United States Department of the Interior

NATIONAL PARK SERVICE

GRAND TETON NATIONAL PARK
P.O. DRAWER 170
MOOSE, WYOMING 83012

IN REPLY REFER TO:

4.A(GRTE)

FEB 18 2014

Ms. Clara Conner
Division Engineer
Western Federal Lands Highway Division
610 East Fifth Street
Vancouver, WA 98661

Dear Ms. Conner:

We appreciate receipt of the Moose-Wilson Corridor Road Safety Audit (RSA) Report dated February 13, 2014. Visitor safety is a top priority for the park and the NPS would like to thank the RSA team for their efforts in independently conducting the RSA and preparing the report. The report will be used to inform the Moose-Wilson Corridor Comprehensive Management Plan and Environmental Impact Statement (Plan/EIS), which is expected to be finalized in late 2015. The Record of Decision from that Plan/EIS will serve as a more complete response to the RSA report.

Over the past two decades the Moose-Wilson Road within Grand Teton National Park has experienced a substantial increase in traffic volumes. The road is open to vehicles seasonally each year, generally from May through October, and its primary purpose as a park road is to provide visitors with opportunities to enjoy the area through which it passes. We appreciate recognition in the RSA of constraints that affect the NPS management of the corridor. We will consider these recommendations during the Plan/EIS with park resources and values in mind.

We appreciate that the report identifies positive safety attributes of corridor roads such as, surface conditions, warning and guidance signs and other road characteristics that keep speeds slow and reduce the number and severity of incidents. This information will be used by the NPS in both our on-going maintenance and planning efforts in the corridor.

As part of our commitment to safety, there are some recommended items that can be addressed in the near future outside of the planning process. Specific examples include improving the visibility, clarity and consistency of signs throughout the corridor. We will also consider longer closure periods as recommended by the report during scheduled road grading and dust abatement treatments beginning in 2014.

The report's mid and long term recommendations will be considered during the Plan/EIS. The RSA report recommended considering enhanced education regarding the corridor, vehicle management strategies, and opportunities to help improve the cycling experience in the corridor,

among others. We intend to consider one or more alternatives in the Draft EIS that would allow for construction of a separated multi-use pathway, including a pathway the full length of the corridor.

This report references preliminary data collected by Utah State University (USU). In summer 2014, the park will receive a final technical report from USU on the data collected during summer 2013 regarding the levels, types and patterns of visitor use in the corridor. This technical report from USU will also inform the Plan/EIS.

Thank you for your continuous support of efforts to provide for the safety of visitors to the Moose-Wilson Corridor.

Sincerely,

Kevin Schneider
Acting Superintendent
Grand Teton National Park
John D. Rockefeller, Jr. Memorial Parkway

cc: Sue Masica, Regional Director Intermountain Region, NPS
Victoria Brinkly, Highway Safety Engineer, WFLHD FHWA
Sean O'Malley, County Engineer, Teton County, WY
Craig Allred, Transportation Specialist, FHWA Resource Center
Allen Olsen, Safety Engineer, Wyoming Division, FHWA
Lance Johnson, Safety and Traffic Program Manager, Idaho Division, FHWA
Barbara Burke, Highway Safety Engineer, Central Federal Lands, FHWA

U.S. Department
of Transportation
**Federal Highway
Administration**

Western Federal Lands Highway Division
610 E. Fifth Street
Vancouver, WA 98661
Phone 360-619-7700
Fax 360-619-7846

February 18, 2014
Sent via electronic mail

In Reply Refer To: HFL-17

Kevin Schneider, Acting Superintendent
Grand Teton National Park
P.O. Drawer 170
Moose, WY 83012-0170

Re: Moose-Wilson Road Corridor Road Safety Audit Report
WY NPS GRTE 100(3)

Dear Acting Superintendent Schneider:

We are pleased to announce the completion of the Moose-Wilson Road Corridor Safety Audit (RSA) report, which concludes the work of the RSA team. A copy of the final report is attached.

In June 2013 Grand Teton National Park requested an RSA be conducted on the existing conditions of the Moose-Wilson Road due to safety concerns within that corridor. This request was made after noticing an increase in bicycle traffic due to the completion of pathways both inside and outside the Park. The RSA Team conducted a field review on September 9-11, 2013, and presented, to the Park, an overview of identified safety issues and suggestions for improvement. These issues and improvements are described in the completed RSA report, along with additional background information. Additional data collected since the field review may help refine the suggested improvements and could lead to the identification of other potential areas for improvement.

Our many thanks go out to the RSA team which included Teton County staff, FHWA Resource Center, Western Federal Lands, Central Federal Lands, FHWA Wyoming Division and the FHWA Idaho Division. We would also like to thank the Park staff for their participation and contributions to the Moose-Wilson Corridor RSA by providing data, resources, and meeting arrangements during the field review.

The next step in the RSA process is a formal response from the Park to the RSA Team. It should summarize the Park's response to the suggestions detailed in this report. Responses can be sent to Tori Brinkly, Highway Safety Engineer WFLHD, for distribution to the team.

Sincerely,

Clara H Conner

Clara H. Conner
Division Engineer

CHC/pjw

Ecc: Craig Allred, FHWA Resource Center
Barbara Burke, Highway Engineer, Central Federal Lands
Allen Olsen, Highway Engineer, FHWA Wyoming Division
Lance Johnson, Safety Program Manager, FHWA Idaho Division
Sean O'Malley, Teton County
Jon Christensen, Landscape Architect, Grand Teton National Park
Greg Gifford, Project Manager, WFLHD
George Fekaris, Transportation System Planner, WFLHD

Grand Teton National Park

Moose-Wilson Corridor Road Safety Audit

Conducted September 9-11, 2013

Prepared for:
Grand Teton National Park

Prepared By:
Victoria Brinkly, Western Federal Lands, FHWA
Craig Allred, FHWA Resource Center

February 13, 2014

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Attachment A: RSA Team and Available Documents

Introduction

A Road Safety Audit (RSA) is "a formal safety performance examination of an existing or future road or intersection by an independent audit team."[1] The primary focus of an RSA is safety while working within the context of mobility, access, surrounding land use, resource protection, and/or aesthetics. RSAs enhance safety by identifying potential safety issues affecting all road users under all conditions and suggesting measures for consideration by the design team or responsible agency.

An RSA is not simply a standards check. Standard checks are part of the design process to ensure adherence to design standards and guidelines. Although the RSA team may identify safety issues by comparing items of concern to standards, the general intention of the RSA is to identify areas where applied standards may interact with road user behaviors to generate a list of potential safety issues.

Purpose and Background

The purpose of this RSA was to assess the safety of the diverse users of the Moose-Wilson Road corridor, in Grand Teton National Park (Park), Wyoming. The Park initially requested a Bike RSA be conducted on the Moose-Wilson Road corridor since they have noticed an increase in bicycle use on the road after the 2012 completion of the shared-use pathway from Gros Ventre River to Moose Junction. After further discussions with the Park it was agreed that the RSA should not focus primarily on bicycle users, but assess safety for all users within the Moose-Wilson Road corridor.

The RSA team was comprised of individuals with a variety of backgrounds including: engineering, planning, construction, and traffic safety. The RSA Team included representatives from the Teton County Engineering Department, the Wyoming Department of Transportation, and the Federal Highway Administration's (FHWA) Resource Center, Federal Lands Highway Divisions, and Federal Aid Divisions.

[1] FHWA Road Safety Audit Guidelines, Publication No. FHWA-SA-06-06. Available: http://safety.fhwa.dot.gov/rsa/guidelines/

Grand Teton National Park, shown in Figure 1, was established in 1929 and expanded to its current size in 1950. The park has approximately 2.5 million recreational visits per year, with the peak visitation season extending from June through September; in 2012 the park averaged around 530,000 visitors per month during this period.[2]

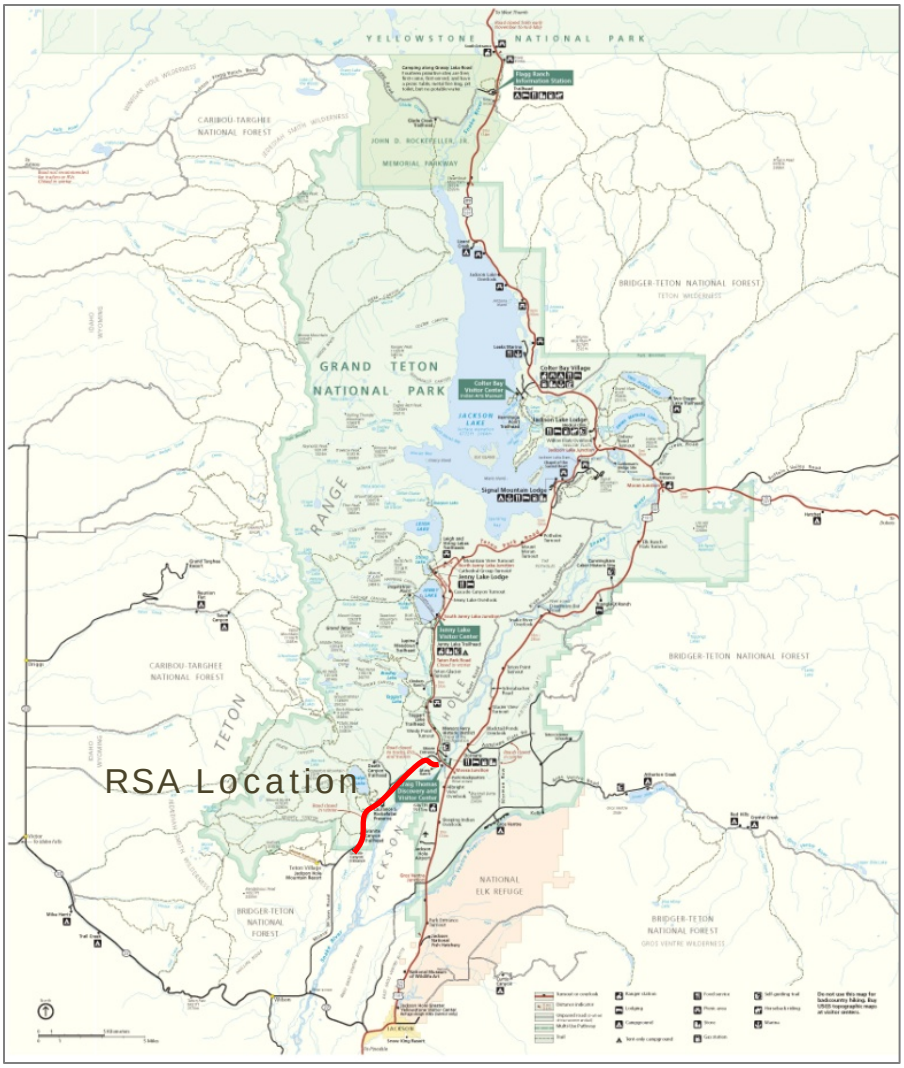

Figure 1. Map of Grand Teton National Park

The 310,000 acre park is approximately 45 miles in length and 25 miles in width and has varying terrain ranging from the sagebrush filled valleys at an elevation over 6,000 feet to the Teton Range with the highest peak at an elevation of 13,770 feet. Average temperatures range from highs around 70 degrees (F) in the summer to lows in the single digits in the winter, with snow blanketing the park from early November through May. The highest temperature ever

[2] National Park Service. Visitor Use Statistics for the Grand Teton National Park. Available: https://irma.nps.gov/Stats/

recorded was 92 degrees in 2003 and the lowest was -63 degrees in 1933.[3] Average precipitation for the year ranges from 1.35 inches in August to 2.59 inches in January.[4]

There are a variety of ways to experience the park from boating and fishing, mountain climbing and hiking, to driving or biking or horseback riding through wildlife and scenic areas. Skiing and snowshoeing are also popular winter activities, especially in the Moose-Wilson Road corridor. There are three visitor centers, six campgrounds, 200 miles of hiking trails, and over 100 miles of paved roads and 14.5 miles of shared use paths available for walking, rollerblading and biking. The first 8 miles of shared use paths in the park were opened in 2009. The park opened a second phase of its system in spring 2012 which connected Moose south to the Gros Ventre River passing through Gros Ventre Junction. This segment connects to a Jackson Hole Community Pathways segment which extends south from the river to the Town of Jackson, Wyoming. The Jackson Hole Community Pathway system also has a route along WY 390, which extends from WY 22 north to the Park boundary at Granite Canyon Entrance Station.

The Moose-Wilson Road corridor is about 10,300 acres in size and is located in the southwest corner of the park. The corridor is an outstanding representation of the Park's major natural ecological communities, all of which are located within a geographical area less than five miles in width and seven miles in length. This corridor is enclosed roughly by the Teton Range to the west, the Snake River to the east, the Teton Park Road to the north, and the Park's south boundary. The corridor contains several visitor use areas, including: Death Canyon and Granite Canyon trailhead parking areas; Laurance S. Rockefeller (LSR) Preserve; White Grass Ranch and Murie Ranch historic districts; Sawmill Ponds overlook; Poker Flats horse trails; and the Snake River levee road.

In 2007, property owned by Laurance S. Rockefeller was transferred to the NPS and opened to the public in 2008 as the Laurance S. Rockefeller (LSR) Preserve. The 1,106 acre property, straddling the Moose-Wilson Road, had been a Rockefeller family's western retreat since the 1930s and was the largest inholding in the Park since its establishment. The LSR Preserve is subject to a conservation easement and property maintenance plan that establishes the standards and conditions that the Park must meet in its management and operations to ensure that it will remain as it is, and will always provide that contemplative experience that was so important to Laurance S. Rockefeller.

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[3] The Weather Channel. Monthly Averages for Grand Teton National Park. Available: http://www.weather.com/weather/wxclimatology/monthly/graph/WYNPGRTE:13

[4] National Park Service. Grand Teton National Park. Things to Know Before You Visit-Weather. Available: http://www.nps.gov/grte/planyourvisit/weather.htm

This RSA reviewed the roadways within the Moose-Wilson Road corridor to assess the safety of visitors who use the corridor for a variety of purposes, including scenic touring, wildlife viewing, hiking, cycling, and other recreational opportunities.

Study Area

The location for this RSA was the Moose-Wilson Road corridor, including three other intersecting roads within this corridor: the road to the Murie (Ranch) Center, the road to the Death Canyon Trailhead, and the road and parking lot at the Laurance S. Rockefeller Preserve (LSR). The RSA only covered roads open to the public and therefore did not include private (e.g., Poker Flats) or administrative (e.g., levee access) roads within the corridor. The RSA Team conducted cursory reviews of the intersecting roads and features within this corridor, but spent the majority of the field review on the main Moose-Wilson Road. This corridor is located on the southwest corner of the park, between Moose and Teton Village, as shown in Figure 2.

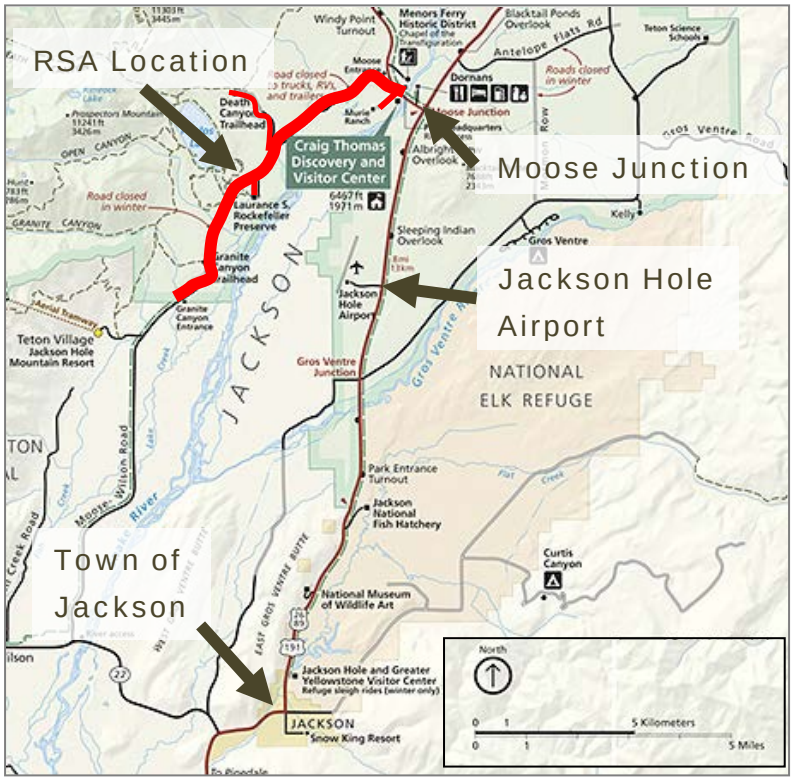

Figure 2. RSA Location

Existing Conditions

Site Characteristics

The Moose-Wilson Road is the primary access to destinations within the corridor, and extends 7.7 miles northward from the terminus of WY 390 at the Park's Granite Canyon Entrance to the Teton Park Road in Moose. The narrow, winding , partially gravel road provides "back door" access to the south end of the Park, and a rustic, slow driving experience for visitors looking for exceptional scenery and wildlife viewing opportunities. The road is also used by some residents and visitors along the increasingly developed WY 390 corridor as a perceived shortcut to the airport and other destinations within or beyond the Park during the summer months. Although the Moose-Wilson Road provides the shortest distance between Teton Village (on WY 390) and the airport (on US26/89/191), the slow speeds and frequent delays along the road may make the travel time longer during the 6 months (May through October) that the road is generally open. With increasing vehicle traffic volumes, congestion along this narrow, rustic, country road has become more common, affecting protection of wildlife and other resources, visitor safety and experience, and Park operations.

Figure 3. Moose-Wilson Road

The study area consists of the Moose-Wilson Road from the intersection with Teton Park Road in Moose to the Granite Canyon Entrance Station in the southwest corner of the Park. The road meanders through sagebrush, wetlands, and alpine and subalpine forested areas. The route was established in the late 1800s as a wagon road to local ranches and residences,[5] and has evolved over time into a road that has about five miles of paved surface at the north end, just over one mile of gravel surface in the middle, and about one mile of paved surface at the south end. The primary intersecting roads include: the Murie Center access road, a short gravel road; the LSR Preserve entrance road, a short paved road; and the Death Canyon Road which has approximately three-quarter miles of paved surface and one mile of rough dirt surface.

[5] National Park Service, Grand Teton National Park, Class III Cultural Resource Inventory of the Moose-Wilson Road Realignment Project

The Moose-Wilson Road is a two-way facility and RSA Team field review measurements showed widths ranging from approximately 17-22 feet. The speed limit for the majority of the route is 25 MPH, though there are 35 MPH sections at the far northern and southern ends of the route. The other intersecting roads are no wider than 19 feet and do not have posted regulatory speed limits. On the paved sections of the Moose-Wilson Road, pavement markings have faded or are completely obliterated. There are some unpaved Park-developed parking areas at trailheads and key wildlife viewpoints, along with some user-created pullouts, that provide parking for wildlife viewing opportunities or the passing of stopped or slow moving vehicles.

Signing on the route consists of some warning signs, guide signs, and regulatory signs. Pedestrian crossings, a single-lane bridge and some curves are signed, but there are generally few advanced warning signs. In addition, many signs are obscured by vegetation, or have inconsistent or unclear language that may not be understood by visitors.

Figure 4. Obscured and Confusing Signs

Some of the most rich and diverse wildlife habitat in the Park can be found in the Moose-Wilson Road corridor, which has led to it becoming a popular visitor destination. Grizzly bears have inhabited the corridor since 2008, and other wildlife species (including black bears, moose, elk, deer, gray wolves, coyotes, and beavers) are also present in the corridor. The closeness of food sources to the road has led to increased viewing opportunities for visitors, which causes frequent “wildlife jams” and the likelihood of unacceptable wildlife-human interactions.

Figure 5. Wildlife Jams

Traffic Data

The Park initiated a traffic data collection plan in July 2013 with the Utah State University[6] as part of a recreation ecology study of the Moose-Wilson Road corridor. Preliminary data was made available to the RSA Team and includes traffic counts and vehicle classification information at key locations along the route, along with some turning movement counts at two intersections. Figure 6 shows the locations of the preliminary traffic counts.

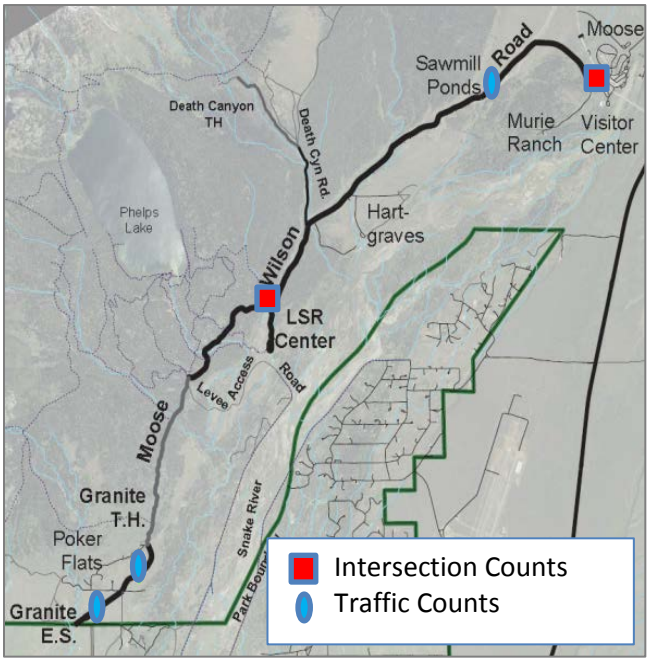

Figure 6. Traffic Count Locations

[6] Preliminary data was provided by the Utah State University (USU). This data is pending full analysis and review by USU, and is subject to change.

Preliminary traffic counts were taken near Sawmill Ponds and Poker Flats from June 5 through August 29, 2013. The average vehicles per day (VPD) at each of these locations ranged from 1800-2350 VPD near Sawmill Ponds and 1500-2200 VPD near Poker Flats, with the first half of August experiencing the highest volume of traffic.[7]

In addition to these traffic counts, seven days of vehicle counts were taken July 28-31, 2013, and August 9-11, 2013, near the Granite Canyon Entrance Station with a video system that could capture vehicle direction and bicycle presence.[7] While two days experienced technical issues with the counters, the other five days showed the directional split of the traffic as approximately 50/50, with an almost even number of entering and exiting traffic each day (Figure 7).

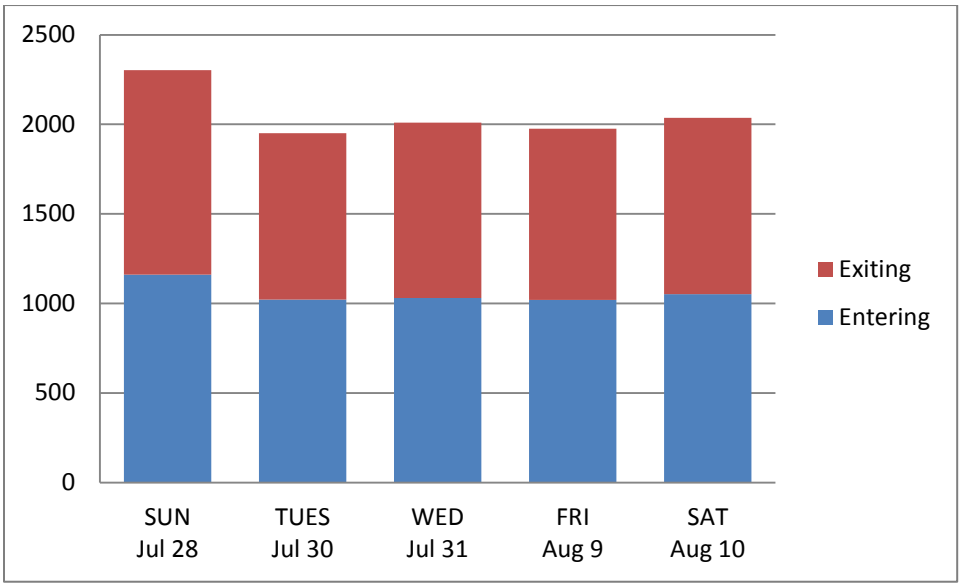

Figure 7. Directional Traffic at Granite Entrance Station

The traffic counts taken at the Granite Canyon Entrance Station were also evaluated for the morning and afternoon peak hours for traffic volume. The morning peak hour for both entering and exiting traffic was between 10:00-11:00 AM for both vehicles and bicycles. The afternoon peak hour for both entering and exiting vehicular traffic was between 4:00-5:00 PM, while the bicycle afternoon peak hour varied from as early as 12:00-1:00 PM to as late as 3:00-4:00 PM. The "Pick-up+" type vehicles (includes all vehicles that are pick-ups and larger) were not considered in the evaluation of the morning and afternoon peak traffic hours due to their small numbers and the variety of times of their peak presence.

[7] Ibid.

The counts taken at Granite Entrance Station also showed a distribution of 97-percent of the traffic being vehicular and 3-percent being bicyclist (Figure 8).

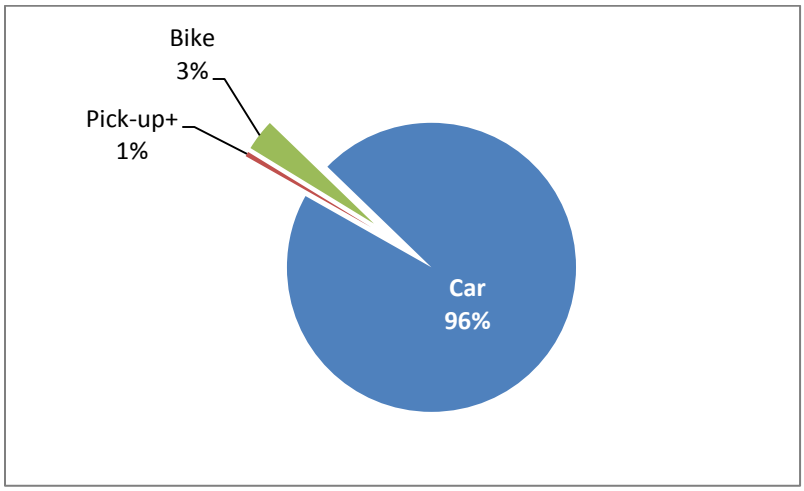

Figure 8. Average Distribution by Traffic Type

Intersection turning movements using a video system that could capture vehicle direction and bicycle presence were gathered at the intersection of Moose-Wilson Road with Teton Park Road (on Sunday, July 28, 2013) and at the intersection with the LSR Preserve (on Saturday, August 10, 2013).[8] This data also included vehicle type classification by car, pick-up+, bicycle, and motorcycle. This classification breakdown was only for the total daily and total peak hour traffic volumes, so the bicycle only peak hour traffic volumes are unknown at these intersections. The turning volume distributions based on the preliminary traffic counts are described in the following paragraphs.

For the Moose-Wilson and Teton Park Road intersection, the dominant traffic movements overall and for the AM and PM peak hours were the through movements on Teton Park Road. Secondary traffic movements included the left turns from the Park Headquarters and the right and left turns from northbound Moose-Wilson Road onto Teton Park Road. The majority of traffic at this intersection appears to be for the through movements on Teton Park Road as visitors enter and exit the Park. Figure 9 shows the overall traffic movements for July 28, 2013, with the red arrows designating the dominant movement from each direction. Bicycle presence at the Teton Park Road intersection was less than 1-percent of the total traffic volume, with the majority of bicycles heading east toward US89 or south on Moose-Wilson Road. However, it was unknown at the time of the RSA whether the bicycles were traveling on the roadway or the pathway along Teton Park Road.

[8] Ibid.

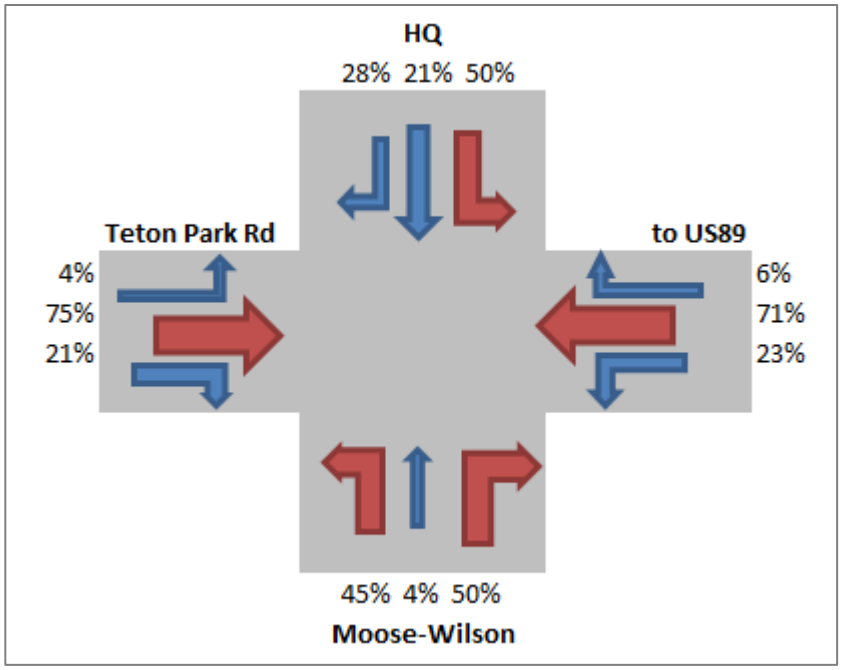

Figure 9. Moose-Wilson and Teton Park Road Intersection
(Distribution of Overall Turning Movements on July 28, 2013)

For the Moose-Wilson and LSR Preserve intersection, the predominant traffic movements overall and for the AM and PM peak hours were the through movements on Moose-Wilson Road and the right turns from the LSR Preserve onto Moose-Wilson Road. Figure 10 shows the overall traffic movements for August 10, 2013, with the red arrows designating the dominant movement from each direction. Bicycle presence at the LSR Preserve intersection was approximately 3-percent of the total traffic volume, with the majority traveling straight through in both directions on Moose-Wilson Road.

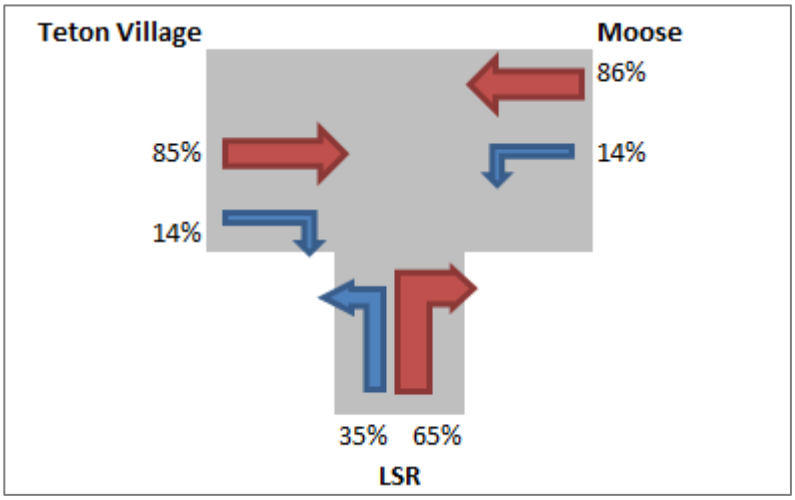

Figure 10. Moose-Wilson and LSR Preserve Intersection
(Distribution of Overall Turning Movements on August 10, 2013)

Collision Data

The Park provided data on 42 reported crashes between January 2002 and December 2012. This data did not include detailed information on crash locations or contributing factors, so the following summary only provides an overview of crash severity, collision types, and time of year. Anecdotally, the RSA Team also heard that there are several incidents of road rage that lead to physical confrontations between drivers, or between drivers and bicyclists, which may not be reflected in this data.

Based on the data from the Park, the crash frequency for Moose-Wilson Road is 3.8 crashes per year (42 crashes/11 years). There are not many roads similar enough to Moose-Wilson Road for in-depth comparisons, but Spring Gulch Road is a local county road with similar traffic volumes, surface conditions, and geometry. Crash numbers provided by Teton County reflects a crash frequency of 9.2 crashes per year, based on 95 crashes that occurred between January 2002 and April 2012 (95 crashes/10.3 years). It should be noted that the frequency calculation does not take into account seasonal closures of a road (which Moose-Wilson Road experiences) so it may still be difficult to compare these two roads based on their crash frequencies.

Approximately 90-percent of the crashes the Park provided information on were property damage only (PDO), with the remaining 10-percent consisting of three injury crashes (two involving bicyclists) and a pedestrian-involved "Other" incident with no reported injuries (Figure 11). The bicycle-related incidents were both bike vs. vehicle during peak visitation months and included one where a cyclist ran into a parked dump truck; both incidents resulted in minor injuries to the cyclists.

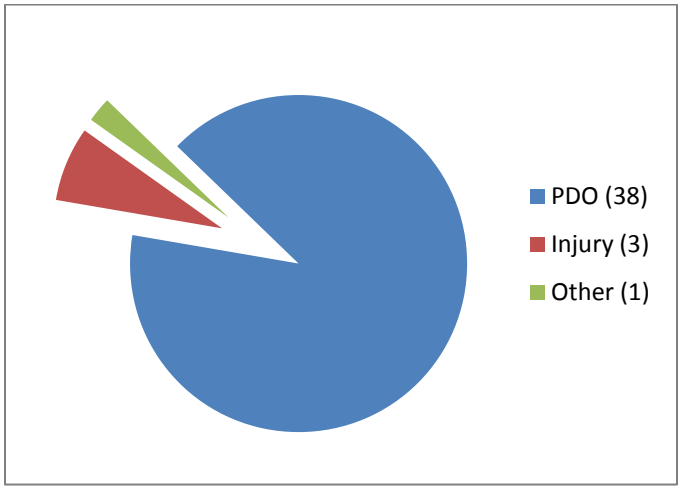

Figure 11. Distribution by Crash Type
(Number of crashes shown in parenthesis.)

Almost half of the crashes on Moose-Wilson Road involved single vehicles in run-off-road (ROR, 19 crashes) incidents and just over a third involved multiple vehicles (Multi, 16 crashes), as shown in Figure 12. The other reported incidents included collisions with wildlife (usually elk), bicyclists, a pedestrian, and an equestrian.

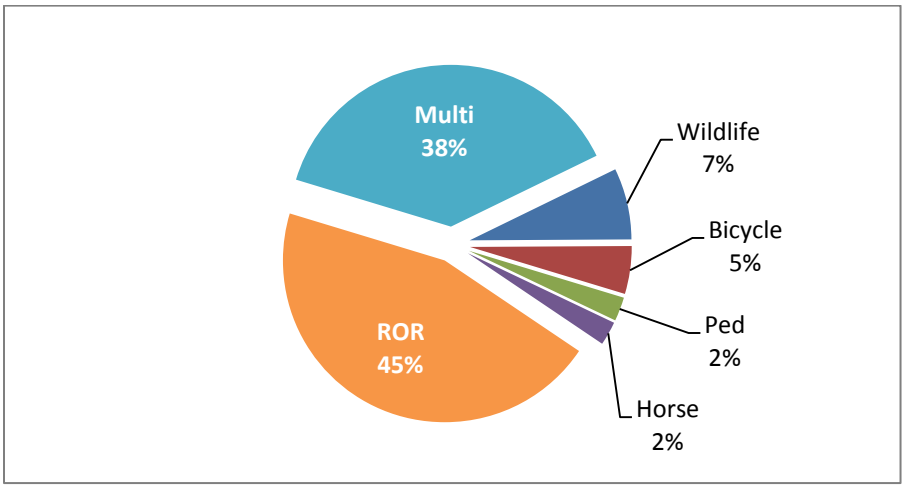

Figure 12. Crash Distribution by Collision Type

The data from the Park also showed that approximately 20-percent of total number of crashes involved government vehicles in run-off-road or multiple vehicle incidents. However, as the number of government vehicles present on the road at any given time is unknown, it is difficult to determine whether this crash involvement is out of the ordinary when compared to other travelers on the road. In addition, government employees most likely have a higher incident reporting rate when compared to the public, which could also affect this data. In either case, this may be something the Park may choose to investigate in the future as part of a more detailed crash data study and analysis.

The majority of the reported crashes happened between June and September, which are the historical peak visitation months of any year,[9] with about 26-percent of the crashes occurring during the other months (Figure 13). Almost half of that 26-percent occurred during October when the road is still open to traffic, while the remaining number of crashes occurred between November and May when the section between the Death Canyon Road intersection and the Granite Trailhead parking area is generally closed to motorized traffic.

[9] National Park Service. Visitor Use Statistics for the Grand Teton National Park. Available: https://irma.nps.gov/Stats/

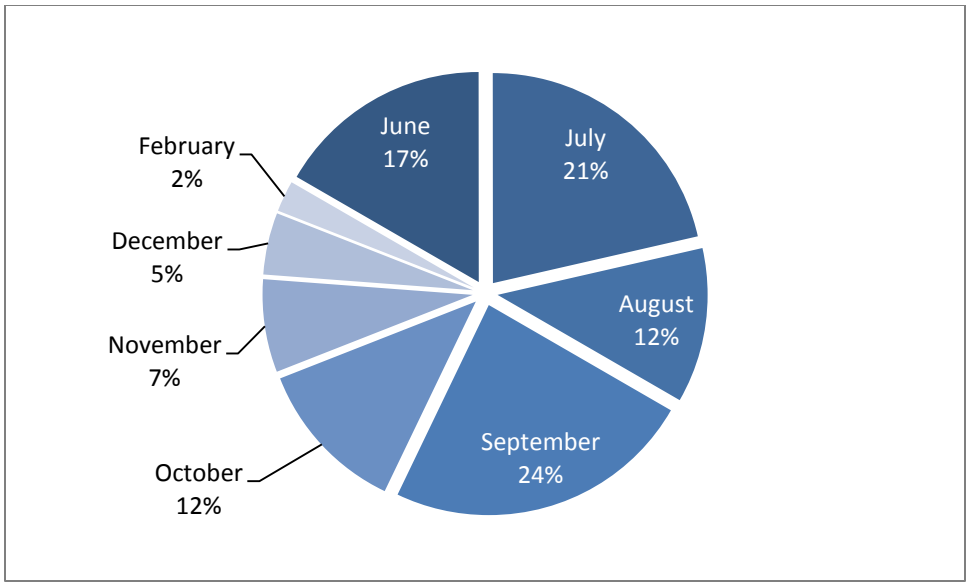

Figure 13. Crash Distribution by Month

No other information on citations or incident specifics was available or in a format that would allow detailed analysis of the data. Therefore, a review of the data based on weather conditions, road conditions, or driver behavior (e.g., speeding, DUI, etc.) was not conducted and is not covered in this report.

Assessment of Findings

Safety Benefits of Existing Roadway

While conducting the field review, the RSA Team noted positive features of the existing roadway, including the following.

- **Wildlife**: There are outstanding wildlife viewing opportunities throughout the Moose-Wilson Road corridor. Park staff is generally responsive to any wildlife-viewing traffic jams that occur, and take efforts to improve traffic flow, reduce wildlife/vehicle conflicts, and pedestrian/vehicle conflicts.

Figure 14. Park staff responding to "wildlife jam."

- **Surface Condition**: The unpaved section undergoes scheduled maintenance treatments three times per year to improve smoothness and compaction of the road. There is an awareness of surface concerns for both the paved and unpaved sections, and there is a desire to improve the conditions for ALL road users even if it is difficult to address everything with the resources on hand.
- **Road Characteristics:** Park staff and the public enjoy the rural, meandering characteristics of the road. The current road characteristics (e.g., narrow width, winding alignment, adjacent vegetation, limited sightlines, wildlife, and mixed traffic use) also tend to keep speeds low which most likely contributes to the low number of crashes and low crash severities, as well as contributing to the lack of wildlife injuries or deaths. Other characteristics of the corridor which may affect speed and driver behavior include the Granite Canyon Entrance Station, the single-lane bridge, the unpaved section, and the “wildlife jams.”
- **Positive Warning and Guidance:** There are signs to inform motorists of pedestrian crossings, a narrow bridge, horses, and vehicle restrictions. The hiking trails crossing Moose-Wilson Road also have signs and guidance to alert pedestrians of the upcoming intersection.
- **Visitor Experience:** Visitors driving in the corridor tend to accommodate other visitors and travel modes (like bicycles and horses), which improves the experience for everyone.

Constraints

Before examining the safety issues and suggestions for improvement, it was necessary to identify potential constraints. As the site is located in a National Park, there are environmental, historical, and visual impacts to consider when suggesting mitigation strategies.

Identified Safety Issues

The following is a detailed discussion of each of the safety issues identified during the RSA with suggestions for improvement. Detailed explanations of the suggested improvements are provided in the following section.

Traffic Control Devices

There are warning, guide, and regulatory devices present, but the messages may not be clear, vegetation may block the view of the devices, and lack of wayfinding through the route can leave some drivers asking pedestrians, "Is this the way to Moose?"

There are pedestrian crossings where the warning signs are situated right at the crossing instead of being in advance of the crossing. These crossings also have stone and colored concrete in the roadway which can be very difficult to distinguish under certain light conditions. Anecdotally, there are an increasing number of cyclists on the road due to the completion of the shared-use Pathways within and just outside the Park boundaries. However, there are few signs warning drivers about the presence of cyclists, especially where the road narrows. In addition, there are recently developed horse trail crossings which have no signs or markings at all.

Figure 15. Pedestrian Trail Crossing

Suggested Improvements to ensure the sign messages and pavement markings are adequate, visible, and effective:

- *Improve location of signs and sign messages*
- *Trim vegetation that block signs*
- *Prepare a sign replacement plan and an assessment or management method for addressing sign retroreflectivity (according to requirements in the Manual on Uniform Traffic Control Devices [MUTCD])*
- *Provide advanced warning and additional wayfinding/guide signing*

- *Provide painted pavement markings at pedestrian crossings and intersections*
- *Provide duplicate information and signing at each end of the corridor regarding conditions and/or restrictions*

Visitor Confusion and Conflicts

Drivers in this corridor are a mix of local residents, Park visitors, and commercial entities. Users of the corridor encounter numerous conflicts between other traffic types (e.g., bicycles, pedestrians, and equestrians), wildlife, and several drivers who are unsure about their location. The RSA team witnessed many drivers stopping in the middle of the road and exiting their vehicles to take photos of wildlife; asking for directions to Moose or Teton Village; driving oversize vehicles despite the presence of restriction signs; and passing on blind horizontal and vertical curves. Park staff have also witnessed these confused visitors and conflicts, and noted that some oversized vehicles access the Moose-Wilson Road through the Granite Canyon Entrance Station during hours when the station isn't manned.

Figure 16. Oversized Vehicle

Suggested Improvements to reduce confusion, conflicts, and unsafe operations:

- *Add wayfinding signs*
- *Improve information on vehicle restrictions and provide a uniform message on signs*
- *Provide designated space at the north end for oversized vehicles to turnaround*
- *Increase enforcement of traffic regulations in corridor*

Education

The Park recognizes the need to have a clear, concise message given to all users in order to enhance their experience while traveling along the Moose-Wilson Road. However, depending on the resource used to learn about the Moose-Wilson Road (e.g., fee station attendant, websites, newsletters, etc.), visitors may learn different things about the road surface condition, vehicle restrictions, and other users on the road. Skillful and prepared bicyclists can navigate the existing roadway with confidence, while less skilled bicyclists (e.g., children) may have experience challenges which could lead to more conflicts with other visitors. Differing messages between the park and other entities do not clarify whether the corridor is recommended for bicycle travel or what type of cycling ability/skill is needed for safely traversing the route.

Suggested Improvements to provide information to safely navigate the route:

- *Provide consistent message on corridor in published newsletters and on Park website*
- *Collaborate with other local agencies, companies, and groups on corridor awareness and a common message regarding visiting the corridor*
- *Consider the development of a bicycle route rating system*
- *Use social media as a way for conveying information to travelers*
- *Use variable message signs to inform the public of local conditions, including conditions on the unpaved section of the Moose-Wilson Road*

Maintenance

The RSA team heard that Park maintenance attempts to keep the road surface (paved and unpaved) in decent condition. However, Park personnel indicated that some maintenance activities (e.g., chemical treatments on the gravel section) are not allowed adequate time to conduct the work in a way that achieves maximum treatment durability. While the corridor may be closed without much notice when grizzlies or other wildlife are present, there is perceived pressure to limit road closures for maintenance activities, which sometimes require extensive public notifications. At times, scheduled maintenance activities occur during poor weather conditions that can compromise the effectiveness of the treatment, resulting in more rapid deterioration of the road surface. In addition, maintenance activities such as removing hazards from the roadside (e.g., tree stumps), eliminating pavement edge drop-offs, and clearing vegetation are not performed regularly due to limited availability of manpower and resources. Park personnel also have to manage the maintenance of current pullouts while keeping the expansion of existing or creation of new pullouts to a minimum.

Suggested Improvements to enhance the effectiveness of maintenance treatments and practices:

- *Create a maintenance plan which allows adequate road or lane closures during times of gravel treatments, pothole repair, roadside hazard clearing and other maintenance activities*
- *Increase the amount of publicity on closure durations and provide more flexibility due to changes in weather*
- *Remove stumps at edge of the road*
- *Improve sight distance around curves and at signs through selective brushing*
- *Develop a corridor-wide pullout strategy*
- *Address edge drop-offs in paved sections*

Travel Demand Management

Managing both the growth of and periodic shifts in traffic demand are necessary elements of managing traffic congestion and travel demand on a transportation system. Managing traffic congestion and travel demand can also contribute to improvements in safety through a reduction in exposure (i.e., lower traffic volumes) due to strategies such as limiting the number of visitors at any given time or restricting access by direction of travel or mode of transportation.

If recent traffic trends continue, the Moose-Wilson Road corridor will attract more visitors, and parking overflow and "wildlife jams" will become more prevalent. Currently the northbound vehicles must enter the Park through a fee station at the Granite Canyon Entrance, but southbound traffic is not required to enter through any control point. Therefore, northbound travelers may be informed by park staff of wildlife-viewing traffic jams, full parking areas, or other road conditions, but southbound travelers may know little about what lies ahead in the corridor. Other parks, such as Zion and Grand Canyon, have implemented measures to control where, when, or how visitors have access to certain park areas through limited transportation options, restricted directional movements (like changing operations from two-way to one-way), or restrictions based on season, time of day, or day of week. For example, the Zion National Park Shuttle System[10] was implemented in 2000 "to eliminate traffic and parking problems, protect vegetation, and restore tranquility to Zion Canyon." Private vehicles are allowed access to the canyon road during the non-peak months (November through March), but are banned from the road when the shuttle system operates during peak visitation months. Bicyclists are allowed on a shared pathway and all roads in the park, but can only be on the Zion Canyon Scenic Drive when the shuttles are operating.

Suggested Improvements enhance the sustainability of the corridor:

- *Provide additional information and orientation opportunities to visitors entering from the North (e.g., kiosks, entrance station, signs, etc.)*
- *Restrict access based on visitor volume, permit system or other methods (wildlife migration, time of day, etc.)*
- *Develop visitor information systems (e.g., map, website, radio, message boards) with typical driving times and road conditions*
- *Improve pullout frequency, location, size, and surfacing*

[10] National Park Service. Zion National Park, Shuttle System. Available: http://www.nps.gov/zion/planyourvisit/shuttle-system.htm

Unpaved Road Section

The middle section of Moose-Wilson Road is unpaved and drainage and ponding issues occur in many locations, along with potholes in many curves. As the route has developed since the 1800s, some portions have been paved while the middle section has remained unpaved. Maintenance in this unpaved section has been focused on smooth surfacing rather than building up a road template, so blading operations in some areas has created a sunken road grade where the native soil is higher than the road. Water runoff in these sunken locations has no escape and creates puddles and potholes due to rain events. Besides being a maintenance issue, the puddles and potholes cause some safety concerns due to drivers veering into oncoming traffic to avoid hitting the potholes. Another observation in the unpaved section was the number of downed trees and stumps in close proximity to the road. It is unknown whether the vegetation in this section is being compromised by gravel maintenance practices, but the stumps greater than 4-inches in height at or near the edge of the roadway can be a hazard for motorists and cyclists.

Figure 17. Unpaved Roadway and Roadside Hazards

Suggested Improvements to provide a higher-quality unpaved surface:

- *Improve roadway template to reduce drainage issues*
- *Improve grading to reduce puddles and potholes*
- *Remove stumps at edge of the road*
- *Evaluate alternative gravel maintenance practices to improve surface life and reduce impacts to vegetation*

Suggestions for Improvement

The following are suggestions for improvement for the identified safety issues presented in the previous section. The short-term and some mid-term suggestions may be items the Park can consider as part of current maintenance and management actions. Other mid-term and all the long-term suggestions are items the Park can consider in park-wide planning processes and other project developments. Note that some of the suggested improvements may apply to more than one issue and the list of improvements in this report is not all-inclusive. In addition, these suggestions do not consider impacts or benefits to other areas of park management (e.g., natural or cultural resources, roadway character, park operations, etc.). Therefore, the Park

must consider the broader park management context when considering the implementation of these suggestions.

Short-Term Improvements

- **Sign Placement Evaluation –**
  Ensure signs are at the proper mounting height and are located where they're not blocked by vegetation or other road features in order to improve driver response. For example, the location of the pedestrian warning signs at the trail crossings south of the LSR Preserve should have a diagonal down arrow (Figure 18) if they will stay at the crossing, or they could be moved away from the crossings to provide advance warning of the upcoming crossing (MUTCD 2C.50). Adjusting the location or adding additional advance warning signs will provide drivers more time to react if there are pedestrians at the crossing.

Figure 18. Pedestrian Crossing Sign: Existing (left), Proposed (right)
(Existing sign on right, proposed signing on left)

- **Travel Time and Road Condition Map –**
  Create a map with general travel times and/or increased travel times due to wildlife activities or weather conditions. Many travelers may not be aware of an increase in travel time on the road due to wildlife activity or due to the condition of the road, especially in the unpaved section. Information on the road conditions would also be useful to motorized and non-motorized visitors, and could help them consider an alternate route depending on their destination. The map could be available on-line and be updated in "real time," or as a brochure for general information. This information would enable visitors to decide whether the road is safe for travel based on surface or weather conditions, along with whether any wildlife presence could cause delays to their travels.

- **Roadside Vegetation Maintenance –** Selective brushing could improve the visibility of warning and guide signs, along with increasing the sight distance for approaching vehicles. Roadside vegetation grows close to the edge of traveled way and can block signs and sight distance around horizontal and vertical curves, which can adversely affect motorist response time and action.

Figure 19. Sign Blocked by Vegetation

- **Bicycle Route Rating Information –**
  While the Moose-Wilson Road is not noted in Park documents as a bicycle route, other agencies and interest groups have included it in their maps and brochures. Other Pathway systems in the area have been designed where a rider with almost any competency level could most likely handle the route, but the Moose-Wilson Road has vastly different features from those pathways. Having a sign, brochure, or other information for cyclists regarding the level of difficulty for traversing the Moose-Wilson Road should be considered and could be similar to the trail rating designations used in skiing.

Mid-Term Improvements

- **Sign Messages and Additional Signs –**

Figure 20. Unclear Sign Message

Evaluate sign messages to be consistent throughout the corridor and to also be pertinent to the purpose of the signs. Bike, pedestrian and equestrian signage could be improved in several ways: 1) to alert motorists to the presence of these non-motorized users along the entire corridor, and 2) to alert motorists prior to specific crossing locations. In addition, warning sign messages may not accurately reflect the purpose of the

message or be understandable by travelers. An existing sign which may be confusing to the public is FROST HEAVES which some might expect to encounter during the winter, rather than when they appear during the spring. Another example is the ROUGH ROAD sign placed before the unpaved section instead of a PAVEMENT ENDS sign, as these messages may have different meanings for different drivers.

Advanced signing for turnouts should be also considered, along with improved wayfinding guide signage at the Death Canyon Road intersection. Being consistent with the message and use of signs throughout the corridor will improve visitor expectations and experience. For example, the signs regarding restricted vehicles have information that is different at each end of the corridor, along with being different from what is shown on Park maps and in the seasonal Park newsletters. In addition, signing at the bridge locations (Lake Creek and Granite Irrigation Ditch) should be evaluated for consistency in the use of warning signs and object markers.

- **Improve Sign Retroreflectivity –**
  Develop an assessment or management method for addressing sign retroreflectivity, and create a sign replacement plan. The MUTCD has requirements regarding minimum retroreflectivity levels for warning and regulatory signs. These regulations require that all road agencies (including National Parks) have a plan in place by June 13, 2014, for how retroreflectivity standards will be met. The MUTCD regulations do not require that all signs be in compliance with the standard by this date, only that a plan to address compliance be in place. A good practice is to have a sign replacement plan that would address the retroreflectivity compliance dates in addition to covering how other signs are replaced or upgraded.

  When replacing signs according to a sign replacement plan, the retroreflectivity of the sign should also be addressed so that the signs are visible at night and in low light conditions. Since the Moose-Wilson Road runs through some forested areas with heavy shadows, retroreflective fluorescent sheeting would improve the visibility of signs that provide

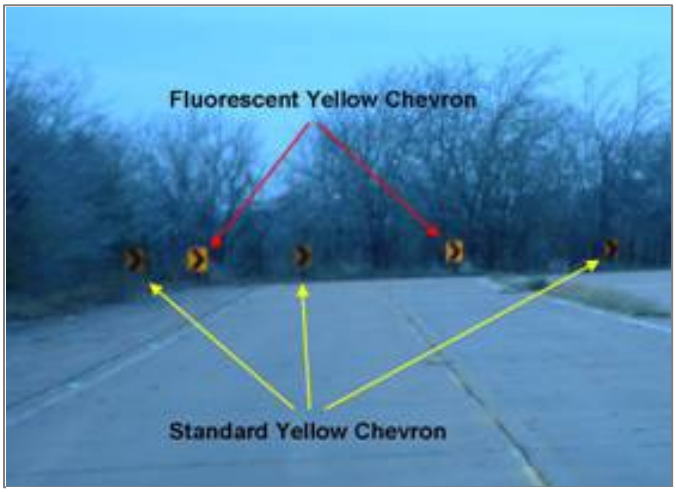

Figure 21. Standard Yellow Sheeting vs. Fluorescent Yellow Sheeting

advance warning of curves, pedestrians, bicyclists, or the single-lane bridge.

- **Pavement Markings on Road –**
  Evaluate the use of center lines, edge lines, crosswalk markings at trail crossings, and intersections markings per the requirements and recommendation in the MUTCD. Even though traffic volumes on Moose-Wilson Road may not meet MUTCD warrants, strategic use of pavement markings should be considered in the paved sections of the road to improve awareness of pedestrian crossings and aid in negotiating through intersections. The current trail crossings lack well-defined pavement markings that could highlight the actual crossing better than the stone-bordered colored concrete that currently exists. Visitors going through the Death Canyon Road intersection face a large paved area which is devoid of pavement markings to indicate which direction goes to Moose or Teton Village or Death Canyon, or where they should be driving when crossing the intersection. Consider the use of shared lane markings or "sharrows" (Figure 22) to alert motorists of the presence of cyclists, which may be especially beneficial on the uphill grades where slow cyclists may be present.

Figure 22. Example of a Sharrow

Figure 23. Stumps along Roadside

- **Roadside Vegetation Maintenance –**
  Remove stumps remaining from dead or downed trees, which are close to the edge of the road, especially in the unpaved section (Figure 23). These stumps, varying in diameter from about 4-inches to more than a foot across and heights up to 10-inches, pose a roadside hazard for motorists and bicyclists. According to the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide a vertical object of more than 4-inches can be a snagging hazard to vehicles that leave the roadway, and could cause an errant cyclist to go over their handlebars. A routine maintenance plan should be developed to address cutting dead or downed trees flush with the ground and provide guidance on when the stumps should be removed.

The FHWA "Vegetation Control for Safety" handbook[11] can provide some useful guidance on improving road safety through the management of roadside vegetation.

- **Improve Unpaved Road Drainage –**
  Improve the drainage and road template to minimize potholes and puddles, which many visitors try to negotiate around by traveling in the opposing traffic's side of the road. The unpaved section of Moose-Wilson Road is sometimes graded below adjacent natural ground levels leading to ponding of water and soft spots at many sites. Grading the shoulder area at the same slope or steeper, will help to avoid trapping water along the edge of the road. Eliminating or reducing the number of potholes and puddles will also improve the driving experience so that visitors can enjoy the scenery instead of focusing on the condition of the road.

- **Unpaved Road Maintenance –**
  Allow sufficient closure periods for necessary "curing" to reduce the number of pothole and wash boarding sites, especially in horizontal curves. Develop a gravel maintenance program which considers alternative materials for increased dust abatement. Raising the driving surface, improving roadside drainage, and narrow widths may keep speeds low and also benefit the wildlife and environmental resources in the corridor.

  The unpaved section was in fairly good condition when the RSA Team conducted the field review, but there were some locations that had potholes. A re-grading and dust treatment of the gravel section had been conducted the week prior, but wet weather and lack of curing time affected the road condition in low spots where water ponds. Either due to the ponding or the chemical treatment, some vegetation along the gravel section is in poorer condition than the rest of the road. This wider disturbed area could possibly benefit from different gravel maintenance strategies which are kinder to the vegetation along the road.

- **Pullout Strategy –**
  Develop a proactive pullout strategy for the corridor in order to better manage, maintain, or expand existing pullouts, along with creating a consistent method for evaluating the creation or closure of user-created pullouts. Providing signs identifying "designated" parking areas may be beneficial in order to minimize illegal parking and "in-road stopping," which in turn may reduce vehicle conflicts, road rage, and congestion. The few "designated" pullouts on the route along with other user-created

[11] Vegetation Control for Safety, FHWA-SA-07-018. Available: http://safety.fhwa.dot.gov/local_rural/training/fhwasa07018/

pullouts serve various needs, including wildlife viewing, turnaround locations, and wayfinding stops. The Park has been managing pullouts by placing cones, logs, or other landscaping material where parking is not desired due to resource or safety concerns.

Figure 24. Pullouts: User Created (on left) and Designated (on right)

- **Corridor Awareness Collaboration –**
  Collaborating with other agencies and entities on corridor awareness is recommended due to the Moose-Wilson Road corridor being a key feature of the Park and of great interest to locals and visitors for recreational and wildlife experiences. This collaboration would focus on education and awareness of the corridor features, road conditions, and recreational use, in addition to the importance of safe behavior when accessing the corridor for both motorized and non-motorized use. Partners in this collaboration could include the Town of Jackson, Teton County, outfitters and tour companies, rental car companies, the cycling community and more. Besides this collaboration at a local region level, there could also be work done with GPS mapping companies (e.g., Garmin, TomTom, etc.) and other entities to ensure Moose-Wilson Road is not advised as a route from the airport to Teton Village, and have warnings about road conditions or "wildlife jams." Working with the mapping companies on appropriate information to post with their maps will ensure visitors who haven't had a chance to look at Park or local sites know what to expect in the corridor, which can help reduce risky behavior and unsafe operations.

- **Travel Time and Condition Map –**
  Develop real-time corridor travel time information through such methods as the use of cell phone technology or transponders handed out at the entrance stations. These real travel times could be uploaded to on-line maps where visitors and residents could determine whether an alternate route to their destination would be better than driving through the Moose-Wilson Road corridor. Providing information on travel times and road conditions through this proposed method could improve safety by reducing the

number of vehicles on the road during times of high visitation, thus reducing the amount of exposure to, and possibilities of, undesired driving behaviors (e.g., speeding, aggressive driving, road rage, etc.).

Long-Term Improvements

- **Managing Travel Demand –**
  Develop travel demand management strategies to address roadway and parking demand and improve the travelers experience in the corridor. This proposed suggestion could improve safety on the road by reducing the number of vehicles during times of high visitation, wildlife migration, or inclement weather, thus reducing the amount of exposure to, and possibilities of, undesired driving or human behaviors (e.g., speeding, aggressive driving, road rage, etc.).

  Travel demand management in the corridor was informally evaluated by the RSA Team both for parking availability and overall access to the Moose-Wilson Road corridor. The parking demand could be managed through improved surfacing at the pullouts, the number and location of pullouts, and the size of pullouts, and better signage for pullouts. The Pullout Strategy, described in the mid-term improvements, could include guidance which would affect how pullouts will be used and managed in the future in this corridor.

  To manage the overall demand for access to the Moose-Wilson Road corridor, the Park could consider restrictions by volume or permit, or through the building of an entrance station at the northern end of the corridor. Controlling the access to the route from both ends is an effective means to reduce the amount of southbound traffic that currently travels the route unrestricted and less informed. Control at both ends would be necessary if restrictions by volume or permit are pursued. Shifting the northern access of the corridor to a location north and west of the Teton Park Road entrance station would also increase both the time and distance (and potential cost) of a trip between the Airport and Teton Village, which could be a disincentive to commercial (taxi) trips, thereby reducing congestion and conflicts between users.

- **Pavement Maintenance –**
  Address edge drop-offs and raveling pavement edges during future road improvements through the incorporation of the Safety Edge$_{SM}$.[12] The Safety Edge$_{SM}$ provides a consolidated 30-degree wedge of asphalt which will not ravel or become a vertical edge drop-off. The wedge is then covered by shoulder material as shown on the right in Figure 25. This would improve the edge of the pavement and allow errant vehicles (motorized and non-motorized) to safely return to the road.

Figure 25. Safety Edge$_{SM}$

- **Bicycling Improvements –**
  It is assumed bicycle presence in the Moose-Wilson Road corridor will continue to increase as the local pathways are expanded and improved. To help improve the cycling experience in this corridor there are several options the Park could consider in future planning efforts, including: a separated (bike) pathway for all or part of the route; a one-way route (for north-to-south or south-to-north traffic) or a one-way couplet (a pair of one-way roads serving the same traffic corridor and performing as a divided facility) for all or part of the route; and a transit only route with a bike lane. While these suggestions are beyond the scope of what's generally considered in an "existing conditions" RSA, they are items the RSA Team encourages the Park to consider when evaluating other improvements to the Moose-Wilson Road during future corridor planning efforts as they can help improve safety for all users.

[12] FHWA Safety Edge. Available: http://www.fhwa.dot.gov/everydaycounts/technology/safetyedge/intro.cfm

Figure 26. Variety of Travel Modes

In addition to the specific suggestions noted above, it is recommended that more traffic and safety data be collected and analyzed as part of long term corridor planning in order to reveal trends in the types, levels, and travel patterns of corridor visitors. This would provide information that could be helpful in identifying other potential areas for improvement. Special attention should also be paid to potentially evolving issues related to bicycle safety in the corridor. Working closely with Park enforcement and emergency services is also recommended as any operational changes could affect response times to incidents and access to medical services.

Conclusion

As noted throughout this report, RSAs are not based solely on documented crash data but also take into consideration the perceived risk.[13] Perceived risk may be based on the expected crash frequency and the expected severity of a crash. Expected crash frequency is qualitatively estimated on the basis of expected exposure (i.e., how many road users will likely be exposed to the identified safety issue) and probability (i.e., how likely is it that a collision will result from the identified issue). Expected crash severity is qualitatively estimated on the basis of such factors as anticipated speeds, expected collision types, and the likelihood that vulnerable road users will be exposed. These two risk elements (frequency and severity) may be combined to obtain a qualitative risk assessment on the basis of the matrix shown in Table 1.

Table 1. Crash Risk Assessment Matrix

Potential Crash Frequency	Potential Crash Injury Severity			
	Low	**Moderate**	**High**	**Extreme**
Frequent	Moderate-Low	Moderate-High	High	Highest
Occasional	Low	Moderate-Low	Moderate-High	High
Infrequent	Lowest	Low	Moderate-Low	Moderate-High
Rare	Lowest	Lowest	Low	Moderate-Low

Using Table 1, along with the information gathered prior to and during the RSA and presented in this report, the overall perceived risk within the Moose-Wilson Road corridor is low to moderate-low. This is because there is a risk of occasional crashes (1-9 per year) with low (property damage only or minor injuries) to moderate injury levels (minor to major injuries). The perceived risk for bicycles and pedestrians in the corridor is moderate-low to moderate-high because there is an infrequent risk of crashes (less than one per year, but more than one every 5 years) with high to extreme injury levels. (See Attachment A for the descriptions of the ratings for frequency and severity.)

The overall purpose of this RSA was to assess the safety of users of the Moose-Wilson Road corridor, identify safety issues, and provide suggestions for improvement. Engineering, education, and enforcement suggestions have been provided for each of the safety issues and have been categorized into short-, mid-, and long-term implementation time frames. During the RSA, six safety issues were identified in this report. While all of the safety issues are important, traffic control devices and visitor confusion and conflicts were identified as the top priorities by

[13] Bicycle Road Safety Audit Guidelines and Prompt Lists, FHWA-SA-12-018. Available: http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/

the RSA team due to the general lack of signs and clear guidance on destinations within the corridor. The other issues, in order of priority, were education, maintenance, travel demand, and the unpaved road section. The owner is invited to consider the suggested changes. To complete the audit process, the owner should prepare a short written response to the issues and options outlined in this report.

Attachment A

This attachment includes information on the RSA Audit Team and information available to the team for the audit from the Park and from the start-up meeting.

Location	Grand Teton National Park (Moose, WY)
Audit Team	Craig Allred, Safety, Resource Center, FHWA Tori Brinkly, PE, Highway Safety Engineer, Western Federal Lands, FHWA Barbara Burke, Highway Safety Engineer, Central Federal Lands, FHWA Lance Johnson, Safety and Traffic Program Manager, Idaho Division, FHWA Allen Olsen, Safety Engineer, Wyoming Division, FHWA Sean O'Malley, County Engineer, Teton County *Bob Hammond, Resident Engineer, Wyoming DOT (invited but could not attend)*
Project Owners	Grand Teton National Park, http://www.nps.gov/grte/index.htm
Interested Agencies	Friends of Pathway Greater Yellowstone Coalition Jackson Hole Community Pathways Jackson Hole Conservation Alliance Jackson Hole Preserve, Incorporated Jackson Hole Wildlife Foundation Teton County Teton Valley Alliance Wyoming Pathways Other Local/Regional Agencies and Organizations
Review Date	September 9-12, 2013
Audit Stage	In-service
Start-Up Meeting	September 9, 2013, 3:30 pm

Documents available for the RSA Team but not included in this report:

- *Moose-Wilson Corridor Adaptive Management Plan (Draft), December 2009*
- *Moose-Wilson Corridor Internal Workshop, February 2013*
- *Start-Up Meeting sign-in sheet and notes*
- *Crash data from Park and County*
- *Preliminary traffic data from Utah State University*
- *GRTE Bike & Stock Brochures, http://www.nps.gov/grte/planyourvisit/brochures.htm*
- *Friends of Pathways Town, County & Winter maps, http://www.friendsofpathways.org/resources*

Frequency, Severity and Risk Tables

Credit:

FHWA *Federal and Tribal Lands Road Safety Audit: Case Studies*, FHWA-FLH-10-05
http://safety.fhwa.dot.gov/rsa/resources/casestudiesflh/
FHWA Tribal Road Safety Audits: Case Studies, FHWA-SA-08-005
http://safety.fhwa.dot.gov/rsa/tribal_rsa_studies/tribal_rsa_studies.cfm

FREQUENCY RATING

ESTIMATED		Expected Crash Frequency	Frequency Rating
Exposure	**Probability**		
High	High	10 or more crashes per year	*Frequent*
Medium	High		
High	Medium	1 to 9 crashes per year	*Occasional*
Medium	Medium		
Low	High		
High	Low	Less than 1 crash per year, but more than 1 crash every 5 years	*Infrequent*
Low	Medium		
Medium	Low	Less than 1 crash every 5 years	*Rare*
Low	Low		

SEVERITY RATING

Typical Crashes Expected	Expected Crash Severity	Severity Rating
Crashes involving high speeds or heavy vehicles, pedestrian, or bicycles	Probably fatality or incapacitating injury	*Extreme*
Crashes involving medium to high speed; head-on, crossing, or off-road crashes	Moderate to severe injury	*High*
Crashes involving medium to low speeds; left-turn and right-turn crashes	Minor to moderate injury	*Moderate*
Crashes involving low to medium speeds; rear-end or sideswipe crashes	Property damage only or minor injury	*Low*

CRASH RISK ASSESSMENT *(May vary on type of RSA or issue)*

Crash Frequency	Potential Crash Injury Severity			
	Low	***Moderate***	***High***	***Extreme***
Frequent	Moderate-Low	Moderate-High	High	Highest
Occasional	Low	Moderate-Low	Moderate-High	High
Infrequent	Lowest	Low	Moderate-Low	Moderate-High
Rare	Lowest	Lowest	Low	Moderate-Low