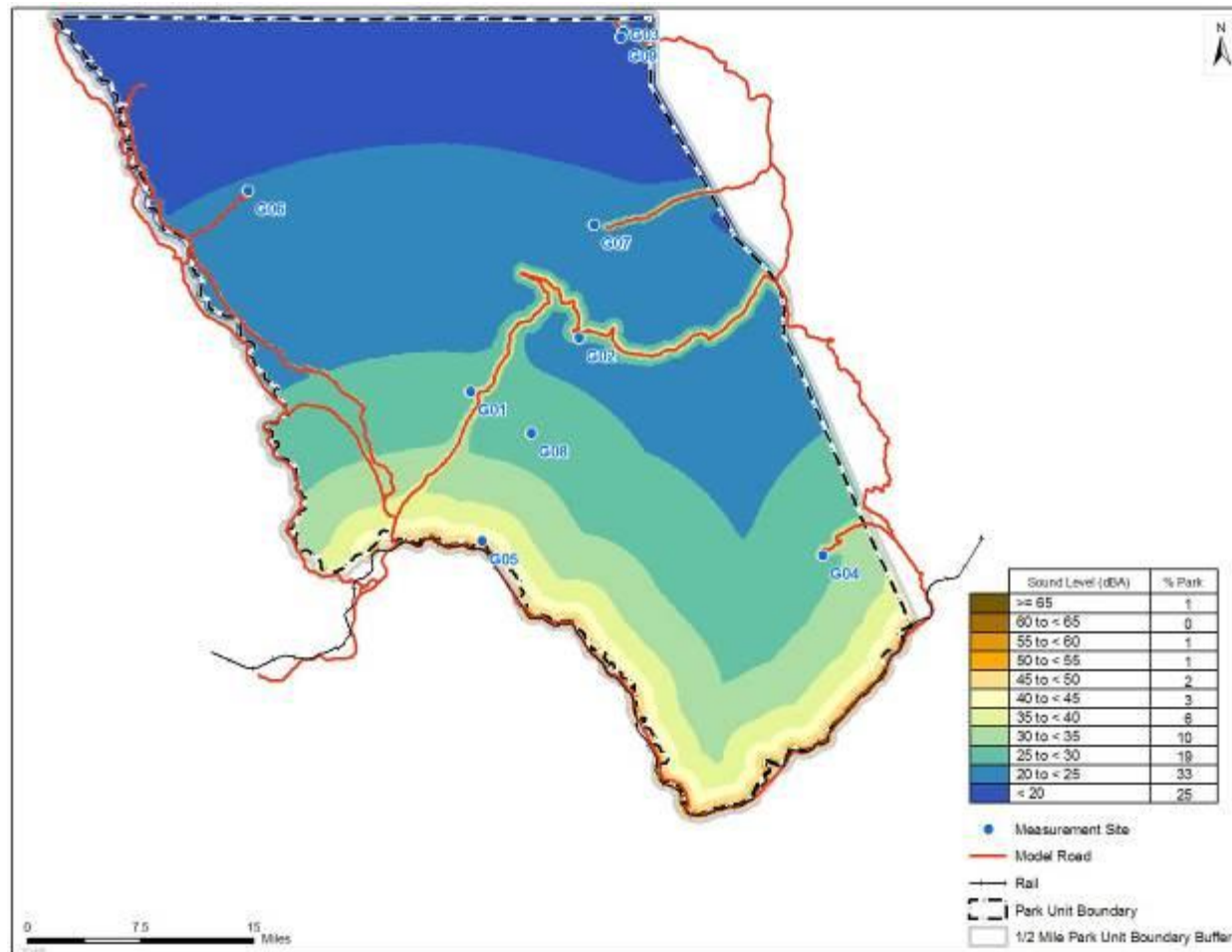
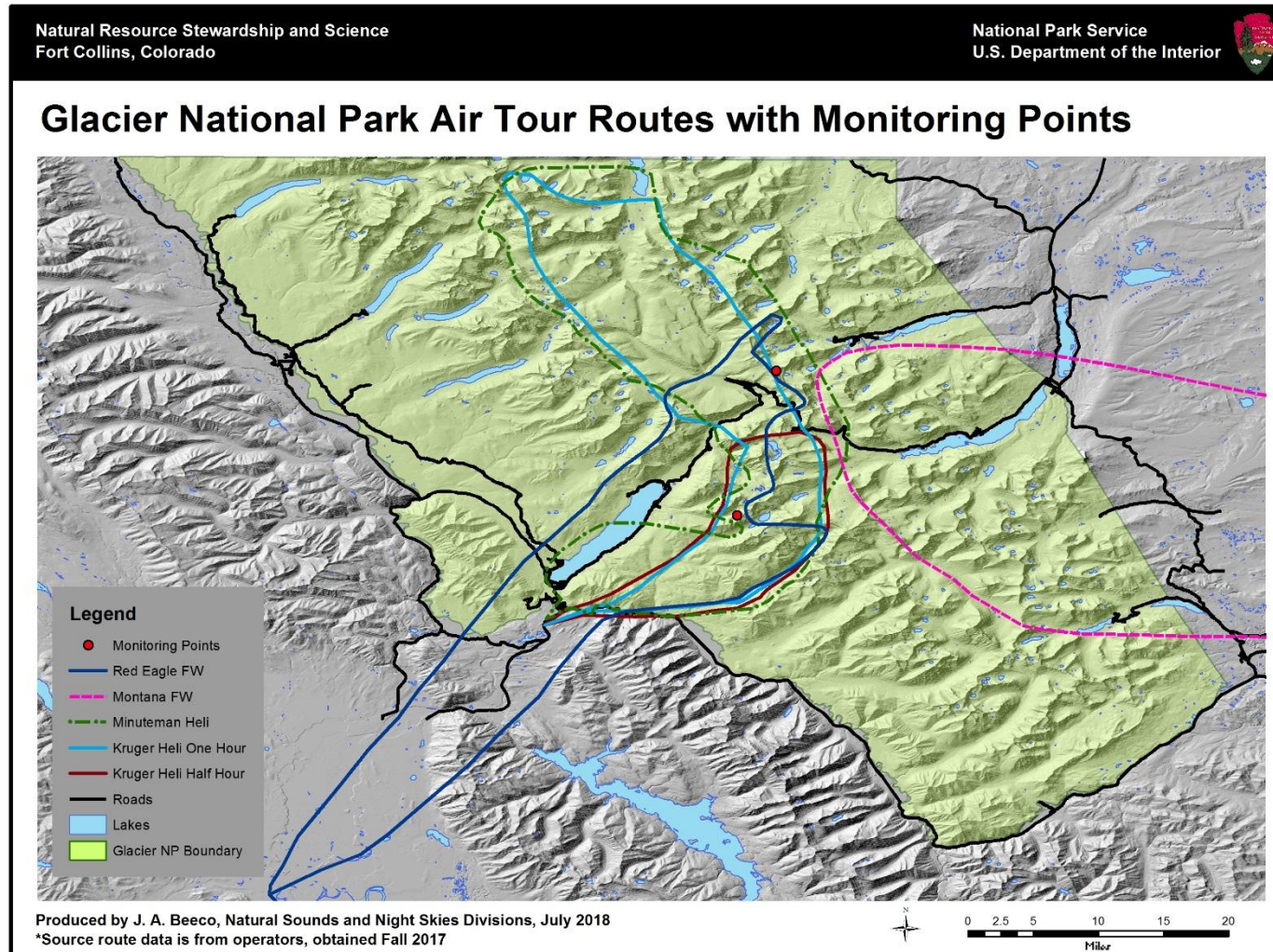


Figure D-6. Map of Air Tour Routes Provided By Operators, Including Proposed Monitoring Sites



- Retrofit and maintain shuttles, park vehicles, and other equipment to reduce noise.
- Participate in the NPS Air Tour Advisory Council.
- Maintain contact and relationships with air tour operators.
- Schedule routine road maintenance activities to minimize the effects of noise on the acoustic environment.

## **OTHER RELATED MONITORING**

### **Parkwide Visitation Levels**

Parkwide visitation remains an important number for the park to track. It is also an information source that stakeholders who also wish to track trends in parkwide visitation are able to access. Two different components are used to evaluate change regarding parkwide visitation levels—annual parkwide visitation and shoulder season parkwide visitation.

### **Annual Parkwide Visitation**

Previously, an indicator and threshold was developed by the University of Montana for annual parkwide visitation. Because the threshold for this indicator is already being exceeded, management actions identified under the preferred/proposed alternative would be implemented immediately on completion of the document. These actions were selected to achieve the desired conditions in the GTSR. The actions included in chapter 2 do not reduce the number of visitors to the park, rather they manage the access in specific places in the GTSR corridor. The park would continue to monitor the number of visitors per year to Glacier National Park and pursue more management controls by site area, if necessary.

### **Shoulder Season Parkwide Visitation**

Historically, the shoulder season for Glacier National Park was June and September but visitation is starting to increase into May and also October. Similar to the annual visitation, the University of Montana developed a monitoring protocol for the park to shoulder season parkwide visitation. In the future, monitoring visitation levels in May and October may also be necessary. If parkwide visitation continues to increase during the shoulder season, the park could consider exploring alternative hiring practices.

### **Human-Wildlife Encounters**

According to Glacier National Park biologists, there is very little data that can be used to explain human-wildlife encounters in Glacier National Park. Although wildlife citations and warnings are recorded by dispatch, these records are not systematic enough for use as an indicator. For instance, the number of park staff working can fluctuate, and the subjective nature of individuals issuing citations and warnings can lead to differences in the consistency of citations and warnings in Glacier National Park. Wildlife observation reports similarly lacked rigor because they are voluntary and underutilized. Therefore, these measures do not meet the “reliable/repeatable” condition necessary for good indicators. Conversations with Glacier National Park biologists revealed a number of other potential indicators including roadkill surveys, surveys of wildlife attractants left in the Logan Pass parking lot, and observational studies of human-wildlife encounters. Ultimately, Glacier National Park biologists felt that observations of human-wildlife encounters would be the best indicator for assessing changes in the GTSR corridor related to human-wildlife encounters. The park would continue to monitor citations and warnings recorded by dispatch as well as wildlife observation

reports. In the future, there may need to be the development of an indicator for human-wildlife encounters in the GTSR corridor.

## **Shuttle System Operations**

The park would continue to monitor components of the shuttle system to ensure its operation for the future. These do not have indicators, thresholds, or associated management actions but are important to achieving the desired conditions in the GTSR corridor.

## **Financial Sustainability of the Shuttle System**

A comparison of expenses versus revenues of the shuttle system as a whole in the GTSR corridor is used to infer conditions related to the financial sustainability of the shuttle system. Annually, the park completes an alternative transit system financial pro forma analysis (NPS requirement) that examines projected transportation fee revenue and operation and maintenance expenses over a seven-year period after a baseline year of actual revenue and expenses is established. Capital expenses such as bus replacement can be entered into the pro forma but are generally not included when considering the financial sustainability of the shuttle system because other fund sources are typically used for bus recapitalization. From 2013 to 2016, expenses averaged 88.5% of the revenues for the shuttle system. If the pro forma indicates that expenses are greater than revenues, then the park may need to increase its transportation fee or decrease operations.

## **Ridership Cost**

The shuttle cost per rider would also continue to be monitored. While visitors do not pay an additional fee to ride the shuttle beyond the park entrance fee, the park calculates the operational cost of the shuttle system per rider (“cost per rider”). This is separate from the financial sustainability of the shuttle system described above as it accounts for the number of visitors who ride the shuttle system in Glacier National Park. This information is calculated by comparing the expenses of operating and maintaining the shuttle system (not including items like replacing the shuttle fleet) and comparing it with the number of people using the shuttle system in the same shuttle operating period. This comparison would be made over an entire shuttle operating period and not just peak season use. As of 2018, the shuttle cost per rider was \$3.69. The park would continue to monitor the shuttle cost per rider.

## **IDENTIFYING AND IMPLEMENTING VISITOR CAPACITY**

### **Overview**

This section provides additional information about identifying and implementing visitor capacity as it relates to the visitor use management framework. Please refer to chapter 1 of this plan for a description of the visitor use management framework.

Broadly speaking, visitor use management is the proactive and adaptive process of planning for and managing characteristics of visitor use and its physical and social setting, using a variety of strategies and tools to sustain desired resource conditions and visitor experience. Within this framework, desired conditions, indicators and thresholds, and management strategies have been drafted. Another component of this framework is identification of visitor capacities. Visitor capacity is a component of visitor use management defined as the maximum amount and types of visitor use that an area can accommodate while sustaining desired resource conditions and visitor experiences consistent with the purpose for which the area was established. Visitor capacities would be used to inform and implement the management strategies selected as part of this plan. The National Park Service is legally



required to identify and implement visitor capacities for all areas of a park unit per the National Parks and Recreation Act of 1978 (IVUMC 2016).

The primary goal of this planning effort is to preserve the fundamental resources and values of Glacier National Park along the GTSR. By managing the maximum amounts and types of visitor use, the National Park Service can help ensure that resources are protected and that visitors have the opportunity for a range of high-quality experiences. Although visitors have mostly noted that their experiences are of high quality, they have also identified a number of concerns related to increasing use levels such as congestion in parking areas, conflicts between user groups, and concerns over resource impacts along trails, proximate to parking lots and near other sensitive resources.

Through this planning effort, Glacier National Park has an important opportunity to proactively safeguard the highly valued experiences and resources along the GTSR. At some sites, current use levels are so high that they are resulting in adverse impacts to resources and experiences. In these cases the visitor capacity has been identified so these conditions are corrected as this plan is implemented. For other sites, current use levels do not appear to be impacting experiences or resources, and therefore visitor capacity has been identified to be at or near current use and are based on the limiting attributes described at the site. This section outlines the considerations and process used to identify and implement visitor capacity for key destinations.

## **BACKGROUND ON VISITOR USE LEVELS AND PATTERNS**

In the last 30 years, park annual visitation has ranged from a low of 1.6 million in 1986 to a record high of 3.3 million in 2017. In addition to yearly fluctuations, park visitation is very seasonal due to its short summers and the limited length of time the entire GTSR is open to vehicle traffic, a main visitor attraction. Over the past 25 years, there have been numerous studies of park visitors that have captured social and economic data about the visiting parties and their households (e.g., Littlejohn 1991; WIS 2001; Nickerson 2002). Oschell, Tanner, and Nickerson (2009) conducted the most current study in 2008. Statistics from these studies, as well as additional information on use levels and pattern can be found in “Chapter 3: Visitor Use and Experience.”

## **PROCESS FOR IDENTIFYING VISITOR CAPACITIES**

The approach for developing visitor capacities is based on the IVUMC’s Visitor Use Management Framework and associated publications and is consistent with the literature and best practices on this topic. Visitor capacities were identified using best practices and examples from other plans and projects across the National Park Service. Based on these best practices, the planning team describes the process for identifying capacity following four key guidelines: (1) determining the analysis area, (2) reviewing existing direction and knowledge, (3) identify the limiting attribute, and (4) identifying visitor capacity.

### **Guideline 1: Determine the Analysis Area**

The amount, timing, distribution, and types of visitor use along GTSR influence both resource conditions and visitor experience. Currently, there is high demand for recreational opportunities in the park, particularly during summer months.

This plan and identified visitor capacities are needed to manage and protect the park through the identification of appropriate kinds and amounts of visitor use. Determining visitor capacity at these key areas ensures visitors have the opportunity to engage with the resources at the park while ensuring the protection of those resources.

Following guidance from the IVUMC, the level of analysis that occurs during visitor use management planning and visitor capacity determination is determined on a sliding scale depending on the complexity and context of the plan. During the planning process it was determined that nine analysis areas of the unit would benefit from a capacity analysis.

A higher level of analysis has been identified as necessary for these analysis locations due to the existing visitor use issues. For the other locations, desired conditions are being met under current use levels and a lower level of analysis is being used. The visitor capacities at these other locations have largely been determined to be near, at, or slightly above current use levels. Future monitoring of use levels and indicators would inform the National Park Service if visitor capacities are encroached. The level of detail provided in the rationales for each capacity determination is commensurate with the level of complexity related to visitor capacity at that site.

In compliance with the 1978 National Parks and Recreation Act and following subsequent guidance from the IVUMC and visitor capacity determinations are legally required for all destinations and areas that this planning effort addresses (IVUMC 2016). Together, the nine analysis areas (below) comprise the majority of the areas with issues directly related to visitor use levels.

1. Avalanche
2. The Loop
3. Big Bend
4. Logan Pass
5. Lunch Creek
6. Siyeh Bend
7. Gunsight Pass and Jackson Glacier Overlook
8. St. Mary Falls
9. Sunrift Gorge

There are other areas of the park (e.g., districts, trails, and other destinations) that are subject to the legal requirement to define a visitor capacity. However, as decisions about the management of these areas are out of scope for this plan, these capacity analyses would be addressed in subsequent planning.

## **Guideline 2: Reviewing Existing Direction and Knowledge**

During this guideline, desired conditions, zoning from the 1999 General Management Plan, indicators and thresholds, with particular attention to conditions and values that must be protected and are most related to visitor use levels were reviewed. Below, under each analysis area, relevant indicators are listed, the associated thresholds and associated actions can be found earlier in this appendix. Relevant desired conditions for both resources and visitor experience were reviewed for each site as part of this process. For descriptions of the desired conditions see chapter 1. An overview of visitor use issues and current use levels is also provided for each analysis area.

## **Guideline 3: Identify the Limiting Attribute**

Guideline three requires the identification of the most limiting attribute(s) that most constrain the analysis area's ability to accommodate visitor use. The limiting or constraining attribute(s) may vary across the analysis area and is described under each analysis area. This is an important step given that an analysis area could experience a variety of challenges regarding visitor use issues. In the cases where the limiting attribute is directly related to an indicator, then the threshold (as the minimally acceptable condition) is used as the primary (but not necessarily only) attribute used to identify the maximum kinds and amounts of use. This section also includes a list of other related indicators. These indicators are not currently limiting attributes; however, monitoring these indicators could include

management decisions in this area to protect resource conditions that are related to the identified limiting attribute. For example, trail width may not currently be the limiting attribute for an area, but trail width thresholds could be exceeded before use level thresholds are exceeded. Therefore, understanding all the potential limiting attributes for an area is an important component of this analysis.

#### **Guideline 4: Identify Visitor Capacity**

To determine the appropriate amount and types of use at analysis areas, a variety of data was reviewed to understand current conditions compared to goals and objectives for the area. Visitor capacity includes consideration of the amount and types of visitor use, including the timing and distribution of visitor activities and behaviors as they relate to desired conditions. It also takes into consideration management objectives, desired conditions, and other management actions for an area (as described in “Chapter 2: Alternatives”).

For Glacier National Park, visitor capacities are most frequently expressed as PAOT increments. PAOT refers to the total number of people that are present at a site at any given point in time. Delineations of sites may vary depending on the specific location. Monitoring can be accomplished in a variety of ways, but should serve to approximate as best as possible the total number of people present at a location. The visitor capacities would be implemented as part of this planning project. Where applicable, specific management strategies outlined in the alternatives that would be used to implement visitor capacities have been included in the visitor capacity for each area. For these and all other locations, visitor capacities would be monitored as described in the “Indicators and Thresholds” section of this appendix, and if associated thresholds are exceeded, potential management strategies would be implemented to ensure that capacities are not exceeded.

In some locations, visitor capacity allocations are also identified. Allocation is the process of distributing visitor capacity among a variety of uses or opportunities to achieve or maintain desired conditions. Once visitor capacity is identified for an area, managers may need to determine appropriate allocations among a variety of uses or opportunities. Information about the categories of use to be allocated should be considered as the visitor capacity is being identified.

#### **METHODOLOGICAL CONSIDERATIONS**

To determine the appropriate amount of use at one time at key locations, a variety of data was reviewed to understand current conditions compared to desired conditions and to quantify limiting attribute(s). Visitation data is collected annually by park staff to track levels of visitor use parkwide. Research was conducted by a variety of researchers from 2005 to present on use levels, types, patterns, and preferences and perceptions of visitors at a specific number of key locations within the park. Results from visitor surveys and visitor counts in various locations inform visitor capacity determinations below. Research on visitor impacts to trails, including informal trails, has been used to understand and determine appropriate kinds and amounts of visitor use with regard to natural resources.

These analysis areas are complex in nature and there may be many opportunities (scenic vistas, hikes, etc.) in a single location that leads to a confluence of limiting attributes for use that originates at a single analysis area. Therefore, this analysis identifies the amounts and types of visitors “delivered to” a specific site with respect to the limiting attribute(s) at the site itself or at locations that are accessed by the site. Given this methodology, this analysis includes all users delivered to an analysis area, regardless of their duration of stay (day and overnight users, commercial tours, and personal vehicles).

This analysis assumes that dominant use patterns (timing, activity usage, activity duration, etc.) persist. Visitor capacities might need to be adjusted to reflect emerging use patterns (provided these



adjustments are consistent with desired conditions (chapter 1) and thresholds [this appendix]). If monitoring of the indicators demonstrates that these use patterns are shifting then these activities may need to be more actively managed (to restore dominant use patterns) or capacities may need to be adjusted. For example, if length of stay is getting longer in a location, parking lots have higher utilization rates in the early morning or late afternoon, or there is a higher proportion of users who are hiking vs. sightseeing in a specific location, the park may adjust accordingly.

A few common factors are used for all analysis areas to identify capacities. Lot functionality and efficiency was taken into consideration in the identification of visitor capacities. Given the dynamic nature of visitor use patterns (mostly duration of stay), lots cannot be assumed to be 100% full at all times. Therefore, this analysis uses an efficiency factor to ensure that lots both operate at a high efficiency level and meet or achieve desired conditions (as expressed in the VAOT indicator). The more directly managed the lot is (i.e., on a reservation system) the efficiency factor is relatively high (90%). Where lots are not actively managed, the efficiency factor applied is slightly lower (85%) to account for what could reasonably be accommodated in the lots under those conditions (Smith 2005).

$$\text{Parking Spaces} \times \text{Efficiency Factor} = \text{VAOT}$$

Where necessary, approximations have been made. For instance, a persons-per-vehicle (PPVh) multiplier has been used to estimate the average number of PAOT who arrive to a site based on private vehicle use (VAOT). While some vehicles may include more or less than the multiplier used, it represents a reasonable average. The PPVh multiplier used at Glacier National Park is three persons/vehicle (NPS PUSO 2018).

$$\text{VAOT} \times \text{PPVh} = \text{PAOT from private vehicles}$$

## ANALYSIS AREAS

### Avalanche Developed Area

**Review of Existing Direction and Knowledge.** Many activities occur at the Avalanche Developed Area, which contains a campground, picnic area, restroom, large vehicle parking and turnaround, the Trail of the Cedars accessible trail, the trailhead for Avalanche Lake, and another hiking trail to Johns Lake. Avalanche is also the transfer point for the west side shuttle service and in the day use zone. In the day use zone, this is a place where visitors and park managers are willing to tolerate higher levels of use so that many visitors do not need to be turned away from this resource and experience, provided that the natural resources in this location remain protected (NPS 1999). It is possibly the most complex attraction point in the park.

Avalanche is a terminus for oversized vehicles, including the larger Optima buses that are not able to navigate the alpine section of the GTSR. Shuttle riders transfer to smaller passenger vans at Avalanche to continue on the shuttle toward Logan Pass. There are currently 98 regular parking spaces in the larger Avalanche developed area, including four accessible spaces. There is also space for three shuttle buses at the shuttle stop (Volpe 2014).

University of Montana researchers have collected data on visitor parking behavior at Avalanche several times since 2006. Nearly 30% of vehicles observed in 2011 were parked longer than six hours, possibly indicating that a significant number of visitors are using the area as a base location for activities at Avalanche or elsewhere in the park. For shorter parking durations, visitors parking at Avalanche stayed an average of 77 minutes in 2011 with a median 50 minute length of stay (Bedoya and Freimund 2012a). These shorter duration visitors could be hiking a portion of the Avalanche Lake

trail, or the Trail of the Cedars, which is one mile long. The relatively short duration of observed parking behavior combined with the 30% of vehicles parked longer than six hours makes it difficult to draw definitive conclusions about how visitors are using Avalanche parking and recreational opportunities.

As noted above, congestion at Avalanche results in a substantial amount of undesignated roadside parking. This has led to the creation of informal trails, with visitors walking along the road to access key points of interest around the Avalanche Developed Area, creating safety and resource concerns. Additionally, private vehicles sometimes block the shuttle turnaround, which then requires shuttle vehicles to circulate through the general parking areas to return to the GTSR; occurrences such as this exacerbate the circulation and safety issues at Avalanche.

Avalanche is considered as a worse condition hot spot for a variety of reasons, including congestion, limited parking, pedestrian conflicts, and complexities from being a turnaround point for the shuttle and a terminus for large vehicles. The qualitative and quantitative data collected and analyzed confirms that Avalanche is heavily used as a destination in itself and as the transfer point for shuttle vehicles.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to a variety of natural resources and some cultural resources. The key limiting attributes driving visitor capacity decisions in this area are the hemlock habitat and the historic character of the campground.

Parking is limited in the lots that provide direct access to the Avalanche area, making competition for parking high during most of the day during the peak summer season. While the park did consider building additional parking in this area to accommodate additional vehicles (and therefore additional visitor use), it was determined that such an action would result in significant adverse impacts to the park's historic character of the campground and to the protected hemlock habitat.

Additionally, the trails around Avalanche Lake are appropriate for high use levels, but a continued increase in use of these trails could lead to increased informal trail development and degraded visitor experiences along those trails. The Avalanche Lake Trail is a trail where "higher use" levels are appropriate. However, from 2012 to 2017, trail use on the Hidden Lake Trail surpassed its indicator and increased from <864 to 1,298 average hikers per day. While some previously implemented infrastructure solutions (trail paving, fencing, signage) and additional actions proposed in this plan to make trail resources more resilient to visitor use, a continued increase in use of this area would result in degradation to the natural resources (via informal trails) and visitor experience (via trails over their trail-specific use threshold).

Other related indicators:

- average trail width over the entire length of trail
- VAOT at key destinations

**Visitor Capacity.** The visitor capacity for this area is identified at 975 PAOT. Beyond this point, conditions would begin to degrade and conditions on the Avalanche Lake Trail would exceed the established threshold for monitoring on this trail (1,080 visitors per day), leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally utilized (this assumes that the lot is 85% full, which is the functional vehicle capacity for this lot). It is expected that 775 of these visitors arrive via private vehicles or tours parked in the lots at Avalanche. The remaining 200 visitors would arrive via transit or tour services. Shuttle service to this area could be expanded if no more than 200 visitors amassed in this area as a result of these services.

## The Loop

**Review of Existing Direction and Knowledge.** The Loop is a popular scenic location for GTSR visitors to stop and take photos or use the restroom facilities. The Loop is in the day use zone (NPS 1999). The lot is also used for overnight parking for visitors hiking to Granite Park Chalet and other backcountry locations, and administrative parking in support of the chalet operation. There are 29 standard passenger-sized vehicle spaces and two accessible spaces between the upper and lower lots. There is also a shuttle bus stop. The parking lots began filling at 9:00 a.m. and were consistently filled until approximately 3:30 p.m.

Park staff report there is always congestion at The Loop during peak hours and the parking lots are full nearly all of that time. There are also pedestrian circulation challenges at The Loop since the trailheads and the east and westbound shuttle stops are on the opposite side of the road from the parking lots and other visitor facilities.

The introduction of the shuttle in 2007 facilitated a one-way hiking opportunity between the Highline Trail and The Loop, as confirmed by trail counts, surveys, and observations. The average length of stay observed by UMT researchers was relatively short at The Loop parking areas; however, 20% of vehicles observed in 2009 were parked longer than six hours. These findings show that there is some use of The Loop as a park-and-ride location for one-way hikes, though likely not as popular as a long-term parking location as other hot spots in the GTSR corridor. Use of this area as a park-and-ride location is confirmed by park employees who observe hikers parking at The Loop early in the morning and either starting The Loop Trail from The Loop or taking a shuttle to Logan Pass to hike the Highline Trail back down to The Loop. With limited parking capacity in this location, long-term parking by visitors for one-way hikes contributes significantly to parking congestion. Due to limited parking, tight shuttle circulation, and increased use of trails and facilities, including one-way hikes, The Loop has been identified as a worse condition hot spot.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural and experiential resource considerations. Primarily, the parking lot in this location is considered a contributing feature of the landscape and cannot be modified to increase vehicle capacity without impacts to the cultural landscape. Secondly, increasing parking in this location, or allowing for increased visitor delivery via shuttle system to this area would result in increased use levels along The Loop Trail. As this trail is designated as a “lower use trail” it’s important to ensure visitor delivery to this area maintains the “lower use” characteristics to achieve desired experiential resource conditions. This would create conditions that continue to be above the identified number of hikers per day thresholds identified for both The Loop Trail and the Highline Trail (see sections on “Indicators and Thresholds” for more information about this condition). The Highline Trail is included in the Logan Pass section below.

Other related indicators:

- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destinations

**Visitor Capacity.** Within the day use zone, this is a place where visitors and park managers are willing to tolerate higher levels of use so that many visitors do not need to be turned away from this resource and experience, provided that the cultural and experiential resources in this location remain protected (NPS 1999). Hikers comprise approximately 20% of the users at The Loop. Considering the composition of use at The Loop, the visitor capacity for this area is identified at 130 people at one time. This number would remain within the threshold established through the average number of

hikers per day, <323 hikers per day (see discussion of “trail use indicator” above). This includes visitors who stop to solely use the restroom, those that hike the trails, and those that pull over to take photos. Beyond this point, conditions would begin to degrade and conditions on The Loop Trail and/or Highline Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally used (this assumes that the lot is 90% full, which is the functional vehicle capacity for this lot), it is expected that 75 of these visitors arrive via private vehicles parked in the lot at The Loop. Most of the rest of these visitors would arrive via transit services to this area (and some visitors may hike to this area from another parking lot). Shuttle service to this area could be expanded, if no more than 55 visitors are accumulated at The Loop as a result of this service. If monitoring indicates that trails are approaching triggers or thresholds in this location, changes to the permit system on the Highline Trail may need to be made or shuttle schedules may need to be adjusted to reduce or distribute delivery rates to this location via this service to maintain trail conditions and manage within the capacity for this site.

## **Big Bend**

**Review of Existing Direction and Knowledge.** This road pullout is a popular stopping point for views of Mount Oberlin, Cannon Mountain, Clements Mountain, and Heavens Peak. This parking area and pullout also provides access to the popular High Line Trail. There are currently 30 parking spaces in this area.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural resource considerations. Primarily, the parking lot in this location is considered a contributing feature of the landscape and cannot be modified to increase vehicle capacity without impacts to the cultural landscape.

Other related indicators:

- average number of hikers per day (HPD) during the peak season (July 1 to August 15)
- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destinations

*Visitor Capacity*— Considering all of these limiting attributes and studies along with the operational conditions of the environment, the visitor capacity for this area is identified at 145 PAOT. Beyond this point, conditions would begin to degrade and conditions on the Highline Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally utilized (this assumes that the lot is 90% full, which is the functional vehicle capacity for this lot under the managed access scenario described in chapter 2), it is expected that 80 PAOT of these visitors arrive via private vehicles or tours parked in the lot at Big Bend. The rest of these visitors would arrive via the Highline Trail connector or transit services to this area.

## **Logan Pass**

**Review of Existing Direction and Knowledge.** Logan Pass is 32 miles from the West Glacier Entrance and 18 miles from the St. Mary Entrance and is a major stopping point for most visitors. The parking area and visitor center sit at the Continental Divide with sweeping views into the interior of

the park. The location also provides immediate access to several trailheads, including the extremely popular Highline and Hidden Lake Trails, which serve approximately 830 and 1,600 people per day, respectively, during the peak season (Freimund et al. 2014). Logan Pass is a transfer point for shuttle passengers between the east and west shuttle routes and receives an average of 650 shuttle passengers per day (Freimund et al. 2013). There are 234 visitor parking spaces, 9 accessible spaces, and 20 park administration parking spaces in the Logan Pass parking lot. There is also space designated for up to five shuttle vehicles and six historic Red Buses at one time. This analysis area includes the Hidden Lake Trail area.

Based on 2012 vehicle counter data, Logan Pass is busiest from 10:00 a.m. to 5:00 p.m. Entrance activity at Logan Pass peaks between 11:00 a.m. and noon, with about 200 vehicles arriving at the lot. Exit activity peaks around noon and remains high until 2:00 p.m. Based on UMT observations from 2012, on a typical day during the peak season visitors can wait an average of 13 minutes for a parking space between the hours of 10:00 a.m. and 2:00 p.m. In 2013, an average of 37% of vehicles (57% of vehicles during the peak hour) departed the Logan Pass parking lot without parking (Freimund et al. 2014).

The average length of stay for parking vehicles was observed to be 136 minutes in 2012. This is up significantly from 62 minutes in 2006. Anecdotally, park staff cited a number of possibilities for the increase in length of stay, including more one-way hikes using the shuttle, more hiking to Hidden Lake, increased interest in off-trail hiking and climbing routes, improvements to the visitor center and interpretive displays, and more picnicking activity, even though there is no designated picnic location. Survey data from the University of Montana collected in 2007 and 2012 confirms that nearly one-third of shuttle riders are using the service to facilitate one-way hikes, very often along the Highline Trail between Logan Pass and The Loop (Baker and Freimund 2007; Bedoya and Freimund 2012b). In 2012, a maximum of 2,340 people/day visited Logan Pass with an average of 1,760 people/day. During average busy times of day in 2012, an estimated 280 vehicles at one time are accumulated in the Logan Pass parking lot (exceeding available parking capacity by ~20%).

The Logan Pass parking area is staffed by NPS visitor service assistants (VSAs) who monitor parking availability, manage traffic flows, and assist visitors as needed. According to the VSAs, the Logan Pass parking area reaches capacity and is closed for a short period of time almost daily in the peak season. The closures usually occur in the late morning and early afternoon, and are reported to the entrance gate employees by radio, who inform incoming visitors. Park staff have observed that the shuttle service has ameliorated some parking congestion at Logan Pass but has added to pedestrian and hiker traffic congestion. Logan Pass operates as one of the premiere attractions on the GTSR and has significant congestion issues that have resulted in conditions that are not meeting desired condition attributes for this area. Within the day use zone, this is a place where visitors and park managers are willing to tolerate higher levels of use so that many visitors do not need to be turned away from this resource and experience, provided that the natural resources in this location remain protected (GMP 1999).

**Limiting Attributes.** The limiting attributes related to visitor capacity of this area relate to a variety of natural resources and some cultural resources. Parking is limited in the lots that provide direct access to Logan Pass making competition for parking high during most of the day during the peak summer season. While the park did consider expanding parking in this area to accommodate additional vehicles (and therefore additional visitor use), it was determined that such an action would result in significant adverse impacts to the park's natural and cultural resources including grizzly bear habitat (a federally listed species) and the historic character of the GTSR. Additionally, the trails around Logan Pass are home to alpine plan communities that are sensitive to visitor use. From 2012 to 2017, trail use on the Hidden Lake Trail exceeded the threshold established in 2012 and increased from <1145 to 1,604 average hikers per day. While some previously implemented infrastructure

solutions (trail paving, fencing, signage), and additional actions proposed in this plan to make trail resources more resilient to visitor use, continued over use of this area would result in impacts to the fragile alpine plant communities along the trails in this area. Therefore, managing to the “average number of hikers per day (HPD) during the peak season (July 1 to August 15)” indicator, is key for maintaining desired conditions in this area.

Other related indicators:

- VAOT at key destinations
- number of linear feet of informal trails leaving a formal trail

*Visitor Capacity*— Considering all of these limiting attributes and studies along with the operational conditions of the environment, the visitor capacity for this area is identified at 1,390 PAOT. Beyond this point, conditions would begin to degrade and conditions on the Hidden Lake Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally utilized (this assumes that the lot is 90% full, which is the functional vehicle capacity for this lot under the managed access scenario described in chapter 2), it is expected that 680 PAOT of these visitors arrive via private vehicles or tours parked in the lot at Logan Pass. Most of the rest of these visitors would arrive via transit services to this area (and some visitors may hike to this area from another parking lot). Shuttle service to this area could be expanded, if no more than 707 visitors at one time are delivered to Logan Pass and its associated trailheads as a result of this service.

## Lunch Creek

**Review of Existing Direction and Knowledge.** Less than a mile from Logan Pass, Lunch Creek and its associated parking area make it an attractive stopping point. Surrounded by wildflowers in the summer, Lunch Creek flows down a natural rock staircase from the backdrop of Pollack Mountain. It attracts visitors looking for a quick snack or lunch, or just a rest while driving the GTSR. It has also become a climbers route to peaks directly above the GTSR. Due to its popularity, informal trails are increasingly prevalent, although no formal trails exist, leading to resource damage.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural and experiential resource considerations. Primarily, the parking lot in this location is considered a contributing feature of the landscape and cannot be modified to increase vehicle capacity without impacts to the cultural landscape. Secondly, increasing parking in this location would result in increased use levels along the trails and viewing platforms in this location, leading to undesirable visitor experience conditions and forcing visitors off the hardened sections of trail, thereby increasing the extent and frequency of unofficial trails created by visitor use.

*Visitor Capacity*— The visitor capacity for this area is identified at 85 PAOT delivered to this area. Beyond this point, conditions would begin to degrade and conditions in the lot and surrounding areas would exceed the established trigger for monitoring on this lot, leading to a compromised desired condition of this cultural resource and associated experiences.

## Siyeh Bend

**Review of Existing Direction and Knowledge.** Siyeh Bend is designated as a poor hot spot due to high parking demand. Siyeh Bend is at a hairpin turn in the road and has a shuttle stop and five parking pullouts in proximity to the Siyeh Bend Trailhead. There are a total of 33 parking spaces in the five pullouts. Siyeh Bend contains the first trailhead and shuttle stop east of Logan Pass. Hikers can

use the Siyeh Bend Trailhead to connect to multiple destinations, with popular routes including Siyeh Pass or Piegan Pass, connecting to the Baring Creek Trail and Sunrift Gorge. They can also use Siyeh Bend to start point-to-point hikes facilitated by the shuttle. A 2012 survey of hikers at Sunrift Gorge reports that 47% of hikers interviewed left their vehicles at Siyeh Bend and hiked to Sunrift Gorge.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to experiential resource considerations. One of the fundamental resources and values of the park is to have a “variety of recreational opportunities” that includes opportunities to experience solitude (or low density experiences) in their recreation. To maintain this diversity of experience and the opportunity for lower density experiences, consistent with the philosophy of the backcountry zone that this parking lot provides access to.

Current use of the Siyeh Pass Trail is slightly in excess of the trail-specific trigger for average number of hikers per day (127 people per day), but still below the threshold (142 people per day). As this trail is designated as a “lower use trail” it’s important to ensure visitor delivery to this area maintains the “lower use” characteristics. This would be monitored with the “average number of hikers per day during the peak season (July 1 to August 15)” as described above.

Other related indicators:

- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destination

*Visitor Capacity*— The visitor capacity for this area is identified at 190 PAOT delivered to this area to access the multiple opportunities. Beyond this point, conditions would begin to degrade and conditions on the Siyeh Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally used, it is expected that 90 PAOT of these visitors arrive via private vehicles or tours parked in the lot at Siyeh Bend. Most of the rest of these visitors would arrive via transit services to this area (and approximately 15 PAOT have hiked to this area from other parking lots). Shuttle service to this area could be expanded, if no more than 85 PAOT are accumulated at Siyeh Bend and its associated trails as a result of this service.

## **Gunsight Pass Trailhead and Jackson Glacier Overlook**

**Review of Existing Direction and Knowledge.** Jackson Glacier Overlook was reconfigured between 2013 and 2014 to include the shuttle stops that were previously at Gunsight Pass. Approximately one-third of the parking spaces at Jackson Glacier Overlook were removed to make room for the stops. The eastbound and westbound shuttle stops are on opposite sides of the road and each can accommodate a single shuttle vehicle. Gunsight Pass is the overflow parking area for Jackson Glacier Overlook, which somewhat redistributes activity between the two locations. The reorganization places 15 informal spaces at the overlook and maintains 30 formal spaces at Gunsight Pass. The changes to Jackson Glacier Overlook formalize pedestrian, shuttle, and parking areas to facilitate circulation. Based on parking lot observations, it is estimated that between 7%–15% of visitors are using these parking areas to access hiking opportunities, with the remainder of visitors using this area for short scenic viewing stops.

The hotspot designation ranked Jackson Glacier Overlook as “poor” and park employees commented during the 2013 existing conditions workshop that there are significant vehicle and pedestrian conflicts here as well as congestion. Observations were conducted by the University of Montana in 2005, prior to the introduction of the shuttle service. At that time, the average length of stay for

vehicles was about five minutes with a median of four minutes. Unlike Siyeh Bend, only 7% of the observed vehicles were present longer than the six-hour observation period, indicating that the average is not understated, although this data is from before the shuttle service facilitated one-way hikes. The location is clearly a quick stop for the majority of visitors to take a picture and enjoy the view. In the visitor service zone, visitors and park managers are willing to tolerate higher levels of use so that many visitors do not need to be turned away from this resource and experience, provided that the cultural and experiential resources in this location remain protected (GMP 1999). However, this area also provides access to trails in the backcountry zone that are areas for lower density experiences.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural and experiential resource considerations. Primarily, the parking lot in this location is considered a contributing feature of the landscape and cannot be modified to increase vehicle capacity without impacts to the cultural landscape.

One of the fundamental resources and values of the park is to have a “variety of recreational opportunities” that includes opportunities to experience solitude (or low density experiences) in their recreation. Gunsight Pass Trail current use is in exceedance of its trail-specific threshold and is therefore not consistent with the desire to manage these trails for lower density experiences. In 2017, the average number of hikers per day during peak season was 90 and the threshold is 34 visitors per day during peak season. This increased use, or continued current use, of these trails could also lead to degraded trail conditions as visitors widen trails to increase the ability to pass other groups. Additionally, it could lead to increased frequency of informal trails as visitors create their own travel paths to avoid crowded conditions on the designated trail (though both trails are within their thresholds for these indicators at current use levels).

Other related indicators:

- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destination

*Visitor Capacity*— The visitor capacity for this area is identified at 140 PAOT delivered to this area to access the multiple opportunities including the overlook and parking in visitor services zone and hiking trails in the backcountry zone. Beyond this point, conditions would begin to degrade and conditions on the Gunsight Pass Trail would exceed the established threshold, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally used, it is expected that 125 PAOT of these visitors arrive via private vehicles parked in these lots. Additional visitors would arrive via transit services to this area, approximately 15 PAOT.

## **St. Mary Falls**

**Review of Existing Direction and Knowledge.** Park staff identified St. Mary Falls as the most congested location east of Logan Pass. The peak period of activity starts around 10:00 a.m. and continues until 4:00 p.m. Parked vehicles often block portions of travel lanes and through traffic cannot pass. Vehicles also often park in the shuttle stops, which causes congestion and delays since the shuttle vehicles are forced to load and unload from the travel lane. Rehabilitation of the parking and shuttle areas in 2014 resulted in the reorganization of circulation for the location. There are now 19 designated parking spaces at the trailhead to St. Mary Falls. The shuttle stops have been consolidated to one area on the eastbound side of the road, just west of the St. Mary Falls parking lot and trailhead. There is a designated footpath between the two areas to facilitate pedestrian circulation.



An improved overflow parking lot with eight spaces is also located just east of the larger formalized parking area.

Observations at St. Mary Falls were conducted by the University of Montana in 2005, prior to the introduction of the shuttle service. The average length of stay observed was 43 minutes while the median length of stay was about 22 minutes. More than half of the vehicles observed were parked longer than the six hour observation period. For the cars that were parked for less than six hours, the average length of stay was about 45 minutes (as observed in 2005).

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural and experiential resource considerations. Primarily, the parking lot is as large as it could be without making changes to the road itself; therefore, the lot cannot be further modified to increase vehicle capacity without impacts to the cultural landscape. Secondly, increasing parking in this location, or allowing for increased visitor delivery via shuttle system to this area would result in increased use levels along the St. Mary Falls Trail. This would create conditions that continue to be above the identified use level thresholds identified for this trail (see sections on “Indicators and Thresholds” for more information about this condition). In 2017, the average number of hikers per day during peak season was 782 and the threshold is 752 hikers per day during peak season. Increased use, or continued current use, in this area would also continue to deteriorate trail conditions as visitors widen trails to increase the ability to pass other groups and increase frequency of informal trails as visitors create their own travel paths to avoid crowded conditions on the designated trail.

Other related indicators:

- average number of hikers per day during the peak season (July 1 to August 15)
- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destinations

*Visitor Capacity*— Considering the above attributes and studies along with the operational conditions of the environment, the visitor capacity for this area is identified at 160 PAOT. Beyond this point, conditions would begin to degrade and conditions on the St. Mary Falls Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally used (this assumes that the lots are 90% full, which is the functional vehicle capacity), it is expected that 60 PAOT of these visitors arrive via private vehicles or tours parked in the lot at St. Mary Falls. Most of the rest of these visitors would arrive via transit services to this area (and some visitors may hike to this area from another parking lot). Shuttle service to this area could be expanded, if no more than 100 PAOT are accumulated at St. Mary Falls as a result of this service.

## **Sunrift Gorge**

**Review of Existing Direction and Knowledge.** Sunrift Gorge provides convenient access to trails for Baring Falls and Piegan Pass. There is a main parking lot as well as parking near the shuttle stop. The parking areas have a combined total of 33 regular spaces. The lots are busy from 10:00 a.m. to 4:00 p.m. daily. Park staff noted that vehicles often park in the shuttle stop, which requires the shuttle to stop in the traveling lane for boarding and unloading. They also noted that the area has pedestrian and vehicle conflicts, safety and parking issues, which was confirmed by observations done in 2008 (Volpe 2014).

UMT researchers observed parking activities at Sunrift Gorge in 2005, 2008, and 2011. Over that time period, the average length of stay increased from 13 minutes to 26 minutes, while the median remained relatively consistent between 13 and 14 minutes (Freimund et al. 2006; Volpe 2014; Bedoya and Freimund 2012a). The increase appears to be due to a rise in hiking activity. The 2005 observations noted that 55% of visitors stopped to take a picture and 13% went hiking. In 2011, these activities were 55% and 32%, respectively. It is unclear the degree to which the shuttle service has contributed to the increase in hiking. However, Sunrift Gorge is often an end point for hikers on the Siyeh Pass Trail. Nearly 50% of hikers surveyed at Sunrift Gorge in 2012 commented that they left their car at Siyeh Bend and hiked to Sunrift Gorge, while only 18% left their vehicle at Sunrift Gorge (Bedoya and Freimund 2012b). These results are consistent with the parking observations. The location was designated a worse condition hot spot, which is in agreement with feedback from the staff and the UMT data showing increasing use of this area for hiking, which reduces vehicle turnover in parking areas.

**Limiting Attribute(s).** The limiting attributes related to visitor capacity of this area relate to cultural and experiential resource considerations. Primarily, the parking lot in this location is considered a contributing feature of the landscape and cannot be modified to increase vehicle capacity without impacts to the cultural landscape. Secondly, increasing parking in this location, or allowing for increased visitor delivery via shuttle system to this area would result in increased use levels along the Siyeh Pass Trail. Current use of the Siyeh Pass Trail is slightly in exceedance of the trail specific trigger for average number of hikers per day (127 people per day), but still below the threshold (142 people per day). As this trail is designated as a “lower use trail” it’s important to ensure visitor delivery to this area maintains the “lower use” characteristics. This would be monitored with the “Average number of hikers per day during the peak season (July 1 to August 15)” as described above.

Increased use or continued current use in this area would also continue to deteriorate trail conditions as visitors widen trails to increase the ability to pass other groups and increase frequency of informal trails as visitors create their own travel paths to avoid crowded conditions on the designated trail.

Other related indicators:

- average trail width over the entire length of trail
- total number of human waste sites near the trail over the entire length of the trail
- VAOT at key destinations

*Visitor Capacity*— The visitor capacity for this area is identified at 190 PAOT delivered to this area to access the multiple opportunities. Beyond this point, conditions would begin to degrade and conditions on the Siyeh Trail would exceed the established trigger for monitoring on this trail, leading to a compromised desired condition of this resource and experience.

If parking in this area is fully and functionally utilized, it is expected that 90 PAOT of these visitors arrive via private vehicles or tours parked in the lot at Sunrift Gorge. Most of the rest of these visitors would arrive via transit services to this area (and approximately five PAOT have hiked to this location from other parking lots). Shuttle service to this area could be expanded, if no more than 95 PAOT are accumulated at Siyeh Bend and its associated trails as a result of this service.

*This page intentionally left blank.*

## **APPENDIX E: MITIGATION MEASURES**

Mitigation includes those measures and actions taken to reduce the anticipated environmental effects of the proposed action. These measures may include actions to minimize or mitigate potential impacts. Mitigation measures are an integral component of the proposed action and would be implemented as part of the project. A number of mitigation measures related to protecting natural and cultural resources and visitor experience are common to all alternatives and are included in cost estimates for each alternative. Some of the mitigation measures below are common to all alternatives, or common to all construction activities. Others are specific to only one or two alternatives.

### **GENERAL CONSTRUCTION MEASURES**

A number of mitigation measures for construction-related activities would be incorporated into the project design to reduce natural and cultural resource impacts. An overview of construction-related mitigation measures is provided below. These measures would be applied to actions like redesign of the Avalanche developed area, additional new parking areas, and trail construction.

Construction zones would be identified and fenced with appropriate materials to confine activity to the minimum area required for construction. All protection measures would be clearly stated in construction specifications, and workers would be instructed to avoid conducting activities beyond the construction zones.

- A safety plan would be developed prior to initiation of construction work to ensure the safety of park visitors, workers, and park personnel.
- Construction staging areas would be identified and limited to existing areas of disturbance or within the specific work zone for each project.
- No material borrow sources (other than native rock collection) or asphalt batch plants would be located in the park.
- Equipment servicing or refueling within 100 feet of streams or water bodies would be prohibited. Contract specifications would include restrictions on the location of fueling sites, requirements for spill containment, and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants.
- All chemicals and petroleum products would be stored and contained away from water sources.
- All hazardous material use would require contractor compliance with applicable federal and state laws.
- No chemicals would be used for dust abatement.
- Vehicle traffic would be managed in the construction zone, and contractor hauling of materials, supplies, and equipment would be controlled to minimize disruptions in visitor traffic.
- Traffic delays and other limitations in visitor access would be disclosed in advance of construction.

Resource specialists, including landscape architects, biologists, botanists, historians, environmental specialists, and archeologists, would be involved in inspections and monitoring and would provide recommendations prior to specific project implementation and as needed throughout the project area.

### **SUSTAINABLE DEVELOPMENT**

New construction projects (buildings, facilities, utilities, roads, bridges, trails, etc.) or reconstruction projects (e.g., road reconstruction, building rehabilitation, utility upgrade, etc.) would be designed to

blend with the surroundings, including in areas prone to erosion. Projects would reduce, minimize, or eliminate air and water point and nonpoint source pollution. Projects would be sustainable whenever practicable by recycling and reusing materials, minimizing materials, minimizing energy consumption during the project, and minimizing energy consumption throughout the life span of the project.

## **NATURAL RESOURCE MITIGATION**

Mitigation and conservation measures would be incorporated into the selected alternative to minimize potential impacts on wildlife, aquatic life, and other sensitive plant and wildlife species. Measures applicable to protecting resources and minimizing impacts are described below.

## **WILDLIFE, AQUATIC, AND SENSITIVE RESOURCES**

- Design projects to avoid prime nesting time and times when the area would be used for prime foraging or other habitat use.
- Avoid removing snags, cavity nest trees, and other high-value natural features to the extent possible. If clearing is necessary, remove cavity trees during the nonbreeding season.
- Surveys for sensitive and listed bird species nests would be conducted prior to design activities, as necessary.
- Where existing informal trails are formalized, actions would be taken to prevent creation of new informal trails.
- Locate construction activities to minimize interference with wildlife foraging and movement patterns by time of day and season.
- Evaluate habitat prior to construction activities and take steps to minimize impacts on species likely to occur and those species determined to be especially vulnerable.
- Install and maintain temporary fences or other barriers to protect sensitive resources adjacent to construction sites (as defined by wildlife-friendly fence specifications).
- Alert construction crews to follow contract stipulations related to food storage and bear-aware policies.
- Maintain routes of escape for animals that might fall into excavated pits and trenches and cover post holes and other narrow cavities or crevices.
- Take appropriate measures to reduce the potential for human-bear conflicts. All contractors and employees would be trained and required to comply with the park's bear management plan and food storage regulations during construction and rehabilitation activities. All project staff, trainees, and other personnel would be briefed about food storage needs and bear safety protocols.
- Bear-resistant garbage containers would be required. Food, fuel, and other attractants would be stored and handled to minimize potential conflicts (i.e., no food, garbage, drink, trash, or food and drink containers would be placed outside vehicles, trailers, or bear-resistant containers except during times when they are being attended). Equipment, materials, and supplies in the staging area(s) would be secured by hard-sided storage containers. Work would be temporarily halted if bears approach within 100 yards of an unfenced work area. Workers would allow the bear(s) to pass through the work area before starting or resuming mobilization, construction, or demobilization activities. All bear sightings would be reported to resource management staff. Any human-bear conflict would be reported to Glacier Dispatch immediately. The handbook *Bear Safety, Site Sanitation and Other Requirements While Working in Glacier National Park: a Handbook for Construction Contractors* would be provided to all contractors and work crews.
- Use wildlife volunteers to inform visitors about the possible presence of wildlife before, during, and after construction projects are completed to minimize immediate and long-term impacts on wildlife and wildlife habitat.

- Define boundaries of developed areas to confine human use and limit radiating impacts. Avoid use of roadway development and maintenance features that would present a barrier or hindrance to wildlife movement and migration.
- Limit the effects of light and noise on adjacent habitat through control of sources during construction activities.

## **GEOLOGY, SOILS, AND WATER RESOURCES**

Geologic features would be protected to the extent possible. Excavation for trails and parking areas would be selectively used to complete the project or necessary rehabilitation around construction sites. Care would be taken to avoid damaging geologic features and remaining rock.

Erosion and sediment control measures from the “Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects” (FHWA 1996 and updates) would be used for rehabilitation work along with other best management practices that include those generally accepted technical measures that are considered most effective and practicable for controlling pollutants and minimizing impacts to the environment. In addition, a stormwater and sediment control plan would be prepared prior to construction to protect soil resources, minimize erosion, and prevent sediment-laden water from reaching nearby streams. Components of this plan include implementation of measures to minimize the loss of soil material before, during, and after construction. General erosion control best management practices typically would include the following:

- Minimize the area of disturbance to defined construction zones and limit the time of soil exposure.
- Conduct site-specific geotechnical and drainage monitoring.
- Install filter barriers as necessary (silt fences, certified weed seed-free straw bales, coir logs).
- Construct sediment retention structures on a site-by-site basis (temporary and permanent sediment traps, sediment basins).
- Provide culvert outlet protection on a site-by-site basis (riprap aprons or basins to reduce water velocity and prevent scour) and provisions for fish passage.
- Revegetate disturbed areas.
- Conduct periodic water quality monitoring in nearby streams.

Topsoil would be removed prior to road and parking lot construction and stored for use in revegetation rather than importing topsoil from outside the park. Selective topsoil redistribution to soil-deficient areas would be used as needed, but topsoil would not be stockpiled over the winter. Long-term soil protection would come from prompt revegetation of disturbed areas following construction as described below.

## **FEDERALLY LISTED CANDIDATE SPECIES AND OTHER WILDLIFE SPECIES OF MANAGEMENT CONCERN**

The US Fish and Wildlife Service would be consulted on the frequency required for surveys prior to commencement of construction activities. Site and design facilities/actions would be applied to avoid adverse effects on rare, threatened, and endangered species.

- Develop and implement restoration and/or monitoring plans, as warranted. Plans should include methods for implementation, performance standards, monitoring criteria, and adaptive management techniques.
- Inform construction workers and supervisors of the potential for special status species in the work vicinity. Contract provisions would require the cessation of construction activities if a special status species was discovered in the project area until park staff reevaluates the project.

This would allow modifications of the contract for any measures determined necessary to protect the discovery.

### **Grizzly Bear (in addition to those measures described above for bears in the “Wildlife, Aquatic and Sensitive Resources” section)**

- Enforce speed limits on the road to reduce vehicle-related injuries of bears and other wildlife whose carcasses could attract bears to the road, further increasing risk of injury.
- Implement measures to reduce the potential for human-bear conflicts. Specifications for storage and disposal of food, refuse, construction materials, petroleum products, human waste, and other attractants would be incorporated into the construction contract to minimize the potential for impacts.
- Construction personnel would be trained in how to behave in the presence of bears. Should a habituated bear frequent the area, construction activities may be temporarily suspended while management actions are implemented.
- Timing and location of construction activities would be considered when planning specific projects to minimize disruption of wildlife foraging and movement patterns.
- The park’s resource management staff would monitor the activity of grizzly bears and other wildlife. Law enforcement rangers would enforce requirements for storage of food, garbage, petroleum products, and other attractants, and enforce regulations that prohibit feeding wildlife during construction activities.

### **Bald Eagle**

- Timing and location of construction activities would be used to minimize disruption of bald eagle foraging and movement patterns in consultation with resource management staff.
- Establish buffer zones of at least 328 feet surrounding bald eagle forage sites to reduce human disturbance to foraging eagles (NPS 1999).
- Most construction activities would not occur in the winter, reducing impacts on bald eagle winter locations at St. Mary Lake.
- If a nest is found to be active within 328 feet of a project site, the contractor may be required to implement noise reduction mitigation depending on the date, time, type, and duration of work to ensure bald eagle nesting success.

### **Canada Lynx**

- Plan the timing and location of construction activities to minimize disruption of wildlife foraging and movement patterns.
- Any observation of Canada lynx in a project area would be reported to resource management staff and appropriate action would be taken to reduce potential impacts.

### **Bull Trout**

- Involve resource specialists in inspections and monitoring, and provide recommendations during relevant project work.
- Locate any proposed facilities (shuttle stops or vault/backcountry toilets) at least 100 feet from the stream channel outside the riparian area to avoid adversely modifying bull trout critical habitat.
- All hazardous material use would require contractor compliance with applicable federal and state laws.
- Store chemical and petroleum products away from water sources. Avoid servicing and refueling equipment within 100 feet of streams or water bodies. Contract specifications would

include restrictions on the location of fueling sites, requirements for spill containment and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants. Draining oil, hydraulic fluids, anti-freeze, or other chemicals in the park would be prohibited.

- Minimize the areas of disturbance to defined construction limits.
- Conduct site-specific geotechnical and drainage monitoring.
- Install filter barriers as needed.
- Construct sediment retention structures (temporary and permanent sediment traps, sediment basins) as needed.
- Provide culvert outlet protection. If culverts are added or replacements are needed, oversized culverts would be considered in order to address fish passage concerns where appropriate. Park culverts have a minimum diameter of 19 inches for permanent stream crossings and cross drains to enable fish passage.
- Implement best management erosion and sediment control measures to prevent sediment introduction into wetlands and waterways. The National Park Service would provide contractors with acceptable locations, amounts, and timing of water withdrawals from streams and lakes to minimize impacts to aquatic life and spawning habitat. Pumps for water withdrawals would be required to have screens to prevent fish entrainment.
- Construction activities such as culvert or trail work in perennial streams would be conducted outside spawning season to avoid impacts to native fish.

## **VEGETATION AND PLANT SPECIES OF CONCERN**

Impacts to native vegetation in and adjacent to proposed work sites would be minimized by limiting the area of disturbance and using temporary barriers to define the work zone. NPS staff restoration biologists and landscape architects would work closely with construction contractors to minimize impacts to vegetation and ensure acceptable reclamation and revegetation of disturbed areas.

Mitigation to reduce impacts on vegetation resources and ensure revegetation areas would include the following:

- Implement best management practices to prevent wind and water erosion (FHWA 1996 and updates).
- Salvage topsoil with existing seed sources along with suitable plant material for transplanting.
- Implement landscaping design features, such as slope rounding, to minimize visual impacts and to aid in creating suitable site conditions for revegetation.
- Apply topsoil and native seed according to site-specific conditions and vegetation communities.
- Apply soil amendments, mulches, organic matter, and other measures, as appropriate, to facilitate revegetation.
- Revegetate to restore native vegetation to areas disturbed during construction.
- Reseed and replant using native species from genetic stocks originating in the park. Plant species density, abundance, and diversity would be restored as nearly as possible to pre-construction conditions for nonwoody species.
- Monitor to evaluate vegetation cover and develop contingency and maintenance plans if vegetation cover is not similar to original ground cover.
- Plan projects for periods when vegetation is less susceptible to damage.
- Conduct rare plant surveys of site areas as appropriate.
- Prepare vegetation management plan for the entire GTSR corridor.



Additional measures to prevent the introduction and spread of noxious weeds during construction include the following:

- Continue current weed management practices in accordance with the park's Exotic Vegetation Management Plan (NPS 1991) and including preventive measures in all construction contracts.
- Conduct weed control measures prior to ground-disturbing activities.
- Minimize the area of disturbance and the length of time that soils are exposed.
- Avoid using topsoil currently supporting nonnative plants.
- Require that all construction vehicles be pressure washed to remove mud and weed seed prior to entering or reentering the park.
- Limit fertilizer use that may favor weeds over native species.
- Use periodic inspections and spot controls to prevent weed establishment. If weeds invade an area, an integrated weed management process to control particular weed species would be used.

## **Wetlands**

- Conduct a wetland survey by qualified NPS staff or certified wetland specialists to certify wetlands in or adjacent to project areas. Clearly mark delineated wetlands before construction work begins and apply protection measures before any ground disturbance.
- Through consultation with the NPS regional wetland ecologist, determine if a wetlands statement of findings is needed for any future project implementation that could affect wetlands and produce wetlands statement of findings documents where necessary.
- Perform construction activities in a careful manner to prevent damage caused by equipment, erosion, siltation, etc.
- As appropriate, protect wetland resources by avoiding wetlands during construction. Use bridge crossings or retaining walls wherever possible, exercising increased caution to protect wetland resources from damage caused by construction equipment, erosion, siltation, and other activities with the potential to affect wetlands. Take measures to keep construction materials from escaping work areas, especially near streams or natural drainages. Use elevated pathways over wetland sections where it is not feasible to avoid the wetland.

## **Wilderness**

- If helicopter flights are necessary for projects in recommended wilderness, they would be combined with other administrative helicopter flights whenever possible. They would be part of the 50-flight annual quota.
- Flights would only occur May 1 to October 1 in accordance with the conservation measures in the park's programmatic biological assessment for administrative flights.
- Guided day hike group sizes would be limited on some trails.
- A permit system for day hikers could be implemented on some trails if wilderness character deteriorates.

## **Air Quality**

- Implement a dust abatement program. Standard dust abatement measures may include the following elements: water spraying or otherwise stabilizing soils, covering haul trucks, employing speed limits on unpaved roads, minimize vegetation clearing, and revegetate after construction.
- Reduce or eliminate idling of construction and public vehicles.
- Assure all construction equipment complies with EPA emission standards in effect at the time of manufacture.

- If needed, locate asphalt batch plants outside the park and sited in compliance with Montana Department of Environmental Quality requirements.

## **Night Skies**

- Use artificial light only where needed and only at times when needed. Controls that automatically dim or switch outdoor lights may be used to mitigate environmental impacts and conserve energy.
- Select the most efficient lamps and fixtures that minimize negative impacts and use the minimum amount of light necessary.
- Shield and direct downward all artificial light to prevent any up-light and minimize glare.

## **Visual Resources**

- Site and design trails to route people away from sensitive natural and cultural resources while still allowing access to important viewpoints.
- New construction would be designed to blend with existing structures to the extent practicable through similar architectural features, materials, and color.
- Use existing vegetation and additional landscaping to screen new infrastructure to the extent possible.

## **Natural Sounds**

- Select quiet technology options for park equipment and installations, including but not limited to pavement, engines, and machinery.
- Schedule projects to avoid creating noise intrusions during important wildlife activity times or key visitation times.
- Conduct periodic noise monitoring at key locations.

## **Cultural Resource Mitigation**

Construction would be conducted in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (USDI 1997) and recommendations from the cultural landscape inventory (RTI 2001) and cultural landscape report (RTI 2002, 2003). The National Park Service would consult with the SHPO and Advisory Council on Historic Preservation on a project by project basis. If during the course of final design, circumstances occur that result in an unavoidable adverse effect, the National Park Service would work with the SHPO and Advisory Council on Historic Preservation according to section 106 procedures to determine mitigation requirements. The type and level of mitigation required would vary depending on the resource involved and the level of damage. Historic documentation, public interpretation, and restoration of related historic resources are among potential mitigation steps.

General measures applicable to protecting cultural resources and minimizing impacts are described below.

## **Historic Structures, Sites, Cultural Landscapes, and Visual Resources**

- Design all new construction within or adjacent to historic sites, districts, and cultural landscapes to be compatible in terms of architectural elements, scale, massing, materials, and other character-defining features.
- Landscaping and revegetation would be implemented to reduce the visual impacts of new construction on historic sites, districts, and cultural landscapes.

- Any proposed additional signage would be designed and placed in a way that does not detract from cultural resources, their historic character, or viewsheds.

### **Archeological and Ethnographic Resources**

- Tribes hold a body of knowledge that may result in the identification of ethnographic resources in the area in the future. If ethnographic resources are identified later, consultation would occur in accordance with federal law, regulation, and NPS policy.
- As appropriate, conduct archeological surveys or monitoring prior to any ground disturbance.
- Should construction unearth cultural resources, work would stop immediately in the area of discovery and the park would consult with the State Historic Preservation Office(r) and the Tribal Historic Preservation Officer. In the unlikely event that human remains are discovered during construction, provisions outlined in the Native American Graves Protection and Repatriation Act of 1990 would be followed.
- All contractors and subcontractors would be informed of the penalties for collecting artifacts or intentionally damaging paleontological materials, archeological sites, or historic properties.
- Follow site-specific planning and compliance procedures for all projects with the potential for ground disturbance. Adverse impacts to cultural resources would be avoided to the extent possible in accordance with the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation*.

### **Quality of the Visitor Experience**

- Implement measures to reduce adverse effects of construction on visitor experience. Measures may include, but are not limited to, noise abatement, visual screening, and directional signs so visitors are able to avoid construction activities.
- Conduct construction work to avoid peak visitor use times (i.e., weekends, holidays, and peak season/times of day) to minimize inconveniences to visitors to the extent practicable.
- Make information available to the public regarding implementation of projects in public areas.
- Continue to collect and use visitation data and other information to identify user conflicts.
- Implement an interpretation and education program to promote visitor understanding of the history and character of the corridor, changes being made to corridor management, appropriate uses of the corridor, and avoidance of potential resource impacts.
- Improve directional signs and interpretive media at waysides and other visitor service areas.

### **Access and Opportunities**

Make every reasonable effort to ensure that National Park Service and partner facilities, programs, and services are accessible to and usable by all people, including those who are disabled. This policy is based on the commitment to provide access to the widest cross-section of the public and to ensure compliance with the intent of the Architectural Barriers Act (42 USC 4151 et seq.) and the Rehabilitation Act (29 USC 701 et seq.).

## APPENDIX F: OTHER PAST, ONGOING, AND REASONABLY FORESEEABLE FUTURE ACTIONS

**Table F-1. Glacier National Park**

Action	Geographic Location	Activity	Schedule / Time Periods
Going-to-the-Sun Hgwy. Rehabilitation	50 miles of the GTSR	Rehabilitation of the historic GTSR	Through 2019
Apgar Transit Center Parking Lot Expansion	Apgar Transit Center Glacier National Park	Expand the parking lot to add 60-70 additional spaces	2013
Apgar Circulation Management Plan	Apgar Village Glacier National Park	Develop a plan manage visitor circulation through Apgar Village	Future
Shuttle System	GTSR Corridor	Two-way shuttle service operated along GTSR	July–September Annually
Vegetation Management	Glacier National Park Lands	Weed pulling, spraying and monitoring, wildfire suppression and management, and development of a nonnative vegetation management plan	Ongoing
Administrative Helicopter Flights	Glacier National Park Lands	Infrastructure maintenance and repair, and search and rescue flights	Periodic, ongoing
GTSR Hiker/Biker Activity	GTSR Corridor	Hiker and biker use of the GTSR corridor during the spring and fall	Spring and fall, ongoing
Radio System Improvement	Glacier National Park Lands	Continued improvement to the radio system including moving and/or placement of towers	Ongoing
Lake McDonald Properties Management Plan	Lake McDonald	Develop a plan to manage cabins/structures owned by NPS on Lake McDonald	Ongoing
West Glacier Entrance Station Improvements	West Glacier Entrance Station	Improvements to the entrance station to improve traffic flow, visitor experience, and work environment	2008
Water Improvements	Glacier National Park Lands	Improve water storage and capture capabilities at Logan Pass, and Granite Sperry Chalets	Ongoing
GTSR Snow Plowing	GTSR Corridor	Annual spring operation required to remove snow and debris from GTSR	April–July
Lake Trout Removal	Quartz and Logging Lake	Removal of nonnative lake trout to promote bull trout conservation	Ongoing
Aquatic Invasive Species Inspections	Glacier National Park Lands	Inspect watercraft for the presence of aquatic invasive species prior to their use on park waters	Ongoing
Inventory, Monitoring, and Research	Glacier National Park Lands	Inventory and monitoring of park's resources (wildlife, cultural, geographic, etc.)	Year-round
Increased Use in Other Areas in the Park	Glacier National Park Lands	Other areas within Glacier see use level increases similar to GTSR corridor	Ongoing and future
Bark Ranger Program	Glacier National Park Lands	Canine ranger used to educate and mitigate human-wildlife interactions within the GTSR corridor	Ongoing

**Table F-2. Private**

Action	Geographic Location	Activity	Schedule/Time Periods
Park Concessions	Glacier National Park Lands	Operation and maintenance of concession facilities and activities such as restaurants, lodging, horseback rides, guided hikes, and boat and bus tours	Ongoing April to November
Scenic Air Tours	Airspace above Glacier National Park	Helicopter and small aircraft tours of the park	Ongoing
CenturyLink Tower	St. Mary	Install a microwave radio antenna tower	2013
East Glacier Water Bottling Plant	East Glacier Park Village	Proposed construction of a commercial water bottling plant	Future
Expanding Apgar Business Community	Apgar Village	An increasing number of business ventures in Apgar Village	Ongoing April to November
Hotel Development	Surrounding communities	Development of additional overnight lodging	Ongoing

**Table F-3. US Forest Service, State, Tribal, and Canadian Lands**

Action	Geographic Location	Activity	Schedule/Time Periods
Bypass Construction	US Highway 93 adjacent to Kalispell	Bypass construction	Ongoing
Bridge Replacement	US Highway 2 South Fork of the Flathead River Crossing	Replace the existing bridge with new construction	2019
Gateway to Glacier Bicycle Trail Construction	Between Columbia Falls and West Glacier	Construct a bike path adjacent to Highway 2	Ongoing
Highway 89 Widening	Between Browning and the Hudson Bay Divide	Proposed widening of the existing highway	Underway
Highway 3 Wildlife Crossing	Highway 3 north of the Canada-United States Border	Considered installation of wildlife over and underpasses	Future
linnii Initiative	Blackfeet Reservation Badger Two Medicine, Glacier National Park, Water Lakes National Park and Surrounding Lands	Restore bison to Crown of the Continent Landscape	Ongoing
Blackfeet Nation Oil and Gas Development	Lands bordering east side of the park	Development of oil and gas resources on tribal lands	Ongoing

## APPENDIX G: STRATEGIES AND ALTERNATIVES CONSIDERED BUT DISMISSED

A variety of concepts and specific ideas for future management of visitors and transportation in the corridor were examined during the planning process, but eliminated from further analysis in this document. Ideas and concepts considered and the rationale for their dismissal are discussed below in table G-1.

In addition, the park considered a full range of potential alternatives through the planning process. Over time, it was determined that some alternatives should be dismissed based on analysis and feedback from the public and park staff. The preliminary alternatives newsletter released in spring 2015 described alternative 2, which focused on building additional parking and infrastructure along with maintaining the shuttle to accommodate increased visitation. During the completion of the environmental assessment, alternatives B and C were dismissed. Table G-2 describes the evolution of the alternatives as they were presented in the newsletter and throughout the planning process. According to the NPS *Director's Order 12 Handbook*, reasons to eliminate alternatives include, but are not limited to:

- technical or economic infeasibility
- inability to meet project objectives or resolve need
- duplication with other, less environmentally damaging or less expensive alternatives
- conflict with an up-to-date and valid park plan, statement of purpose and significance, or other policy, such that a major change in the plan or policy would need to be implemented
- too great an environmental impact

The three alternatives dismissed and the rationale for their dismissal are discussed below.

**Table G-1. Other Ideas Considered but Dismissed from Further Analysis**

Topics	Description of Ideas or Action	Rationale for Dismissal
Transportation	Shuttle lease option	The park considered a shuttle lease option. Analysis found that a conventional leasing arrangement for the bus fleet could offer a way to provide transit services without the initial capital cost of outright shuttle bus purchase, and could offer some short-term operational flexibility. However, these benefits would come at a very high, long-term cost. Viewed from a 20-year life-cycle perspective, an operating lease would cost more than double that of a direct purchase agreement. Therefore, the park dismissed leasing as an option to acquire and manage the shuttle bus fleet.
	Some commenters suggested a one-way traffic option to reduce traffic congestion on the GTSR and to provide for more bike and shuffle opportunities.	A one-way traffic option was analyzed in the park's 2003 GTSR Rehabilitation Plan / EIS. A one-way traffic option was dismissed from further analysis because it is duplicative of other traffic management strategies described in the action alternatives and would have greater negative effects on visitors, would result in slower emergency response time, and could have negative socioeconomic effects on gateway community businesses.

Topics	Description of Ideas or Action	Rationale for Dismissal
	<p>Some commenters suggested charging visitors for parking and/or to charge a higher vehicle entrance fee during periods of high demand.</p> <p>Some commenters suggested using only one mode of transportation along the GTSR. Suggestions were for shuttle only, or bike only.</p> <p>Some commenters suggested allowing reservations on the shuttle system to be assured a seat with other members of a group or on a shuttle at a specific time.</p> <p>Some commenters suggested lowering speed limits to reduce noise and improve road safety.</p> <p>Use Logan Pit as a shuttle transfer site.</p>	<p>Under current NPS policy, charging for parking is considered fee layering on top of an existing entrance fee. While an adjustable fee schedule is being considered at other parks where it might make some difference, charging a higher fee was not seen as a reasonable option for the GTSR corridor. This is because visitors typically plan vacations in advance, particularly families with children in school. A slight change in entrance fees would therefore be unlikely to cause changes in visitation and visitor use that would address roadway and parking lot congestion, diminishing visitor use quality along the corridor at key destinations; natural and cultural resource impacts; and heavy stress on park facilities, services, and operations. While the use of parking permits was carried forward, free parking options in the park would be maintained.</p> <p>Limiting the GTSR to shuttle only would be inconsistent with the park's GMP, which considered but rejected this option. The park remains committed to keeping the road open to a variety of uses, including access by cyclists and private vehicles, consistent with the desired conditions described in chapter 1, and Closing the road and allowing bikes only would serve a small portion of visitors who come to the park, which would not meet this desired condition.</p> <p>This was considered but dismissed due to the complexity and added cost of managing a reservation system for the shuttle. The shuttle systems designed in this plan take into account reasonable wait times, demand, and capacity issues.</p> <p>The park speed limits are based on FHWA recommendations, and are adjusted as needed. Speed limits would continue to be evaluated outside the scope of this plan and be modified if collision and other data suggest a change is needed to improve road safety.</p> <p>This location is the only reasonable location along the road to store and stockpile critical materials needed for annual road maintenance. Moving this staging area to a location outside the road corridor would create inefficiencies in routine maintenance.</p>
<b>Bicycles</b>	<p>Some commenters suggested bike lanes along the GTSR, along the shore of Lake McDonald, and to convert other trails to allow bicycles.</p> <p>Some commenters suggested bikes should be required to move off the road, be eliminated during the busy season, or only used during low visitation periods.</p>	<p>There are no reasonable locations within the proposed area for a bike path that would not be in recommended wilderness, or have an adverse effect on the historic character of the road. Opening additional trails to bicycles would have adverse effects on existing wildlife that frequent most areas of the park in great numbers.</p> <p>Current regulations require that bicyclists move to the side if four or more vehicles are backed up behind them. With regard to eliminating or limiting bicycle use, biking the GTSR is becoming increasingly popular and the NPS proposal seeks to find ways accommodate some level of bicycle use. In support of desired conditions to provide a variety of visitor experiences (see chapter 1).</p>

Topics	Description of Ideas or Action	Rationale for Dismissal
	Some commenters suggested bike only days or weeks.	The planning team considered a range of recreation opportunities for bicyclists along the GTSR. For the majority of the time, the park would retain access for a wide variety of transportation types. However, the team recognized that bicycling is a unique recreation opportunity that can be less enjoyable when faster moving vehicles are on the road. Therefore, the park would consider “bike and shuttle only” hours during low travel times during the shoulder seasons if administratively feasible.
<b>Visitor Experience</b>	Some commenters suggested changing the Logan Pass visitor experience to discourage visitors from lingering including removing exhibits and/or removing the Logan Pass retail outlet and focusing that space on additional NPS visitor education.	Logan Pass serves as a necessary point of information for visitors. Maps, hiking books, and consultation with visitor center staff are necessary to ensure a safe and enjoyable visitor experience in the park’s alpine section. Removing those services would inadequately prepare visitors for their park experience and would not meet desired conditions for opportunities for orientation, interpretation, and education (see chapter 1)
	Extend season and concession options, including overnight accommodations.	The 2004 Commercial Services Plan provides guidance on concession operations, season, and overnight options. Adjustments to this portion of the Commercial Services Plan would be looked at separately if visitation or climate patterns shift significantly.
	Remove interpretive guided hikes from trails.	This was considered but rejected because in many ways guided hikes provide better visitor education and management of visitors on trails. It also offers a unique and valuable visitor experience not found in many parks anymore and eliminating this experience would not meet desired conditions for a variety of visitor experiences (see chapter 1).
	Develop a picnic area at Moose Country Pond, north of Lake McDonald Lodge.	This site has very limited views, is unlikely to be well used by the public, and would require new disturbance that would have too great of an impact.
	Manage vista opportunities including limiting vista clearing. Develop a comprehensive sign plan that meets visitor education needs but does not impact cultural resources and historic character.	The park has a vista management plan for the GTSR and such actions are outside the scope of this plan. A comprehensive sign plan is beyond the scope of this plan. Any proposed additional signage under this plan would be designed and placed in a way that does not detract from cultural resources, their historic character, or viewsheds.
<b>Resource Protection</b>	Provide a masonry crew to work on the road, including historic features.	This is beyond the scope of this plan. The park continues to evaluate the work needed and its ability to complete that work on a case-by-case basis.

**Table G-2. Evolution of Alternatives Considered**

Preliminary Alternatives Newsletter, Spring 2015	Environmental Impact Statement and Technical Reports (2015–2017)	Environmental Assessment (2018)
Alternative 1 – No Action	Alternative A – No Action	No-Action Alternative
Alternative 2 – Build additional parking and infrastructure and maintain shuttle to accommodate increased visitation	Dismissed (located in appendix M)	Dismissed (located in appendix M)
Alternative 3 – Increase shuttles and manage the number of vehicles in the GTSR corridor	Alternative B – Increase shuttles and manage the number of vehicles in the GTSR corridor	Dismissed (located in the appendix M)



<b>Preliminary Alternatives Newsletter, Spring 2015</b>	<b>Environmental Impact Statement and Technical Reports (2015–2017)</b>	<b>Environmental Assessment (2018)</b>
Alternative 4 – Discontinue shuttles and manage the number of vehicles in the GTSR corridor	Alternative C – Discontinue shuttles and manage the number of vehicles in the GTSR corridor	Dismissed (located in appendix M)
Alternative 5 – Adaptive response to alternative futures	Alternative D – Adaptive response to alternative futures (NPS Preferred Alternative)	Preferred/Proposed Alternative C – Adaptive Management Approach to Address Visitation Levels

## **ALTERNATIVE 2: TO BUILD ADDITIONAL PARKING AND INFRASTRUCTURE AND MAINTAIN SHUTTLE TO ACCOMMODATE INCREASED VISITATION**

This alternative was “alternative 2” described in the spring 2015 GTSR newsletter. Under this alternative, the National Park Service would significantly expand infrastructure to accommodate increases in future visitation, and make other substantial changes including widening the Highline Trail. Based on the totality of the impacts listed below, this alternative has been dismissed because it would result in too great an environmental impact to the park’s natural and cultural resources including federally listed threatened and endangered species and a national historic landmark:

- Adding 150 parking spaces at Logan Pass and expanding trail widths would affect undisturbed alpine tundra.
- Expansion of most of the parking lots would extend into recommended wilderness.
- Impacts on wildlife, including threatened and endangered species due to habitat removal. As wildlife becomes more stressed from lack of water, habitat removal would add additional stress and likely displacement. This would be a permanent adverse impact.
- This alternative would violate the park’s commitment to the Grizzly Bear Conservation Strategy that stipulates that land management agencies in the northern Continental Divide ecosystem not build additional infrastructure that removes grizzly bear habitat.
- There would be considerable adverse impacts on a national historic landmark, the GTSR.
- The costs associated with constructing and then maintaining additional parking would be significant and likely unsustainable.
- Analysis shows that adding 150 parking spaces to Logan Pass would not have a substantial benefit. It would only delay when the parking lot fills by one hour. The analysis shows that it would fill at approximately 11:00 a.m. rather than 10:00 a.m. Data indicates that there is enough latent demand that providing additional parking would not substantively resolve the issue of crowding at places such as Logan Pass.
- Recent parking additions related to the GTSR rehabilitation confirm the above point—that additional parking does not meet the current demand for parking spaces, much less parking for future visitation levels.
- It should be noted that many of the actions from this preliminary alternative that would not have too great an environmental impact have been included in the other alternatives, including some additional parking development.

## **ALTERNATIVE B: TO INCREASE INFRASTRUCTURE AND SHUTTLE SYSTEM TO ADDRESS VISITATION LEVELS**

### **Concept**

Alternative B assumes that visitation would continue to increase with unmanaged access and identifies solutions to respond to increases in visitation. The main components involve substantially increasing the size of the shuttle system and building additional parking lots inside the park. Under alternative B, through partnerships, the size of the parkwide shuttle system would expand and would offer 32 shuttle stops (an increase of 16), including 10 stops outside the park boundary. The expanded shuttle system would encourage visitors to disperse throughout the corridor and to leave their vehicles in gateway communities or just inside the park boundary. All trails and locations would be managed for higher use levels. Additional parking would be provided at each end of the corridor.

The following adverse resource impacts were identified:

- Driving and parking would see an increase and additional growth further congesting roads and parking areas. Competition for parking would be high. There would be a parking shortfall of 890 private vehicle spaces requiring visitors to leave their vehicles outside the park or drive the corridor without stopping to park.
- The shuttle system would be increased in size to accommodate approximately 7,700 visitors. The fleet would be composed of 168 buses, which is more than seven times the park's current fleet requiring a capital investment of over \$20 million. With an operating cost of almost \$13 million annually, this shuttle system would accommodate approximately 18% of visitors. This is an increase of about 14% from current conditions. It was concluded that despite the high cost, the increase in shuttle operations may not make a measurable difference in roadway congestion.
- An increase in visitor numbers and associated congestion and additional vehicle traffic would contribute to increased traffic noise that would diminish the natural quiet and sounds of nature that are valued by park visitors; therefore, this would contribute to long-term adverse impacts on the natural soundscape in the GTSR corridor.
- The unmanaged access to the corridor could potentially impact the experiences, opportunities, and resources of the GTSR, which is inconsistent with the desired conditions for visitor experience in Glacier National Park.
- As a result of this analysis, it was determined that this alternative should be dismissed because it would be economically infeasible; it would not satisfactorily meet project objectives or resolve the project need; and it would have to great an environmental impact on natural quiet.

## **ALTERNATIVE C: TO DISCONTINUE SHUTTLES AND MANAGE THE NUMBER OF VEHICLES IN THE GTSR CORRIDOR**

The focus of this alternative was to remove the shuttle system and respond to increased visitation by directly managing the number of vehicles traveling on the GTSR at any given time. This alternative proposed the removal of supporting infrastructure such as shuttle stop signs, a fueling station in West Glacier, and a redesign of administrative space such as desks in existing facilities. This alternative would have also considered other strategies for managing vehicle demand, improving trails, increasing bicycling opportunities, and other partner opportunities. Some of the other strategies reflected in the action alternatives described above were not dismissed along with this alternative.

The National Park Service considered the potential effects of this alternative (see below) and it was determined that removal of the shuttle system would greatly restrict the number of visitors who could

potentially access the experiences, opportunities, and resources of the GTSR, which would be inconsistent with the purpose of the plan and desired conditions for visitor experience in Glacier National Park. Additionally, removing the shuttle would disproportionately incentivize private vehicle travel in this area, leading to impacts on soundscapes, creating higher competition for parking and potentially creating a transportation barrier for those visitors who cannot or prefer not to drive a private vehicle. Therefore, this alternative was dismissed because it would be inconsistent with the purpose of the plan and desired conditions for visitor experience in Glacier National Park; and would have too great an environmental impact.

## **Visitor Experience**

Under this alternative, driving and parking would see an immediate increase, with additional growth further congesting roads and parking areas. A timed reservation system would be needed to manage congestion in the corridor and would result in many visitors unable to access areas at their convenience and choosing. However, visitors who are able to access the corridor would see improved conditions. Competition for parking would be high. Trail use would increase in some locations, but would actually decrease in others. A diversity of experiences would be available for those hikers who were able to access the GTSR corridor. Visitors wanting to camp in the GTSR corridor would have a difficult time finding a camping site as some campsites would be converted to day use parking to compensate for the loss of the shuttle system. As visitors forego or are unable to access the corridor, other areas in the park would begin to see increased use levels.

## **Socioeconomics**

Under this alternative, employment supported by park visitation and management would increase by 25%. Businesses most affected would include accommodation and food services, retail and wholesale trade, business services, and recreation services. Stimulated by new jobs, the population would increase by about 750, and 300 units of vacant housing would be absorbed. Changes to the shuttle system under the preferred/proposed alternative could result in a wide range of effects to visitors and to gateway communities, although it is unclear whether the changes would increase, reduce, or not affect visitation based on experience at other national parks. A shift of visitation to the shoulder seasons, as intended by managed entry, would affect business operations and labor, which in turn would spill over to community resources such as housing and public safety.

## **Natural Soundscapes**

This alternative would result in an 85% increase in visitation days and a 25% increase in visitor numbers and associated congestion and increase in vehicle traffic, which would contribute to increased unnatural sounds. Diminishment of the natural quiet and sounds of nature that are valued by visitors to the park would contribute to long-term adverse impacts on the natural soundscape in the GTSR corridor. This alternative would eliminate shuttle bus traffic, but substantially increase both daily and seasonal, privately owned vehicle (POV) traffic in the GTSR corridor, which would increase noise levels during the highest level traffic periods to 55.1 to 62.6 dBA at 100 feet and 41.0 to 50.9 dBA at 984 feet from the GTSR. This would be up to 6% louder than the no-action alternative. In addition, this alternative would increase the length of time each day and the number of days during the visitation season affected by excessive traffic noise compared to the no-action alternative.

## **APPENDIX H: IMPACT TOPICS CONSIDERED BUT DISMISSED**

### **ARCHEOLOGY**

Archeological sites are the locations of past human occupation or activity that retain physical evidence of prior use. Sites may be prehistoric (with use predating European American occupation) or historic.

The proposed action is not expected to impact archeological resources. Proposed construction activities would be mainly confined to previously disturbed areas. However, any new ground disturbance in previously undisturbed and unsurveyed areas would undergo archeological surveying prior to construction. In the unlikely event that archeological resources were identified during construction, construction activities in that area would stop and consultation would occur in accordance with federal legislation and regulations and NPS policy. As a result, there would be limited potential for impacts to archeological resources and therefore they are dismissed from further analysis.

### **ETHNOGRAPHIC RESOURCES**

Ethnographic resources are defined by the National Park Service as “the cultural and natural features of a park that are of traditional significance to traditionally associated peoples” (NPS 2006). The Kootenai Tribe informed the park of ethnographic resources located in the Avalanche area. Ongoing consultation would continue with the Kootenai Tribe during the design and development of proposed activities at Avalanche, and efforts would be made to avoid and/or minimize impacts to these resources. Neither the Blackfoot Tribe or the Confederated Salish and Kootenai Tribes raised concerns about the proposed actions during initial consultation meetings for the project in 2012, 2013, and 2017. Because potential impacts to ethnographic resources at the Avalanche area would be avoided/minimized, and no other ethnographic resources were identified along the GTSR corridor, these ethnographic resources are dismissed from further analysis.

However, Glacier National Park recognizes that the tribes hold a body of knowledge that may result in the future identification of ethnographic resources within the GTSR corridor. If ethnographic resources are identified, additional consultation would occur before the implementation of future management actions.

### **SOCIOECONOMIC ENVIRONMENT**

In 2017, spending by visitors to Glacier National Park generated an estimated \$195 million in value added (or change in gross domestic product) and supported 4,600 jobs in the local communities around the park (NPS Visitor Spending Effects 2017). As none of the plan alternatives propose to limit the number of visitors entering the GTSR corridor, there would be no change to park visitation or to the beneficial economic impacts associated with visitor spending.

The plan proposes a number of small-scale construction projects to improve parking, etc. These projects would have beneficial economic effects that are minor and temporary in nature. There are changes to commercial guided hiking on the Highline and St. Mary Falls Trails, which limit the size and number of groups that each provider can lead, and do not allow use of Avalanche as a staging area during peak season. The park’s commercial services plan previously established limitations for guided hiking in the park that include a parkwide maximum capacity of 5,000 hikers and group size restrictions. At recent visitation levels of 3.3 million, these 5,000 guided hikers would account for less than 0.2% of all park visitors. As a result, the socioeconomic effects of the proposed changes to guided hiking would likely be minimal due to the small scale of this activity relative to total park visitation, the

existing group size limit of 25 that already exists for the Highline Trail (and 35 for St. Mary Falls and Avalanche Lake), and the lack of restrictions for guided hiking operations elsewhere in the park.

Because there would be no noticeable socioeconomic effects associated with the implementation of any plan alternative, this topic was not carried forward for detailed analysis in this environmental assessment because it does not have the potential for any meaningful adverse effects.

## **AIR QUALITY**

Glacier National Park is classified as a mandatory class I area under the Federal Clean Air Act (42 USC 7401 et seq.). This most stringent air quality classification is aimed at protecting parks and wilderness areas from air quality degradation. The park was established in part for its “superb and unique scenery.” The importance of scenic resources to the park is captured further in the park’s 1990 Land Protection Plan, 1999 General Management Plan, and 2006 Comprehensive Interpretive Plan.

Mobile combustion associated with the operation of privately owned vehicles would continue to be the largest contributor of emissions in the park. Visitation and vehicle numbers in the GTSR corridor are expected to continue increasing under both alternatives. But traffic management under the action alternative, including shifting transportation modes from privately owned vehicles to shuttles and buses, encouraging the use of more efficient compact or electric vehicles, ride sharing, a parking reservation permit system, and time limits at some locations would help relieve traffic congestion, reduce idling time, and reduce vehicle miles traveled per visitor resulting in beneficial impacts on air quality. Emissions associated with construction activities for recreational development under the preferred/proposed alternative, including parking lot and trail additions and improvements, would result in temporary negligible adverse impacts on air quality during the three-to four-month construction season over several years. Air quality was dismissed from detailed analysis because the preferred/proposed alternative would help reduce vehicle-related emissions over the long-term and only cause slight, temporary increases in construction-related emissions along the GTSR corridor that would not cause substantive impacts on air quality-related values compared to background levels of air pollution from sources outside the park.

## **DARK SKIES**

The alternatives proposed in this plan would not contribute additional artificial light into the lightscape and as a result would not have an impact on dark sky resources. Therefore, this topic was dismissed from further analysis.

## **FLOODPLAINS**

NPS *Management Policies 2006* and NPS Director’s Order 77-2: *Floodplain Management* and Executive Order 11988, “Floodplain Management,” provide guidelines for proposed actions in floodplains. It is NPS policy to preserve floodplain values and minimize potentially hazardous conditions associated with flooding. In the GTSR corridor, there are a number of existing developments in the 100- and 500-year floodplains. These include developed areas near McDonald Creek including Apgar Village and the picnic and restroom area at Avalanche, areas near Sprague Creek including Sprague Creek Campground, a sewage lift station, and picnic area west of the Continental Divide. East of the Continental Divide, Rose Creek floodplain impacts the Rising Sun area, Divide and Wild Creek floodplains impact the developed areas of St. Mary including the St. Mary Visitor Center and parking lot. All of the proposed development would either occur outside the floodplain or consist of excepted actions. Therefore, there would be no impacts to floodplain values and this topic was dismissed from further analysis.

## **NATURAL SOUNDSCAPE**

NPS policy preserves, to the greatest extent possible, the natural soundscapes of parks. Natural soundscapes exist in the absence of human-caused sound. They are an important resource and have intrinsic value as a part of the unique environment of the park. Natural sounds like wind, water, wildlife, and other natural phenomena predominate throughout most of the park. Natural sounds occur within and beyond the range of sounds that humans can perceive. Natural quiet exists when the sounds of these natural components of the park prevail.

Traffic management under the action alternatives, including shifting transportation modes from privately owned vehicles to shuttles and buses, encouraging the use of more efficient compact or electric vehicles, ride sharing, and a parking reservation permit system, and time limits at some locations would result in less congestion, reduce miles traveled, and fewer cars circling or waiting for a parking space to become available, which would reduce vehicle-related acoustic impacts during peak visitation periods.

Construction to add parking areas, restrooms, shuttle stops, and widen roads would involve the use of noise-producing heavy equipment. The level of noise would vary depending on the stage of the project and the equipment in use but could produce noise above existing ambient sound levels within the vicinity of the project resulting in temporary adverse impacts to the natural soundscape. Most heavy equipment would only be used intermittently over the course of the construction period for short durations (measured in hours). Potential impacts to natural soundscape would be further considered for those proposed actions that require additional design and compliance. Work on the new or improved trails in recommended wilderness areas would be conducted with hand tools and would cause temporary increases in noise during construction and would generally be low—disturbance would mostly be contained to the narrow trail corridor. Exceptions include use of mechanized equipment such as chainsaws, rock drills, generators, possible rock blasting, and use of helicopters for material delivery. With implementation of mitigation measures such as the use of quiet technology options to lower sound levels and scheduling construction to avoid important wildlife activity times or key visitation times, impacts of construction on natural soundscapes would be minimized.

Natural soundscape was dismissed from detailed analysis in this environmental assessment because the action alternatives would help reduce vehicle-related acoustic impacts and noise caused by construction activities would be mitigated and temporary.

## **SOILS**

The preferred/proposed alternative would permanently reduce soil productivity on up to approximately 11 acres by constructing 7.5 miles of new trails or bike paths, widening 1.25 miles of road, and adding or expanding four parking lots in high visitor use areas. The area of soil affected would be less than 1% of the GTSR management area. The new or improved trails and other proposed facility improvements would be designed and constructed to minimize or avoid impacts on soils susceptible to erosion. Soils was dismissed from detailed analysis because construction under the preferred/proposed alternative would impact a relatively small area and improving or adding new trails and adding new restroom facilities in heavily used areas would help reduce soil erosion by limiting off-trail use, stabilizing surface soil conditions, stop over-widening and development of braided trail sections, and allow existing braided or over-widened trail sections to naturally stabilize and revegetate. In addition, best management practices would be carried out during and after construction to stabilize soils and minimize erosion.

## **WATER RESOURCES**

The State of Montana has designated all surface waters in Glacier National Park as outstanding resource waters (ARM 17.30.617) and prohibits any new or increased point source discharge that would result in a permanent change in water quality (ARM 17.30.638). The Montana Board of Environmental Review may not issue an authorization to degrade state waters that are classified outstanding resource waters (MCA 75-5-303). This designation provides the maximum amount of protection to water quality under the Clean Water Act.

The preferred/proposed alternative would protect water resources by carrying out mitigation measures in appendix I and other best management practices required for controlling runoff pollution during and after construction of 7.5 miles of new trails and bike paths, facilities at five frontcountry and five backcountry locations, widening 1.25 miles of road, and four new or expanded parking lots. An additional mile of the Avalanche Lake Trail would be hardened and an additional 15 square feet of the Hidden Lake overlook would be hardened to help stabilize adjacent surface soil conditions. Erosion and sediment control measures at new or improved trail construction sites that have hydrologic connections to nearby aquatic habitat, such as stream crossings, would be the most effective in preventing sediment from entering streams or wetlands. The new parking lots at the West Side construction staging area and 1913 Ranger Station and the expanded St. Mary Visitor Center parking lot covering a total of approximately 2.99 acres would be designed to capture and treat stormwater runoff to remove pollutants and protect nearby water quality. In addition, keeping hikers on the new or improved trail alignments would allow the nearby braided informal trails to naturally stabilize and revegetate resulting in reduced sediment runoff that would have long-term benefits to water quality and aquatic organisms.

Water resources was dismissed for detailed analysis because the preferred/proposed alternative would improve or add new trails and add new restroom facilities in heavily used areas that would help reduce sediment entering nearby aquatic habitat by limiting off-trail use, stabilizing surface soil conditions, preventing over-widening and development of braided trail sections, and allowing existing braided or over-widened trail sections to naturally stabilize and revegetate. In addition, best management practices for controlling runoff pollution would be carried out during and after construction of the proposed facilities.

## **WETLANDS AND RIPARIAN AREAS**

NPS *Management Policies 2006* and NPS Director's Order 77-1: *Wetland Protection* and Executive Order 11990, "Protection of Wetlands" provide guidelines for proposed actions in wetlands and riparian areas. It is the NPS directive to implement a "no net loss of wetlands" policy. The wetlands and riparian areas of the GTSR Management Area provide a variety of valuable ecosystem functions including essential habitat for plants and animals, surface water filtration and storage, flood abatement, erosion prevention, and natural water quality treatment. Within the GTSR corridor, there are approximately 13,527 acres of wetlands spread throughout the entire geographic area. They are primarily palustrine (1,052 acres) and lacustrine (11,698 acres) wetlands as well as 776 acres of riverine wetlands (NPS 1999). Proposed actions that would occur near wetlands would be designed to avoid any impact. Therefore, wetlands were dismissed from further analysis.

# APPENDIX I: HISTORY OF CIVIC ENGAGEMENT, AGENCY CONSULTATION, AND COORDINATION

## INTRODUCTION

This appendix describes the history of public involvement for the GTSR Corridor Management Plan. It describes coordination with federal and state agencies and tribal governments, and lists agencies, organizations, and individuals that received notice of the project. It also summarizes the themes captured during public comment periods to date.

## INTERNAL SCOPING

Internal scoping was conducted by the GTSR corridor planning team, including park staff and NPS staff from the Intermountain Region and the Denver Service Center beginning in late 2012. At the outset of the planning process in the summer of 2012, the project team conducted a two-day workshop with a cross-section of park staff to identify hot spots and related issues addressed in this plan.

In the spring of 2013, the park introduced the planning effort at all park staff and concessioner spring orientation meetings.

## EXTERNAL SCOPING

Initially it was determined that an environmental impact statement would be prepared. Scoping for the corridor management plan and draft environmental impact statement was held from June 17 to September 6, 2013. External scoping was conducted to inform the public about the proposal to develop a visitor use and transportation plan for the GTSR corridor and to ask for comments and input on the proposed planning effort. The public scoping newsletter (newsletter 1) was mailed June 2013 to individuals, government offices, local chambers of commerce, and interested nonprofits. A press release was sent to local, regional, and national newspapers. Letters were also mailed to representatives of two park-affiliated tribes. A “Notice of Intent” to prepare an environmental impact statement was published July 19, 2013, in the *Federal Register*.

**Table I-1. Public Open House Events for the Visitor Use and Transportation Plan**

Location	Date
Kalispell, MT	June 24, 2013
Missoula, MT	June 25, 2013
Great Falls, MT	June 26, 2013
Waterton, Alberta Canada	June 27, 2013
Glacier National Park, MT	July 19, 2013*
Glacier National Park, MT	August 9, 2013*

\*Meetings were held at all three locations both dates: Apgar Visitor Center, Logan Pass Visitor Center, and St. Mary Visitor Center.

The park held public scoping meetings in Montana and Waterton, Alberta, Canada during which attendees were encouraged to identify issues and provide information to the National Park Service that could be considered to develop this plan. The park received 156 written comments. An additional



283 comments were gathered at open house events. The dates and locations of the open house sessions are listed in the adjacent table.

The public expressed the following concerns and opportunities during the scoping period.

### **Road Use and Parking**

Numerous commenters shared their experiences on the roadway and suggested management actions to improve their roadway experience. These included ideas about private vehicles on the road, maintenance operations, and how long the road is open each season. Comments ranged from how enjoyable driving a vehicle is along the GTSR, to frustration with traffic conditions and narrow travel lanes. Commenters identified opportunities for improvement including alternate snow plowing schedules, a permit system, time limits on parking, no overnight parking, and increased park personnel presence to manage visitors and vehicles and reduce parking demand.

### **Alternative Transportation**

Alternative transportation was widely supported during public scoping. Commenters had numerous and diverse ideas about how to improve it. Some indicated that they hoped the free shuttle system wouldn't go away and that it added value to their trip experience.

Others suggested improvements to the shuttle schedule and methods for accommodating larger group sizes. Some commenters drew connections between the shuttle service and parking and hiking patterns in the park. Some of these commenters were supportive of continuing to use the shuttle system to facilitate loop hikes and better trail access. Others suggested making the system bigger to handle more riders. Others were concerned about the costs of the shuttle operation and that the service was not adequate and many expressed concern about increasing numbers of hikers due to the shuttle. The most common other form of alternative transportation highlighted during scoping was the use of bicycles in the park. Commenters ranged widely in recommendations about bicycles on the GTSR. Some wanted more bicycle access and greater restrictions on private vehicles. Others suggested greater bicycle restrictions, indicating that they felt the road was too crowded to accommodate multiple types of transportation.

### **Park Fees and Funding**

The park entrance fee structure and funding mechanisms used to pay for the park shuttle system were frequently brought up during scoping. Some commenters suggested adjusting the entrance fee structure to promote different types of vehicle use or to change the amount being directed to the shuttle system. Others suggested that riders should pay a boarding fee for the shuttle to replace or augment current funding.

### **Trails**

Many commenters identified popular trails in the GTSR corridor as extremely congested and noisy. Respondents recommended improving trail conditions and increasing park staff presence on trails to manage resource impacts. Some offered solutions like hardening trails or creating boardwalks, while others did not support additional infrastructure in trail corridors, and suggested that the park should manage the number of people on the trails to reduce impacts.

### **Information and Park Services**

Many respondents recommended increased information about shuttle opportunities and conditions in the park to help them plan their trips in advance. Some recommended increasing visitor service-related infrastructure such as restrooms, food service, signage, and campsites. Some commenters

recommended that the park provide better education about appropriate behavior in the park to minimize impacts to wildlife and other resources.

### **Natural and Cultural Resources**

Respondents touched on a variety of different resource topics based on observed resource conditions and visitor behaviors they saw in the park. Concerns respondents raised ranged from the number of people in the park overusing popular attractions to suggestions about how park staff should respond to resource issues and violations.

The most prevalent resource issue raised during scoping was about park wildlife, particularly wildlife and human encounters. Respondents typically indicated that wildlife sightings were a very important and wonderful part of their visit. However, many were concerned about close encounters they observed between visitors and wildlife. Another common comment received pertained to the GTSR itself, encouraging protection of its historic character and significance.

### **Additional Public Outreach**

In the spring of 2014, the park released a second newsletter (newsletter 2) to approximately 400 contacts who requested updates on the corridor planning process. The second newsletter summarized public scoping comments received during 2013. It also provided an overview of some of the research data about visitor use and natural and cultural resources that was being gathered in conjunction with the planning process.

### **PRELIMINARY ALTERNATIVES**

In the spring of 2015, the park sent out newsletter 3, which shared five preliminary alternatives with the public. These were: (1) no action, (2) build additional parking and infrastructure and maintain shuttle to accommodate increased visitation, (3) increase shuttles and manage the number of vehicles in the GTSR corridor, (4) discontinue shuttles and manage the number of vehicles in the corridor, and (5) adaptive response to alternative futures. Updated information was also shared on visitor and transportation research in the park focusing on data gathered since 2013.

Approximately 300 comments were received.

### **DECISION TO PREPARE AN ENVIRONMENTAL ASSESSMENT RATHER THAN AN ENVIRONMENTAL IMPACT STATEMENT**

In November 2017, a determination was made that an environmental impact statement was not necessary since none of the impacts were significant. It was determined that the original scoping was still relevant and therefore the plan did not need to be re-scoped. In February 2019, the park released a press release to the public announcing their 2019 planning efforts. The press release included an update regarding the status of this plan and the decision that an environmental assessment was a more appropriate compliance pathway given the scope of the plan. A link to the park's planning page for the project was also included.

### **AGENCY COORDINATION AND CONSULTATION**

Agency coordination was initiated through correspondence, telephone communication, and review of project-related materials. Letters were sent to the US Fish and Wildlife Service, the Federal Highway Administration – Western Lands Division, the Montana State Historic Preservation Office, the Montana Department of Environmental Quality, the Montana Department of Natural Resources and Conservation, and the Montana Department of Fish, Wildlife and Parks. All agencies, including the

Montana State Historic Preservation Office, received newsletters 1, 2, and 3. The Federal Highway Administration was invited and agreed to be a cooperating agency in May 2015.

### **Native American Consultation**

Glacier National Park initiated written correspondence with the Confederated Salish and Kootenai Tribes and the Blackfeet Tribal Council during scoping in the summer of 2013 as required by 36 *Code of Federal Regulations* (CFR) 800. No response letters or e-mails were received. The park met with the Tribal Historic Preservation Officer for both the Blackfeet and Confederated Salish and Kootenai Tribes in June of 2015 to review preliminary plan alternatives, including possible development concept designs for the Avalanche area. No comments were received. Meetings were held again with both the Blackfeet and the Confederated Salish and Kootenai Tribes in spring 2017. No concerns were expressed.

### **State Historic Preservation Office**

Glacier National Park initiated written correspondence with the State Historic Preservation Officer during scoping in the summer of 2013, as required. The SHPO was briefed on progress of the plan at annual meetings in 2013 and 2014. The park met with the SHPO in summer 2015 to review preliminary alternatives. The SHPO was briefed again in July 2017. The park determined in 2018 that the structure underneath the GTSR road in St. Mary could result in an adverse effect to the historic road and therefore a memorandum of agreement would be required. A conference call was held with the SHPO in December 2018 to discuss the draft memorandum of agreement. In addition, proposed actions and adaptive management options at the Avalanche Developed Area would result in adverse impacts to elements of the Avalanche Campground and Picnic Area Historic District. Following further design and clarification of an area of potential effect for these proposed and potentially implemented actions, further consultation with the SHPO would be initiated and the National Park Service would work with the SHPO and ACHP according to section 106 procedures to determine mitigation requirements for any unavoidable adverse impacts. The type and level of mitigation required would vary depending on the resource involved and the level of damage. The proposed actions would not be implemented until a signed agreement was in place.

### **Section 7 Consultation**

Consultation was initiated with the US Fish and Wildlife Service in the summer of 2013 during scoping. They were sent all newsletters including preliminary alternatives. The National Park Service determined that the proposed management action (excluding trails from Big Bend to the Highline Trail and Siyeh Bend to Logan Pass) *may affect, but is not likely to adversely affect* the grizzly bear, Canada lynx, and Canada lynx critical habitat. The National Park Service determined the proposed action *would not jeopardize* the continued existence of the wolverine, and would have *no effect* on bull trout, bull trout critical habitat, meltwater lednian stonefly, western glacier stonefly, Spalding's campion (or catchfly), and water howellia. If implemented under adaptive management options, additional compliance and consultation would be done prior to constructing the trails mentioned above.

A biological assessment will be sent to the US Fish and Wildlife Service for review and concurrence. This process is ongoing.

## APPENDIX J: PLANT SPECIES OF CONCERN WITH THE POTENTIAL TO OCCUR NEAR PROPOSED AND POTENTIAL NEW TRAIL SEGMENTS UNDER THE PREFERRED/PROPOSED ALTERNATIVE

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Alpine glacier poppy <sup>1</sup> <i>Papaver pygmaeum</i>	S2S3	Known to occur in sparsely vegetated areas with stony soils on exposed slopes and ridgetops in the alpine zone of the park.
Arctic buttercup <sup>1</sup> <i>Anunculus grayi</i>	S3	Habitat consists of gravelly, usually moist, sparsely vegetated soils found on benches, moraines, and open slopes near timberline or in the alpine zone.
Arctic eyebright <sup>1</sup> <i>Euphrasia subarctica</i>	S2	Habitat consists of open soil in grasslands, meadows, and tundra in the alpine zone. Only known to occur in a few locations in Glacier National Park.
Banff bluegrass <sup>1</sup> <i>Poa laxa ssp. banffiana</i>	S1	Banff bluegrass can be found on north-facing mudstone slopes in the alpine zone.
Barratt's willow <sup>1</sup> <i>Salix barrattiana</i>	S2	Habitat includes cold, moist soils in the alpine zone.
Coastal sand sedge <sup>1</sup> <i>Carex incurviformis</i>	S2	Coastal sand sedge can be found on wet rock ledges and moist tundra in the alpine zone.
Dense-leaf draba <sup>1</sup> <i>Draba densifolia</i>	S2	Habitat consists of gravelly, open soil of rocky slopes and exposed ridges in the montane to alpine zones.
Five-leaf cinquefoil <sup>1</sup> <i>Potentilla nivea var. pentaphylla</i>	S3	The five-leaf cinquefoil can be found in dry, gravelly soil of exposed ridges and slopes in the montane to alpine zones.
Glaucous gentian <sup>1</sup> <i>Gentiana glauca</i>	S2S3	Habitat consists of wet, boggy tundra soils in the alpine zone. The only known Montana population is found in the GTSR area.
Goose-grass sedge <sup>1</sup> <i>Carex plectocarpa</i>	S3	Goose-grass sedge can be found in shallow, wet, stony soil around streams in the alpine zone.
Hudson's Bay Bulrush <sup>1</sup> <i>Trichophorum alpinum</i>	S2	The Hudson's Bay bulrush can be found in wet, cold organic soils of fens and slopes in the montane and subalpine zones.
Macoun's draba <sup>1</sup> <i>Draba macounii</i>	S2S3	Macoun's draba can be found on wet rock ledges and moist tundra in the alpine zone.
Moonworts <sup>1</sup> <i>Botrychium spp.</i>	S1-S3, varies	Moonwort species can be found in various dry to mesic sites from valley bottoms to the subalpine, including roadsides and other disturbed habitats.
Northern beechfern <sup>1</sup> <i>Phegopteris connectilis</i>	S2S3	Found in mesic, western red cedar forests and shaded cliffs in the valley to subalpine zones.
Northern buttercup <sup>1</sup> <i>Ranunculus pedatifidus</i>	S3	Northern buttercup habitat is limited to moist alpine tundra environments.
Rock sedge <sup>1</sup> <i>Carex petricosa</i>	S1S2	Rock sedge can be found on dry, calcareous barrens, cliffs, and talus slopes in the alpine or subalpine zones. It is currently known to occur in the park.

Species Name	Status <sup>a</sup>	Species of Concern Distribution and Habitat in GTSR Management Area
Rocky Mountain twinpod <sup>1</sup> <i>Physaria saximontana</i> var. <i>dentata</i>	S3	Rocky Mountain twinpod is typically found in limestone-derived talus, fellfields, and gravelly slopes at moderate to high elevations.
Running-pine <sup>1</sup> <i>Lycopodium lagopus</i>	S2	Running-pine habitat consists of turf along drainages and moist slopes in the alpine zones.
Simple kobresia <sup>1</sup> <i>Kobresia simpliciusula</i>	S3	Simple kobresia habitat in the park includes montane fens to moist tundra in alpine zones.
Small tofieldia <sup>1</sup> <i>Tofieldia pusilla</i>	S2	Small tofieldia is found in moist tundra habitat in the alpine zone. In Montana, it is known in only a very small area in Glacier National Park.
Stalk-leaved monkeyflower <sup>1</sup> <i>Mimulus ampliatus</i>	S3	This species can be found in open seeps and vernal moist soil along slopes, cliffs, and streams from the valleys to the subalpine zone.
Three-flowered rush <sup>1</sup> <i>Juncus triglumis</i> var. <i>albescens</i>	S3	Three-flowered rush can be found in wet, organic soils and moist, well-developed turf in the alpine zone.
Tufted club-rush <sup>1</sup> <i>Trichophorum cespitosum</i>	S2	The tufted club-rush occurs in wet meadows and sphagnum-dominated fens in the montane to alpine zones.
Meesia moss <sup>1</sup> <i>Meesia uliginosa</i>	S1	Meesia moss habitat consists of fens, peaty soil banks, seeps, meadows, and rock fissures on exposed, damp organic soil in upper montane to subalpine coniferous forest.
Myurella moss <sup>1</sup> <i>Myurella tenerima</i>	S1	Myurella moss occurs on soil in rock crevices and fens in the alpine zone. The species is usually in moist calcareous habitats.
Norwegian twist moss <sup>1</sup> <i>Tortula norvegica</i>	S1	This species can be found on calcareous rocks and walls in the alpine zone.
Paraleucobryum moss <sup>1</sup> <i>Paraleucobryum enerve</i>	S1	Paraleucobryum moss occurs on logs, tree bases, or siliceous rocks in the alpine zone. Habitat is limited because the species is lime-intolerant.
Schleicher's bryum moss <sup>1</sup> <i>Bryum schleicheri</i>	S1	Schleicher's bryum moss is found in Pacific maritime, wet tundra, and rock at high elevations, often near snowfields.
Chocolate chip lichen <sup>1</sup> <i>Solorina bispora</i>	S1S2	Chocolate chip lichen appears on calcareous soil or humus on moist sites in the alpine to subalpine zones.

**Montana Natural Heritage Program Rankings** – **S1** = At high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state; **S2 or SGCN2** = At risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state; **S3 or SGCN3** = Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas; **SOC** = Species of Concern. **Data Sources:** <sup>1</sup>Montana Natural Heritage Databases (MNHP 2012a, 2012b, 2018a, 2018b)

**APPENDIX K: TRAFFIC COUNTS AND  
LEVEL OF SERVICE ON GOING-TO-THE-SUN ROAD REPORT**

# **Traffic Counts and Level of Service on Going-to-the-Sun Road**

**Douglas Dalenberg<sup>1</sup>, Wayne Freimund<sup>2</sup>, and Zachary Miller<sup>3</sup>**

**A Report Prepared for Glacier National Park**

**April 24, 2017**

---

<sup>1</sup> Professor of Economics, Department of Economics, University of Montana

<sup>2</sup> Arkwright Professor of Protected Area Studies, College of Forestry and Conservation, University of Montana

<sup>3</sup> PhD Candidate, College of Forestry and Conservation, University of Montana

# TRAFFIC COUNTS AND LEVEL OF SERVICE ON GOING-TO-THE-SUN ROAD

## PURPOSE AND METHOD

The purpose of this report is to give a general picture of traffic relative to road capacity for Going-to-the-Sun Road both for 2012 and into the future. This is not a traffic engineering report and the authors are not traffic engineers; rather we use previous research and existing data to generate a portrayal of summer traffic relative to road capacity in 2012 and into the future.

During the summers of 2012, 2013 and 2014, Dr. Wayne Freimund of the University of Montana, and his team deployed magnetic vehicle counters at key locations along the Going-to-the-Sun Road in Glacier National Park.<sup>6,7</sup> We combine these traffic counts with estimates of the design Level of Service, which is a measure of the road's ability to keep traffic flowing. The Level of Service estimates for the Going-to-the-Sun Road were found in the 1990 Glacier National Park Transportation Plan.<sup>8</sup> This allows a comparison of traffic volume to the road's design Level of Service.

In applying the information from this study we make a number of important assumptions. The Level of Service numbers reported in the 1990 Transportation Plan<sup>9</sup> use counts from 1984 and the Level of Service is based on the 1985 Level of Service methodology which has since been superseded by the 2000 and 2010 methodologies,<sup>10</sup> so we must assume changes to the methodology have minimal impacts on the capacity estimates for the Going-to-the-Sun Road. Similarly, we must assume that physical changes to the road that impact capacity between 1990 and today are minimal. Given the historical nature of the road this appears to be a reasonable assumption. Thus throughout this report, we assume that the 1990 Level of Service estimates still provide reasonably good estimates of design Level of Service for the Going-to-the-Sun Road. Another important caveat to keep in mind is that we are using traffic count data from the period of significant construction and an active shuttle system on the Road. Construction may impact traffic by discouraging use or by causing traffic to “bunch” as delays occur due to construction. No adjustments have been made to account for potential changes in use caused by the construction or by visitation patterns that have changed over time. Park visitation was high in the early 1980s so total visitation in 1984 was not much below visitation in 2012. Figure 1 illustrates Park visitation over time and shows the spike in 1983-84 in the official visitation counts. All of these factors have the potential to impact the hourly or daily traffic counts, so further monitoring after completing the construction is recommended.

---

<sup>6</sup> The shuttle transit system was in operation in these years. Removal of the shuttle system would immediately increase traffic.

<sup>7</sup> See Weinberg, Alex, Wayne Freimund, and Douglas Dalenberg, *2012 Going to the Sun Road Corridor Vehicle Use*, University of Montana, March 14, 2014 for further details. A sample of visual counts was used to calibrate the magnetic counts. Counters were placed on each side of the road to count traffic in each direction.

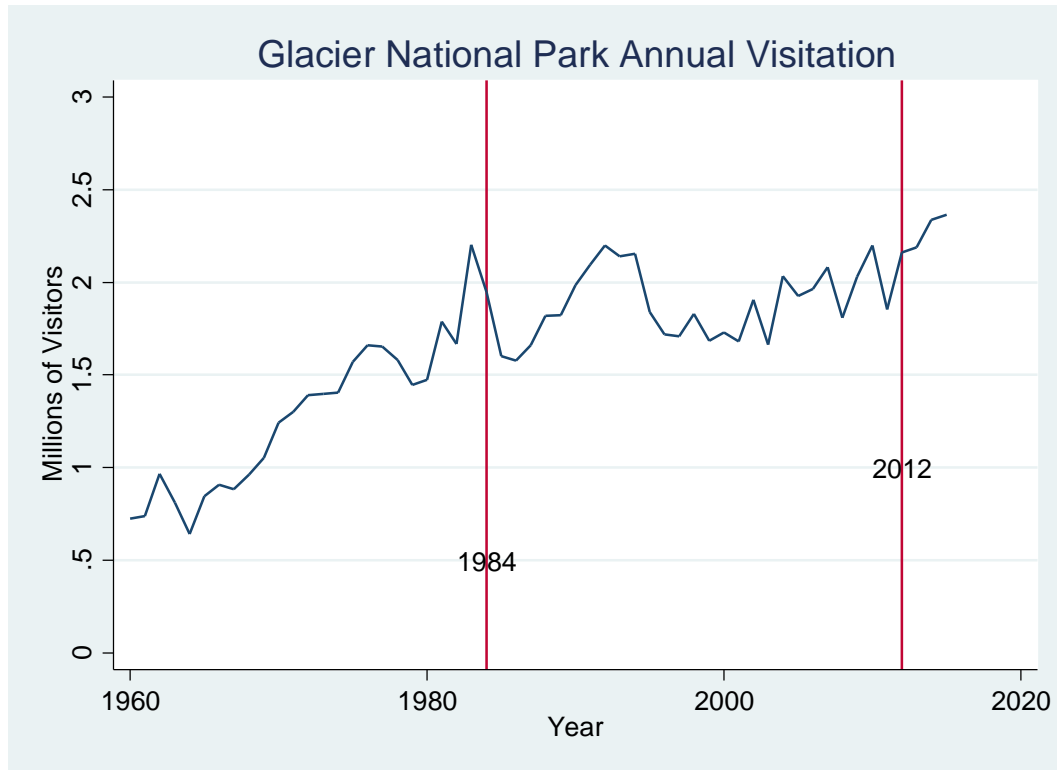
<sup>8</sup> Thanks to Mary Riddle of Glacier National Park for pointing us to this report.

<sup>9</sup> United States Department of the Interior, *Transportation Plan: Glacier National Park Montana*, Glacier National Park, July 1990.

<sup>10</sup> [http://www.fdot.gov/planning/systems/programs/sm/Level of Service/pdfs/LOSProcedure.pdf](http://www.fdot.gov/planning/systems/programs/sm/Level%20of%20Service/pdfs/LOSProcedure.pdf). The 2010 *Highway Capacity Manual* addresses multimodal issues including bicycles.



**Figure 1. Glacier National Park Annual Visitation**



Source: <https://irma.nps.gov/Stats/Reports/Park>.

Transportation professionals rate levels of service of a road from A to F, with level A being the best and least congested and level F operating beyond design capacity. The 1990 Transportation Plan defines Levels of Service D, E and F as:

- Level of Service D: Approaching unstable flow with tolerable operating speeds although considerably affected by changes in operating conditions. Drivers have little freedom to maneuver and pass other vehicles; comfort and convenience are low.
- Level of Service E: Represents operations at even lower speeds than level D, with volumes near the capacity of the highway. The highest volume attainable under E defines the capacity of the roadway. Flows are unstable and momentary stops may occur.
- Level of Service F: Forced or breakdown flow operation at low speeds where volumes exceed capacity. Speeds are reduced substantially and stops may occur for short or long periods of time because of downstream congestion. National Park Service (1990) *Transportation Plan: Glacier National Park / Montana*, July p. 20.

The 1990 Plan contains the Level of Service E range of vehicle counts (referred to as Range of Volumes by the traffic engineers, Table 3, p. 23) along with 1984 Level of Service. Table 1 shows road segments Level of Service in 1984 and the 2012-14 estimated Level of Service and counter locations. It is important to note that visitation in 2012 was only 11% higher than visitation in 1984.

**Table 1. Level of Service in 1984**

Road Segment	1984 Level of Service	Range of Volumes for Level of Service E	2012 Approximated Level of Service <sup>a</sup>	Counter Names and Years
Camas Road to Lake McDonald Lodge	D	520-1320	D	gtsr1 (2012, 2013, 2014)
Lake McDonald Lodge to Avalanche Creek	D	520-1320	D	aval1 (2012), aval3 (2014)
Avalanche Creek Campground to Logan Creek	D	520-1030	D	aval2 (2012), aval4 (2014)
Logan Creek to West Portal, West Side Tunnel	E	285-850	N/A	N/A
West Portal, West Side Tunnel to Logan Pass	E	215-685	E	lp1 (2012)
Logan Pass to St. Mary Falls Trailhead	E	285-855	E	lp2 (2012), smf1 (2013)
St. Mary Falls Trailhead to Rising Sun	E	305-880	N/A	smf2 (2013)
Rising Sun to St. Mary Entrance	D	555-1320	N/A	sm_ent (2013, 2014)
Park Visitation	1,946,703	N/A	2,162,035	N/A

<sup>a</sup> Approximation based on average traffic volumes. See footnote 6 for details.

<sup>b</sup> Visitation counts from <https://irma.nps.gov/Stats/Reports/Park>, Annual Visitation Statistics, Glacier National Park.

Source: National Park Service, (1990), *Transportation Plan: Glacier National Park / Montana*, July.

## DAILY MAXIMUM HOUR TRAFFIC OBSERVED 2012

For each day we selected the hour with maximum traffic flows and compared it to the Level of Service E threshold.<sup>11</sup> Figures 2 through 6 show the maximum hour traffic counts by date in 2012 for several key locations.<sup>12</sup> Most locations in 2012 were operating in Level of Service D, just below the minimum Level of Service E threshold. However, Logan Pass traffic was well into Level E, yet none of the areas were approaching Level F. Thus, the 2012 data shows the same pattern of traffic volume relative to Level of Service as in 1984 presented in Table 1.

<sup>11</sup> Rather than using Peak Hour Volume, as used in transportation studies, for each day we select the hour with maximum traffic counts and we call those counts the Maximum Hour Traffic to distinguish it from Peak Hour Volume. Peak Hour Volume and Maximum Hour Traffic would be calculated differently but will be similar. Peak Hour Volume selects the hour with the highest 15 minute traffic count and uses the total for that hour. Peak Hour Volume also counts trucks as 1.5 cars. Maximum Hour Traffic uses the hour with the largest count and ignores the adjustment for trucks. These two measures will be highly correlated. See [http://www.webpages.uidaho.edu/niatt\\_labmanual/Chapters/signaltimingdesign/exampleproblems/PeakHourVolumeDesignFlowPHF.htm](http://www.webpages.uidaho.edu/niatt_labmanual/Chapters/signaltimingdesign/exampleproblems/PeakHourVolumeDesignFlowPHF.htm) for an example of calculating Peak Hour Volume.

<sup>12</sup> We believe the counters are reliable but there are occasional missing hours or days of data due to a variety of counter problems.

Figure 2. Camas Road to Lake McDonald Lodge 2012

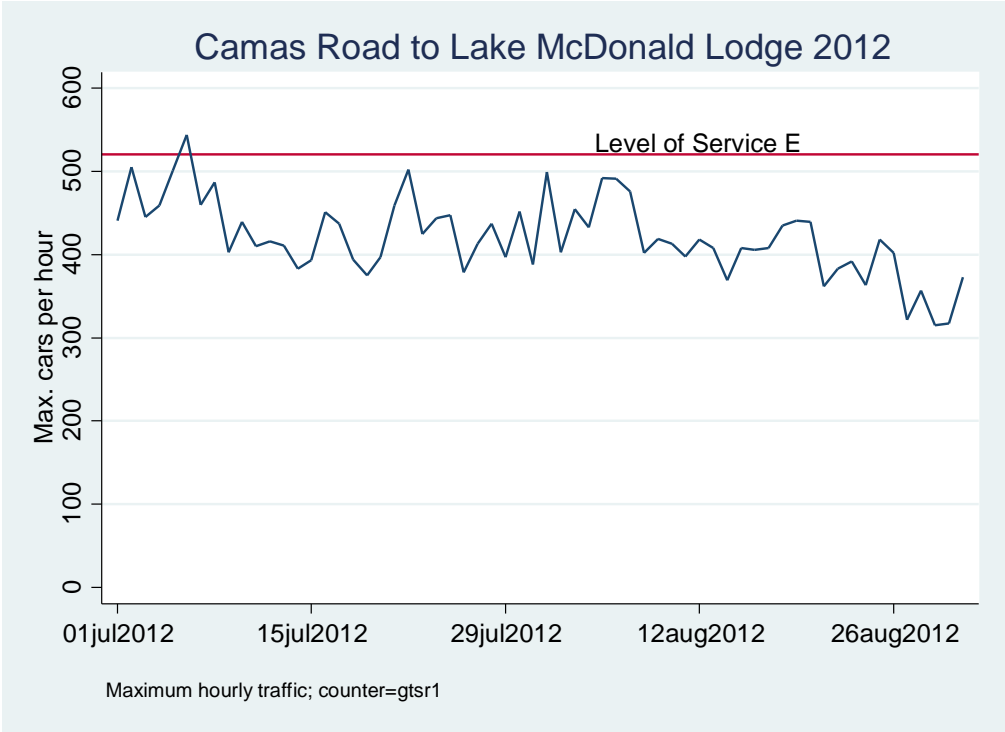
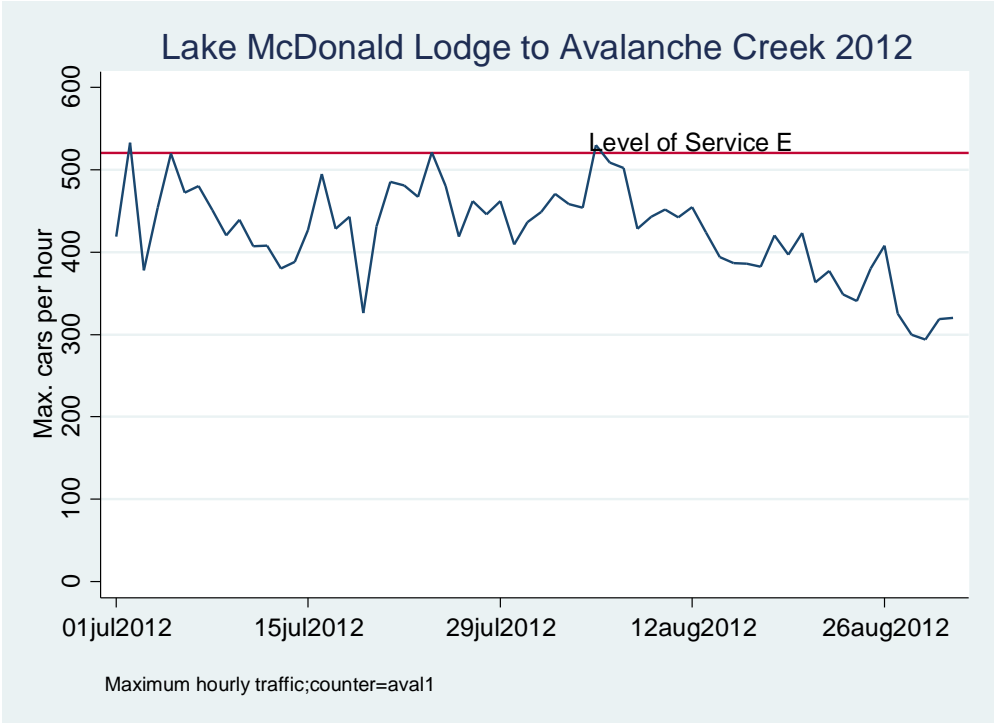
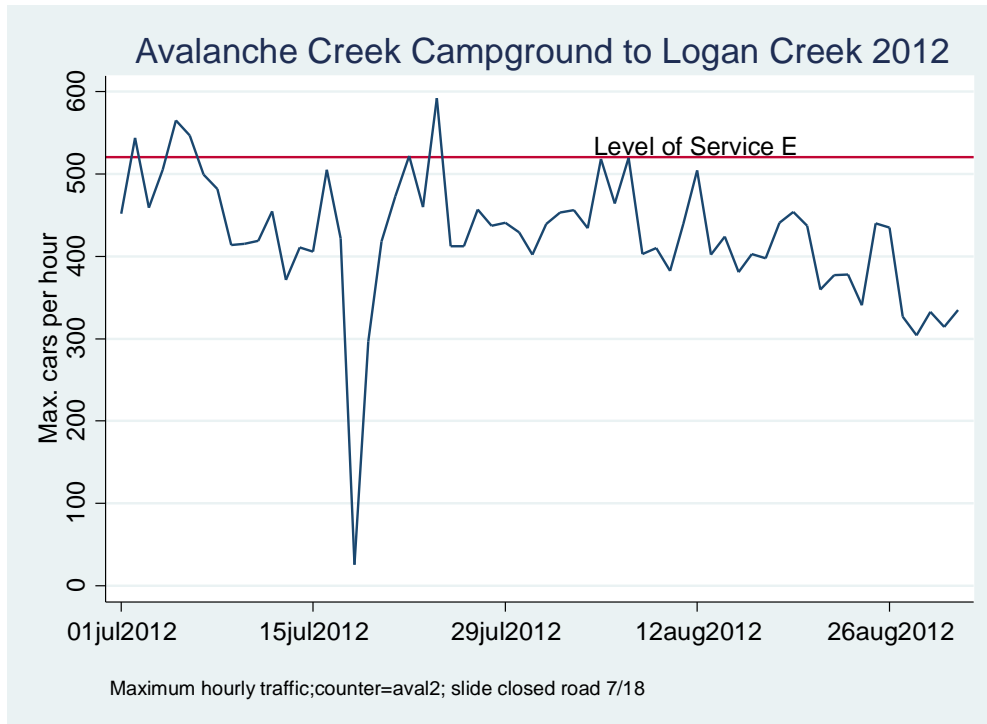


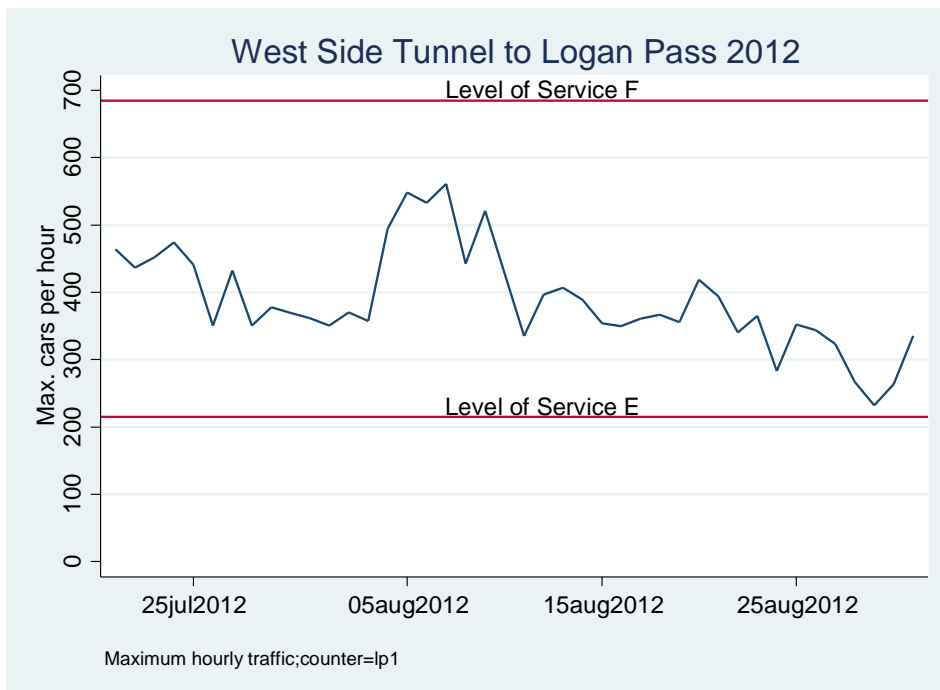
Figure 3. Lake McDonald Lodge to Avalanche Creek 2012



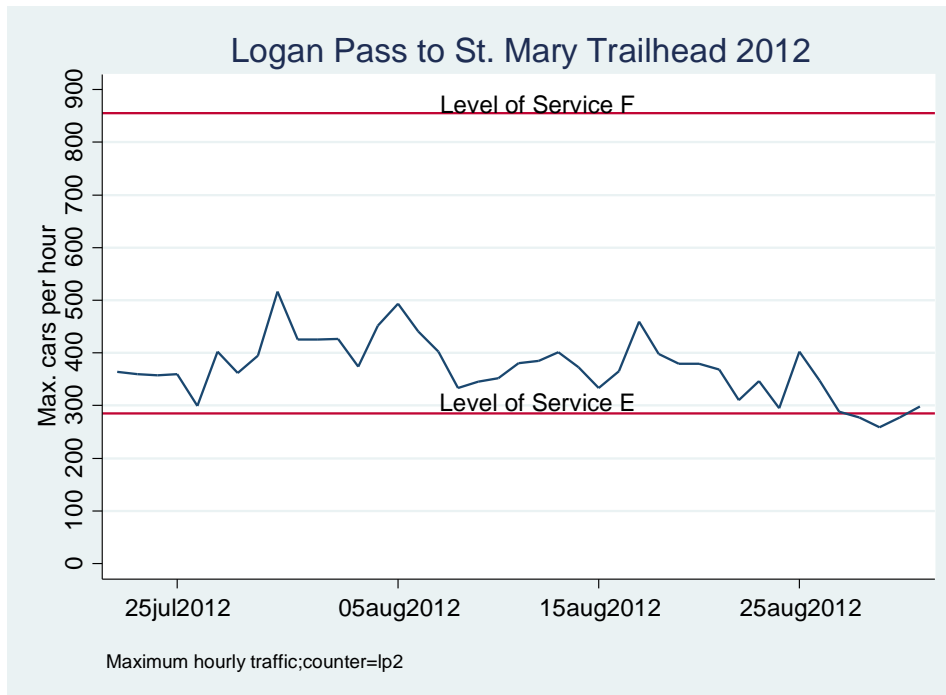
**Figure 4. Avalanche Creek Campground to Logan Creek 2012**



**Figure 5. West Side Tunnel to Logan Pass 2012**



**Figure 6. Logan Pass to St. Mary Trailhead 2012**



## DAILY MAXIMUM HOUR TRAFFIC OBSERVED 2013 AND 2014

Several counters provided data at different locations for 2013 and 2014. Figures 7 through 11 show the daily maximum hour traffic counts from 2013 or 2014 as the counters were moved. Visitation was 1.3% higher in 2013 compared to 2012 and grew another 6.8% in 2014.<sup>13</sup> Figures 9 and 10 show the same location for 2013 and 2014 and show similar maximum hour traffic despite visitation being significantly higher in 2014. Construction may account for part of the lack of observed difference at this location.

<sup>13</sup> 2014 visitation was 8.2% higher than 2012 visitation.

Figure 7. Lake McDonald Lodge to Avalanche Creek 2014

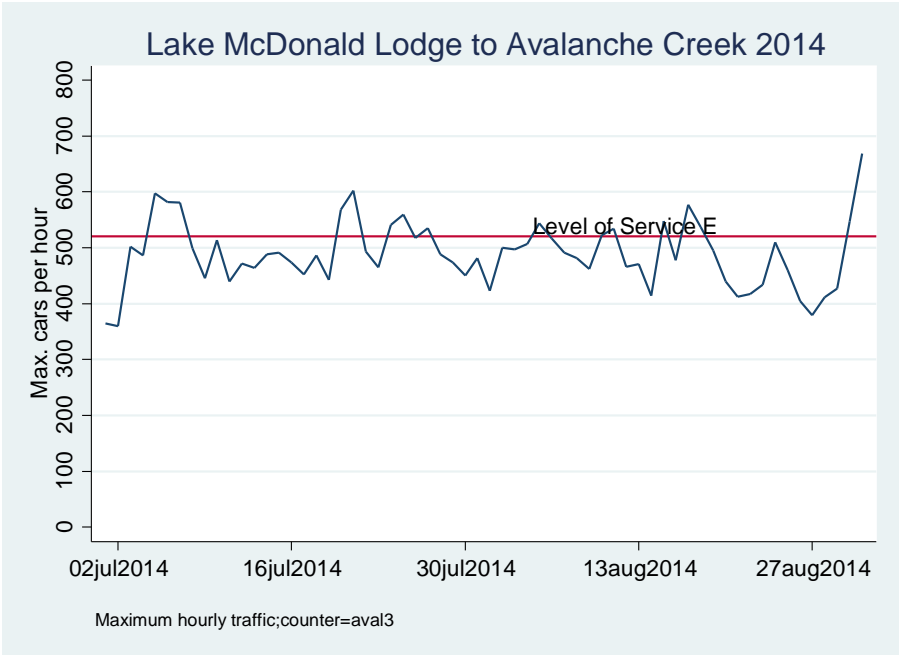


Figure 8. Avalanche Creek Campground to Logan Creek 2014

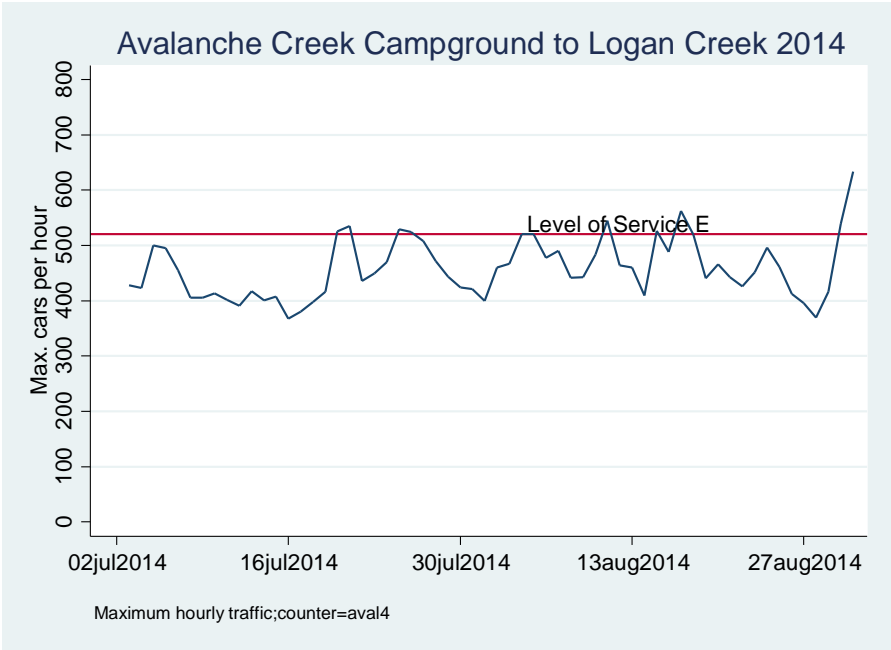


Figure 9. St. Mary Trailhead to Rising Sun 2013

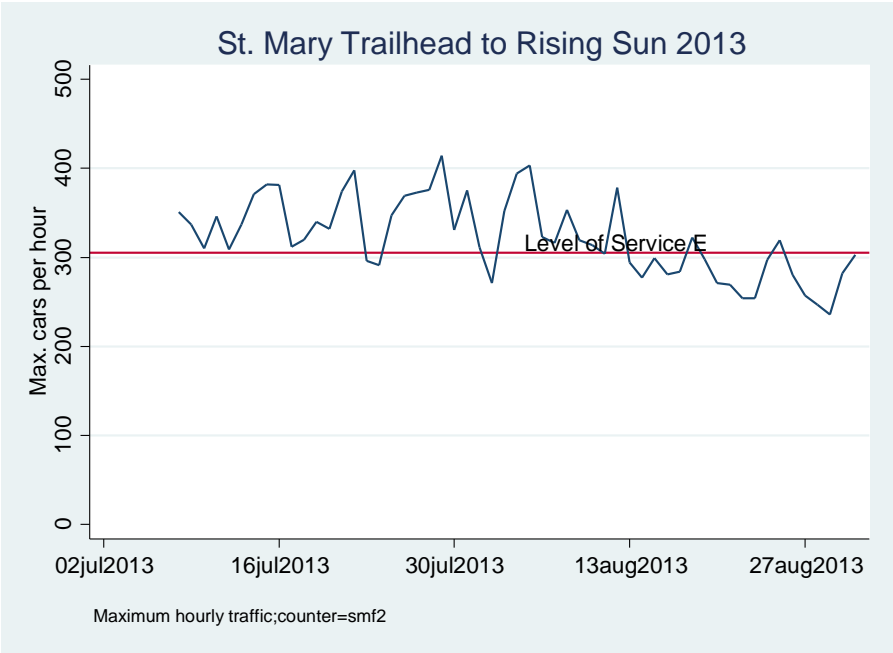
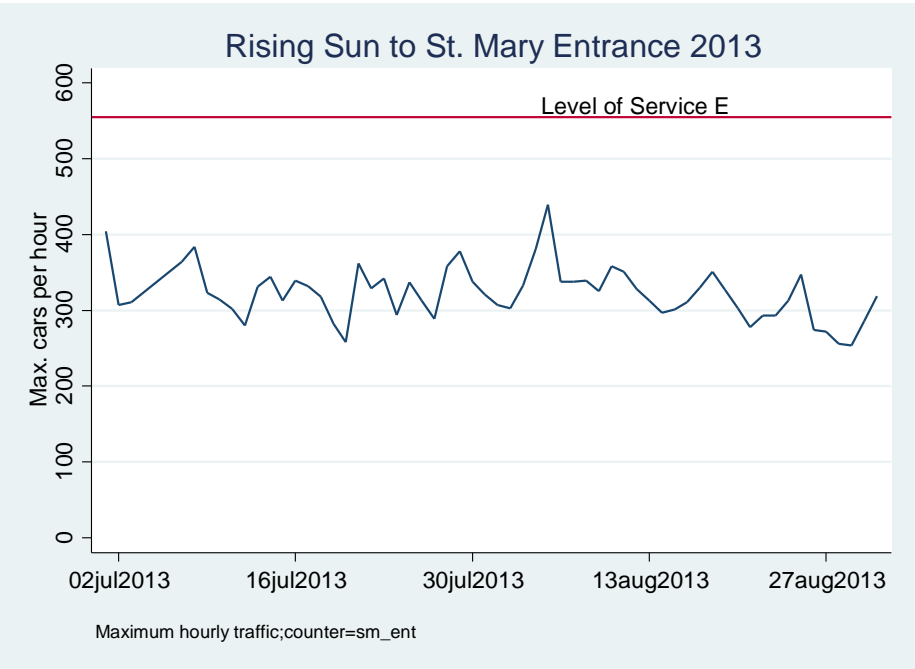
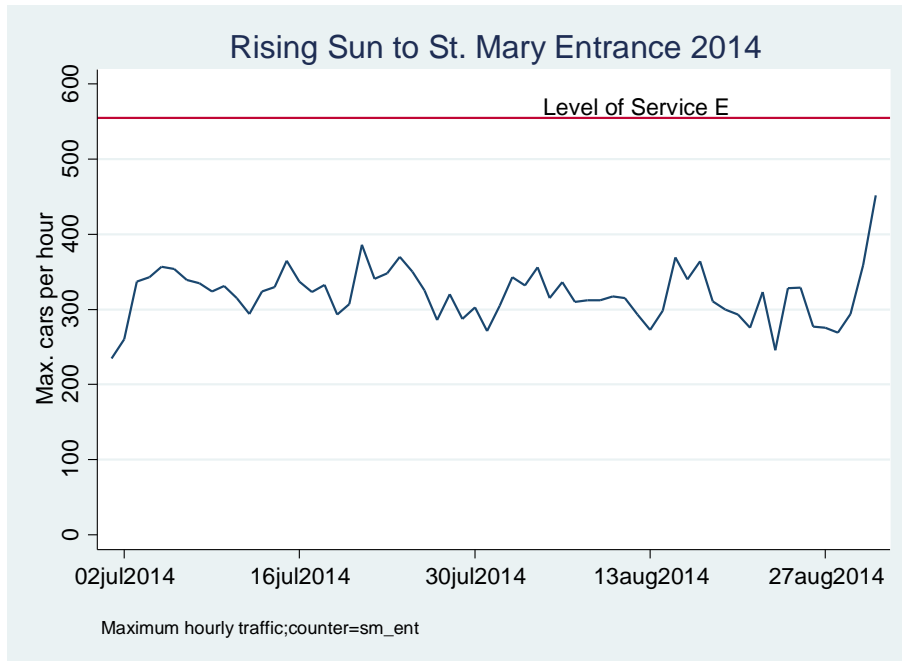


Figure 10. Rising Sun to St. Mary Entrance 2013



**Figure 11. Rising Sun to St. Mary Entrance 2014**



## THE FUTURE: EXTRAPOLATION

One way to think about increases in visitation and the impact upon traffic is to use simple extrapolation. This may be an oversimplification because people may adjust the timing of their visit as visitation increases, both over the season and during the day. Thus the maximum hourly traffic may not rise as dramatically as simple extrapolation would predict but may be spread over a longer period during the day and season. In addition, construction on the road may have caused delays and, as a result, the bunching of cars could be leading to higher peak hourly volumes than would have occurred in the absence of construction.

If we believe that visitation timing and construction had minimal impacts, we can perform a test of how well simple extrapolation works by comparing extrapolation between 2012 and 2014 to actual counts in 2012 and 2014 near Lake McDonald Lodge. For a limited number of days we have measures of traffic from both years. Although visitation in 2014 was 8% above 2012, the number of vehicles entering the Park through the West Entrance and St. Mary in July and August was about 9% higher in 2014 than in 2012.<sup>14</sup> We include a 9% increase in the 2012 values in Figure 12 for comparison. We see that the 2014 values were generally slightly higher than the simple 2012 extrapolated by 9% predicted.<sup>15</sup> Therefore, extrapolation seems like a reasonable forecast for future use.<sup>16</sup>

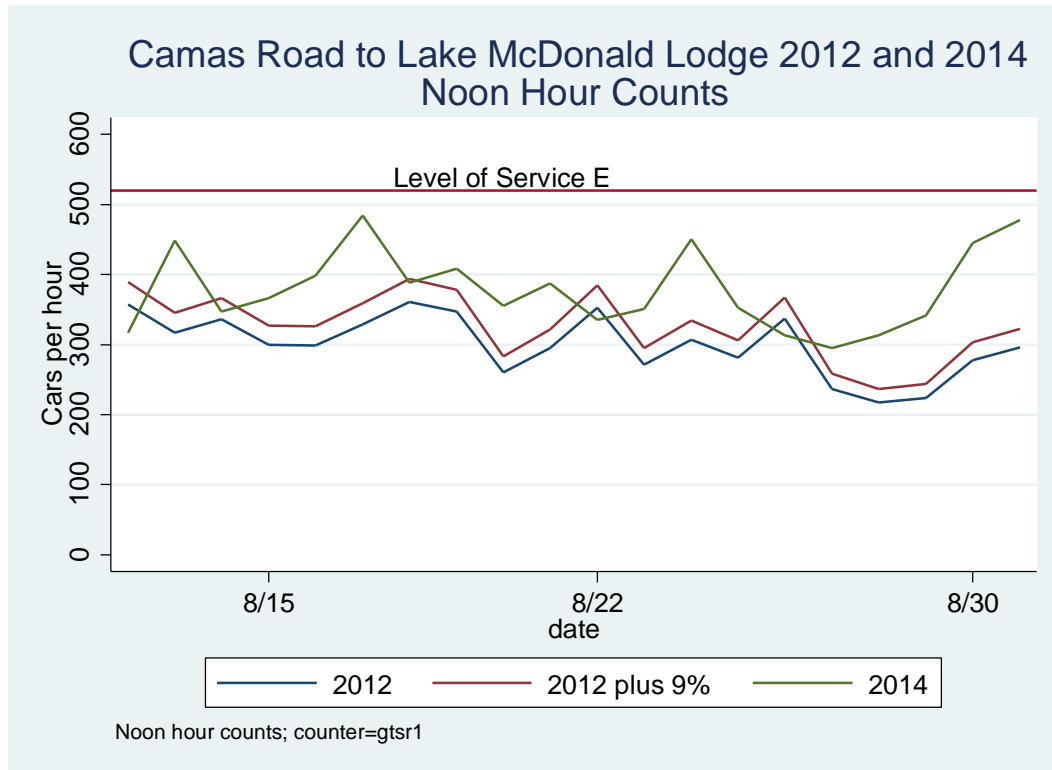
<sup>14</sup> <https://irma.nps.gov/Stats/Reports/Park> using Glacier NP and Traffic Counts by Location. Viewed 1-25-17.

<sup>15</sup> Other factors such as the amount and types of road construction inside and outside of the park could be impacting the comparison.

<sup>16</sup> This simple test assumes that the impacts of construction are equal in the two years.

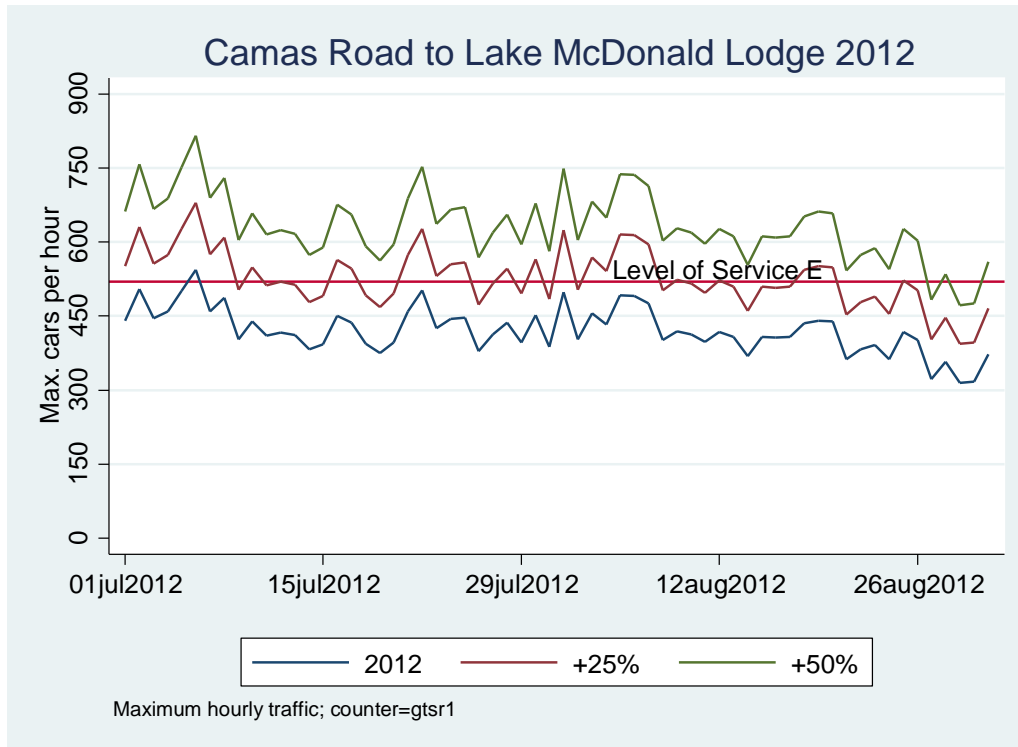


**Figure 12. Traffic on the Same Date and Hour in 2012 and 2014**



Figures 13 through 17 show the impact of increasing 2012 traffic levels by 25% and 50%. The overall impact is to move traffic levels to the middle of Level of Service E. For the stretch between the West Side Tunnel and Logan Pass, the Level F threshold is exceeded on 2 days with a 25% increase in traffic and 7 days for a 50% increase in traffic using July and August 2012 data.

**Figure 13. Extrapolation Camas Road to Lake McDonald Lodge 2012**



**Figure 14. Extrapolation Lake McDonald Lodge to Avalanche Creek 2012**

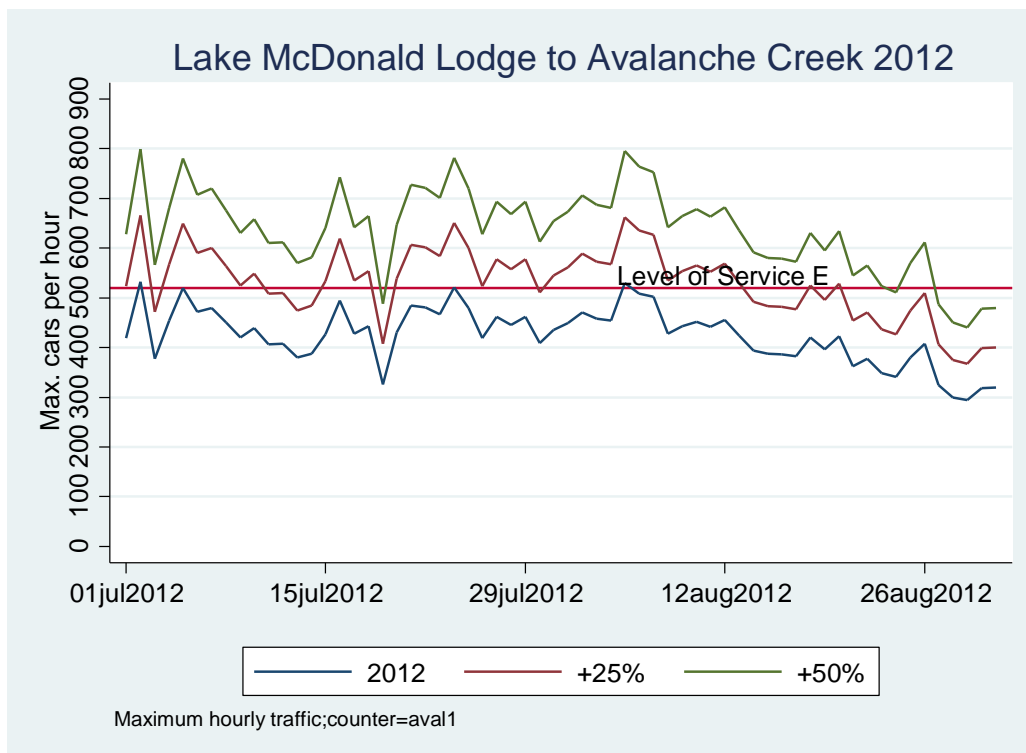


Figure 15. Extrapolation Avalanche Creek Campground to Logan Creek 2012

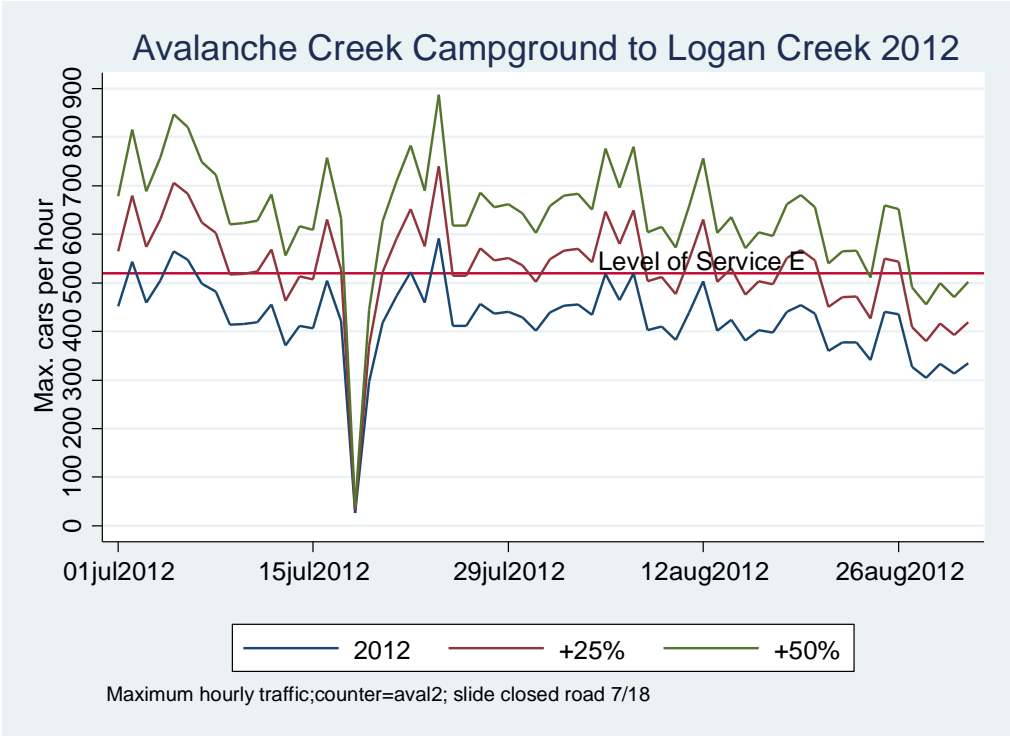
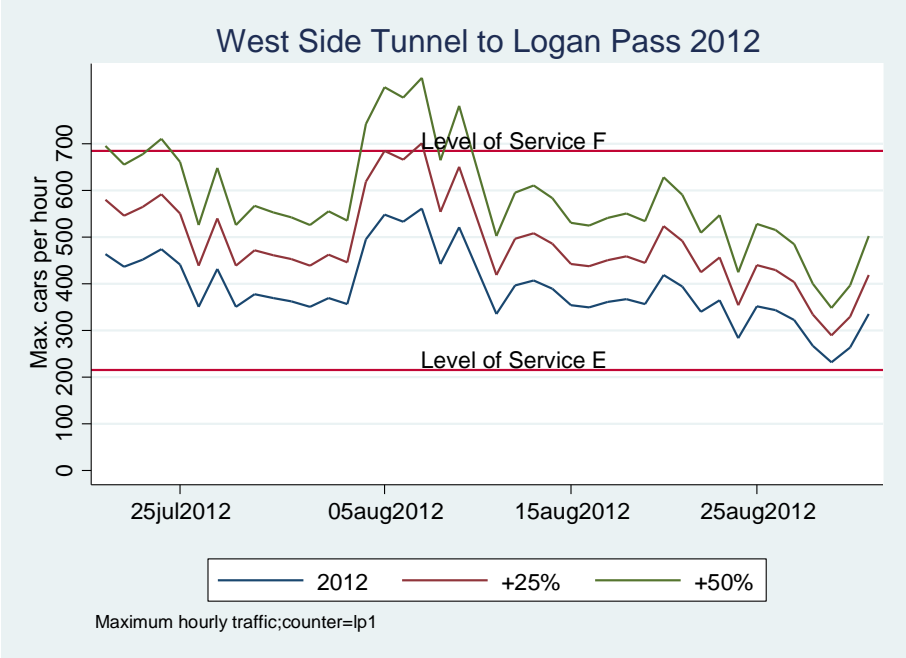
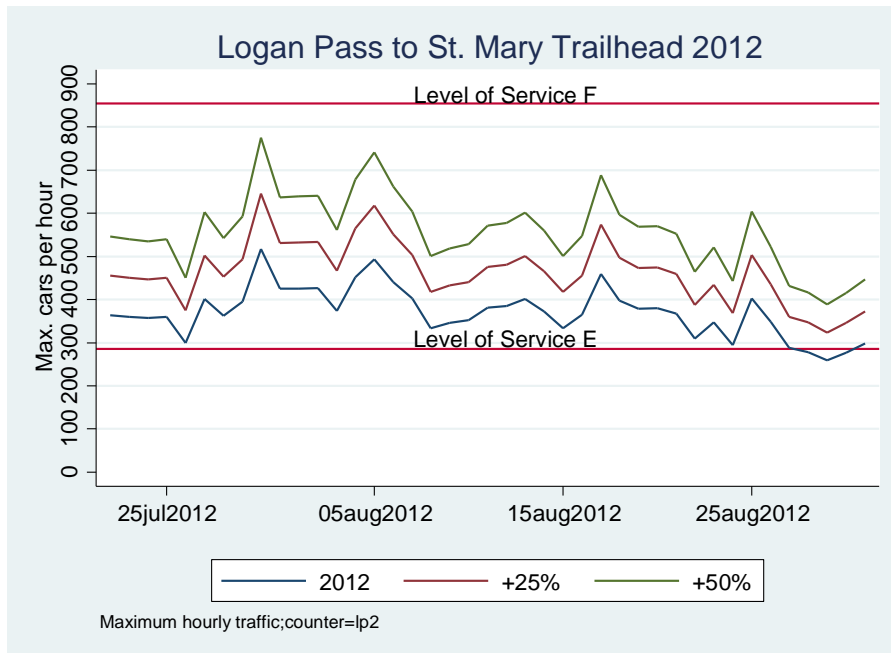


Figure 16. Extrapolation West Side Tunnel to Logan Pass 2012



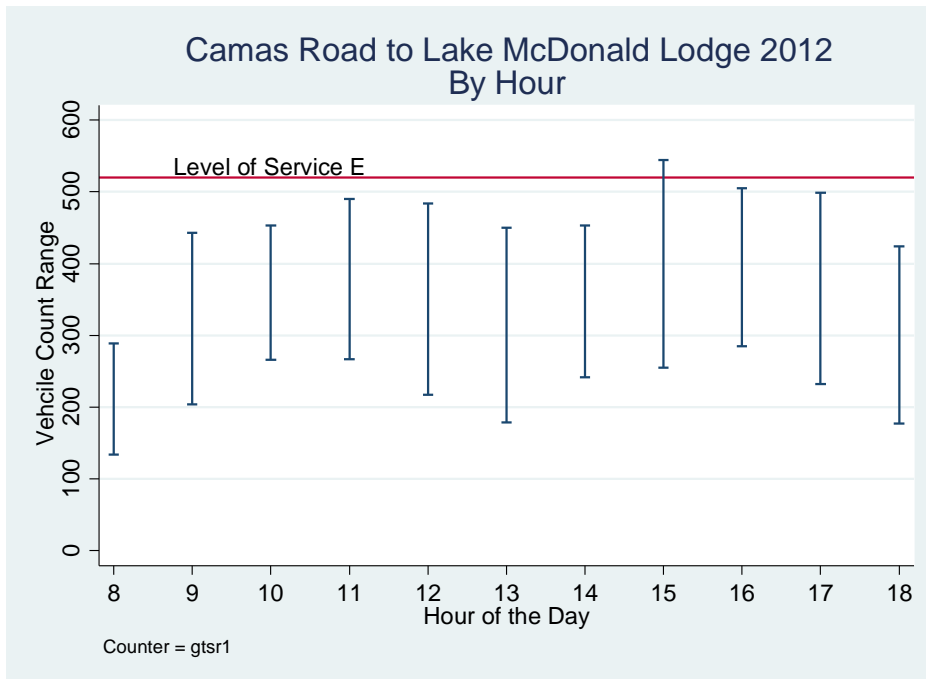
**Figure 17. Extrapolation Logan Pass to St. Mary Trailhead 2012**



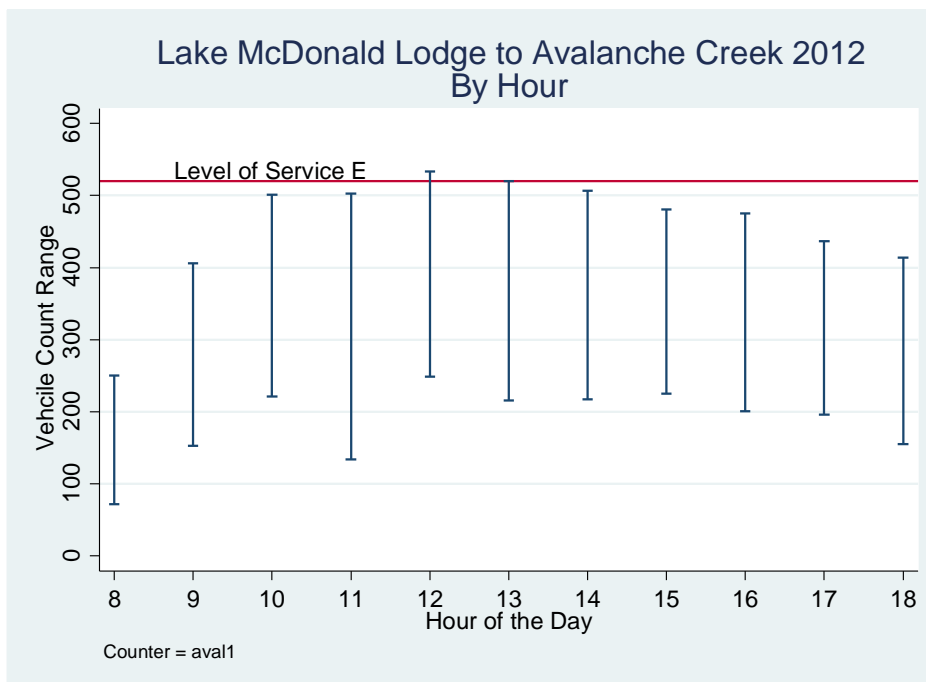
## DETAILED DATA BY HOUR OF THE DAY

Although maximum hourly counts are more consistent with the method traffic engineers conduct Level of Service analysis, it is instructive to examine hourly traffic counts versus the Level of Service standard. Figures 18 through 22 show the range of counts for each hour for measured days in July and August 2012 for key locations along the road.

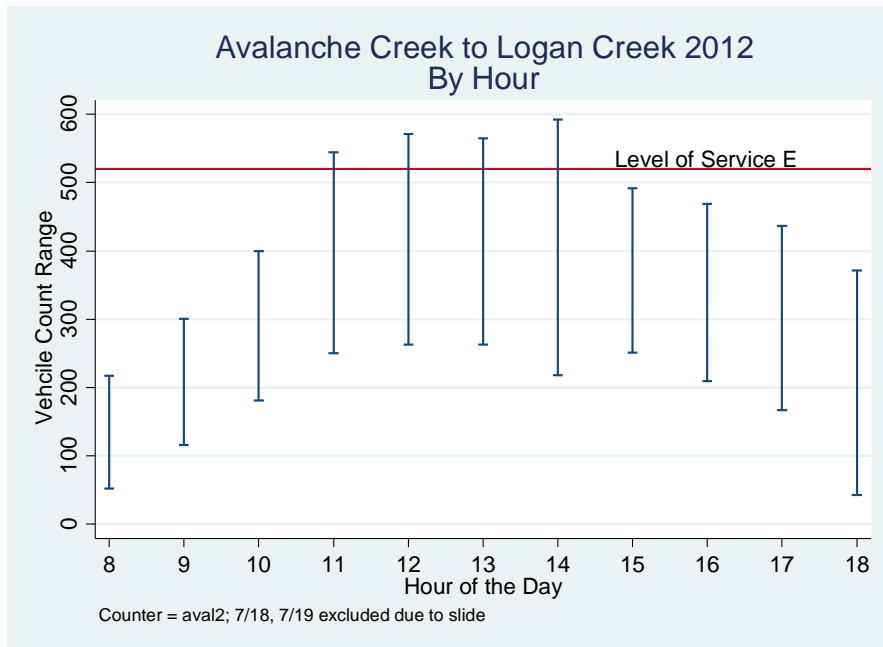
**Figure 18. Camas Road to Lake McDonald Lodge 2012 by Hour**



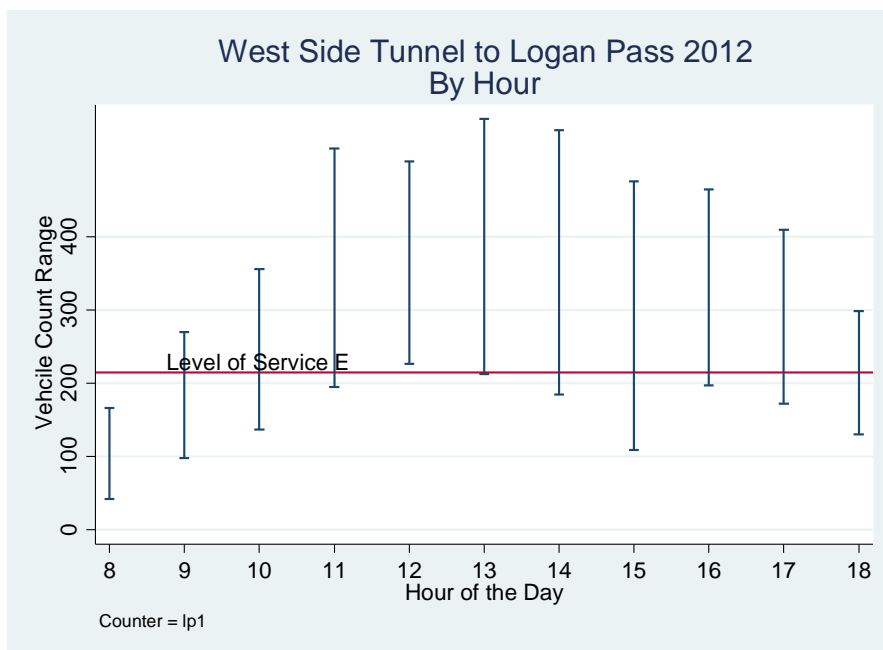
**Figure 19. Lake McDonald Lodge to Avalanche Creek 2012 by Hour**



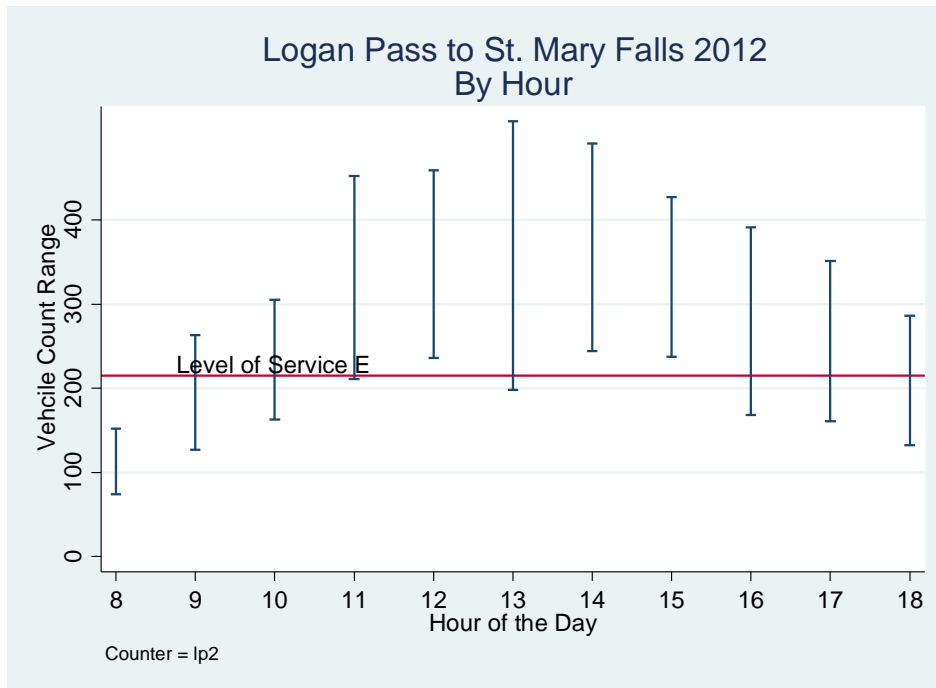
**Figure 20. Avalanche Creek to Logan Creek 2012 by Hour**



**Figure 21. West Side Tunnel to Logan Pass 2012 by Hour**

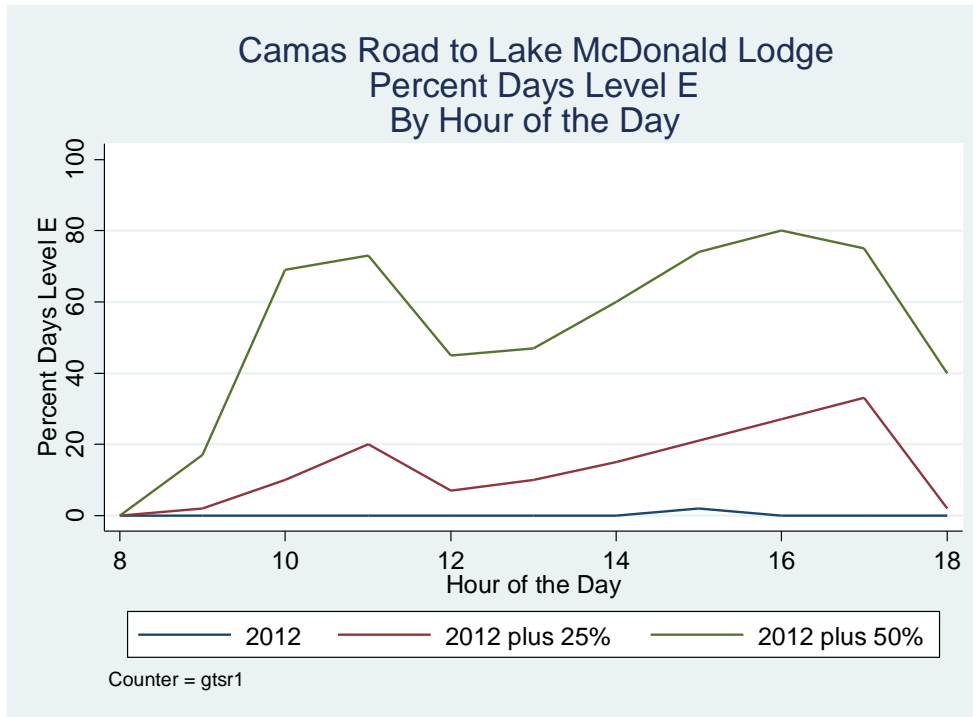


**Figure 22. Logan Pass to St. Mary Falls 2012 by Hour**



Figures 23 through 27 show the impacts of extrapolation on the hourly counts along Going-to-the-Sun Road. For each hour, we increase traffic and then calculate the percentage of days that exceed the Level E threshold for that hour. Simple extrapolation is a very strong assumption for the hourly data as we would expect drivers have more flexibility over the course of a day than between days. However, it gives a sense for the times of day when congestion occurs. At a 25% increase, the road along Lake McDonald stays below Level E for a majority of days for each hour, however at a 50% increase, several hours exceed the threshold for level E for a majority of days. Logan Pass tells a different story where Level E is exceeded almost every day for most hours in the day with a 25% or 50% increase in traffic. Appendix Tables 1 through 5 show the tabular version of the impact of increasing traffic by 25% and 50%.

**Figure 23. Percentage of Days Level E by Hour of the Day: Camas Road to Lake McDonald Lodge**



**Figure 24. Percentage of Days Level E by Hour of the Day: Lake McDonald Lodge to Avalanche**

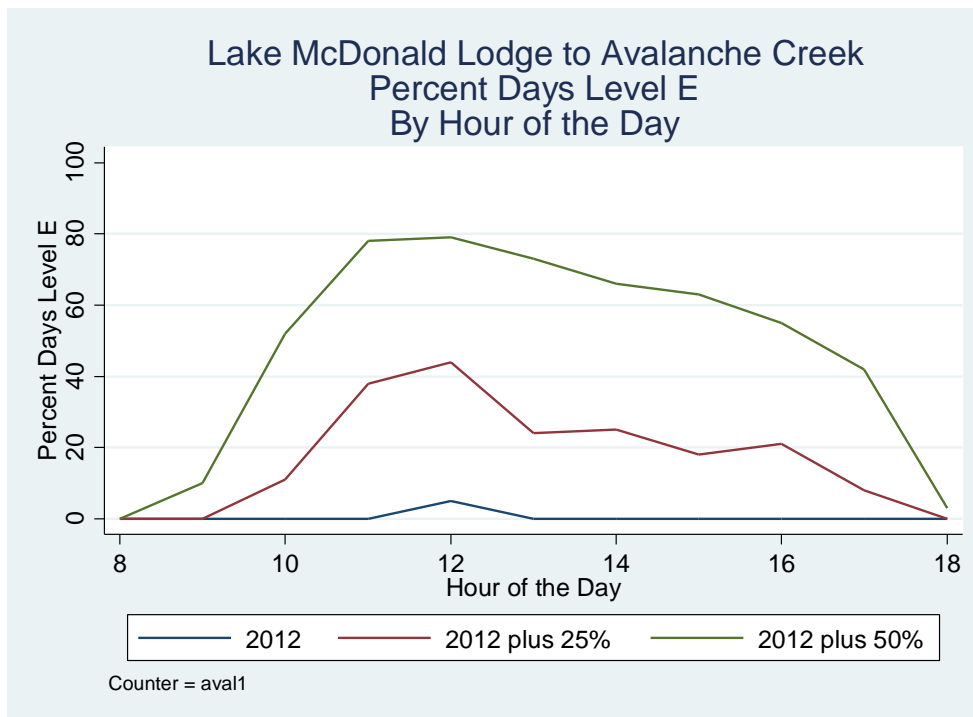




Figure 25. Percentage of Days Level E by Hour of the Day: Avalanche Creek Campground to Logan

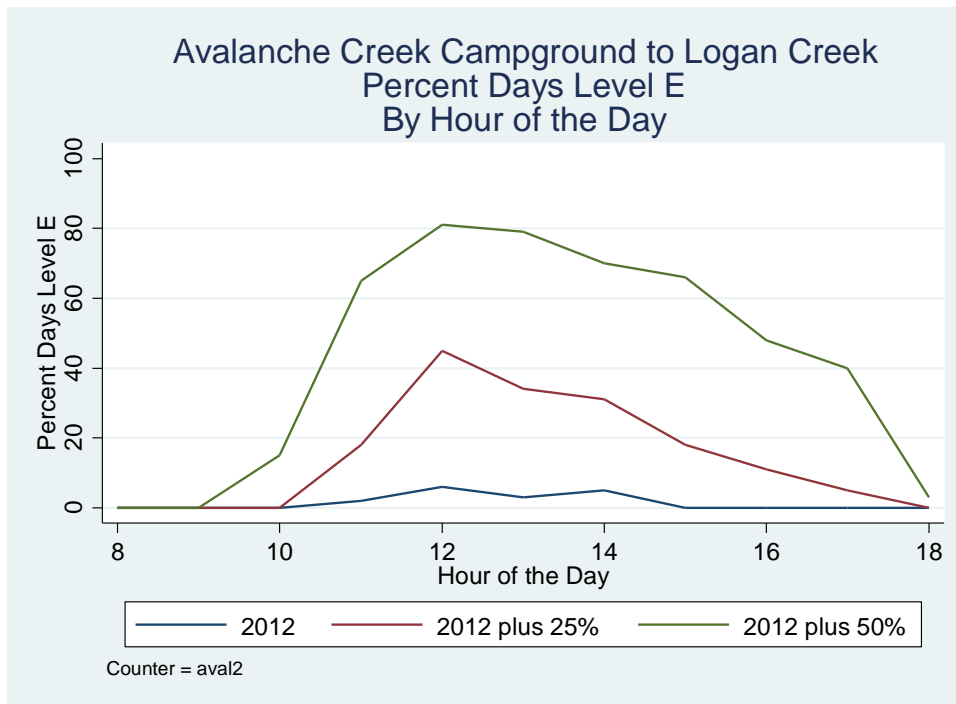


Figure 26. Percentage of Days Level E by Hour of the Day: West side Tunnel to Logan Pass

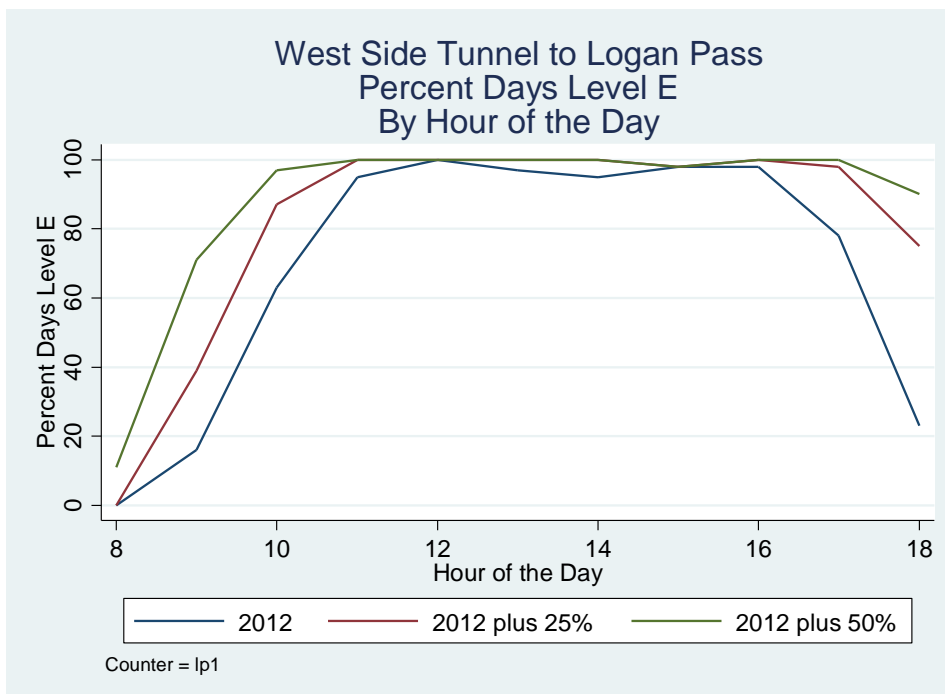
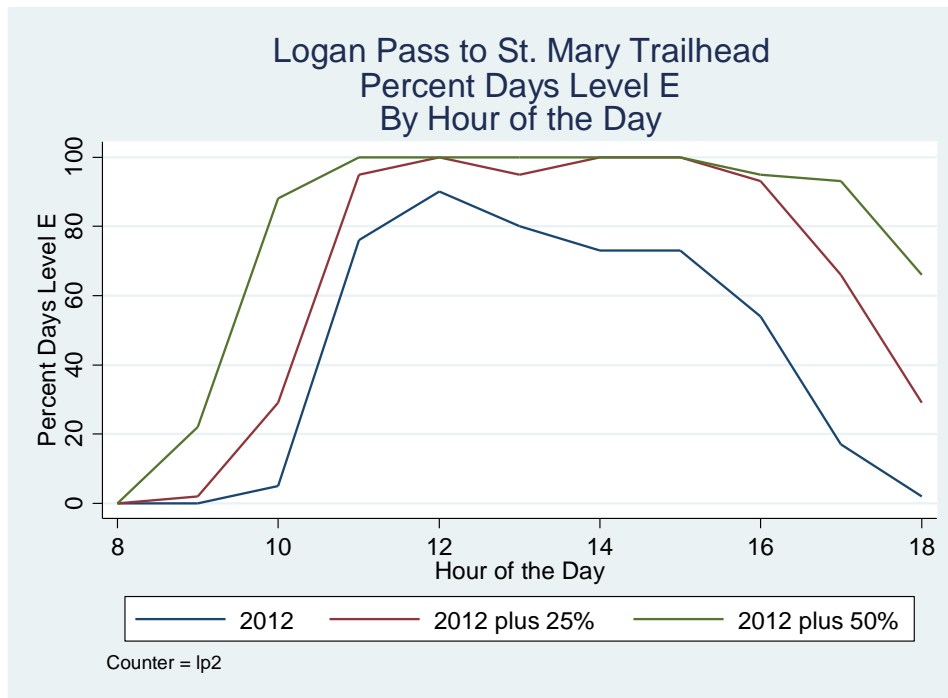


Figure 27. Percentage of Days Level E by Hour of the Day: Logan Pass to St. Mary Falls Trailhead



## CONCLUSIONS

Increasing visitation has brought increased congestion on Going-to-the-Sun Road. Traffic engineers define Level of Service E as having “volumes near capacity” with unstable flows. In 2012, along Lake McDonald, traffic volumes rarely reached Level of Service E. However, near Logan Pass, volumes frequently reached Level of Service E. A simple extrapolation shows that traffic would generally exceed the Level E threshold for most locations and would approach Level F near Logan Pass. Although simple extrapolation indicates the potential for a problem, simple extrapolation may not adequately measure drivers’ adjustments to congestion. In addition, traffic counts from this period of analysis may have been skewed by the road construction causing more bunching. Further monitoring after completion of construction may give a clearer picture of the challenges. In addition, management actions and driver adaptation to more congestion may spread traffic across the day and season and reduce congestion. Park planners may be able to prepare for this and design policies designed to mitigate the congestion problems if traffic volumes continue to grow.

## APPENDIX

**Appendix Table 1. Camas Road to Lake McDonald Lodge 2012 – Observed, +25%, +50%**

Hour of the day	Avg both directions 2012	Pct days Level E 2012	Avg both directions +25%	Pct days Level E at +25%	Avg both directions +50%	Pct days Level E at +50%
8	217	0%	272	0%	326	0%
9	301	0%	377	2%	452	17%
10	364	0%	456	10%	547	69%
11	379	0%	474	20%	569	73%
12	341	0%	427	7%	512	45%
1	343	0%	429	10%	514	47%
2	359	0%	449	15%	539	60%
3	381	2%	476	21%	572	74%
4	388	0%	485	27%	582	80%
5	388	0%	485	33%	582	75%
6	330	0%	412	2%	494	40%

61 observation days. Averages may not sum due to occasional missing observations. Counter = gtsr1a and gtsr1b.

**Appendix Table 2. Lake McDonald Lodge to Avalanche Creek 2012 – Observed, +25%, +50%**

Hour of the day	Avg both directions 2012	Pct days Level E 2012	Avg both directions +25%	Pct days Level E at +25%	Avg both directions +50%	Pct days Level E at +50%
8	183	0%	229	0%	274	0%
9	282	0%	352	0%	423	10%
10	351	0%	438	11%	526	52%
11	392	0%	490	38%	588	78%
12	401	5%	501	44%	602	79%
1	372	0%	465	24%	558	73%
2	366	0%	458	25%	549	66%
3	361	0%	452	18%	542	63%
4	355	0%	444	21%	533	55%
5	341	0%	427	8%	512	42%
6	254	0%	317	0%	381	3%

62 observation days. Averages may not sum due to occasional missing observations. Counter = aval1a and aval1b.

**Appendix Table 3. Avalanche Creek Campground to Logan Creek 2012 – Observed, +25%, +50%**

Hour of the day	Avg. both directions 2012	Pct. days Level E 2012	Avg. both directions +25%	Pct. days Level E at +25%	Avg. both directions +50%	Pct. days Level E at +50%
8	134	0%	167	0%	201	0%
9	208	0%	260	0%	312	0%
10	287	0%	359	0%	431	15%
11	365	2%	456	18%	547	65%
12	397	6%	496	45%	596	81%
1	384	3%	480	34%	576	79%
2	377	5%	471	31%	565	70%
3	356	0%	446	18%	535	66%
4	341	0%	426	11%	511	48%
5	333	0%	416	5%	499	40%
6	232	0%	290	0%	348	3%

62 observation days. Averages may not sum due to occasional missing observations. Counter = aval2a and aval2b.

**Appendix Table 4. West Side Tunnel to Logan Pass 2012 – Observed, +25%, +50%**

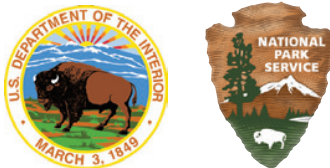
Hour of the day	Avg. both directions 2012	Pct. days Level E 2012	Avg. both directions +25%	Pct. days Level E at +25%	Avg. both directions +50%	Pct. days Level E at +50%
8	100	0%	125	0%	149	11%
9	168	16%	210	39%	252	71%
10	235	63%	294	87%	353	97%
11	320	95%	400	100%	480	100%
12	344	100%	430	100%	516	100%
1	354	97%	443	100%	532	100%
2	330	95%	413	100%	496	100%
3	322	98%	403	98%	484	98%
4	311	98%	389	100%	467	100%
5	255	78%	319	98%	383	100%
6	195	23%	244	75%	293	90%

42 observation days. Averages may not sum due to occasional missing observations. Counter = lp1a and lp1b.

**Appendix Table 5. Logan Pass to St. Mary Trailhead 2012 – Observed, +25%, +50%**

Hour of the day	Avg. both directions 2012	Pct. days Level E 2012	Avg. both directions +25%	Pct. days Level E at +25%	Avg. both directions +50%	Pct. days Level E at +50%
8	113	0%	142	0%	170	0%
9	173	0%	216	2%	260	22%
10	222	5%	278	29%	333	88%
11	322	76%	402	95%	483	100%
12	348	90%	435	100%	522	100%
1	335	80%	419	95%	503	100%
2	327	73%	408	100%	490	100%
3	312	73%	390	100%	468	100%
4	288	54%	361	93%	433	95%
5	246	17%	308	66%	369	93%
6	205	2%	257	29%	308	66%

42 observation days. Averages may not sum due to occasional missing observations. Counter = lp2a and lp2b.



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

GLAC 117/156281  
September 2019



