Environmental Assessment
September 2001

Canyon Junction to Tower Junction Road Improvement

YELLOWSTONE

National Park ! Wyoming / Montana / Idaho

SUMMARY

The segment of Grand Loop Road from Canyon Junction to Tower Junction in Yellowstone National Park is in an advanced state of deterioration, primarily due to age. The pavement is rutted from wear and cracking because of poor drainage, poor-quality base material, and increasingly heavy vehicle use. The pavement edge has broken down resulting in an inconsistent 5.8 to 6.7 meters (19 to 22 feet) road width. The road was not designed or constructed to accommodate current traffic volumes, vehicle widths, lengths, and weights. Safety hazards include narrow pavement width, inadequate visibility at pullouts and intersections, steep side slopes, poor road surface, rockfalls, and curve alignments that do not meet modern engineering safety standards. A transportation analysis was completed that concluded that this road segment affords no opportunity for slow vehicles to pull out of the traffic stream to allow other vehicles to see the road ahead and pass. The report further summarized that the narrow width and winding alignment of this road result in poor vehicle operating conditions. These factors, in conjunction with the volume of traffic, result in a "level of service" which reflects very congested traffic flows- with a high probability of long delays to road users.

Improvement of the entire Canyon Junction to Tower Junction road segment, 29.3 kilometers (18.4 miles) is proposed. This improvement would take place in two construction phases over a period of four to six years, if funding were available. Alternative A (preferred) would reconstruct the road and associated parking areas and pullouts. The road would be widened to 7.2 meters (24 feet) with 3.0-meter (10-foot) lanes and 0.6-meter (2-foot) paved shoulders. The centerline of the road would be moved for about a 0.40 km (0.25-mile) segment in the immediate vicinity of Calcite Springs parking area for safety purposes. Alternative B would also reconstruct the road, parking areas, and pullouts. A road width of 9.2 meters (30 feet) would be built along the existing alignment. Alternative C would reconstruct the road, parking areas, and pullouts with a width of 6.0 meters (20 feet). In all three action alternatives, problems such as rockfall, poor drainage, inadequate or inappropriate parking, and standard design deficiencies would be corrected. Appropriate mitigation actions would be incorporated in construction design and documents. Alternative D (no action) would continue existing road maintenance. No major road reconstruction work would occur.

Under Alternative A, about 35 to 38 hectares (86 to 94 acres) of soils and vegetation would be disturbed. About 0.35 to 0.45 hectares (0.85 to 1.10 acres) of wetlands would be included in the total disturbance. In Alternative B, 48 to 53 hectares (119 to 131 acres) of soils and vegetation would be disturbed including 0.45 to 0.55 hectares (1.10 to 1.35 acres) of wetland. In Alternative C, 27 to 30 hectares (67 to 74 acres) of soils and vegetation would be disturbed including 0.30 to 0.40 hectares (0.75 to 1.00 acres) of wetland. In all alternatives, impacts to wildlife, including threatened, endangered, and candidate species, would be minimized through construction stipulations and/or mitigation measures as part of the construction contracts. Efforts to avoid, then minimize, then mitigate impacts to all jurisdictional waters and isolated wetlands would be made.

Cultural resources within the areas potentially affected by construction have been inventoried, and their eligibility for inclusion on the National Register of Historic Places (NR) evaluated. Thirty-seven sites have been identified, including the Grand Loop Road Historic District and the Chittenden Road Historic District. Seven of these properties are eligible for the National Register. The 1993 programmatic agreement among the Wyoming and Montana State Historic Preservation Officers (SHPOs), the Advisory Council on Historic Preservation (ACHP), and the National Park Service (NPS) provides direction for the preservation and protection of these properties. Through project planning and design, impacts on most of these properties would be avoided. Where impacts could not be avoided, appropriate mitigation strategies would be developed and mitigation plans prepared in consultation with the Wyoming State Historic Preservation Officer and Advisory Council on Historic Preservation.

Yellowstone visitors would be inconvenienced by road closures during construction. In the long term, road improvements would provide safer and more enjoyable driving experiences for visitors.

This environmental assessment will be on public review for 60 days.

NOTE TO REVIEWERS AND RESPONDENTS

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their home address from the record, which we will honor to the extent allowable by law. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment.** We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

Comments are due November 23, 2001 and should be addressed to:

Superintendent
Canyon to Tower Road Improvement
Attn: Office of Planning and Compliance
P.O. 168
Yellowstone National Park, WY 82190

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INTRODUCTION

Park roads, such as those in Yellowstone National Park, are intended to accommodate park visitors safely and efficiently while enhancing visitor experiences according to *Park Road Standards* (NPS 1984). The National Park Service is responsible for constructing, operating, and maintaining its roads in a safe and aesthetically pleasing condition to the greatest extent possible.

In keeping with this mandate, the National Park Service, in cooperation with the Federal Highway Administration, is in the process of rehabilitating or reconstructing the principal park roads in Yellowstone. The Surface Transportation Assistance Act (PL 97-424), passed in 1982, established the Federal Lands Highways Program (FLHP). This program distributes funds from federal motor fuel tax revenues for work on roads in parks and on other federally administered lands. Examples of work performed under this program are: reconstruction of the park road between Old Faithful and West Thumb; paving overlay work between West Entrance and Madison and between Norris and Canyon; reconstruction of the Grand Loop Road between Madison Junction and Biscuit Basin; between Madison Junction and Norris Junction; and between the Fishing Bridge intersection and Sylvan Pass on the East Entrance road. Road improvements in Yellowstone generally take many years to complete because of limited funding, a relatively short construction season and, to the extent possible, the park's desire to allow visitor traffic through construction zones.

The next major road reconstruction project for Yellowstone under FLHP is the improvement of the Grand Loop Road from Canyon Junction to Tower Junction (Dunraven Road) in the north central portion of the park (see Vicinity map page 5). Work is proposed to begin in early 2002 and be completed in two construction phases over the following four to six years, subject to availability of funding. This Environmental Assessment *Canyon Junction to Tower Junction Road Improvement* describes the proposed project, the alternatives considered, and the associated environmental effects. The proposals in this document are based on standards and guidelines set forth in the *Parkwide Road Improvement Plan*, (NPS 1992). That plan described the road improvement program expected to be carried out in Yellowstone over the next 20 or more years. It established standards for improvement of the park's principal roads (for example, width and design speed) and analyzed the cumulative effects of the long-term road improvement program. This route-specific environmental assessment evaluates the effects of road improvement in the Canyon Junction to Tower Junction project area, and documents current compliance activities. This will be used in applying for project-specific permits and ensuring that appropriate mitigation measures are implemented.

MANAGEMENT OBJECTIVES

Visitor Experience

- Provide a dramatic mountain driving experience
- Provide additional viewing and pullout areas along the road
- Provide a variety of wildlife viewing opportunities
- Provide a visitor-friendly experience without compromising park resources
- Improve information, orientation, and interpretation

Resources

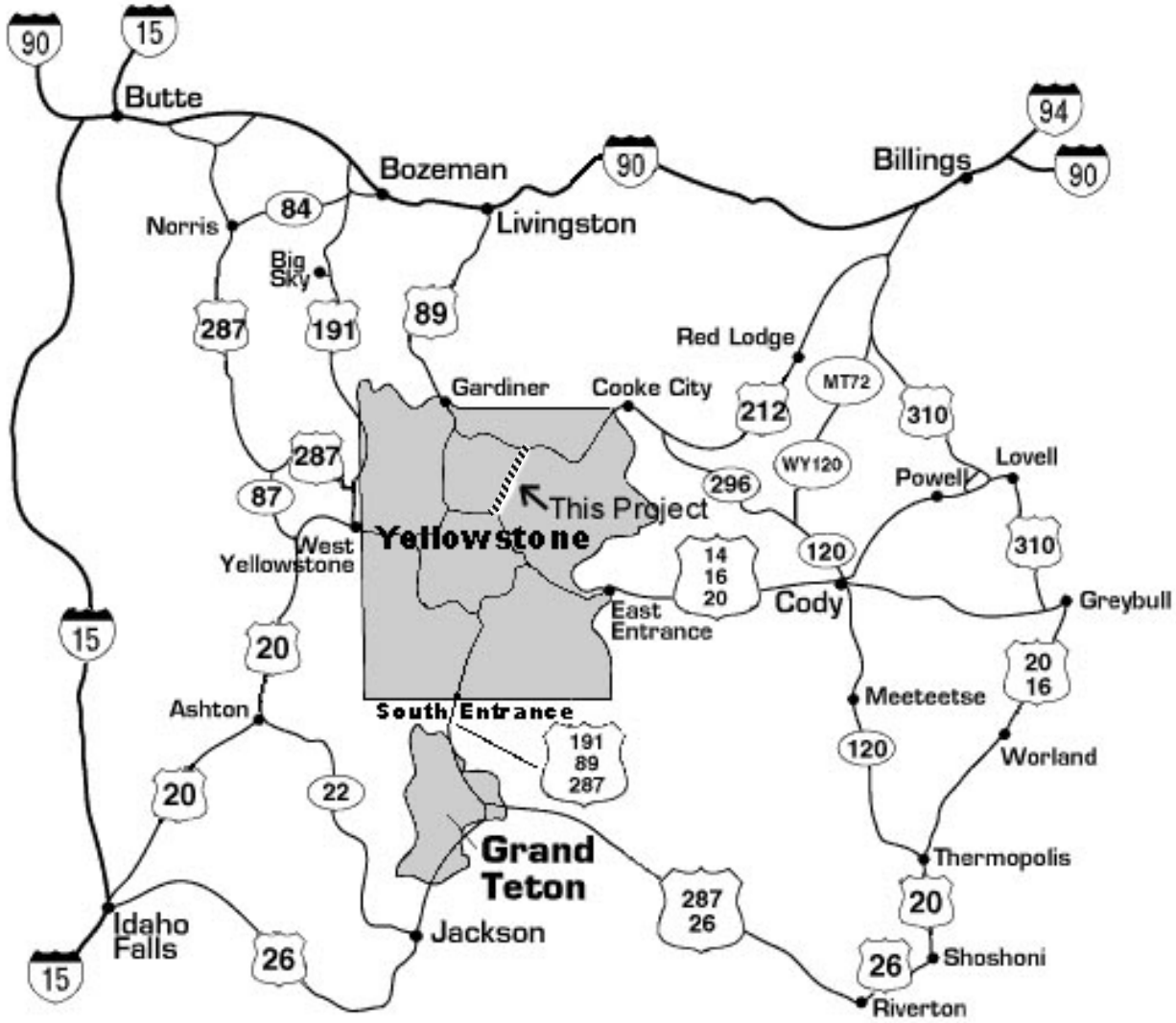
- Protect wildlife habitat and conserve the Yellowstone landscape, and its associated cultural features

Safety and Operation

- Promote a steady flow of traffic
- Provide required administrative access
- Provide an adequate number of pullouts for viewing and passing
- Continue the current seasonal visitor use (NPS does not intend to extend the visitor use season for this road segment)
- Provide for emergency vehicle access
- Limit the risk of accidents

Cost and Cost Effectiveness

- Capital costs and maintenance costs should be affordable within reasonably anticipated funding levels
- The selected alternative should offer an appropriate balance of costs and benefits



Vicinity Map

PURPOSE OF AND NEED FOR THE ACTION

The National Park Service (NPS) is proposing to improve a 29.3-kilometer (18.4-mile) segment of the Grand Loop Road between Canyon Junction and Tower Junction (Dunraven Road). Construction would occur from the junction of the Northeast Entrance road at Tower Junction to the junction of the Tower to Canyon road and the Canyon to Norris road. Improvement of the road is needed in order to meet acceptable engineering safety standards, to provide safe and pleasant driving experiences, to facilitate park operations and emergency services, to improve resource protection, and to enable more efficient use of park funds. The Canyon Junction to Tower Junction road segment was identified in the *Parkwide Road Improvement Plan* (NPS 1992) as one of the park roads in need of major reconstruction. Goals for this project are identified in the Introduction section on page 3.

The Canyon Junction to Tower Junction road segment connects the Canyon developed area to the Tower developed area via Dunraven Pass in the north central portion of the park (see Project Area map page 17). Also called the Dunraven Road, the route generally parallels the route of the Yellowstone River northeast from Canyon Village. The road crosses Dunraven Pass on the southwest flank of Mt. Washburn and continues around the western and northwestern sides of the mountain. The highest section of the road, at 2,438 meters (8,000 feet) to 2,708 meters (8,884 feet) in elevation, is characterized by steep side slopes and sharp curves. The 1988 fires heavily burned the surrounding forest on the north side of Mt. Washburn. The road also connects the northeastern part of the park to Yellowstone Lake. It provides a road corridor in Yellowstone National Park (YNP) between communities such as Cody, Wyoming and Gardiner and Cooke City, Montana and Jackson, Wyoming. This road provides a critical link in the Grand Loop Road system and access to the Mt. Washburn trailhead, Tower Fall, Overhanging Cliff, and Calcite Springs areas. The road is not only a connector road with visitor attractions along the way, but an attraction itself. There are also three designated picnic areas, two trailheads, and one campground located along this road.

The Canyon Junction to Tower Junction segment was the last section of the Grand Loop Road constructed, with survey work starting in 1899. The actual construction began in 1903 and was nearing completion at the end of 1904. In 1930 the road was reconstructed and 7.6 kilometers (4.7 miles) of the road, now known as the Chittenden Road, was abandoned to reroute a portion of the road at a lower and more economical elevation. Much of the road is typical of the older roads in Yellowstone that have not had complete reconstruction for more than 50 years. The top width and base material are not designed to accommodate the greater traffic volumes and wider and heavier vehicles of today. As with other older park roads, maintenance costs are escalating at an accelerating rate just to keep the road passable. In August 1998 the road was closed for several days on an emergency basis due to its unsafe condition. Pothole patching and an asphalt overlay were accomplished during the closure.

The pavement condition on Dunraven Road is contributing to a degraded visitor experience. This necessitates high maintenance costs for patching and may be a hazard to visitor and administrative traffic. The construction of Dunraven Road has presented engineering challenges due to its mountainous terrain. The steep side slopes adjacent to the road present road designers with additional challenges to gain width for vehicles, even more so than for other Yellowstone roads.

The *Parkwide Road Improvement Plan* (NPS 1992) recognized that the parkwide standard for road improvements, a 9.2-meter (30-foot) paved width, might not be appropriate for Dunraven Road. Vehicle size limits and other traffic management strategies were considered to reduce the road width that would be required to safely and efficiently accommodate visitor and administrative travel along Dunraven Road. Road design elements such as width are influenced by numerous factors. These include park resource considerations, existing and/or planned volumes and types of traffic, safety, terrain, and design speed.

Visitors travel over this road between such features as Lamar Valley, Grand Canyon of the Yellowstone, and Tower Fall. In 1999 the park received in excess of three million recreational visits, and visitation over the past five years has ranged from 2.84 million to 3.13 million. These visits represented more than one million vehicles entering the park and using the road system within the six-month period from May through October.

The Canyon Junction to Tower Junction road segment had an Annual Average Daily Traffic (ADT) of 1,160 vehicles in 1993. The road segment carries about 4,000 vehicles per day (total in both directions) during the peak season in July and August. The traffic is about the same in the northbound and southbound directions. The National Park Service's *Park Road Standards* (NPS 1984) recommends minimum widths of 3.4 meters (11 feet) per lane and 1.2 meters (4 feet) per shoulder for an ADT of 4,000 to 8,000.

According to *Transportation Study, Dunraven Road, Yellowstone National Park* (BRW, Inc. 1997) large vehicles (including buses, service and delivery trucks, recreational vehicles, and pickups with campers) make up about 6.6 percent of the traffic volume. Of the vehicles using the Dunraven Road, 93 percent were less than 6.7 meters (22 feet) in length. A large majority of vehicles (97percent) were not towing another item. In the 1980s the U.S. Department of Transportation increased the maximum legal width of motor vehicles to 8 feet, 6 inches; with side mirrors extending beyond this width. The number of large buses is expected to increase because of the upward trend in senior citizen and foreign tour group visits. Cross-country bicyclists use the park roads, and other visitors transport bicycles to the park for short, local bike trips. Bicycle traffic volume is unrecorded but noticeably increasing.

The condition of the Canyon Junction to Tower Junction road segment is generally poor. Lack of drainage, frost heaving, infiltration of water into the base and sub-base, and poor road building materials all contribute to the continuing deterioration

of the road and the need for improvement of this 29.3-kilometer (18.4 mile) segment. The existing roadway pavement width is generally between 5.8 to 6.7 meters (19 to 22 feet) in width. Sections of the road contain tight curves, with the most restrictive curve having an inside edge radius of less than 15.2 meters (50 feet). Sight distance is inadequate for safe passing along most of the road. Pullouts are located for viewing, but no passing pullouts are provided. Slow-moving vehicles can cause relatively long back-ups of traffic during periods of high traffic volume. Much of the road has abrupt pavement edges and no shoulders. The asphalt pavement surface is rough and breaking up, with numerous potholes, cracks, and frost boils. Drainage deficiencies contribute to a rough and rutted pavement. Ditches and culverts are inadequate or clogged with deposits and do not carry surface water away from the roadway. A high percentage of the road subgrade and base material is of poor quality. This contributes to excessive flexing and damage to the pavement surface, which results in rutting and broken pavement. Improperly located and inadequately sized drainage structures, along with natural wearing, limit natural stream flow under the roadway and often affects wetland functions. Many letters received by the park are complaints from visitors concerning rough road surfaces.

A number of safety issues are related to the existing road design. Some pullouts and intersections have limited sight distance for drivers entering or exiting traffic lanes. Bicyclists are often in danger because the roadway is narrow. Some sections of the road do not comply with current engineering safety standards for curve configurations. Ditches are generally shallow and do not prevent falling rocks from hitting travel lanes. Numerous instances of material or debris slides on the roadway have occurred. These safety problems diminish the enjoyment of traveling the road, require a greater than normal amount of driver concentration, and contribute to accidents. There are rockfall problems and fault-line slumping of the road through the Overhanging Cliff area. Movement of the road has caused this area to need maintenance nearly every year to repair cracks in the road and overlays to maintain a safe driving surface. Viewing of wildlife without adequate pullouts in the Antelope Creek area causes gridlock on the flow of traffic.

Many informal pullouts created by visitors intrude on sensitive resource areas and are located in unsafe areas. Some of the formal parking areas were not designed to meet current needs; they do not properly direct motorists or maximize parking capacities, and they may pose safety hazards. During much of the summer season, there is insufficient space at pullouts and parking areas. The Dunraven Pass parking area is typically overflowing with vehicles parked along both sides of the road and people walking across traffic lanes in areas with poor sight distances.

Relationship of the Proposed Action to Previous Planning Efforts

The *Parkwide Road Improvement Plan* (NPS 1992) proposed that most principal park roads be reconstructed on their existing alignments. In the Canyon Junction to Tower Junction area however, there is an opportunity to consider a shift in the centerline of the road for some sections of the road. At Calcite Springs the road

currently passes immediately adjacent to a parking area where cars are required to back out into travel lanes. The area is adjacent to a curve with minimal sight distances. Although considered, the desire to maintain the current alignment and the high costs of an expensive bridge to cross Tower Creek are the reasons to avoid realignment of the road in the Overhanging Cliff area.

The *Alternate Transportation Modes Feasibility Study, Yellowstone National Park* (BRW, Inc. 1994) looked at various modes of transportation for Yellowstone visitors and proposed a visitor transportation system based on buses. If such a system were implemented, improvement of the road segment between Canyon Junction and Tower Junction would be required to accommodate the volume of bus traffic that the system would generate and to minimize any related impacts.

The *Transportation Study, Dunraven Road, Yellowstone National Park* (BRW, Inc. 1997) looked at various transportation issues to identified feasible and potentially effective options for improving the road. The study was based on historic data on the use of Dunraven Road; data on traffic volumes, parking, and vehicle characteristics collected in July 1996 (BRW, Inc. 1997); a survey of visitor travel patterns in Yellowstone collected in 1993; information provided by Yellowstone National Park staff; and available published information on cultural and natural resources. The NPS Public Use Statistics Program Center prepared forecasts of future visitation in Yellowstone National Park that were used to estimate visitor use demand on Dunraven Road in the year 2010. Traffic flows were predicted to degrade from the years 1996-2010 to a level that would include operating conditions at or near the capacity of the roadway. Predictions indicated that comfort and convenience levels would be extremely poor, and driver frustration would be generally high.

Impact Topics

Issues and concerns affecting the proposed project were identified by specialists in the National Park Service, as well as from the input of other federal, state, and local agencies. Impact topics are the resources of concern that could be affected by the range of alternatives. Specific impact topics were developed for discussion focus to ensure that alternatives were compared on the basis of the most relevant topics. The following impact topics were identified on the basis of federal laws, regulations, orders, and *National Park Service Management Policies* (NPS 2001a). A brief rationale for the selection of each impact topic is given below, as well as the rationale for dismissing specific topics from further consideration.

Soils and Vegetation

The National Environmental Policy Act (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals *National Park Service Management Policies* (NPS 2001a). Therefore, soils and vegetation will be addressed as an impact topic.

Rare Plants

The Endangered Species Act (1973) requires an examination of impacts on all federally-listed threatened or endangered species. National Park Service policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. Therefore, Threatened, Endangered, Candidate Species and Species of Special Concern will be addressed as an impact topic.

Hydrothermal Resources

The National Environmental Policy Act (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals *National Park Service Management Policies*, (NPS 2001a). Therefore, hydrothermal resources will be addressed as an impact topic.

Fisheries and Aquatic Resources

The National Environmental Policy Act (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals (*National Park Service Management Policies*, (NPS 2001a). Therefore, fisheries and aquatic resources will be addressed as an impact topic.

Wetlands and Other Waters of the United States

National Park Service policies require protection of water quality consistent with the Clean Water Act. Section 404 of the Clean Water Act authorizes the U.S. Army Corps of Engineers to prohibit or regulate, through a permitting process, discharge of dredged or fill material into U.S. waters.

The Storm Water Rule (40 CFR, Parts 122, 123, 124) requires an Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Notice of Intent be submitted to the EPA, with a copy sent to the Wyoming Department of Environmental Quality, on construction activities, including clearing and grading, that occur on land in excess of five acres (less than five acres if construction occurs in 2003 or after) or if the proposed action is part of an overall common plan of development. A NPDES notice of intent would be submitted to both the EPA and the Wyoming Department of Environmental Quality, prior to any ground disturbing activities. When construction is complete, a notice of termination would be sent to the EPA and Wyoming Department of Environmental Quality.

In addition, the EPA NPDES process requires preparation of a Storm Water Pollution Prevention Plan. The plan would be the guiding tool for the prevention, minimization, and mitigation of soil erosion and water pollution during construction activities. Should the proposed action be implemented, the contractor would be responsible for developing a park-approved plan. The plan would be available for public and agency inspection at the construction site.

Therefore, water quality will be addressed as an impact topic.

Air Quality

Section 118 of the 1963 Clean Air Act (42 U.S.C. 7401 et seq.) requires a park to meet all federal, state, and local air pollution standards. Yellowstone National Park is designated a Class I air quality area under the Clean Air Act, as amended. A Class I area is subject to the most stringent regulations of any designation. Class I areas must not exceed the maximum allowable increment over baseline concentrations of sulfur dioxide and particulate matter as specified in Section 163 of the Clean Air Act. Further, the Clean Air Act provides that the federal land manager has an affirmative responsibility to protect the park's air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. Thus, air quality will be addressed as an impact topic in this document.

Wildlife

The National Environmental Policy Act (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals *National Park Service Management Policies*, (NPS 2001a). Therefore, wildlife will be addressed as an impact topic.

Threatened and Endangered Species

The Endangered Species Act (1973) requires an examination of impacts on all federally-listed threatened or endangered species. National Park Service policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. Therefore, Threatened, Endangered, Candidate Species and Species of Special Concern will be addressed as an impact topic.

Cultural Resources

The National Historic Preservation Act, as amended in 1992 (16 USC 470 et seq.), and the National Environmental Policy Act, as well as the National Park Service's Director's Order-28, Cultural Resource Management Guideline (1994), Management Policies (2001), and Director's Order-12, Conservation Planning, Environmental Impact Analysis and Decision-Making (2001), require the consideration of impacts on cultural resources listed on or eligible for listing on the National Register of Historic Places

Socioeconomic Environment

The National Environmental Policy Act (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including creating and maintaining conditions under which man and

nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans. Therefore, socioeconomic will be addressed as an impact topic.

Impact Topics Dismissed from Further Consideration

Environmental Justice

According to the Environmental Protection Agency, environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

Presidential Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The proposed action would not have health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Draft Environmental Justice Guidance (July, 1996). Therefore, environmental justice was dismissed as an impact topic.

Prime and Unique Agricultural Lands

The Canyon Junction to Tower Junction road improvement project is within the boundaries of Yellowstone National Park. No park lands are classified as agricultural, therefore, no unique agricultural values or prime farmlands are included in this project. Therefore, agricultural lands were dismissed as an impact topic.

Floodplain Management (Executive Order 11988)

Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains.

Before taking an action, each agency shall determine whether the proposed actions will occur in a floodplain-- for major Federal actions significantly affecting the quality of the human environment, an evaluation is require to be prepared under Section 102 (2) (C) of the National Environmental Policy Act. The project area does not affect any floodplains. Therefore floodplains were dismissed as an impact topic.

ALTERNATIVES CONSIDERED

Three road width alternatives: Alternative A- (preferred) 7.2 meters (24 feet), Alternative B- 9.2 meters (30 feet), and Alternative C- 6.0 meters (20 feet), and Alternative D- a No Action Alternative are presented in this section. A number of possible road width and management options were considered (see "Alternatives Considered but Rejected" section). The following alternatives were determined to be the most reasonable and feasible range of alternatives, considering both visitor use and resource protection options.

ITEMS COMMON TO ALL "ACTION" ALTERNATIVES

The following items would be common to all action alternatives considered and would be implemented as a portion of whichever alternative is selected.

DEVELOPED AREA DESIGN SUMMARY

PARKING LOTS	EXISTING CAPACITY	PROPOSED CAPACITY	VAULT TOILETS
Cascade Lake Trailhead	New	+/- 22 auto and +/- 3 RV/Bus	
Washburn Hot Spring Overlook	6	7 auto and 1 RV/Bus	
18 + 120 R (survey location)	3	7 auto and 1 RV/Bus	1 New
Dunraven Pass Trailhead	20	33 auto and 4 RV/Bus	1 Existing
Blister Rust Overlook	10	9 auto and 1 RV/Bus	
26 + 350L (survey location)	new	10 auto and 1 RV/Bus	1 New
Tower Fall	53 formal 40 informal	87-97 auto 9 RV 1Bus Drop-off spot	Existing Flush Toilets
Calcite Springs	30	27 auto and 3 RV/Bus	

PICNIC AREAS	TYPE	CAPACITY	VAULT TOLIET
Cascade Lake	Existing	14 sites	1 existing
Dunraven Road	Existing	8 sites	1 existing
Buffalo Paddock	New	+/- 10 sites	1 new

Pullouts

- There are five existing paved pullouts and 59 existing gravel/dirt pullouts, or disturbed areas.
- Nine existing pullouts would be obliterated and approximately 54 pullouts would be paved.
- Paving of eight asphalt aprons onto unpaved drives would occur.

Centerline Shifts

- The only notable alteration of the centerline is at Calcite Springs parking area. The centerline would be shifted about 30-60 meters (about 150 feet) to the west to allow the parking area to be off the main roadway for additional safety of users. Shifting the road would also allow several mature Douglas fir trees to be saved from construction disturbance.

Revegetation

- Collect native seed to use on revegetation of disturbed areas.
- Transplant shrubs and small trees, especially whitebark pines, with a tree spade to accelerate migration of trees and shrubs into the disturbed areas.

Items of special concern

- Revegetating the new cuts and fills, which would be very visible, in the Antelope Creek drainage below Mae West curve.
- Stabilizing any existing seeps that would be disturbed or new seeps that develop due to slope cuts.
- Shape ash and conglomerate cut slopes to allow the greatest retention of topsoil in order that pockets of regrowth can re-established.

ALTERNATIVE A (PREFERRED): RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 7.2-METER (24-FOOT) PAVEMENT WIDTH

The preferred alternative is to reconstruct 29.3 kilometers (18.4 miles) of the Grand Loop Road between Canyon Junction and Tower Junction to a 7.2-meter (24-foot) paved width (3.0-meter/10-foot travel lanes and 0.6-meter/2-foot paved shoulders). The existing road alignment would be followed except for a 0.4-kilometer (0.25-mile) section directly adjacent to the Calcite Springs parking area. In this area the road would be shifted approximately 30 to 61 meters (100 to 200 feet) west of its current location for safety reasons. The location of the centerline was designated to also allow the retention of some very large and old Douglas fir trees. Improved pullouts and drainage would also be included. The road would be designed for 9.2-meter (30-foot) vehicles and design speeds of 56 km (35 mph). In some sections the completed road may be wider than 7.2 meters (24 feet) due to curve widening and guardrail offset issues. Curve widening and guardrail offsets would occur predominately from Dunraven Pass to Mae West curve. Curve widening in this area would be applied to approximately 42 of the 65 curves in this stretch of road.

Alternative A is preferred because it improves the condition of the road pavement and its underlying structure, improves separation of vehicles traveling in opposite lanes, and balances resource impacts with the function of the road. The wider road would better accommodate existing traffic volumes, allow smoother traffic flow, enhance the maneuverability of larger vehicles, and provide a consistent width throughout the road segment. This 7.2-meter (24-foot) road width is also projected to help meet future growth in traffic volumes beyond the year 2010 by maintaining Level of Service D (see page 51 for description). Shifting the centerline of the road away from the existing Calcite Springs parking area would improve traffic safety from the existing situation of cars backing out into travel lanes. While total disturbed acreage of this alternative is more than in Alternative C, traffic flow, safety, and ease of driving would be greatly improved. Bicycle traffic would not be promoted on this section of road. Reestablishment of a more natural landform and better revegetation on existing cut and fill slopes would be accomplished by reducing the steepness of these slopes where possible.

Design Recommendations

The posted speed limit would be maintained at 56 km/hr (35 miles-per-hour). Specific sites would be posted at lower speeds due to traffic congestion. For example, Dunraven Pass and the Tower Fall area may be posted at 40 km/hr (25 mph).

The existing pavement would be milled and stockpiled for use within the new pavement structure. Areas where roadway soils are of poor quality would be repaired by excavating these materials and replacing them with better-draining aggregates. New base material would be imported or obtained from cuts elsewhere in the project. The roadway would also be widened by excavation of cut slopes and or addition of embankment fill. Wherever possible, roadway widening would be

confined to one side, with the centerline shifted accordingly to avoid important natural or cultural features and to minimize cut-and-fill slopes along the roadside. Centerline shifts would depend on existing road geometry and would comply with safety design standards.

A standard fill:slope ratio of 1:4 would be the design standard for the slope from the edge of the pavement to the bottom of the ditch or where the slope catches the natural terrain. This slope design has the effect of eliminating the need for guardrails and aiding reclamation/revegetation, but it extends the slopes horizontally and widens the construction area. In sensitive resources areas, this design standard would be altered. Here the use of walls or steeper slopes (perhaps with guardwalls or guardrails) could be used. In appropriate areas, the fill slope area would be increased in steepness 1:4 to 1:3. The ditch slope could also be increased in these same areas to 1:3 to further reduce resource impacts.

Most cut and fill slopes would be in the 3- to 6-meter (10- to 20-foot) range, with maximum cuts of about 23 meters (75 feet) in height and maximum fills of about 9.2 meters (30 feet) in depth. Rock cuts would be designed and treated to minimize visual impacts by producing a form and texture compatible with natural rock outcrops and cliffs. Drill holes from blasting would be removed. Excavation into stable cliffs would be made at steep angles to reduce disturbance. Some slope tops might need to be rounded back to reduce rockfall, and ditches provided at the bottom to catch falling rock. Soil slopes would be flattened (slope angle reduced) from existing cut and fill slopes, where required to reduce erosion and promote revegetation.

Approximately 800 meters (2,625 feet) of retaining wall would be used in about 12 locations to reduce disturbance in cut and fill situations. Four possible types of retaining walls have been identified for use- rockery walls, soil-nail wall with natural or simulated rock, reinforced concrete retaining walls with natural or simulated rock, and mechanically stabilized embankment (MSE) walls faced with natural or simulated stone. The standard rockery wall would be used the most. In intermediate height areas a 0.9 to 2.4 meters (3 to 8 feet) high rockery wall or a soil-nail wall could be used. A rockery wall consists of large blocky stones stacked to create a steep retaining wall. A soil-nail wall involves reinforcing soil material within the area being excavated by installing steel bars horizontally into the slope. Soil-nail walls, if used, would be faced with natural or simulated stone similar to other walls on the road this and other segments of the Grand Loop Road. Reinforced concrete walls would be used in limited situations and would be faced with natural or simulated rock, similar in appearance to walls along the East Entrance road in the park. Reinforced concrete retaining walls with natural stone would be constructed at the Dunraven Pass parking area near the spot where the trail to Mt. Washburn starts. MSE walls would involve layers of soil materials reinforced with wire mesh that would stand nearly vertically and then be faced with stone. A limited number of this type of wall could be used during the second phase of this proposed road project in areas of unstable soils. From Canyon Junction to the Chittenden Road intersection, predominantly rockery walls would be used. From the Chittenden Road intersection to Tower Junction, predominantly soil-nail walls with natural stone or simulated

stone facing would be used.

Highway guardrails or guardwalls could be used in select areas. To ensure compatibility with the roadway historic district, new guardrails would be w-beam made of Corten [tm] steel or masonry guardwalls, similar to those installed on portions of the East Entrance road. These would be used in areas where guardrail presently exists. Additional sections of new guardrail would be added to existing guardrail area to improve safety to the area, for a total of approximately 1,600 meters (5,249 feet). All historic dry-laid stone retaining walls affected by construction would be repaired and restored. In accordance with the terms of the road programmatic agreement (Appendix C) any stone masonry headwall not visible from the road or other visitor areas and not reconstructed, would be salvaged for use along the roadway elsewhere within the road segment. Minor guardwall repairs would be done where needed by lowering the roadbed in some areas that has risen because of numerous overlays and existing guardwalls would be restored to their original height.

Where trees must be cleared along the road edge, designs would create an irregular forest edge and preserve as many large trees on the edge of disturbance as possible.

PROJECT AREA MAP

Bridges

There is one bridge in this section of the Grand Loop Road. The Tower Creek Bridge is a contributing feature of the Grand Loop Road Historic District, which is listed in the National Register of Historic Places. The bridge is an arched, stone masonry structure, constructed in 1933. The bridge would not be widened as the structure is of sufficient width to accommodate the new roadway at any of the three proposed widths. The asphalt surface on the bridge travel lane would be milled and repaved along with the rest of the road segment. Erosion of materials has undermined a dry-laid stone wall adjacent to the masonry stone abutments of the bridge. The dry-laid stone wall at the northeast corner of the bridge would be repaired as a part of this project. An in-kind repair of the approach guardwall at the southwest corner of the bridge would also be completed. The existing defined pedestrian walkway, on each side of the bridge, would be maintained close to the present width.

Culverts and Headwalls

Culverts would be replaced, headwalls would be removed and reconstructed, and new culverts added where necessary to correct drainage problems. Pipe culverts would be replaced and lengthened to compensate for a wider roadway. To maintain the historic character of the roadway, repair of existing headwalls, and design and materials for new culvert headwalls would be in keeping with stipulations agreed upon by the Advisory Council on Historic Preservation (ACHP), National Park Service, and Wyoming State Historic Preservation Officer (SHPO) in the 1993 programmatic agreement.

The ten box culverts located on this segment of road would be left in place, with in-kind repairs made to the floors of four box culverts. Rolling rocks and other debris during spring runoff and high-water events has damaged these box culverts. The headwall on one box culvert may need to be extended vertically in height to allow slopes from adjacent wider road surface to “catch” above the head walls. Spillways at the outlets of these box culverts would also be improved. Dry-laid rubble walls above some box culverts may be repaired by hand with like materials where possible. The box culvert headwalls would remain intact and would not require reconstruction.

Treatment of the historic box culverts, retaining walls and stone culvert headwalls would adhere to provisions of the programmatic agreement (Appendix C); that is, historic stone features that retain physical integrity and are visible from the road or other visitor use areas would be documented, dismantled, and reconstructed. Stone from headwalls that did not meet the criteria of historic integrity and visibility would be salvaged for reuse elsewhere along Yellowstone's historic roads. All culverts and headwalls have been documented using the Historic Building/Structure Survey Form and the List of Classified Structures Single Entry Report. The Wyoming SHPO has reviewed this documentation, and on July 5, 2000 concurred that these features contribute to the National Register eligibility of the Grand Loop Road. This documentation completes the park’s survey responsibilities.

Approximately 195 culverts with stone headwalls are located within Canyon to Tower segment of the roadway and would be affected by road widening. Many of

these headwalls are in fair to poor condition and require stone replacement. New stones would be selected from road cuts and existing quarries and cut to match the existing masonry.

Parking Areas and Pullouts and Visitor Facilities

New and reconstructed parking areas and pullouts would be designed to be in scale with the natural and historic setting. Use of native materials would maintain the continuity and historic character of the roadway. Logs or stone would be used for curbing. Walls would be of native rock, rock veneer, or simulated stone stained to match native rock. Medians between the roadway and parking would be constructed of cobblestone. Round peeled log posts would be used for all signs. Parking areas and pullouts would have appropriate drainage structures and sediment control devices installed. As funding is available, additional vault toilets would be placed at appropriate pullout areas. Restrooms and other structures would be of a rustic nature to reduce their visual intrusion on the historic scene and to ensure compatibility with the adjacent Grand Loop Road Historic District.

There would be an overall net increase in total parking, including additional parking for recreational vehicles (RVs). About 55 informal and formal pullouts would be retained and improved at key wildlife and scenic viewing areas and other areas of interest. These standard parallel pullouts would be approximately 5.0 meters (17 feet) wide with tapers. All new pullouts would utilize alignment shifts, informal or gravel pullouts, existing paved pullouts, or otherwise previously disturbed areas. Some informal pullouts and parking areas would be obliterated and revegetated.

Cascade Lake Trailhead

A large existing gravel pullout presently exists on the main road a few hundred meters south of the Cascade Lake picnic area. This pullout would be formalized and paved to accommodate 22 cars and 2 RVs for trailhead use. Presently visitors using the Cascade Lake Trail park in the Cascade Lake picnic area and leave their vehicles in one (or more) of the picnic site parking spurs. This practice makes the picnic sites unavailable to picnickers. The last few hundred meters of the existing trail from the picnic area would be obliterated and new trail would be constructed to the new trailhead parking area.

Cascade Lake Picnic Area

A paved "apron" (entrance) on the approach to the picnic area would be constructed as part of this project. A left turn lane from the south would also be added.

Dunraven Road Picnic Area

A paved approach apron to the picnic area would be constructed by this project.

Washburn Hot Springs Overlook

This is an existing, poorly paved, pullout with a capacity of six vehicles that serves an overlook of Washburn Hot Springs and the Yellowstone caldera rim. The pullout would be repaved and formalized with parking to accommodate seven passenger

cars and one RV.

New Vault Toilet and Parking (18+120R)

A new vault toilet would be added at the site of an existing gravel pullout located approximately 640 meters (0.4 miles) south of Dunraven Pass (survey location 18 + 120R). The pullout would be paved and formalized to allow for seven passenger cars and one RV.

Dunraven Pass

Dunraven Pass is a popular trailhead and parking area for the Mt. Washburn Trail. There are approximately 20 unstriped parking spaces at the trailhead. These spaces are typically full and visitor parking overflows to adjacent roadside areas on summer days with good hiking weather. The maximum observed parking congestion was 38 vehicles, seen while gathering data for a transportation study of the road segment completed in 1997. This parking area would be redesigned to accommodate 33 passenger cars and four RVs. The existing vault toilet would be relocated within the parking area. Striping, curbs, and pedestrian access walks would be added. The existing Dunraven Pass parking area lies adjacent to a wetland area to the south. The proposed parking area expansion would impact about 0.6 hectares (0.45 to 0.49 acres) of wetland. Mitigation for this loss is detailed in "Other Stipulations" at the end of this section.

Blister Rust Overlook

The Blister Rust overlook is named for a former campsite for workers involved with combating white pine blister rust on pine trees in the area. This area is used mostly by visitors who stop to see the vistas and the variety of wildflowers that bloom in the area during the summer months. This pullout would be formalized to allow for head-in parking of nine passenger cars and one RV.

New Vault Toilet South of Chittenden Road (26+350L)

A new vault toilet would be installed at a new pullout to be constructed approximately 300 meters (1,000 feet) south of the Chittenden Road intersection (survey location 26 + 350L). A paved pullout/parking area would be constructed to accommodate 10 passenger cars and one RV with 90-degree head-in parking. The area is located on the west side of the road in a meadow surrounded by an area of lodgepole pine that burned during the 1988 fires.

Chittenden Road

A paved apron would be constructed at the intersection. The intersection would be better defined by reducing the size of the approach and moving it to the south and reducing the grade at the intersection to improve sight distances. The remaining portion of the narrowed intersection would be rehabilitated. The road to the Chittenden Road parking area would not be paved as part of this project. However, there would be an addition of bollards and bumper logs to help define the parking area.

Buffalo Paddock

In the 1902s, bison were corralled in the old Buffalo Paddock parking area for visitor viewing. The pens have long been removed, and the area now affords a view

of the lower Antelope Creek drainage. This area would not be paved other than an apron from the Canyon Junction to Tower Junction road. The area would have approximately six picnic tables installed, and the parking would remain informal. A single vault toilet could be added in the future.

Tower Fall

These facilities include a popular trail to the base of Tower Fall. There is an existing general store at the site, and a paved parking area with 53 marked spaces. There is room for approximately 40 additional vehicles to park, located informally along the edge of Dunraven Road across from the store and trailhead. Large numbers of visitors have to cross the roadway from those roadside-parking spaces to the activity areas on the opposite side. Parking congestion, safety factors, and a desire to consolidate facilities in developed areas, have led to a decision to remove the Tower Fall store from this location. A new store may be located at Tower Junction. An environmental assessment for a new store will be written separately from this document. After removal of the current Tower Fall store, the area would continue to function as a trailhead for Tower Fall. The existing restroom would remain in place. Approximately six picnic tables would be installed adjacent to the Tower Creek Bridge, to allow visitors to picnic while enjoying the view of the creek and bridge. Excess material between 20,000 and 30,000 cubic meters (23,900 to 35,900 cubic yards) would be used to fill the area adjacent to the south end of the existing parking area. This would allow for redesign of the parking area to improve traffic flow and better organize the layout. Redesign of the parking area would allow 87 to 97 passenger car-parking spaces, nine to twelve RV/bus parking spaces and a bus drop off zone. A paved apron would be constructed at entrances to the Tower Fall campground, though the access road to the campground would not be repaved as a part of this project.

Overhanging Cliff

Approximately 0.4-kilometer (0.25-mile) of the road crosses an area that is slowly slumping towards the Yellowstone River. Faultlines in this area are causing the road and fill slope to inch its way downhill, creating cracks in the road surface and uneven pavement that require continual maintenance. Three borings were taken within the road April 1999. Hard rock was encountered deep in two of the holes. The third never encountered hard rock after 30 meters (100 feet) of drilling. Presently 460 meters (1,509 feet) of road is subsiding towards the Yellowstone River.

Presently, two options for repair are being considered for solving this problem. Both of these options are considered within the scope of this analysis. If further geo-technical and engineering studies point to options outside the current disturbance area, additional compliance requirements would be considered.

The first option would include anchoring the road back into the hard rock cliff face by drilling large pilings every 2.4 meters (eight feet) along the 460 meters (1,509 feet) of road. The pilings would be between 24-49 meters (80 and 160 feet) deep. This permanent repair of the road would cost in excess of 12 million dollars to complete.

A second option that could lead to a slow tip of the road rather than an abrupt subsiding would be a reinforcement treatment of the road in this area. The repair is estimated to help the subsiding for a period of 20-30 years, and would cost about $330,000. A 20-meter (66 feet) length of road adjacent to the stacked rock retaining wall would be excavated to a depth of about 12 meters (40 feet). The rest of the 460 meters (1,509 feet) of roadway would be excavated to a depth of about 1.8 meters (six feet). In this excavation a Geogrid™ wrapped soil wall would be constructed to the height of the existing road surface. The dry-laid stone retaining wall would be reconstructed against this soil-wrapped wall.

To allow for placement of the 7.2-meter (24-foot) wide road, the north end of the large cliff face at Overhanging Cliff would have a small portion of the cliff face taken back, perhaps two meters (6.5 feet). Some blasting would be necessary to widen in this area. Approximately 1,000 to 2,000 cubic meters (1,196 to 2,392 cubic yards) of material would be removed.

Calcite Springs

Calcite Springs is the site of an existing boardwalk trail that allows visitors to view the Yellowstone River and thermal features on its banks from high above on the canyon rim. An existing 30-car paved parking area would be increased in size to accommodate 26 passenger cars and three bus/RVs. The Dunraven Road would be relocated about 45 meters (150 feet) south and west of its present location for a distance of about 0.4 kilometers (0.25 miles) before rejoining its existing alignment. The existing parking area presently requires visitors to back into the main travel lanes of the road in an area that has poor sight distances. The new centerline would be located to avoid losing the large Douglas-fir trees south of the existing parking area. The abandoned section of the existing road would be removed and the area returned to a natural state. The slopes would be recontoured and revegetated to reestablish a natural landform.

Material Source

Aggregate material for this project would be obtained from aggregates previously stockpiled at Grebe Lake pit, the Sylvan Pass gravel quarry or from contractor-located sources. Sources outside the park material would most likely come from the North and/or Northeast entrances of the park. About 130,000 metric tons of aggregate material would be used for the Canyon Junction to Tower Junction road improvement. In addition, about 25,000 metric tons of select borrow (a range of specifically sized rock) would be required, although this quantity might decrease depending on the suitability of material obtained from rock cuts. Limited road base material would be obtained by recycling asphalt removed from the existing road. Before transporting material into the park, any out-of-park material would be certified as free of weed seed or the material would be heated to kill exotic plants and seeds. The material would be stored and transported to minimize introduction of exotic species. Construction equipment would be thoroughly pressure washed and checked for cleanliness before entering.

Select stone is needed for masonry work on structures such as headwalls, retaining

walls, guardwalls, curbs, and walkways to maintain their historic character. If suitable, boulders and rocks within the construction limits would be used as a source of stone. The masonry culvert headwalls and retaining walls along the canyon would be salvaged and the stone reused where needed. A supplemental source of rock outside of the park would also be used if necessary.

Staging, Stockpiling, and Disposal Sites

Parking and pullout areas along the road segment (including use of the road surface itself) would be utilized for staging and stockpiling of materials and equipment during periods of full road closure of the two segments. If later phases allow the road to be open for limited public travel, selected parking and pullouts would be used some of these areas would not be available.

Truck turn-around areas would be necessary throughout the project area. Existing disturbed areas, such as informal pullouts and parking areas, would be used where possible. The turn-around areas would be well marked and delineated to reduce inadvertent collisions and impacts to resources.

Areas that would be considered for disposal of excess excavated material would be at the Grebe Lake pit (up to 6,000 cubic meters or 7,848 cubic yards), Canyon employee's ball field area (up to 30,000 cubic meters or 39,239 cubic yards), Frog Rock pit (up to 30,000 cubic meters or 39,239 cubic yards), and the now-abandoned Canyon cistern (up to 1,000 cubic meters or 1,308 cubic yards). An asphalt pugmill or concrete batch plant and rock crusher may be set-up at the Grebe Lake pit, and the Frog Rock pit. The Canyon ball field disposal site may also be the site of a concrete batch plant. Work limits and mitigation measures would be defined in construction contract specifications. The total net quantity of material for disposal would be about 40,000 cubic meters (52,000 cubic yards). Most of the material generated, (excavated material other than the material to be disposed of), would be recycled back into the road project in some manner— as select borrow, stone masonry, topsoil on completed slopes, or natural contour fill along the roadway.

The use of the Grebe Lake pit as a disposal area would involve the construction of a new access spur road off the Canyon to Norris road. It is not envisioned that this road would exceed 300 meters (984 feet) in length. This road would be necessary for accessing the pit as new thermal areas have been discovered adjacent to and under the original access road. If driven over, the weight of trucks and waste material could cause potential damage to these thermal features. Appropriate inventories would be conducted in the proposed area prior to construction.

Reclamation/Revegetation

Reclamation and revegetation following established guidelines (see Appendix A, "Vegetation Management for Construction in Yellowstone National Park") would be funded and implemented as part of the road improvement project. The park policy is to conserve topsoil and salvage vegetation for reclamation of disturbed areas. For this project, due to total road closure, the contractor could stockpile material on the road itself.

During construction, topsoil would be salvaged, stored in windrows, and reused during reclamation to reduce long-term soil loss. No imported topsoil would be used in reclamation. Borrow and aggregate materials and construction equipment would be carefully checked to avoid the importation of exotic vegetation. (Requirements to eliminate exotics from construction equipment and materials are discussed in Appendix A). Native plant materials would be used for revegetation, and areas disturbed by construction would be monitored for early detection and removal of exotic species. Standard, approved erosion control techniques and structures would be used during and after completion of construction. Disturbed areas contributing sediment to surface waters as a result of construction activities would be promptly stabilized and revegetated to maintain water quality.

Approximately 35 to 38 hectares (86 to 94 acres) of disturbance would require reclamation and revegetation due to the cuts and fills associated with widening of the road.

At the Calcite Springs site, the centerline of the road would be shifted to improve safety at the parking area. The old roadbed would be obliterated and the site would be recontoured and revegetated to reestablish a more natural landform. Approximately 0.5- hectare (1.2 acres) would be recontoured and revegetated. Excess earth materials from road reconstruction would be used in reestablishing natural contours along the old cut.

Level of Service (LOS)

The definition of Level of Service (LOS) is a qualitative measure that is used to characterize operational conditions within a traffic stream, and the perception of those conditions by drivers and/or passengers. Refer to page 51 of this environmental assessment for a more complete discussion on LOS.

Traffic volumes of the existing road are predicted to increase by the year 2010 to a point at which the current LOS D would degrade to LOS E. However, the Dunraven Road Transportation Study (BRW, Inc. 1997) showed road widening to 7.2-meter (24-foot) would not alone meet future traffic growth needs. The level of service would still drop to E, unless vehicle length restrictions were added. Therefore, posting signs recommending that vehicles exceeding 9.2 meters (30 feet) in length do not use the road is also a part of this alternative. In coming years, this recommendation could be changed to a restriction that all vehicles over 9.2 meters (30 feet) in length could not use this road. This may be necessary to maintain a LOS D (a goal of this project) in the future.

Visitor Transportation System

The Intermodal Surface Transportation Efficiency Act of 1991 called for a study of alternative means of transportation in national parks. Three parks, including Yellowstone, were selected for specific study. The *Alternate Transportation Modes Feasibility Study, Yellowstone National Park*, (BRW, Inc. 1994) looked at various modes of transportation for Yellowstone visitors, proposed a visitor transportation system based on buses or a cog rail system. The implementation of a cog rail option

would be more complex and time consuming than implementing a bus shuttle system. The cog rail system was estimated to cost 362 million dollars for construction and implementation vs. 30 million dollars for the bus system. Both are stated in 1994 dollars (BRW, Inc. 1994). Key to such a system is an adequately designed, constructed, and maintained road network. At present a bus system would be negatively affected by the poor condition of many of Yellowstone's roads. This alternative for the Canyon Junction/Tower Junction road project would provide the necessary improvements to allow future implementation of a bus system along this section of the Grand Loop Road, if a system were to be implemented in the future.

The park would continue to explore implementation of optional bus systems along this road, as an alternative to private automobiles.

Geology/Thermal Features

Before construction, personnel from the Cascades Volcano Observatory of the U.S. Geological Survey (USGS) would relocate existing geological benchmarks away from the road.

This road crosses no hot ground; therefore, a thermal design was not needed for this project. Subsurface investigations and blasting during road construction could affect geothermal areas. Subsurface investigations would be carried out under the guidelines being developed by park staff. Blasting techniques would be defined in the contract specifications. All basting would be done in accordance with Director's Order #65, *Explosives Use and Blasting Safety* (NPS 1999b). Blasting in the vicinity of Calcite Springs, Overhanging Cliff, and Washburn Hot Springs would be done with numerous small explosive denotations, or "shots", versus one single large shot. This would allow for more control in shaping cuts and reduce the risk of any changes to thermal plumbing in these general areas.

Wetlands and Other Waters of the United States

All wetlands, and waters of the US within 60 meters (200 feet) of the proposed road alignment were surveyed and mapped before road design began so the designer could reduce impacts to wetlands. Techniques to avoid or minimize wetland impacts would include shifting the centerline to avoid wetlands and steepening fill slopes to avoid or reduce areas of fill at specific wetlands.

Wetland mitigation for unavoidable impacts would be accomplished through restoration using a minimum of a one-to-one ratio (i.e., If one acre of wetlands is disturbed, one acre of similar disturbed wetlands elsewhere in the park would be restored). The Federal Highway Administration would apply for a 404 permit from the Army Corps of Engineers which may require 401 certification from the Wyoming Department of Environmental Quality.

Consistent with National Park Service policy, there would not be mitigation for ditch wetlands, (incidental artificial wetlands). The Army Corps of Engineers would only require mitigation for jurisdictional wetlands; Yellowstone National Park would mitigate all jurisdictional and isolated (natural) wetlands affected by this project.

Wildlife

Construction employees would be given instruction on safety in areas frequented by bison, elk and other large mammals found in the area to avoid potential wildlife/human conflicts.

Threatened and Endangered Species

Much of the project area is in prime grizzly bear habitat. In order to mitigate the effect of human activity on bears along the road corridor during and following construction activities, the following actions would be incorporated as part of the proposal:

All project-related employees, such as contract and government construction employees, would be given orientation on how to avoid disturbing or encountering bears and how to minimize unavoidable effects or encounters. Orientation would include information about park regulations regarding food storage, disposal of garbage and other bear attractants, and approaching or harassing wildlife.

At staging areas, no long-term food storage or garbage retention would be permitted. Only bear-proof garbage cans would be used in designated staging or construction-related sites and emptied regularly.

No employee or contractor camps would be permitted outside of existing park residential or camping areas, if housing is required within the park. There is presently a proposal to construct an additional fifty RV sites for use by contractor employees at Canyon. Increased numbers of rangers would be assigned, as necessary, to staging areas to help patrol for food security. Areas within the park that have been used in the past as dry camps, could be used in this capacity again for this construction project.

If carrion or associated bear activity is documented in the project vicinity, site specific use restrictions may be imposed.

Planting of native whitebark pine seedlings would occur in the areas to be disturbed by road construction activities. Approximately 4,000 to 5,000 of these seedlings would be planted as part of this alternative.

Project design would minimize road-kills of wildlife by providing for good visibility and maintaining the general curvature of the road.

Because the nature of wolves is to travel widely, there is potential for wolf activity in the project area. The project stipulations outlined for grizzly bears would include an orientation on wolves and a restriction on night work in whitebark zones after September 1st.

Due to the sensitive cliff environment of Tower Fall, Overhanging Cliff, and Calcite Springs and the birds found in this area, blasting should not occur during the incubation period that would extend from late April until mid-June

depending on the species. Therefore, no blasting would be allowed until after June 15, from Rainy Lake to Tower Fall.

Cultural Resources.

Historic properties (including archeological sites and historic structures and features) that have been determined to be eligible for the National Register of Historic Places would be protected and preserved according to the 1993 programmatic agreement "Programmatic Agreement Among NPS, ACHP, Wyoming SHPO, Montana SHPO, for Principal Park Road System Improvement, Yellowstone National Park" (Appendix C). Protective measures and proposed mitigation are discussed below.

A plan for treatment of prehistoric sites was developed by the Midwest Archeological Center in 1993 (NPS 1993a). An addendum to this treatment plan, addressing historic archeological sites, was developed by William Hunt in 1993 (NPS 1993b). Both plans have been reviewed by the Wyoming SHPO and the ACHP. These plans provide general guidance for resource-sensitive treatment and protection strategies.

The proposed roadwork and staging areas have been designed, as much as possible, to avoid historic properties eligible for the National Register, including archeological sites and historic road features. In addition, appropriate stop-work provisions and provisions for borrow sources and stockpile areas would be included in the project specifications to minimize potential impacts on historic and archeological resources.

Discovery procedures have been developed according to the provisions of the road programmatic agreement, outlines the process to be followed in the event of an inadvertent discovery. Work limits would be defined in areas near historic properties to prevent inadvertent damage to sites. Sensitive design, monitoring of construction activities and definition of work limits would help prevent any adverse project impacts.

Multi-component prehistoric sites 48YE742 and 48YE743, located in the Roosevelt Lodge Historic District, close to the current road alignment, would not be impacted by the reconstruction of the road to a 7.3-meter (24-foot) width. The limits of construction impact of this project would be no greater than the footprint of previous road construction.

Prehistoric site 48YE101, located in the Tower Fall area, is situated on a rise near the road. The centerline of the 7.3-meter (24-foot) road would swing to the other side of the road, avoiding impact to the knoll and the prehistoric site.

A feature of the Tower Fall Soldier Station (site 48YE163) would be impacted by Alternative A, the 7.3-meter (24-foot) road width. Because of the curve and angle of the road through the site area, the limited visibility, and the presence of glacial boulders and old-growth Douglas-firs, impacts to a portion of the historic site are likely unavoidable. Additional historic archival research was conducted (Karsmizki 2000) and magnetic survey of the area completed to identify subsurface historic

debris and artifacts. Following the procedures identified in the programmatic agreement for the parkwide road improvement program (Appendix C) a data recovery plan for the excavation and recovery of information from those features has been developed and provided to the WYSHPO and the ACHP for review and comment. Excavation of a portion of the site would be done in summer 2001. A final report would be issued to provide information concerning the artifacts recovered, addressing the research questions identified in the treatment plan for historic archeology. According to the road programmatic agreement, the recovery of information mitigates the adverse effect to the site caused by excavation.

The 7.3-meter (24-foot) alternative for the widening and reconstruction of the Tower Junction to Canyon Junction road would retain the present road alignment, with a centerline shift at Calcite Springs to provide safe access to parking. The man-made features of the road would be repaired using the natural materials from which they were constructed. New features that may need to be constructed, such as culvert headwalls and guardwalls, would also incorporate natural materials whenever possible and would be designed to blend with the existing features (NPS 1996c). Work on the road would be guided by the protective and mitigation measures described in the road programmatic agreement. Guardwalls and retaining walls would be repaired without having to be reconstructed. Box culverts located along the road segment would be repaired, in kind. Through the use of natural materials and designs that are compatible with the Grand Loop Road Historic District, road features, parking areas, and pullouts would be repaired and modified without adverse effects on their historic qualities. The Tower Creek Bridge, 48YE799, is a stone masonry bridge constructed with a roadway width of 9.2 meters (30 feet) and wide enough to accommodate the 7.3-meter (24-foot) alternative.

Scheduling of Work Activities

This project would be expected to be constructed in two phases: Canyon Junction to the Chittenden Road intersection and Chittenden Road intersection to Tower Junction. Construction would be expected to begin in the spring of 2002 and continue through about 2007 subject to funding.

Road closures would vary from year to year depending on the specific construction work. In general, the road would be closed to all traffic for the summer seasons of 2002 and 2003 for Canyon Junction to Chittenden Road; and 2005 and 2006 for Chittenden Road to Tower Junction. In 2004 and 2007 construction activity could continue and may involve additional road closures such as nightly closures of 9p.m. - 9a.m. or only open during the specific hours of 6a.m.-10a.m. and 6p.m. to 10p.m. Visitor access from either Canyon or Tower (depending on the segment under construction) would be maintained to either the Chittenden Road or Dunraven Pass during this time. This access would occur only during the normal season in which this road is open, mid-June to mid-October.

To address concerns with grizzly bear feeding patterns, no nighttime construction activities would occur after September 1 in whitebark pine zones located between 5.68-km (3.53-mile) north of the Dunraven Pass trailhead and a point 3.04-km

(1.89-mile) south of the Dunraven Pass trailhead.

Visitor Information

Even while the road is open to the public, some visitors would encounter up to 30-minute traffic delays because of road construction activities. Park staff would develop and implement a public information program to alert people to closures and projected delays. The full road closure for the first two years of each construction phase would allow the project to be completed in a shorter time. This reduces the impacts of additional construction seasons and reduces cost to the government.

Construction Stipulations and Mitigating Measures

Measures to mitigate the adverse natural and cultural resource impacts of this alternative have been incorporated into the road design. These measures are intended to avoid, minimize, or rectify impacts as described in 40 CFR 1508.20. Additional mitigating measures to protect sensitive wildlife and threatened and endangered species would be initiated as operating stipulations. These measures and stipulations are described with the appropriate description of the proposed work to be accomplished.

Other Stipulations

No additional housing or offices would be specifically built for this project. Some contractor employee housing and offices could be provided within the park in existing park housing/administrative areas. A contractor camp for multiple construction projects has been proposed to be built at Canyon. A separate Environmental Assessment (EA) has been prepared and will be used in determining whether this project will be approved.

Any use of or association with hazardous materials would require contractor compliance with applicable federal, state, and local laws, codes, ordinances, and regulations. In addition, the *Yellowstone National Park Hazardous Materials Response Plan* (NPS 1993c) would be followed to mitigate potential hazardous material incidents within the park boundary and similar incidents outside the boundary requiring mutual aid.

A stormwater pollution prevention plan would be prepared and incorporated into design and specifications, to control sediment on site so that it would not enter nearby streams or creeks. The Federal Highway Administration would develop a pollution prevention plan with the Wyoming Department of Environmental Quality under the national pollution discharge and elimination system (NPDES) stormwater management program.

Equipment would not be serviced or refueled near streams; storage and refueling or construction parking and staging areas, would be at least 46 meters (150 feet) from streams or riparian areas. Fuel would be stored in fuel trucks or aboveground storage tanks, and all fuel storage would be in staging areas. Refueling would take place in staging areas and might occur at material source sites.

Water for construction/dust abatement could be pumped from surface waters at a small un-named fork of Sulphur Creek, 0.6 km (0.37 miles) north of Dunraven Picnic Area and from Antelope Creek, approximately 2.0 km (1.25 miles) south of Tower Fall, Otter Creek or the Yellowstone River near Otter Creek. Pumping of water from Rainy Lake for use in construction/dust abatement would not be allowed.

A mitigation program designed to minimize fugitive dust from construction activities would be implemented. No chemicals would be used in dust abatement. Dust abatement would include watering of disturbed areas. Vehicle traffic would be managed within the construction zone, and contractor hauling of materials, supplies, and equipment would be controlled.

Under this alternative no night construction work (defined as 9p.m. to 7a.m.) would be allowed after September 1st, from 5.68-km (3.53-mile) north of the Dunraven Pass trailhead to a point 3.04-km (1.89-mile) south of the Dunraven Pass trailhead. This night closure is planned to reduce the displacement of bears feeding on whitebark pine seed middens during nocturnal forays.

To help reduce the effects on grizzly bears from the removal of whitebark pine trees from roadside clearing, 4,000-5,000 native whitebark pine seedlings would be planted in disturbed areas. Seed for propagation would be collected from trees within the project area, and propagated in commercial or Forest Service nurseries.

There would be no blasting from late-April to mid-June from 0.8 kilometers (0.5 miles) north of Calcite Springs to 0.8 kilometers (0.5 miles) south of Tower Fall.

Construction limit staking could be adjusted by park staff to further minimize impacts to whitebark pine, and to avoid impacts by saving large trees (when possible) by making on-the-ground decisions concerning minor clearing limit changes.

Mitigation for wetlands destroyed would be done through restoration of disturbed wetlands located elsewhere in the park on a minimum 1:1 ratio. Wetland disturbance from this alternative totals approximately 0.4 hectares (0.96 acres). Locations for wetland mitigation would include the Canyon Junction vicinity and portions of the abandoned East Entrance Road between the Pelican Creek trailhead and the East Entrance.

Project Cost

Implementing this alternative, including material excavation and processing, road construction, and reclamation, would require $21.9 million (2001 dollars).

ALTERNATIVE B: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 9.2-METER (30-FOOT) PAVEMENT WIDTH WITH NO USE RESTRICTIONS

A 29.3-kilometer (18.4-mile) section of the Grand Loop Road between Canyon Junction and Tower Junction would be reconstructed on the existing alignment to the park standard of 9.2-meter (30-foot) paved width (3.4 meter/11-foot travel lanes with 1.2-meter/4-foot shoulders). The existing road alignment would be followed except for a .40-kilometer (0.25-mile) section directly adjacent to the Calcite Springs parking area. In this area the road centerline would be shifted approximately 30 to 60 meters (100 to 200 feet) west of its current location for safety reasons. The road reconstruction would include appropriate drainage improvements. Some new exposed slopes would be created, requiring revegetation. Some areas would require the construction of cut-side and fill-side retaining walls of varying heights. Improved pullouts would be included in this alternative. In the immediate vicinity of Overhanging Cliff, the road would be widened only to 7.2-meters (24 feet) to reduce resource impacts in this area.

Design Recommendations

The design recommendations would be different than those in Alternative A. In this 9.2-meter (30-foot) alternative the intent is to design a road that allows for a continuous flow of traffic- despite numerous visitors stopping to view wildlife- and that could allow for bicycle traffic on this segment of road.

Most cuts and fills would be in the 3 to 9.2 meters (10 to 30 feet) height range, with maximum cuts of about 26 meters (85 feet) and maximum fills of about 14 meters (45 feet).

About 1,200 meters (3,937 feet) of retaining wall would be used in about 13 to 16 places to reduce disturbance in cut and fill situations. Four possible types of retaining walls have been identified for use. The standard rockery wall would be used the most. In intermediate height areas a 0.9 to 2.4 meters (3 to 8 feet) high rockery wall or possibly soil-nail wall may be used. A rockery wall consists of large blocky stones stacked to create a steep retaining wall. A soil-nail wall involves reinforcing soil material within the area being excavated by installing steel bars horizontally into the slope. Soil-nail walls, if used, would be faced with natural or simulated stone similar to other walls on the road segment. Reinforced concrete retaining walls with natural or simulated rock would be constructed at the Dunraven Pass parking area near the spot where the trail to Mt. Washburn starts. (MSE) walls faced with natural or simulated stone. A limited number of this type of wall could be used during the second phase of this proposed road project in areas of unstable soils.

From Canyon Junction to the Chittenden Road intersection, predominantly rockery walls would be used. From the Chittenden Road intersection to Tower Junction, predominantly soil-nail walls with natural stone or simulated stone facing would be

used.

Highway guardrails or guardwalls could be used in select areas. To ensure compatibility with the roadway historic district, new guardrails would be w-beam made of Corten™ steel or masonry guardwalls, similar to those installed on portions of the East Entrance road. These would be used in areas where guardrail presently exists. Additional sections of new guardrail would be added to existing guardrail area to improve safety to the area, for a total of approximately 1,600 meters (5,249 feet). All historic dry-laid stone retaining walls impacted by construction would be repaired and restored. In accordance with the terms of the roads programmatic agreement, any stone masonry headwalls not visible from the road or other visitor areas and not reconstructed would be salvaged for use elsewhere within the road segment. Minor guardwall repairs would be done where needed and the height of the existing guardwalls would be restored to their original height. This would be done by lowering the roadbed in some areas that have had numerous overlays, (in essence increasing the effective height of the guardwall).

Where trees would be cleared within construction limits, this would be done so that an irregular forest edge remained.

Bridges

The existing bridge would not require reconstruction or widening of the bridge deck for a 9.2-meter (30-foot) road. However, a 1.2-meter (4-foot) paved shoulder would replace the existing delineated walkways on each side of the bridge.

Culverts and Headwalls

Treatment of culverts and headwalls would be the same as in Alternative A. The extensions would be longer to accommodate the increased road width of this alternative as compared with Alternative A.

Parking Areas and Pullouts and Visitor Facilities

The same parking areas and pullouts would be constructed in this alternative as in Alternative A.

Material Source

Proposals for obtaining materials for road improvement would be the same as described in Alternative A. Under this alternative, approximately 170,000 metric tons of material would be used for road improvement as well as about 45,000 metric tons of select borrow.

Staging, Stockpiling, and Disposal Sites

Locations for staging, stockpiling, and disposal of materials would be the same as described in Alternative A. The net quantity of waste material would be about 50,000 cubic meters (65,000 cubic yards).

Reclamation/Revegetation

The same processes would be used as in Alternative A, except that approximately 48 to 53 hectares (119 to 131 acres) of disturbance would require reclamation and

revegetation due to the cuts and fills associated with widening of the road.

Level of Service (LOS)

Traffic volumes of the existing road are predicted to increase by the year 2010 to a point where the current LOS D level would degrade to LOS E. The study (BRW, Inc. 1997) showed that a road widening to 9.2 -meter (30-foot) would meet future traffic growth needs. The level of service would remain at D. Therefore no vehicle length recommendations/restrictions are part of this alternative.

Visitor Transportation System

Alternative B would provide the necessary road improvements to allow future implementation of a bus system as in Alternative A.

Geology/Thermal Features

This would be the same as Alternative A. However, the road would only be a narrower 7.2-meter (24-foot) paved width at the Overhanging Cliff location due to expense and potential resource damage at this location. As this road crosses no hot ground, a thermal design was not needed for this project.

Wetlands and Other waters of the United States

This would be the same as Alternative A except those acres of disturbed area would equal 0.45 to 0.55 hectares (1.10 to 1.35 acres).

Wildlife

Same as for Alternative A.

Threatened and Endangered Species

All items listed under Alternative A for this topic would be implemented as a part of this alternative as well.

Cultural Resources

The two multi-component prehistoric sites located in the Roosevelt Lodge Historic District, close to the current road alignment, would be monitored to ensure the sites were not impacted by the reconstruction of the road using the 9.2-meter (30-foot) road width alternative. Because turn lanes have previously been incorporated into the east-west portion of the Grand Loop Road at Tower Junction, there would be no need to further widen the road in this area. The limits of construction impact for this project would be no greater than the impact of previous road construction in the area. The prehistoric archeological site in the Tower Fall area is on top of a rise near the road. With the 9.2-meter (30-foot) road alignment, the centerline would swing to the other side of the road, avoiding impact to the knoll and the prehistoric site.

Alternative B, the 9.2-meter (30-foot) road width alternative, would impact two features of the Tower Fall Soldier Station (site 48YE163). Because of the curve and angle of the road through the site area, the limited visibility, and the presence of glacial boulders and old-growth Douglas firs, impacts to a portion of the historic site

are unavoidable at this road width. Following the procedures identified in the programmatic agreement for the parkwide road improvement program (Appendix C), a data recovery plan for the excavation and recovery of information from those features impacted by road reconstruction would be developed and provided to the WYSHPO and the ACHP for review and comment. After excavation, a final report would be issued to provide information concerning the artifacts recovered, addressing the research questions identified in the treatment plan for historic archeology. According to the road programmatic agreement, the recovery of information mitigates the adverse effect to the site caused by the impact of the road reconstruction.

It would not be possible to widen the road to 9.2 meters (30 feet) through the Overhanging Cliff area without impact to the delicate geologic formations of the cliff. The retaining wall and masonry guardwalls on the other side of the road from Overhanging Cliff would need to be removed and reconstructed to facilitate the 9.2-meter (30-foot) road. This alternative would maintain a narrower 24-foot road corridor through the Overhanging Cliff area. There are several other places along this road segment when the 9.2-meter (30-foot) road would impact existing historic retaining wall/guardwall structures and box culverts. Some of the box culverts are buried to a depth of up to 15 meters (50 feet) below the roadway. Excavation to lengthen these large drainage structures would be very costly and difficult to accomplish. These box culverts would be left in place and the floors of four would be repaired.

Scheduling of Work Activities

Same as for Alternative A.

Visitor Information

Same as for Alternative A.

Construction Stipulations and Mitigating Measures

Construction stipulations and mitigation would be the same as under Alternative A, with the following exceptions. Alternative B would involve more wetland mitigation than Alternative A due to a wider road template that would further encroach upon existing wetlands. Wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 0.45 to 0.55 hectares (1.10 to 1.35 acres) of previously disturbed wetlands elsewhere in the park.

Other Stipulations

Same as for Alternative A.

Project Cost

Implementing this alternative, including material excavation and processing, road construction and reclamation, would require $28 million (2001 dollars).

ALTERNATIVE C: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 6.0-METER (20-FOOT) PAVEMENT WIDTH, WITH 6.7-METER (22-FOOT) VEHICLE LENGTH RESTRICTIONS

This alternative would require reconstruction of a 29.3-kilometer (18.4-mile) section of the Grand Loop Road between Canyon Junction and Tower Junction. This section would be reconstructed on the existing alignment to a 6.0-meter (20-foot) paved width (3.05 meter/10-foot travel lanes with no shoulders), including drainage improvements. Improved pullouts would also be included in this alternative.

While this alternative would reconstruct the road at its present width, the addition of drainage structures, increased road bed height due to improved base material, and proper slopes off the side of the road would cause the road template to expand into adjacent terrain along the roadway. For example guardrail offsets of 1.2 meters (four feet) from the fog line and curve widening of at least 0.6 to 0.8 meters (2.0 to 2.6 feet) would be expected on some curves. Therefore a 6.0-meter (20-foot) reconstruction would have disturbance beyond the existing road prism.

Design Recommendations

The design recommendations would be different from Alternative A and B. The intent of this design was to minimize impacts to resources adjacent to the road. This alternative would not address improvements to traffic flow other than benefits provided by improved and additional vehicle pullouts. The alternative would correct present shortcomings in road base materials and drainage issues. The result of this alternative continues present shortcomings in traffic flow, despite numerous visitors stopping to view wildlife. This alternative would not address improvements to accommodate bicycle traffic.

Most cuts and fills would be in the 3- to 6-meter (10- to 20-foot) height range, with maximum cuts of about 18 meters (60 feet and maximum fills of about 6 meters (20 feet).

About 200 meters (656 feet) of wall would be used in about 3 to 5 locations to reduce disturbance in cut and fill situations. Three possible types of walls have been identified for use. The standard rockery wall would be used the most. In intermediate height areas a 0.9- to 2.4-meter (3- to 8-foot) high rockery wall or possibly soil-nail wall may be used. A rockery wall consists of large blocky stones stacked to create a steep retaining wall. A soil-nail wall involves reinforcing soil material within the area being excavated by installing steel bars horizontally into the slope. Soil-nail walls, if used, would be faced with natural or simulated stone similar to other walls on the road segment. From Canyon Junction to the Chittenden Road intersection, predominantly rockery walls would be used. From the Chittenden Road intersection to Tower Junction, predominantly soil-nail walls with natural stone or simulated stone facing would be used. Limited instances of reinforced concrete retaining walls would be used, one instance being near the trailhead to Mt.

Washburn at the Dunraven Pass parking area. MSE walls could be used sparingly at areas between Tower and Mae West curve in areas of unstable soils.

Highway guardrails or guardwalls could be used in select areas. To ensure compatibility with the roadway historic district, new guardrails would be w-beam made of Corten ™ steel or masonry guardwalls, similar to those installed on portions of the East Entrance road. These would be used in areas where guardrail presently exists. Additional sections of new guardrail would be added to existing guardrail area to improve safety to the area, for a total of approximately 1,600 meters (5,249 feet). All historic dry-laid stone retaining walls impacted by construction would be repaired and restored. In accordance with the terms of the roads programmatic agreement, any stone masonry headwalls not visible from the road or other visitor areas, and not reconstructed, would be salvaged for use along the roadway elsewhere within the road segment. Minor guardwall repairs would be done where needed and the height of the existing guardwalls would be restored to their original height by lowering the roadbed in some areas that have had numerous overlays, (in essence increasing the effective height of the guardwall).

Where trees would be cleared within construction limits, this would be done so that an irregular forest edge remained.

Bridges

The 6.0-meter (20-foot) roadway width would not require reconstruction to widen the bridge deck for this alternative. Repairs to the bridge would be the same as in Alternatives A and B. The pedestrian walkways along each side of the bridge would remain.

Culverts and Headwalls

Treatment of culverts and headwalls would be the same as in Alternatives A and B.

Parking Areas and Pullouts and Visitor Facilities

The same parking areas and pullouts would be constructed in this alternative as in Alternatives A and B.

Material Source

Proposals for obtaining materials for road improvement would be the same as described in Alternatives A and B. Under this alternative, approximately 115,000 metric tons of material would be used for road improvement as well as about 20,000 metric tons of select borrow.

Staging, Stockpiling, and Disposal Sites

Locations for staging, stockpiling, and disposal of materials would be the same as described in Alternatives A and B. The net quantity of waste material would be about 30,000 cubic meters (40,000 cubic yards). Construction stipulations and mitigation would be the same as under Alternatives A and B.

Reclamation/Revegetation

Same processes used as in Alternative A, except that approximately 27 to 30 hectares (67 to 74 acres) of disturbance would require reclamation and revegetation due to the cuts and fills associated with widening of the road.

Level of Service (LOS)

Traffic volumes of the existing road are predicted to increase by the year 2010 to a point where the current LOS D level would degrade to LOS E. However, the BRW, Inc. study (1997) showed a road reconstruction of the existing 6.0-meter (20-foot) width would not alone meet future traffic growth needs. The level of service would still drop to E, unless vehicle length restrictions were also added. Therefore, vehicles exceeding 22 feet in length would be restricted from using the road. This would be necessary to maintain a Level of Service D (a goal of this project) into the future.

Visitor Transportation System

Alternative C would not provide the necessary road improvements to allow implementation of a bus system and still allow for two-way traffic in private vehicles, due to the narrower pavement width of this alternative.

Geology/Thermal Features

Before construction, personnel from the Cascades Volcano Observatory would relocate existing geological benchmarks away from the road. As this road crosses no hot ground, a thermal design would not be needed for this project. However the repairs for the slumping road near Overhanging Cliff (described in Alternative A), would apply this alternative as well.

Wetlands

Alternative C would involve less wetland mitigation than Alternatives A and B. Unavoidable impacts would be accomplished through restoration of a minimum of 0.30 to .40 hectares (0.75 to 1.00 acres) of previously disturbed wetlands elsewhere in the park.

Wildlife

Same as Alternative A.

Threatened and Endangered Species

This alternative would incorporate all mitigations and actions described in Alternative A to minimize effects to threatened and endangered species along this segment of road.

Cultural Resources

This alternative would have no impact on the prehistoric or historic sites located within the area of potential effect of this undertaking. The historic Tower Creek Bridge and the masonry features of the road would not be impacted by this alternative. The road width over the historic bridge would remain at its present width.

Scheduling of Work Activities

Same as for Alternatives A and B.

Visitor Information

Same as for Alternatives A and B.

Construction Stipulations and Mitigating Measures

Same as for Alternatives A and B.

Other Stipulations

Same as for Alternatives A and B.

Project Cost

Implementing this alternative, including material excavation and processing, road construction, and reclamation, would require $17 million (2001 dollars).

ALTERNATIVE D: NO ACTION

No major road reconstruction work would occur in the Canyon Junction/Tower Junction area in the near future. Existing use and maintenance of the road and ancillary features would continue. Maintenance activities such as pothole patching, periodic chip-and-seal coat applications, and removal of rockfall and slumping debris would continue. In some roadway sections regular road maintenance would be inadequate because the road has deteriorated to the point where substantial improvement has become necessary. Road maintenance activities would require an increasing proportion of park funds because FLHP funds would not be available. If continued deterioration is allowed to occur the road may need to be closed if it becomes unsafe and if not enough maintenance funds are available to repair damaged areas, as happened for a short time in 1998. No modifications to alignments, road widths, slopes, pullouts, bridges, culverts, walls, guardrails, or signs would be made, and no material excavation/site reclamation would be carried out. Road improvement projects that require large quantities of aggregate material, such as asphalt pavement overlays, would be deferred indefinitely, potentially resulting in road closures.

Implementation of a visitor transportation system using buses would be adversely affected because of the poor road condition and the inadequacy of the road to handle high volumes of bus traffic.

Design Recommendations

The design recommendations would be different from Alternatives A and B and C in that the intent of this alternative is to maintain a road that allows present shortcomings in traffic flow. This would be the situation allowed despite numerous visitors blocking traffic to view wildlife. The road design does not safely accommodate bicycle traffic.

There would be no new cut or fill-side walls constructed and no new disturbance that would require a need for revegetation. There would be no new guardrails installed. No trees along the road edge would be cut to allow for improved drainage.

Bridges

The bridge would remain as is. Needed repairs would compete for park funding along with other projects.

Culverts and Headwalls

Culverts and headwalls would remain in their present condition.

Parking Areas and Pullouts and Visitor Facilities

Safety issues at select parking areas along this route would not be addressed. Informal pullouts would continue to allow the additional resource damage as vehicles continue to enlarge them. Under this alternative the Tower Store would be removed from this location. The store's building site would be revegetated, and no changes to the parking area would occur. No picnic tables would be added. The restrooms and trailhead would remain the same.

Material Source

No material source would be required.

Staging, Stockpiling, and Disposal Sites

No staging or stockpile areas would be required.

Reclamation/Revegetation

No revegetation activities would be anticipated for this alternative. Some existing slopes that were originally cut very steep and have not revegetated well would continue to be poorly vegetated.

Level of Service (LOS)

Traffic volumes of the existing road are predicted to increase by the year 2010 to a point where the current LOS D level would degrade to LOS E. Dunraven Road currently operates at Level of Service D from about 11:00am to 6:00pm on peak summer days. If no road improvements or visitor management measures were implemented, the Level of Service would degrade to E for about four hours per day due to the expected growth in traffic by 2010.

Visitor Transportation System

Alternative D would not provide the necessary road improvements to allow future implementation of a bus system and still allow for two-way traffic in private vehicles.

Geology/Thermal Features

The slumping problem that occurs at the Overhanging Cliff area would continue to require road maintenance to keep the road in a useable condition. Thermal features would not be affected.

Wetlands and Other Waters of the United States

Road maintenance on Dunraven Road would not be expected to affect wetlands.

Wildlife

Road maintenance could temporarily displace wildlife.

Threatened and Endangered Species

There would be no threatened and endangered species impacts.

Cultural Resources

This alternative would have no impact on the prehistoric and historic archeological sites located within the area of potential effect of this undertaking. The historic Tower Creek Bridge and the masonry features of the road would not be impacted by this alternative. The road width over the historic bridge would remain at the present width.

Scheduling of Work Activities

Periodic maintenance activities would be conducted by park crews on their regular work schedules, Monday through Friday, during normal daytime work hours. There may also be short term, mid-summer road closures of five to ten working days to allow park crews to accomplish minor overlay or patching projects.

Visitor Information

Road condition information would be relayed to park visitors via the park's morning reports, and posted as is currently done in campgrounds and visitor centers.

Construction Stipulations and Mitigation

No construction stipulations or mitigation measures would be required.

Other Stipulations

No other stipulations for this alternative would be needed.

Project Cost

Yellowstone has spent approximately $203,200 for road maintenance over the last three years just to keep the road open and passable. This amount of money has been used for patching and minor overlays of pavement. The dollars spent on this level of maintenance have done nothing to correct underlying problems with pavement base or improper drainage.

As the road continues to deteriorate an increasing amount of park funds would be required to keep it usable and open. There is the possibility that some road maintenance activities would be require road closures of one to two weeks.

ALTERNATIVES CONSIDERED BUT REJECTED

Road Design Alternatives

Realignment

A variety of alternatives were considered early in the project to evaluate portions of the road that had notable natural/cultural resource and safety concerns such as wetlands and unstable slopes, traffic congestion, and historic sites. These sites-

Calcite Springs, Overhanging Cliff, Tower Fall, and Dunraven Pass- had redesigns and re-routes considered. This included separating vehicle flow from pedestrians and avoiding impacts to large trees and wetlands.

Overlay of existing roadway at existing width

Overlaying the existing pavement structure with a new layer of asphalt would not correct the problems of improper base material to allow proper drainage that would reduce frost heaves and cracking of the pavement due to freeze-thaw action, and heavy vehicles and improper drainage. Safety issues, such as narrow road, no shoulder, and no recovery zone, would not be addressed.

Traffic Management Alternatives

The following alternatives were analyzed in the Dunraven Road Transportation Study (BRW, Inc. 1997). They are scenarios that could be implemented in the future if conditions warrant. They could be implemented in part or in whole on any of the action alternatives that are being considered.

Close road to private vehicles and leave open for mass transit vehicles

All private vehicles would be restricted from using Dunraven Road during June, July, and August. Vehicles over 6.7 m (22 feet) in length could be restricted during the entire visitation season. It is assumed that the proposed visitor transportation system service would be used by approximately 25 percent of the visitors who would use the road if no restrictions were in place. Two options for a visitor transportation system service were analyzed:

- Option A. The system would be operated as a tour with stops only at major destinations between Canyon Village and Roosevelt Lodge. Shuttles would wait for passengers a minimum of five minutes to a maximum of fifteen minutes, depending upon the location.

- Option B. The system would be operated as a shuttle system. Buses would make one-minute stops at all destinations between Canyon Village and Roosevelt Lodge.

Neither was considered a viable alternative at this time due to a lack of dedicated funding source for the purchase or operation of such a system. Also, current traffic flows were not believed to warrant such as change. However, use of voluntary bus systems would continue to be evaluated.

Make road one-way at existing width

- **Option A** The roadway would operate as a one-lane, one-way northbound, road at its present width with a wide shoulder for passing and use by bicycles. Traffic approaching Tower Junction from Mammoth would be directed to continue along the Northeast Entrance road or to return to Mammoth. Visitor information would be provided at Mammoth advising visitors of the restriction to southbound traffic at Tower Junction. Traffic approaching Tower Junction from the Northeast Entrance station would be

directed toward Mammoth. Administrative traffic would be restricted to the northbound direction. Emergency vehicles might be allowed to travel against the flow of traffic especially if they were carrying injured visitors to the Lake hospital. However, the contra-flow operation of emergency vehicles would represent a notable hazard and probably would not be allowed. Emergency vehicles would need to be stationed at Canyon Village to allow fast response to incidents on the road.

- **Option B** The direction of the traffic on the road would be one-way southbound. Traffic approaching the Canyon four-way intersection would be directed into the Canyon Village area or toward Norris Junction. To afford fast response to accidents or other incidents, emergency vehicles would need to be stationed at Tower Junction.

This alternative presented complicated logistical requirements, visitor inconvenience, and administrative travel problems, especially concerning emergency response needs. Consequently, the alternative was rejected.

Reconstruct roadway at existing width and restrict vehicles over 6.7 meters (22 feet) and provide a shuttle system.

Private vehicles over 6.7 meters (22 feet) in length would be restricted on Dunraven Road for the entire visitation season. A visitor transportation system would provide access to the Dunraven Road corridor. It was assumed that only the visitors with over-length vehicles would use the visitor transportation system. Approximately 50 percent of the visitors in over-length vehicles were assumed to use the system. Two options for visitor transportation system operation were analyzed:

- **Option A** The visitor transportation system would be operated as a tour, with stops only at major destinations between Canyon Village and Roosevelt Lodge. Buses would wait for passengers to view scenery or wildlife a minimum of five minutes to a maximum of fifteen minutes at each stop, depending upon the destination.

- **Option B** The visitor transportation system would be operated as a shuttle system that would make one-minute stops at all destinations between Canyon Village and Roosevelt Lodge. The shuttle service would be convenient for visitors wishing to make extended stays at activity areas along the road and for visitors hiking from one location to another.

At this time traffic volumes were not believed to warrant such restrictions and voluntary bus system line. There was no dedicated funding to implement a shuttle system, and consequently it was rejected.

Overlay of existing roadway at existing width

Overlaying the existing pavement structure with a new lift of asphalt would not correct the problems of improper base material to allows proper drainage that would

reduce frost heaves and cracking of the pavement due to freeze-thaw action, and heavy vehicles and improper drainage. Safety issues, such as narrow road, no shoulders and no recovery zone would not be addressed.

Material Source Alternatives

A number of alternative material sources were considered. Several in-park sources identified in the *Parkwide Road Improvement Plan* (NPS 1992) were sampled and tested by the FHWA. All sources failed to meet one or more of the following criteria: material quality, based on current federal specifications; minimize geothermal effects; and area of potential disturbance less than area of reclamation.

Exclusive use of sources outside the park at distances of about 100 kilometers (62 miles) from the project site, were considered impractical because of long haul distances, travel time, increased traffic congestion, road deterioration, potential for accidents, possible exhaustion of these material sources, and high transportation costs. However, as noted in the alternatives discussion, contractors may opt for non-park sources.

The environmental effects of extracting in-park material sources would generally be comparable to those of extraction outside the park because both in-park and out-of-park sources are in the Greater Yellowstone Area and have comparable natural and cultural resources components and attributes. Compliance and reclamation requirements would have been similar to those for actions occurring off parklands.

TABLE 1: SUMMARY OF POTENTIAL IMPACTS OF ALTERNATIVES

Impact Topic	Alternative A (Preferred)	Alternative B	Alternative C	Alternative D (No Action)
Soils/ Vegetation/ Rare Plants/ Whitebark pine	Approximately 35-38 hectares (86-94 acres) of disturbance to soil and vegetation would occur, including the loss of 0.075-hectare (8,073 square feet) of rare plant habitat. Approx. 16.2 hectares (40 acres) of whitebark or potential food source habitat would be disturbed. Soils and vegetation: Direct, short-term, moderate impacts. Revegetation in the long-term will lessen impacts to a degree defined as minor. Rare Plants: Direct adverse, moderate impacts to affected individual sites. Whitebark Pine: Long-term minor adverse impacts due to loss of cone production to local stand.	Approximately 48-53 hectares (119-131 acres) of disturbance to soil and vegetation would occur, including the loss of 0.095-hectare (10,226 square feet) of rare plant habitat. Approx. 23-25 hectares (56-62 acres) of whitebark or potential food source habitat would be disturbed. Soils and vegetation: Direct, short-term, moderate impacts. Revegetation in the long-term will lessen impacts to a degree defined as minor, even with additional acres in Alt. B. Rare Plants: Direct adverse, moderate, impacts to affected individual sites, even with additional acres in Alt. B. Whitebark Pine: Long-term minor adverse impacts due to loss of cone production to local stand.	Approximately 27-30 hectares (67-74 acres) of disturbance to soil vegetation would occur, including the loss of 0.060 hectare (6,458 square feet) of rare plant habitat. Approx. 13-14 hectares (31-35 acres) of whitebark or potential food source habitat would be disturbed. Soils and vegetation: Direct, short-term, moderate impacts. Revegetation in the long-term will lessen impacts to a degree defined as negligible to minor, due to fewer acres in Alt. C. Rare Plants: Direct adverse, moderate impacts to affected individual sites, even with less overall acres in Alt. C. Whitebark Pine: Long-term negligible adverse impacts due to loss of cone production to local stand.	Existing roadside soils and vegetation would continue to experience negligible, direct adverse impacts from vehicles using informal pullouts to park. Rare plants would not be impacted by this alternative. Whitebark pine would not be impacted by this alternative.
Fisheries/ Aquatic Resources	Alternative A has the potential for increasing stormwater runoff for the 2.5 miles where adjacent to Antelope Creek. This is due to increase of about 17% more pavement (overall) than existing road conditions. Stormwater runoff has the potential to transport sediments into the stream causing minor short-term impacts. Negligible, short-term impacts to fisheries during construction; no long-term adverse impacts to fisheries.	Alternative B has the potential to increase storm-water runoff where close to Antelope Creek. This would be due to an increase of about 46% in pavement over existing conditions. No long-term adverse impacts to fisheries.	Alternative C would increase storm-water runoff to a negligible amount due to minor additions of new pavement in turnouts and ditch work. No long-term adverse impacts to fisheries.	Maintenance activities such as roadside ditching and maintenance of ditches would have a short-term negligible increase in sedimentation in creek due to runoff.

Impact Topic	Alternative A (Preferred)	Alternative B	Alternative C	Alternative D (No Action)
Amphibians/ Reptiles	Impacts to amphibian habitat may include degradation of water quality, changes to pond substrate and shoreline characteristics, disruption of breeding activities and larval development, direct and indirect mortality of adult and larvae due to human activities and operation of equipment, etc. Impacts to reptile habitat may include loss or reduction of summer shelter and winter den sites for snakes, reduction in prey abundance if amphibian populations are reduced, and direct or indirect mortality. There would be direct, minor, adverse long-term effects to Rainy Lake populations.	Impacts would be similar to those in Alternative A, except that additional fill material would be placed into Rainy Lake and/or the adjacent wetland increasing the impacts to amphibians and reptiles of that area. Shoreline (the defined habitat area) is impacted the same in Alternatives A and B.	Impacts would be less than those described for Alternatives A&B. Less fill material, if any, would be placed along the existing road at Rainy Lake. This would cause negligible short-term impacts to shoreline characteristics, thereby reducing the impacts to amphibians and reptiles.	No new adverse impacts to amphibians and reptiles.
Wetlands and Other Waters of the U.S.	Approximately 0.35- 0.45 hectares (0.85-1.10 acres) of wetlands would be impacted. Mitigation would include restoration of at least the same amount of wetlands. Mitigating measures would be used to minimize water pollution from construction work.	Approximately 0.45-0. 55 hectares (1.10-1.35 acres) of wetlands would be impacted. Mitigation would include restoration of at least the same amount of wetlands. Mitigating measures would be used to minimize water pollution from construction work.	Approximately 0.30-0.40 hectares (0.75-1.00 acres) of wetlands would be impacted. Mitigation would include restoration of at least the same amount of wetlands. Mitigating measures would be used to minimize water pollution from construction work.	Existing areas of roadside erosion would continue to have a negligible affect on water quality and wetlands.
Wildlife/ Road-kill	Some increase in vehicle speeds could occur. However road-kills are expected to remain low, therefore a negligible long-term impact would occur. There would be negligible long-term impacts to wildlife due to habitat loss.	Some increase in vehicle speeds could occur; however, road-kills are expected to remain low. Therefore long-term impacts would be negligible.	An increase in vehicle speeds would not be expected, thus road-kills would remain at similar levels. No effect would be expected in the short- or long-term.	Road-kills would continue to contribute to wildlife mortalities; however, road-kills are expected to remain low. No long-term adverse impacts expected.
Threatened and Endangered	This alternative may affect but is not likely to adversely affect grizzly	Same as Alternative A.	Same as Alternative A	This alternative would have no effect on grizzly bears, lynx,

Impact Topic	Alternative A (Preferred)	Alternative B	Alternative C	Alternative D (No Action)
Species	bears. May have some minor negative impacts, but are not likely to adversely affect lynx. Other threatened and endangered species would not be affected.			wolves, bald eagles, and whopping cranes.
Air Quality	Localized effects on air quality would be temporary and limited to the duration of construction. Short-term, there would be direct, minor adverse impacts. There would be no long-term impacts	Same as Alternative A.	Same as Alternative A	No new impacts would occur.
Prehistoric and Historic Archeological Resources	Archeological site 48YE101, 48YE742 & 48YE743 would be monitored to ensure no new impact. Data recovery site 48YE163 would mitigate the adverse impact of road construction to features of this site.	Same as Alternative A.	Same as Alternative A. Minimal data recovery would be necessary on site 48YE163.	Sites would continue slow deterioration from erosion and use of informal pullouts.
Historic Roadway System/ Cultural Landscapes	The only work proposed for 48YE826 may be grading and routine maintenance of the existing gravel road surface. The Tower Bridge 48YE799 would need only in-kind repair. No widening is necessary.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Social/ Economic	In the short-term, some visitors would be inconvenienced by total road closures for up to four summer seasons. There would be moderate, short-term impacts to concession operations, especially at Tower/Roosevelt and Canyon. Most other businesses within the park would not be negatively affected in a noticeable manner. Businesses and individuals located outside the park should not be affected at all.	Impacts on the socioeconomic environment would be similar to those of Alternative A. Some minor beneficial safety improvements related to bicycle and vehicle use of the road would occur with the construction of 4' wide paved shoulders. The use of bicycle traffic in a high use bear area would still be a concern. Concession operations would	Impacts on the socioeconomic environment would be similar to those of Alternative A, except many of the safety-related problems associated with the narrower road width would not be adequately addressed. Commercial bicycle use would be restricted. Concession operations would see the same impacts as Alt A. Also traffic flow would not be appreciably improved.	Continuing the current situation in the project area would not improve visitor experiences and would expose visitors, staff, and their property to increasing risk of injury and damage. Although the cost of road improvements would be avoided in the short-term, those savings would be achieved at the threat of damage to life and property and much greater operational expenditures in the

Impact Topic	Alternative A (Preferred)	Alternative B	Alternative C	Alternative D (No Action)
	The regional economy would be enhanced by construction expenditures of approximately $17-$28 million and other spending induced by this work on the park road system. Long-term benefits would result from improved safety, a smoother and wider surface, and more enjoyable experiences for motorists and bicyclists. The tourism segment of the regional economy would be made more secure by improvements to the road system within Yellowstone. Park operations would improve because of reduced road maintenance costs, better access for park vehicles, and a safer road. Short-term cost to visitors would be offset by short- and long-term benefits. Commercial bicycle tours would not be allowed on this road segment.	see the same impacts as Alt A. Traffic congestion and the likelihood of traffic interruptions or delays would be alleviated the most by implementation of this alternative. Also, in Alternative B, the dollar direct benefits from construction related expenditures would be a minor increase than for Alternative A. Commercial bicycle tours may be allowed on this road segment.	Traffic congestion and the likelihood of traffic interruptions or delays would persist. Also, in Alternative C, the dollar direct benefits from construction related expenditures would be less than that for Alternative A and Alternative B. Commercial bicycle tours would not be allowed on this road segment.	long run. On-going maintenance and safety problems would not be resolved. Commercial bicycle tours would not be allowed on this road segment. Concession operations would not be impacted by road closures. Increased vehicle numbers predicted in the future would have a moderate adverse impact on traffic flow.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

- Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.

- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

- Preserve important historic, cultural, and natural aspects of our heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.

- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.

- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Given the above criteria, Alternative A was determined to suitably fit the balance that is required to be met as the environmentally preferred alternative. Alternative A best preserves and enhances cultural and natural resources over the long-term. Road reconstruction to a 24-foot width best meets the national environmental policy expressed in NEPA (Sec. 101(b)) to fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

- Alternative D, the No Action Alternative, would not strike the balance between public safety and preservation and repair of cultural features. Alternative D would also allow the traffic Level of Service to degrade to LOS E due to the expected growth in traffic by 2010.

- All of the action alternatives (Alt. A, B, C) would create some levels of change to the immediate roadside conditions.

- Alternatives A and C would also have additional paved width due to curve widening on many of the sharper curves. Increased paved width of 0.6 to 0.8 meters (2.0 to 2.6 feet) would be expected on some curves.

- The disturbance created by the clearing limits necessary for a 6.0-meter (20-foot) Alternative C includes the same additional four-foot offset for guardrails from the fog lines, as in Alternative A and B.

- As the narrowest road width option of any of the action alternatives, Alternative C does not provide a needed level of public safety.

- The road width standard typically called for within the park is 9.2 meters (30 feet) as described in Alternative B. However for the Dunraven Road segment, this width was considered to be difficult to achieve without causing impacts to cultural features and natural features. The difference with this road segment compared to most others in the park was the very steep terrain and rock cliffs. Aside from increasing road width, there were other methods to provide for public safety.

AFFECTED ENVIRONMENT

REGIONAL CONTEXT

Yellowstone National Park is at the heart of the region known as the Greater Yellowstone Area. The area comprises almost 4,856,247 hectares (12 million acres) and is one of the last largely intact ecosystems in the world's temperate zone. In addition to Yellowstone National Park, the area contains two other national park system units - John D. Rockefeller, Jr., Memorial Parkway and Grand Teton National Park. Portions of six national forests - Gallatin, Custer, Shoshone, Bridger-Teton, Caribou-Targhee, Beaverhead-Deerlodge- are within the Greater Yellowstone Area, as are two units of the national wildlife refuge system, the National Elk Refuge and Red Rocks National Wildlife Refuge. Although public lands make up the majority of the area, state and private lands are also included. The area extends across portions of 17 counties in three states. Yellowstone's size and the number of geopolitical entities at the federal, state, and local level combine to create a complex administrative environment within the Greater Yellowstone Area.

Yellowstone National Park encompasses about 890,312 hectares (2.2 million acres) primarily in northwestern Wyoming and extending into Idaho and Montana. The park has a surfaced road system of about 531 kilometers (330 miles). Roads enter from the north, northeast, east, south, and west and connect to the historic Grand Loop Road, a figure-eight road system (see the Vicinity map page 5).

The park road system was originally surfaced and paved before the beginning of World War II. Most roads have since deteriorated to the point where routine maintenance can no longer preserve them or provide visitors with safe and enjoyable driving experiences.

ROAD CHARACTER

The Dunraven Road in itself provides a travel experience that is unequaled along the rest of the Grand Loop Road. It winds through varied and dramatic scenery including high cliffs, steep gullies, mountain meadows and whitebark pine forests. These features together with the relatively narrow width and winding alignment of the road may help to reduce traffic speeds and encourage drivers to be aware of their surroundings. The road character is derived from all the features of the road itself when taken in its entirety. These features include stone headwalls of drainage culverts, a stone bridge and guardwalls, winding alignment, and log guardrails.

ROAD USE

Information under this heading is from the *Transportation Study Dunraven Road* (BRW, Inc. 1997). The following describes the current road features and usage. Vehicle types, parking areas, pullouts, traffic flow and volumes, and accident statistics are described. Features are shown on the Dunraven Road Project Area map page 17.

Pullouts and Parking Areas

- At the main public parking area in the Canyon Village area there are a total of 447 parking spaces. Additionally, 55 spaces are located at the camper service area, and 55 more spaces are provided at the horse corral.
- The Cascades Lake and Dunraven Road picnic areas have 14 and 8 parking spaces, respectively. They are located on the west side of Dunraven Road, and these areas provide access for short-term use by picnickers. Farther north, along the east side of Dunraven Road, a pullout with a capacity of six vehicles serves as an overlook of Washburn Hot Springs and the Yellowstone caldera rim.
- At Dunraven Pass, a trailhead and parking area provide access to the Mt. Washburn Trail. At the trailhead there are approximately 20 unstriped parking spaces. These spaces are typically full, and visitor parking often overflows to adjacent roadside areas on summer days with good hiking weather.
- Approximately eight kilometers (five miles) north of Dunraven Pass, Dunraven Road intersects the Chittenden Road that heads south toward the summit of Mt. Washburn. A large parking area three kilometers (two miles) from the Dunraven Road intersection provides 80 spaces for use by hikers. The Chittenden Road is closed to private vehicle access beyond the parking area, but the road is maintained for administrative access to the Mt. Washburn fire lookout.
- Along the 9.7-km (6-mile) distance from the Chittenden Road to Tower Fall, numerous pullouts are scattered along the east side of the Dunraven Road overlooking Antelope Creek. Together these pullouts can accommodate approximately 30 vehicles. At the old Buffalo Paddock area there is a water intake and small parking area that can be used by hikers headed downstream along Antelope Creek. The upper reaches of the creek and its drainage are closed to visitor use because of prime grizzly bear habitat in the area.
- At the Tower Fall trailhead and store there are 53 marked spaces in a paved parking area. Approximately 40 additional unmarked spaces are located along Dunraven Road across the road from the store and trailhead. Large numbers of visitors cross the roadway from the roadside parking spaces to the activity areas on the opposite side. The current parking situation creates hazards for drivers encountering the congested roadway, as they suddenly encounter parked vehicles lining the road's edge.
- Calcite Springs may be viewed from a short trail that heads north from Dunraven Road between Tower Fall and Tower Junction. A parking area with 30 spaces is provided for visitor use at this location.
- Dunraven Road ends at Tower Junction. Parking in this area is provided at the service station (15 spaces), Roosevelt Lodge (30 spaces), and horse corral (45 spaces).

Dunraven Road Parking Occupancy

Parking Area	Design Capacity	Maximum Observed Occupancy
Cascade Lake Picnic Area	14	21
Dunraven Road Picnic Area	8	14
Caldera Overlook (Washburn Springs)	6	5
Dunraven Pass/Mt. Washburn Trailhead	20	38
Chittenden Road Trailhead	80	34
Antelope Creek Viewpoints (combined)	30	27
Calcite Springs Overlook	30	18
Roosevelt Corral	30	20
Roosevelt Lodge	30	32

Source: Lee Engineering, Observations July 17-18, 1996- counted 4 times on both days.
Transportation Study Dunraven Road (BRW, Inc. 1997) page 26

Many of the parking and view areas along Dunraven Road are used at levels near or in excess of their design capacity. In particular, parking in the Dunraven Pass/Mt. Washburn trailhead parking area was observed to be nearly double the estimated capacity. At the same time, the Chittenden Road Trailhead parking area had many unused parking spaces. Parking demand at some of the pullouts is related to the opportunity to observe wildlife. Bear sightings in the Antelope Creek area can cause parking demand in excess of the capacity of the pullouts in that area.

Vehicle Classification and Length

Data on the length and type of vehicles traveling the Yellowstone road system were collected during July 16 to 18, 1996 at the location identified below. Data were collected for two-hour periods during the morning, midday, and afternoon peak travel times from:
Tower Junction, Canyon Village (four-way intersection); West Thumb Junction, Madison Junction, Norris Junction, Mammoth Junction.

Total Vehicle Length-Peak Periods
Canyon 4-way Intersection

	< 6.7meters (< 22')	6.7-9.2m (22'-30')	9.2-12.2m (30'-40')	12.2m + (40' +)	Total
Total	1,026 (93.3%)	47 (4.3%)	22 (2.0%)	4 (0.4%)	1,099

Source: Lee Engineering, July 16-18, 1996. BRW, Inc. 1997 page 19, summarized.

Vehicles Towing an Item-Peak Periods
Dunraven Road

	Not Towing	Towing	Total
Total	1,068 (97.2%)	31 (2.8%)	1,099

Source: Lee Engineering, July 16-18, 1996. BRW, Inc. 1997 page 20. Summarized

No noteworthy differences were identified in the length of vehicles by time period. The lengths of vehicles also were generally similar at all locations where observations were collected. At most locations, more than 90 percent of the vehicles in the peak travel periods were less than 6.7 m (22 feet) in length. These consisted of those passenger cars, motorcycles, and pick-ups with camper units; that were not towing another vehicle.

On Dunraven Road, approximately 93 percent of the vehicles were less than 6.7m (22 feet) in length. The traffic using the road consisted primarily of passenger vehicles. A large majority of vehicles (97 percent) were not towing another item.

Roadway Level of Service (LOS)

Roadway level of service (LOS) is a qualitative measure that is used to characterize operational conditions within a traffic stream, and the perception of those conditions by drivers and/or passengers. Level of service on a given road is a composite measure of speed and travel time, the freedom of individual vehicles to maneuver, and the likelihood of traffic interruptions or delays. The comfort and convenience of travel and the relative safety of travel are affected by the quality of traffic flow as measured by level of service.

As traffic volumes increase on a given road, congestion worsens, delays increase, and the level of service declines. The number of travel lanes, the width of the lanes, the presence of usable road shoulders, the roadway grade, and the mix of traffic all influence level of service. The traffic level of service on Dunraven Road for a given volume and mix of traffic would be lower than that for a typical two-lane road in level terrain for the same volume due to the mountainous terrain it crosses, the limited amount of passing that can occur, and the narrow pavement with no shoulders.

Six levels of service are defined in the *1994 Highway Capacity Manual* for several types of roadway facilities. The levels of service are given letter designations, from A to F, with levels of Service A representing the best operating conditions and the level of F the worst. The service levels apply to typical operating conditions. The level of service measures do not address accidents, weather, road conditions, and other incidents (such as delays from animal viewing). The impact of incidents or degraded road conditions on traffic flow is greater for the lower level of service ranges of operation.

- **Level of Service A** represents free flow. Individual users are virtually unaffected by the presence of others on the road. The general level of comfort and convenience provided to the motorist, passenger, and pedestrian is excellent.
- **Level of Service B** represents high quality, stable traffic flow. The presence of other users in the traffic stream begins to be noticeable to individual drivers. The level of convenience provided to individual travelers is somewhat less than at LOS A , because the presence of others in the traffic stream begins to affect individual behavior.
- **Level of Service C** marks the beginning of the range of traffic flow in which the

travel of individual users becomes significantly affected by other vehicles in the traffic stream. Maneuvering within the traffic stream requires substantial vigilance on the part of the driver. The general level of comfort and convenience declines noticeably at this level.

- **Level of Service D** represents the upper end of traffic volumes that can be accommodated while maintaining the stable traffic flow. Vehicle speeds and the freedom to maneuver are severely restricted for nearly all users. Drivers and pedestrians experience a generally poor level of comfort and convenience. Most users on Dunraven Pass would be delayed by other vehicles and visitors would perceive the conditions as crowded under LOS D conditions.
- **Level of Service E** represents operating conditions at or near the capacity of the roadway. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level of usually unstable because small increases in flow or minor disruptions within the traffic stream will cause all traffic to stop.
- **Level of Service F** is used to define forced flow. LOS F occurs when more traffic attempts to use a road segment than the capacity of the segment. Long queues form in the traffic stream. Operations within the queues are characterized by stop-and-go waves, and flow is extremely unstable. Comfort and convenience are extremely poor and drivers may become frustrated.

Traffic flow along Dunraven Road is affected by a variety of factors in addition to the volume and mix of traffic and the characteristics of the road. Animals adjacent to or crossing the road cause interruptions to the flow of traffic when visitors stop to view them. Longer distance animal viewing opportunities attract visitors to the pullouts along the road. If numerous visitors are attracted to a particular pullout, other visitors may stop along the roadside, encouraged by the apparently popular view. Traffic delays due to animal viewing or animals crossing the road are an expected part of the visitor experience in Yellowstone and may or may not have a negative impact on visitor enjoyment depending on the type of experience the visitors are seeking. However, traffic back-ups from such incidents affects administrative traffic and can hinder the response to emergency situations.

Currently on Dunraven Road, level of service B conditions occur only before 9:30am and after 8:30pm. Given the existing mix of traffic, the topography, and the width of the road, Dunraven operates at level of service D between approximately 11:30 am and 6:30pm on a typical peak season day. During peak traffic conditions, traffic flow is in the upper third of the range of level service D operation.

Traffic Volumes for Level of Service Range

Roads are planned and designed based on a “design hour” of volume of traffic. The design hour does not represent the maximum demand on a road, but is selected to represent typically busy conditions. Because each park is unique in the distribution of visitation over the year and during each day, no NPS standard can be developed to select a design hour for park roadways. For Dunraven Road, it is recommended that traffic flow on an average peak day (in July or August) be used to establish the design hour for planning and design purposes. This is because the volume of traffic remains fairly constant on a day-to-day basis in these months.

Most urban roads and roadways in recreational corridors that experience peaks in use are designed to maintain level of service D for the design hour traffic flow. Given the mountainous terrain traversed by the Dunraven Road and speeds generally 48 km/hr-68 km/hr (30 mph-42 mph), level of service D is recommended.

Traffic Volumes for Level of Service Ranges on Dunraven Road

Level of Service	Lower End of Range (Vehicle/Hr)	Upper End of Range (Vehicle/Hr)
A	0	25
B	25	150
C	150	250
D	**250**	**450**
E	450	1,240
F	1,240	N/A

Source: BRW, Inc. 1997 page 22.

Traffic Volumes

Dunraven Road is open to visitor traffic from late May through mid-October, depending on snow conditions. Private or concession-operated snow vehicles are not allowed on the road due to avalanche danger during the winter. Traffic statistics for the roads are reported on the following (all reflect traffic in two directions).

Historic Traffic Data Dunraven Road

Year	AADT (Annual Average Daily Traffic)	SADT (Seasonal Average Daily Traffic)	Peak Season Volume (estimated)
1988	725	1847	2,228
1991	1,134	2,889	3,485
1994	1,429	3,640	4,391

Source: BRW, Inc. 1997 page 16.

AADT- (Annual Average Daily Traffic)- The estimate of total annual traffic divided by 365 days per year. This is a standard basis for comparing total traffic use of different roads. Roads that have seasonal closures, including Dunraven Road, will have low AADT compared to roads that are maintained for year-round travel.

SADT- (Seasonal Average Daily Traffic)- The estimate of total traffic during the visitor season (late-May through mid-October) divided by the number of days in the visitor season (135-140 days).

Typical Peak Season Daily Traffic- The typical traffic volume on the road in the peak

visitation months of July and August.

Traffic Volume Projections

From the available data, the average peak season daily traffic was estimated to be 4,022 vehicles per day in 1996. The year 2010 average peak season volume was estimated by factoring the 1996 volume up 26 percent, reflecting the NPS forecast of growth in visitation to the park. For the year 2010, average peak season daily traffic is estimated to be 5,068 per day.

Estimated Peak Season Traffic Volume Dunraven Road

Year	Peak Season Daily Traffic	Source
1992	4,000	NPS Estimate
1994	4,391	Estimate based on count on Aug 2, 1994
1996	4,022	Estimate based on count July 16-18, 996
2010	5,068	Estimated 26% Increase

Source: BRW, Inc. 1997 page 17

Transportation Services

A park concessioner offers three park bus tour routes that traverse the Dunraven Road. Approximately one trip per day is made on both the "Grand Loop" tour, the "Washburn Expedition" (Upper Loop) tour and the "Evening Wildlife" tour routes. The Grand Loop Tour begins and ends in Gardiner, MT and covers the entire Grand Loop, including a northbound trip along Dunraven Road near the end of the full day itinerary. The Washburn Expedition or Upper Loop tour begins and ends at Lake Village, picking up passengers at Canyon Village on its clockwise route. The Evening Wildlife tour leaves Lake, then picks up passengers at Canyon, drives over Dunraven Pass, through the Lamar Valley and drops passengers at Canyon and finally at Lake. A small number of other commercial buses travel along the road.

Bus Tours on Dunraven Road, June15 to August 15, 2000

TOUR ROUTES	Total Passengers	Avg. Daily Ridership
Grand Loop	1,383	12
Washburn Expedition	1,117	16
Evening Wildlife	1,892	30

2000 figures, Diane Renkin, Amfac Recreational Services

Travel Pattern

An exit survey was conducted at all entrance/exit stations in Yellowstone from July 29 to August 4, 1993. Visitors were questioned regarding the duration of their stay in the park, use of certain road segments in the park and the entrance station they had used to enter the park. Of all surveyed visitors leaving the park, 47 percent had traveled along Dunraven Road during their visit to Yellowstone. The table below

shows the percentages of visitors at each exit station that had used Dunraven Road. A very large proportion of the visitors at the Northeast Entrance station had driven Dunraven Road.

Use of Dunraven Road by Exit Station

Exit Station Used	Percentage of Exit Station Users That Had Traveled Dunraven Road
North	50%
West	34%
South	46%
East	42%
Northeast	73%
All	47%

Source: Exit survey July 29-August 4, 1993. BRW, Inc. 1997 page 17.

Vehicle Speeds

During the years the study was taken, Dunraven Road was signed for 72 km/h (45 mile per hour) limit with the exception of short sections near canyon Village and Tower Junction, which had speed limits of 40 km/hr (25 mph) and 56 km/hr (35 mph), respectively. At Canyon Village and Tower Junction, the reduced speed limits reflected the increased intensity of adjacent roadway activity. After the publication of this study, the entire Dunraven Road segment had the posted limit lowered to 56 km/hr (35 mph).

In July 1996, speed studies were conducted at four locations along Dunraven Road. Observed speeds were affected by the condition of the roadway surface which is generally poor, with potholes, cracks, and extensive patching. The roadway lanes are narrow and the shoulders are narrow or non-existent. Tight curves, the narrow road, and topographic features restrict sight distances. The amount of pullout activity along either side of the road also affects speeds.

At each location where speed studies were performed, the 85th percentile speed was defined. This represents the speed at or below which 85 percent of the vehicle samples were traveling. The 85th percentile speed typically represents an initial estimate of an appropriate speed limit for a roadway. The lowest observed 85th percentile speeds were in a winding section of the road in the vicinity of Mt. Washburn, 48 km/hr (southbound) -49 km/hr (northbound) (30 mph-31 mph). Another slow speed area was located north of Tower Fall, ranging from 48 km/hr (30 mph northbound) to 51 km/hr (32 mph southbound). The speeds observed are affected by a series of tight horizontal curves in the roadway alignment and the extent of the roadway activity in and around Tower Fall parking area.

The fastest 85th percentile speeds observed were in the area south of the old Buffalo Paddock area. Speeds there ranged from 61 km/hr (38 mph southbound) to 68 km/hr (42 mph northbound). Higher speeds were also observed in the area around the Dunraven Road picnic area, where speeds ranged from 53 km/hr (33

mph northbound) to 60 km/hr (37 mph southbound). In the area south of the old Buffalo Paddock area, the increased speeds are due to the relatively minor horizontal and vertical curves that permit vehicles to travel faster. In the area around the Dunraven Road picnic area, the increased speeds are due to the relatively straight sections of the road alignments. In some instances, poor quality of the road surface may have reduced traffic speeds.

In general, the circa-1996, 72 km/hr (45 mph) speed limit was too high for the roadway and traffic conditions. The 85th percentile speed at all locations was below the posted speed limit. As noted above, posted speed limits were lowered to 56 km/hr (35 mph) after 1997.

Accidents

Recent accident data indicate that accidents on Dunraven Road have increased at a slower rate than other roads within the park. From 1982 to 1993, the number of vehicular accidents parkwide increased approximately 48 percent, or four percent per year. During the same period, but measured only in the summer season, the number of vehicle accidents on Dunraven Road increased 39 percent or three percent per year. During this time period, park use increased at an annual rate of two percent.

Number of Accidents 1982-1995

	1982-1984	1990-1993	1993-1995
Parkwide	1,228	1,820	N/A
Dunraven Road	33	46	59

Yellowstone NP Traffic Safety Program Review, Peccia and Denver Service Center. BRW, Inc. 1997

Of the 59 accidents recorded on Dunraven Road during 1993-1995, 29 involved collisions between two vehicles. The majority of these accidents (48 out of 59 accidents) involved property damage only. Therefore, 11 accidents involved injury, however none were fatal.

Dunraven Road 1993-1995
(Property Damage Only)

Location	Number of Property-Damage Only Accidents
Tower Junction	9
Tower Fall	10
Canyon Village	7
Seven Mile Section Between Cascade Lake Trailhead and Chittenden Rd	14

Source: BRW, Inc. page 35. Summarized

As shown in the previous table, concentrations of property-damage-only accidents occurred at locations of increased roadside activity. There were also six injury accidents along the 11-km (7-mile) section between Cascade Lake Trailhead and Chittenden Road, the highest concentration of injury accidents along Dunraven

Road. The concentration of accidents may be the result of restricted sight distances due to the winding alignment of the roadway and resultant conflicts with vehicles pulling into and out of the pullouts along the road. This is of particular concern at the Dunraven Pass parking area where overflow parking occurs along the road edge. Park staff have also cited snow and ice as potential reasons for higher concentrations of accidents in this area.

NATURAL RESOURCES

Geology, Topography, and Soils

The project area is primarily located in the Washburn Range, which has rugged to rolling terrain. Elevation changes from 2,413 meters (7,917 feet) at Canyon Junction to 1,909 meters (6,264 feet) near Tower Junction. The road goes over Dunraven Pass at 2,704-meter (8,873-foot) elevation. In the Tower Fall area the roadway hugs the walls of the canyon of the Yellowstone River. Vertical to overhanging cliffs and slopes exist in places between Calcite Springs and Tower Fall. South of Tower Fall the roadway follows the drainage of Antelope Creek up the flanks of Mt. Washburn. Near the Chittenden Road turn-off, the main road crosses a drainage divide west into the Carnelian Creek drainage, and rises up the slope of Mt. Washburn to Dunraven Pass. South of the pass the roadway enters the Sulphur Creek and its tributary drainages while closely following the caldera margin before dropping into Canyon Junction.

The project area includes at least three distinct geologic terranes. From Tower Junction to Tower Fall the road corridor passes through varied exposures of volcanic rocks, basalt lava flows, and hydrothermally altered areas associated with Calcite Springs.

Immediately south of Tower Fall, the project area comprises exposures of the Lava Creek and Huckleberry Ridge tuffs and Absaroka volcanic rocks. Absaroka volcanic rocks are associated with Mt. Washburn, an extinct stratovolcano that rests on the northeastern margin of the Yellowstone caldera. The Lava Creek and Huckleberry Ridge tuffs were produced by the collapse of the Yellowstone caldera. The caldera is a large depression created by a massive volcanic eruption about 640,000 years ago that produced the Lava Creek tuff. The Huckleberry Ridge tuff is older and was formed by an earlier caldera eruption approximately 2.1 million years ago. Collapse of the Yellowstone caldera actually bisected the extinct Washburn volcano, exposing the earlier volcanic vent. Rocks formed by volcanic eruptions from Mt. Washburn are well exposed along Washburn's flanks north of Dunraven Pass.

South of Dunraven Pass, near the Washburn Hot Springs overlook, the road closely follows a portion of the rim of the Yellowstone caldera. Dunraven Road continues north and enters younger, caldera-filling rhyolite lava flows. More recent geological events throughout the project area include glaciation, mass movements, and recent streamflow that have together deposited sediments including boulders, gravel, and sand over portions of this area.

There are four main rock types present in the project area:

- The Junction Butte Basalt and Basalt of the Narrows are 2-million and 1.5-million-year old lava flows in and near the Overhanging Cliffs area. These basalts have zones of columnar jointing that formed during cooling of the lava and can produce rockfalls of diverse size. Rockfalls can be initiated by normal freeze-thaw processes and by mechanical disturbances such as seismic events and blasting.
- The Huckleberry Ridge and Lava Creek welded ashflow tuffs are exposed north of Mt. Washburn flanking Tower Creek and were deposited by two distinct caldera eruptions. Welded ashflow tuffs are susceptible to debris flow movements with extreme climatic events (rainfall and snowmelt) and if slopes are disturbed. Debris flows occur in channels formed in the steep slopes on the flanks of Mt. Washburn. The tuff weathers into coarse granular sand, poor in nutrients and water retention capability.
- Rocks that make up the Mt. Washburn edifice include the Lamar River and Langford Formations of the Absaroka Volcanic Supergroup (Smedes and Prostka, 1972). The Lamar River Formation is the older of the two and stratigraphically underlies the Langford Formation. Both units were likely deposited between 49 and 47 million years ago. Both units have vent facies (rocks produced near the eruptive source), intrusive rocks, lava flows, and alluvial volcaniclastics. Volcaniclastic rocks are essentially sedimentary accumulations of newly erupted volcanic products. The Lamar River Formation comprises a sequence of brown andesitic lavas, volcaniclastic rocks, and minor mafic lavas (basalts). One source of these volcanic rocks includes eruptions from Mt. Washburn. The bulk of the Lamar River Formation is well-bedded coarse alluvial volcanic conglomerates. Some intrusive (non-erupted) diorites and andesites also occur. The Langford Formation is a sequence of light colored andesitic lava flows and volcaniclastics. The light color is due primarily to its light gray ash-rich matrix. Absaroka Volcanic rocks weather into a generally finer-grained and more fertile soil than that produced by weathering of tuffs or rhyolites.
- Finally, Caldera-filling Plateau Rhyolite flows make up the southern extent of the project area. The Dunraven Road Flow occurs on the east side of the road from south of Dunraven Pass to Canyon.

Geologic benchmarks have been placed along the Grand Loop Road. These benchmarks are used for monitoring by the Cascades Volcano Observatory of the U.S. Geological Survey to determine ground deformation. Any benchmarks existing along this road segment would be protected and, if necessary, relocated by Cascades Volcano Observatory before construction begins.

Soils are predominately glacial till or colluvium in origin, developed primarily from weathered Absaroka volcanic rocks (Rodman et al. 1996). These fine to moderately-coarse soils have higher plant nutrient levels relative to the rhyolitic soils that are developed near Canyon Junction in the Central Plateau region. Hydrothermal soils occur near Calcite Spring at the north end of the project.

Vegetation

The Grand Loop Road from Tower Junction to Canyon climbs 792 meters (2,600 feet) from Yellowstone's northern range near Tower Junction up through the Washburn Range to Dunraven Pass and drops down onto the Yellowstone Plateau, thereby providing the greatest diversity in vegetation types of any road segment within the park. In the north portion of the project in the vicinity of Tower Junction, the vegetation is a sagebrush steppe dominated by mountain big sagebrush with an understory of Idaho fescue and numerous other grasses and forbs. As the road climbs away from Tower Junction, the forest is composed primarily of Douglas-fir, often with an understory of pinegrass. As the elevation increases the forest composition shifts to lodgepole pine forest so characteristic of Yellowstone. Extensive areas of subalpine meadow allow spectacular views of the Washburn Range from the road, with the rich forb meadows dominated by species such as one-flowered helianthella, lupine, and arrowleaf balsamroot. The vegetation in the vicinity of Chittenden Road to Dunraven Pass is a mosaic of high-elevation forest dominated by whitebark pine, Engelmann spruce, and subalpine fir interspersed with open subalpine meadows and rocky outcrops that in some locations approach the composition of an alpine tundra. Near Canyon Junction the forest again is characterized by lodgepole pine canopy so typical of the Yellowstone Plateau with an understory of elk sedge and grouse whortleberry.

Rare Plants

Prior to the survey along the Dunraven Road segment, no plant species of special concern were known to occur in this area (NPS 2000b).

During the summer of 1997, the road from Tower Junction to the Chittenden Road was surveyed for rare plants. The rare plant survey was completed during the summer of 1998 from Chittenden Road to Canyon Junction. Additionally, the old road from the Tower Campground to the Grand Loop Road above Antelope Creek was surveyed during the summer of 1999, including several borrow pits that occur in the vicinity of the road.

There are no federally listed or candidate (category I) plant species that occur in the park. However, there are two endemic plant species that occur only in Yellowstone Park, Ross' bentgrass, *Agrostis rossiae*, which occurs in geothermal areas along the Firehole and in the Shoshone Geyser Basin and Yellowstone sand verbena, *Abronia ammophila*, which is restricted to sandy lakes around Yellowstone Lake. Neither species was found along this segment of road.

Plant species of special concern are those species that have been recognized by the state heritage programs as being rarely encountered within the state. Since Yellowstone occurs near the state boundaries of three states, Wyoming, Montana, and Idaho, all three state lists were consulted though the primary emphasis was on surveying for Wyoming plant species of special concern. A total of seven species of special concern occur along the Tower Junction to Canyon Junction road segment: *Antennaria flagellaris, Carex deweyana* var. *bolanderi, Carex parryana,* var. *parryana, Castilleja crista-galli, Cirsium foliosum, Juncus tweedyi, Orobanche*

ludoviciana var. *arenosa, Agoseris lackschewitzii*. The survey resulted in the mapping of the boundaries of 23 sites within the road corridor where one or more of these species occur.

Parry sedge has been found to occur in several locations within Yellowstone and has been dropped from the Wyoming Plant and Animal Species of Special Concern list since field work was completed on the road segment. Bolander's sedge is only known currently from two locations within the park at this time, with the other in the Middle Creek drainage near the East Entrance. Cock's-comb paintbrush occurs at scattered locations within the park, and tolerates some disturbance.

Whitebark pine

There are 10.46 kilometers (6.5 miles) of the total 29 km (18-mile) Dunraven Road corridor that travels through stands containing whitebark pine. The following is discussed in *Whitebark Pine Communities, Ecology and Restoration*, (Tomback et al. 2001).

Whitebark pine is considered a “keystone species” of upper subalpine ecosystems. R.B. Primbeck (1998) defines keystone species as follows: “Within biological communities, certain species may determine the ability of large numbers of other species to persist in the community.” In the case of whitebark pine, it maintains biodiversity in multiple ways. In the late summer, the seeds serve as a food source for a number of birds and mammals, including nutcrackers, squirrels, and bears. With the largest seed of all conifers at subalpine elevations, the seed contains 21percent carbohydrates, 21percent protein and 52 percent fat by weight. They are therefore a good dietary fit for nutcrackers and other birds. Of high importance is the whitebark pine seeds used as a major seasonal food source for grizzly bears and black bears. Based on twenty years of scat data from the Greater Yellowstone Area, Mattson et al. (1991) concluded that the major food types consumed by grizzly bears are ungulates in the spring, grasses in the summer, and whitebark pine seeds in the fall. When available, Yellowstone grizzlies will feed on the seeds nearly exclusively. Whitebark pine seeds were recorded in the grizzly bear diet from May through October, but particularly in September and October. Because of the importance of whitebark pine seeds to grizzly bear ecology in the Greater Yellowstone Area, whitebark pine communities are designated as critical habitat in grizzly bear recovery plans for that area and others (e.g., U.S. Fish and Wildlife Service 1997).

In the *Demography of the Yellowstone Grizzly Bears* (Pease 1999) the current state of white pine blister rust as it affects whitebark pine was summarized this way:

Whitebark pine is at considerable risk of major declines within the next 100 years. White pine blister rust (*Cronartium ribicola*), an introduced pathogen, has already devastated many whitebark stands in the Northwest United States, and is present in the Yellowstone area (Kendell 1995). Even though whitebark pine may re-establish on sites burned by fires, such as those in Yellowstone during 1988, production of a substantial number of cones is not expected for a century (Mattson and Reinhart 1994).

Hydrothermal Resources

There are hydrothermal features located in the general vicinity of the road corridor at Calcite Springs. These features are created from movement of hot fluids and gases up along fractures and faults that emerge at or near the bottom of the canyon of the Yellowstone River. Features present include fumaroles and springs. The fumaroles and warm and hot water springs issue from the bank of the Yellowstone River from just south of Bumpas Butte to the Calcite Springs area. These hydrothermal features are located below road grade, to the east side of the road on the west river bank. Areas of relict hydrothermal activity and alteration occur along the road corridor near Rainy Lake and Bumpas Butte. The Washburn Hot Springs also lie off to the east of the road midway between Canyon Junction and Dunraven Pass.

Wetlands and Other Waters of the United States

The wetlands along the 29 kilometers (18 miles) road segment between Tower Junction and Canyon Junction were delineated and mapped between June 1997 and October 1998 using the 1987 U. S. Army Corps of Engineers methods (U.S. Army Corps of Engineers Wetlands Delineation Manual). The data gathered during the course of these wetland delineations found 241 wetlands, totaling 19 hectares (48 acres), within 61 meters (200 feet) of the road. Each wetland was classified according to the Cowardin classification system (Classification of Wetlands and Deepwater Habitats of the United States) and either mapped using traditional survey equipment or using a Trimble Pro-XL GPS unit.

Two main types of wetlands, palustrine and riverine, were encountered with several variations within these types. There were 103 wetlands, totaling 7.48 hectares (18.49 acres), which were predominantly palustrine emergent wetlands. There were 11 wetlands totaling 0.64 hectares (1.58 acres), which were predominantly palustrine forested wetlands. Finally there were 78 wetlands, totaling 10.68 hectares (26.38 acres), within the survey corridor that were at least partially riverine. Antelope Creek 2.48 hectares (6.12 acres), Sulphur Creek 0.89 hectares (2.19 acres), and Cascade Creek 1.49 hectares (3.69 acres) make up the majority of the riverine wetland acreage. One wetland, totaling 0.25 hectares (0.61 acres), contained a small pond, approximately 12x18 meters (40 X 60 ft). The pond was classified as Palustrine, Aquatic Bed, permanently flooded and the surrounding wetland was classified as Palustrine emergent. There were also 51 wetlands, totaling about 1.62 hectares (4 acres), created by natural seeps. As the slopes are cut back, the seeps should re-establish the wetlands on the new slopes.

There is a large concentration of wetlands near Dunraven Pass. The road is above an elevation of 2,652-meters (8,700 feet) for 5.8 kilometers (3.6 miles) and the southern half of this road segment contains 6.15 hectares (15.2 acres) of wetlands. The lowest concentration of wetlands occurs between Antelope Creek and the top of Mt. Washburn. Along this 13-km (8-mile) stretch of road, there are only 22 wetlands totaling 0.37 hectares (0.918 acres).

Some of the wetlands surveyed are man-caused. Forty-eight wetlands are

completely in roadside ditches totaling 0.19 hectares (0.478 acres). It is not believed that any of these would have occurred naturally.

The vegetation in the palustrine communities is dominated by *Agrostis exatara, Calamagrostis canadensis, Carex aquatilis, Carex microptera, Equisetum arvense, Geum macrophyllum, Heracleum lanatum, Mimulus lewisii, moss sp., Picea engelmannii, Senecio triangularis, Saxifraga arguta,* and *Mertensia ciliata*. The vegetation in the riverine communities is dominated by *Arnica longifolia, Calamagrostis canadensis, Carex aquatilis, Carex microptera, Carex utriculata, Epilobium ciliatum, Juncus ensifolius, Mertensia ciliata, Mimulus lewisii, Salix sp., Saxifraga arguta,* and *Senecio triangularis*. *Cirsium foliosum* and *Juncus tweedyi* are considered species of special concern in Wyoming and were also found in wetlands along this road segment.

Air Quality

Air quality and visibility are generally excellent in the project area. Yellowstone is a mandatory class 1 area where air quality degradation is unacceptable under the Clean Air Act of 1963. Acid precipitation is monitored at Tower, and ozone, sulfur oxides, and fine particulates are monitored at Lake. Carbon monoxide conditions are monitored at the West Entrance. There are high amounts of carbon monoxide in winter at the West Entrance. Additional information on Yellowstone's air quality can be obtained from the National Park Service's Air Resources Division publication *Assessment of Air Quality and Air Pollutant Impacts in National Parks of the Rocky Mountains and Northern Great Plains* (NPS 1998).

Wildlife

Overview

Large mammals found in the vicinity of the Canyon to Tower Junction road segment are bison, moose, elk, mule deer, white-tailed deer, bighorn sheep, cougar, pronghorn, mountain goats (exotic), wolves, grizzly bears, and black bears. Smaller mammals include coyotes, wolverine, badgers, porcupines, red squirrels, red fox, pine martens, weasels, and a variety of mice and voles.

Small groups of bull bison are found around the Antelope Creek area in the summer, and the Canyon area throughout the year. They are seen more during the early summer and fall seasons. It is extremely rare to see cow/calf bison herds around Canyon Village.

Black bears are dispersed throughout the park. Although there is some habitat overlap with grizzly bears, black bears are more likely to be found in forested cover types than grizzly bears, which dominate the meadows. Not many black bears are near Mt. Washburn as it is prime habitat for grizzly bears. The grizzlies using the area displace the black bears. Black bears mainly eat grasses and sedges, but they will opportunistically feed on fish, insects, roots, and berries, and they will scavenge. Historically, black bears have been involved in more bear/human conflicts than grizzlies. Since the park's concerted efforts to remove artificial foods began in the early 1970s, black bears have been seen less frequently along roadsides and in

developed areas, and conflicts between black bears and humans have declined. Black bears are still sometimes seen along the road corridor in the Tower/Roosevelt area. Grizzly bears are discussed in the "Threatened and Endangered Species" section below.

Ungulate concentration areas typically provide protein-rich habitats that can be used by grizzly bears and other predators or scavengers for food. Much of the area along this road segment from Canyon to Tower Fall has very little winter-killed ungulates. High snow concentrations near Canyon and over Dunraven Pass prohibit most ungulates from using this area during the winter months. Most of the ungulates, with the exception of some bull elk and moose, migrate to winter ranges closer to Tower Junction.

Moose inhabit the area year-round. Mule deer usually inhabit the area during the spring and fall, and winter at Calcite Springs.

There is a summer elk population that leaves the area in the fall. The lower Antelope Creek area is an important wintering area for bull elk. Middle Antelope Creek area is an important elk calving area. Elk calving peaks about June 1st of each year. Upper Antelope Creek is important elk habitat in the summer.

Red foxes are present along the entire road segment but especially in summer. Although bobcats are rarely seen in the park, the habitat likely supports these animals. Mountain lions are present in the Yellowstone River Canyon. Snow depths in much of the park interior prevents much resident lion activity south of Yellowstone's northern range. Smaller mammals such as weasels, pine marten, and red squirrels are common in the forests of central Yellowstone. Wolverines, which are very wide-ranging and are rarely seen, have been reported. Riparian species such as beavers, river otters, muskrats, and mink are found along the Yellowstone River. Mink and river otters would be anticipated to be found in the Antelope Creek drainage. All use the river and creek or nearby banks for denning and escape.

Bighorn Sheep

Dunraven Road also crosses through bighorn sheep habitat. A field study of the area, (Ostovar 1998a) reported that after lambing along cliffs on the west side of the Yellowstone River, the ewes moved up to Mt. Washburn by mid to late June. During the summer, the group of ewes and lambs seemed to become more habituated to humans and eventually "begged" from visitors both on the road and hiking trails. Group locations occurred primarily in the alpine meadows and burned whitebark pine stands. Snow drifts and seeps provided water sources throughout the summer in numerous locations. The study stated that most road observations associated with begging behavior were along a ¾ - km section of the road in late afternoons, primarily in August or September. The bighorn sheep rarely crossed the road, although they did stay on the road edge for considerable periods of time. During the fall migration the Mt. Washburn ewes spent one to two weeks near Tower Fall in late October where they grazed and moved along the road, which was closed to vehicles at the time. According to the study, "the migration route went behind Tower Ranger Station through the Lost Lake area…a separate, small group

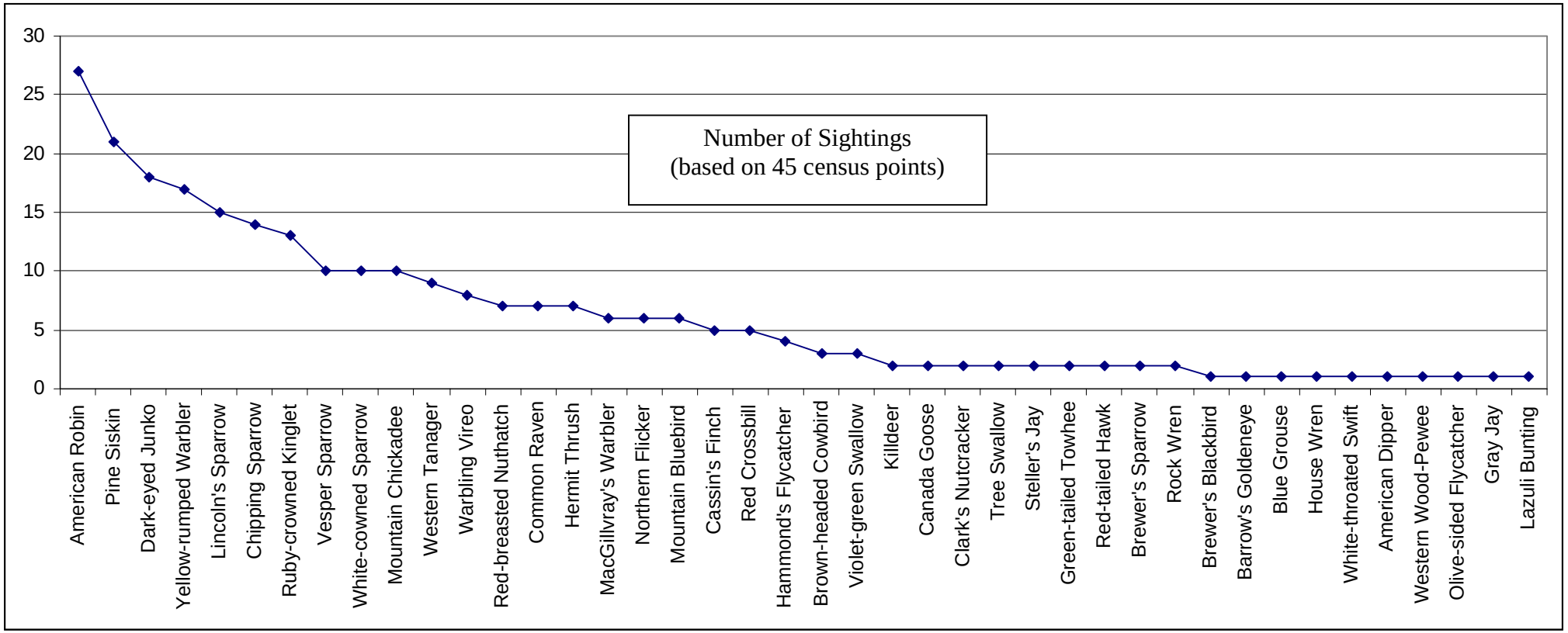
of sheep occupied the cliffs east of Calcite Springs across the Yellowstone River."

During the time that the Dunraven Road was closed for repairs during the prime August visitor season, it did not appear to researchers that the activities of bighorn sheep varied significantly from their normal patterns. Researchers noted that changes in road opening and closure dates could have a potential impact on bighorn sheep activities, (Ostovar 1998b).

Birds

Field data was collected on bird species during the summer of 2000, along the Canyon Junction to Tower Junction road segment. Bird inventories consisted of point counts, aerial surveys, and incidental observations. A total of 43 bird species were detected during the point counts, see Bird Species Richness Chart, Page 65. American robin, pine siskin, dark-eyed junco, and yellow-rumped warbler were the most obvious and abundant species found along this road segment. Four osprey nests have been identified on rock pinnacles in this area. Peregrine falcons are summer residents in Yellowstone from April through October, nesting on large cliffs that overlook rivers or valleys where prey is abundant. Peregrine populations are increasing. A peregrine falcon eyrie is located in close proximity to the road. Three young fledged from this location in the year 2000. The principal environment affected by road construction activities would be the cliff environment found along the Tower to Canyon road between Calcite Springs and the Tower Fall store. Overhanging Cliff in this same area is another notable nesting area for birds. This large cliff is home to a large nesting colony of white-throated swifts. (NPS 2000c).

Bird Species Richness and Abundance



Species Observed

From: An Ornithological Assessment of Federal Highway Projects, NPS 2000c

Amphibians and Reptiles

To assist in the understanding of amphibians, a survey of the Tower Junction to Canyon Junction segment of the Grand Loop Road was conducted (Patla and Peterson 1996, Patla 1999). Based on historical records and the field studies in 1995 and 1999, three amphibians species: blotched tiger salamander (A*mbystoma tigrinum melanostictum)*, western (Boreal) chorus frog (*Pseudacris maculata)*, Columbia spotted frog (*Rana luteiventris*), and one reptile species, the western terrestrial (wandering) garter snake (*Thamnophis elegans vagrans)* are known to occur in the project area. There were four important herpetological sites located within the study area for this proposed project.

The first site at Rainy Lake has been affected by previous road construction. Rocky fill of the current roadbed borders the lake on its southwest shore. The roadway separates the lake from a wetland to the west.

The second site at the Rainy Lake wetland is a shallow flooded area that is separated from Rainy Lake by the raised roadbed, and connected to the lake via a culvert under the roadway at the northern end of the lake. In 1995, the site maintained water throughout the summer, and provided habitat for successful reproduction of boreal chorus frogs. Although no spotted frogs were seen in 1995, they have been seen in this vicinity in the recent past (1989), and this site may also provide breeding habitat. The segregation of this site from Rainy Lake may have some benefits for chorus frogs- salamanders, which prey on chorus frog tadpoles (Woodward and Mitchell 1991), breed in Rainy Lake, and the shallow wetland may provide partial refuge from extensive predation by salamander larvae pools north of Canyon Junction and Canyon pools.

The third site were the pools north of the Canyon Junction area, which were included in the survey. One of the pools appears to be manmade or extensively altered. Despite its lack of aesthetic appeal, it is a good chorus frog-breeding site. The other, more natural appearing pools, had very small number of amphibians present in 1995.

The fourth site in the study area was the Canyon pools. While within the study area this area is not within the area to be affected by this project. This area is south of Canyon Junction and adjacent to the project area. It is included as part of this report because of its importance as a breeding site, its possible status as a source population for the surrounding area, and its vulnerability to local road construction activities. The two pools provide breeding habitat for three species of amphibians. Substantial numbers of all three kinds of larvae were observed in 1995. There are no known breeding sites of similar quality north of Canyon Junction. North of the junction and west of the highway, there are quite extensive wet forest and wet meadow habitats as well as some smaller breeding sites. Individuals from the Canyon Pools may disperse to these areas for foraging and for breeding in some years.

Rare Animal Observations

Observations by park employees and visitors, of wildlife species considered to be rare or of special interest, were recorded at all park ranger stations and visitor centers. Species for which observation were recorded include all amphibians, beaver, bighorn sheep, bobcat, fisher, fox, lynx, mink, mountain goat, mountain lion, otter, raccoon, all reptiles, white-tail deer, wolf, and wolverine. In addition, unusual behavior or atypical locations of common animals were also recorded. Black bear and grizzly bear observations are reported separately. From 1986 through 1995, 1,804 rare animal observation reports were recorded within the park. During the 10-year period, 1986-1995, there were 13 species of mammals observed (and reported) along the Tower Junction to Canyon Village road corridor. These 88 reports comprise 5 percent of the total reported. There were no reported road-kill incidents of these species on Dunraven Road during the 1989-1999 period (NPS 2000d). While of varying reliability, these reports do give indications of the animal species that inhabit certain areas of the park.

Reported Mammal Sightings 1986-1995

"Rare" Species	Number and Locations of Reported Sightings
Badger	Two reported sightings; Canyon Junction and in the Canyon Residential Area.
Beaver	One reported sighting, Calcite Springs Overlook.
Bighorn Sheep	Eight reported sightings, Calcite Springs overlook, Dunraven Pass, and in the cliffs above the Tower Fall Store.
Bobcat	One reported sighting, Canyon Campground.
Long-tailed Weasel	One reported sighting, Washburn Hot Springs Overlook.
Lynx	One reported sighting, Antelope Creek Ski Trail.
Mountain Goat (non-native)	Nine reported sightings, majority at the summit of Mt. Washburn and Dunraven Peak, between Dunraven Pass and the Chittenden Road and on the hills across from Tower Fall.
Mountain Lion	Eleven reported sightings, near the TW horse corrals at Roosevelt, the parking area of Tower Fall and several locations between Tower Junction and Dunraven Pass.
Pine Marten	Three reported sightings, Tower Bunkhouse at Tower Fall, and in Canyon Campground.
Red Fox	Thirty-four reported sightings, Canyon developed area, at or near the summit of Mt. Washburn, in the area of Tower Fall, and several locations between Chittenden Road and Dunraven Pass.
River Otter	Three reported sightings, Tower Creek Trail, and in the area of Tower Fall.
White-tailed Deer	Nine reported sightings, Tower Junction area, Antelope Creek valley, and near Tower Fall.
Wolverine	Five reported sightings, Calcite Springs, between Chittenden Road and Dunraven Pass, along the Tower Fall trail, and just south of Dunraven Pass Picnic area.

Dunraven Road Kill Incidents 1989-1999

As compared to paved, primary roads park-wide, the Dunraven Road has a "large mammal" road kill rate lower than the park-wide average. No threatened, endangered, nonessential experimental or candidate species of mammals were hit and killed by vehicles on the road segment in the 11-year period (1989-99) (NPS 2000a). Although grizzly bears (Gunther et al. 1998, Gunther and Biel 1999) and wolves (D. Smith, YNP Pers. Commun.) have been hit and killed by vehicles in Yellowstone National Park during that time period, none of these incidents occurred along the Dunraven Road corridor. Under existing road conditions and vehicle speeds, the number of large mammals being hit and killed by vehicles on the Dunraven Road is low, resulting in a mortality of less than one percent of the park populations of affected species. A human-caused mortality of less than one percent is not likely to cause a significant negative impact or population decline in these species. The cumulative impacts of road-kill mortality from the Dunraven Road in combination with all other park roads combined is also low, resulting in a mortality of two percent or less for each of the park's large mammal populations (Gunther et al. 1998). A total of park-wide large mammal road-kill mortality of two percent or less probably does not have a significant negative impact on any of the park's large mammal wildlife populations. Bear/vehicle incidents have been rare with two black bears having been hit and killed by a vehicle along Dunraven Road in the eleven years studied between 1989-99. One bear was hit on Dunraven Road near Antelope Creek, the other near Sulphur Creek (NPS 2000a).

Dunraven Road Kill Incidents 1989-1999

OTHER LARGE MAMMALS	THREATENED, ENDANGERED NONESSENTIAL EXPERIMENTAL, CANDIDATE
Bison- 1	Grizzly Bear- 0
Black Bear- 2	Gray Wolf- 0
Elk- 3	Lynx- 0
Moose- 1	
Mule Deer- 12	
Total- Large Mammals = 19	**Total- T&E Species = Zero**

Source: (NPS 2000a)

Posted speed limits, average actual vehicle speeds, road conditions, road design, adjacent roadside vegetation cover type, and wildlife population numbers (Gunther et al.1998) as well as park visitation and mode of transportation (NPS 1999a) all influence the frequency of vehicle-wildlife collisions in YNP. The Dunraven Road is posted at 56 km/hr (35 mph) with the exception of short sections near Canyon Junction which are posted at 40 km/hr (25 mph) (BRW, Inc. 1997). Observed speeds are affected by the condition of the roadway surface, which is generally poor, with numerous potholes, cracks, frost boils and broken side edges, and extensive patching.

The roadway lanes are narrow and shoulders are narrow or non-existent. Tight curves, the narrow road, and topographic features restrict sight distances. It is not uncommon for bighorn sheep or other wildlife to be in or immediately adjacent to the road, further slowing traffic. The amount of traffic pulling in and out of roadside pullouts to observe distant wildlife also affects vehicle speeds along the same sections of road. Under the current conditions, 85th percentile vehicle speeds on the Dunraven Road range from 48 to 50 km/hr (30 to 31 mph) around Mt. Washburn to 61 to 68 km/hr (38 to 42 mph) near the old Buffalo Paddock area (BRW, Inc. 1997). Over 11 years (1989-1999) only one park road (the Bechler Road) had a lower large mammal wildlife road-kill rate than the Dunraven Road. The low average vehicle speed on Dunraven Road is probably a significant factor contributing to the low frequency of wildlife road-kill mortality on the road. Over half (58 percent) of the road-kill mortality that did occur on the Dunraven Road in those 11 years occurred on the southernmost section of the road between the south fork of Sulphur Creek and Canyon Junction. Vehicle speeds (85th percentile) in this area were among the fastest recorded on the road, ranging from 53-59 km/hr (33 mph to 37 mph), probably due to the relatively straight alignment of that section of road (BRW, Inc. 1997).

Fisheries and Aquatic Resources

The proposed reconstruction and improvement section of Grand Loop Road between Canyon Junction and Tower Junction runs adjacent to the Antelope Creek. The distance between the Dunraven Road and Antelope Creek does not get closer than 0.8 km (0.5 mile). The exception to this is an approximately 3.6-km (2.25-mile) stretch, which starts south of Tower Fall. Here, Antelope Creek runs nearly adjacent to the road.

Fish, both native and introduced, are an important component of the park's animal life. When explorers first visited Yellowstone, the vast majority of lakes, and most streams above major waterfalls or cascades, were devoid of fish. As a result of stocking for increased angling opportunities in early park years, the Yellowstone fishery is now comprised of 13 native and five introduced species, including the native westslope and Yellowstone cutthroat trout, longnose dace, mountain whitefish, arctic grayling, longnose sucker, and the introduced brown, brook, and rainbow trout. This mixture provides high-quality angling opportunities for visitors as well as food for birds, otters, grizzly bears, and other wildlife.

The Antelope Creek population of fish may be an isolated population resident to the Upper Antelope Creek drainage. Natural barriers prevent fish from the Yellowstone River from entering this drainage system. The average stream gradient is 8 percent in Antelope Creek. Water quality analysis showed that Antelope Creek rated as good for cutthroat trout. Water tested at a pH of 7.8 and had a temperature of 10^0 C (50^0 F). The creek has stable banks, good diversity of substrates, with a late summer base flow of 0.085 cubic meters/second (3.0 cubic feet/second). Young of the year have been observed in side streams of Antelope Creek. Upper portions of Antelope Creek (from Buffalo Paddock upstream) may be used as spawning areas. Most fish found in the upper area of the creek would be adult/sub-adult, greater than one year old.

In 2000, electro-fishing methods were used to collect information from three separate sections of Antelope Creek to determine species composition and relative abundance of fish. The creek runs, in places, adjacent to the Canyon to Tower road and was surveyed to monitor potential impacts from proposed road reconstruction. The first section was 25 yards below the confluence of an unnamed tributary and the second section was a few hundred yards downstream from the first. The third section was in the canyon below a waterfall barrier approximately 1.6-km (1-mile) upstream from the outlet. Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) was the only species found in the creek and averaged 53 fish per 100 meters (328 feet) of stream, or approximately 533 per kilometer. Fin clip samples were taken from each fish to determine their genetic composition however these samples had not been processed as of this assessment.

Varley (NPS 1981) reports that there is no history of stocking activities in Antelope Creek. Volunteer Angler Report (VAR) cards, submitted by anglers to report catches on waters throughout the park since the 1970s, indicate that anglers have been catching cutthroat trout in Antelope Creek since 1974.

Threatened and Endangered Species

Five species protected under provisions of the Endangered Species Act of 1973 (as amended) are present in Yellowstone National Park. The whooping crane (*Grus americana*) is listed as endangered. The grizzly bear (*Ursus arctos horribilis*), bald eagle (*Haliaeetus leucocephalus*), and Canada lynx (*Lynx canadensis*) are classified as threatened. The gray wolf (*Canis lupus*), was reintroduced into Yellowstone in 1995 and 1996 and is classified as a nonessential experimental population. Although additional flexibility for management of such a population is allowed under the final rule and special regulations promulgated in 1994 (59 FR 60252), wolves that are part of the experimental population are considered a threatened species on any National Park Service or National Wildlife Refuge System lands.

Aerial surveys and ground reconnaissance surveys were conducted during the summer 2000 field season. These studies were done to census threatened and endangered species, sensitive species, and species of special concern. The whooping crane was not seen during field studies. No other sensitive species or species of special interest were noted during the summer 2000 field season.

The U.S. Fish and Wildlife Service (USFWS) removed the peregrine falcon (*Falco peregrinus*) from the list of threatened and endangered species in 1999. Although no longer endangered, peregrine falcons, their eggs, parts, and nests would continued to be protected from unauthorized killing, possession, transportation, and importation by the Migratory Treaty Act. Also, the species would continue to be monitored across the nation for the next 12 years to provide data on at least two generations of peregrines and ensure that the bird is doing well after being de-listed.

Grizzly Bear

Fewer than 1,000 grizzlies are thought to survive in six areas of Montana, Wyoming, Idaho, and Washington. In 1983 the Interagency Grizzly Bear Committee

(IGBC) was formed to ensure that the six ecosystems identified as grizzly bear recovery areas were managed in ways that would help grizzly bear recovery. The "*Grizzly Bear Recovery Plan*" (USFWS 1993) guides the recovery effort.

The greater Yellowstone grizzly bear population is the second largest of the recovery populations and is estimated to have a minimum of 280-610 bears (Eberhardt and Knight 1996). Grizzlies range over 2.2 million hectares (5.5 million acres) within the greater Yellowstone ecosystem, with nearly 40 percent of this range (0.9 million hectares or 2.2 million acres) within Yellowstone National Park. Yellowstone's bear management program is directed toward preserving and maintaining the grizzly bear population as part of the park's native fauna, while providing for visitor safety. Recovery and management of the grizzly bear is of the highest priority.

For specifics about grizzly bear use of this Dunraven area, the following was reported in *Grizzly and Black Bear Activity and Habitat along the Dunraven Pass Road Corridor in Yellowstone National Park,* (NPS 1996b).

Grizzly Bear Habitat Quality along the Dunraven Road Corridor

Note: Throughout the following grizzly bear sections, a 4-km (2.5-mile) Zone of Influence was used to evaluate bear habitat and activity along the Dunraven Road corridor, as per Mattson et al. (1986).

A diversity of grizzly bear habitat is evident along the Dunraven Road corridor during the three seasons of bear activity. As shown in the table below the area is characterized by mainly moderate-quality habitat, (40.7 percent) in spring, in the Antelope Creek (Amphitheater) valley and in the large open meadows on the high-elevation, northwest-facing slopes of Mt. Washburn. Low-quality habitat (43.1 percent) predominates in the whitebark pine areas of Carnelian Creek and in the lower elevations of Mt. Washburn during the spring, if there are not abundant whitebark pine seeds remaining from the previous fall. These whitebark pine cover types are high quality during spring if there is an abundance of over-wintered pine seeds present. Small patches of high-quality habitat (16.2 percent) exist on the south-facing slopes of Mt. Washburn and in the low-elevation meadows around the Tower/Roosevelt area.

The number and percentage of acres of low, moderate, and high quality grizzly bear habitat (based on vegetation only) found in the 4-km (2.5-miles) Zone of Influence of the Tower-Roosevelt to Canyon Junction road corridor.

QUALITY	SPRING		SUMMER	FALL	
	Acres	Percentage	Acres Percentage	Acres	Percentage
HIGH	9,906	16.2	682 1.1	25,452	41.4
MODERATE	25,026	40.7	23,574 38.4	20,300	33.1
LOW	26,491	43.1	37,167	15,671	25.5

		60.5	

Grizzly and Black Bear Activity and Habitat along the Dunraven Pass Road Corridor, (NPS 1996b) page 10.

During the summer, grizzly bear habitat quality along this road segment is predominately low and moderate, see table above. Two small areas of high-quality habitat exist (a total of 1.1 percent). The first is at the northern edge of the Hayden Valley, which enters the southern edge of the Zone of Influence. The second area is near the southern edge of the old Chittenden Road between the Tower Fall Campground and just south of the old Buffalo Paddock area. Moderate-quality (38.4 percent) habitat exists in the open meadows of Mt. Washburn in the Antelope Creek valley, in the low-elevation areas to the northeast of Tower/Roosevelt, and in the open meadows west of the road near Canyon Junction. The majority of the habitat during the summer in the Zone of Influence is low-quality habitat (60.5 percent). As in the spring, whitebark pine cover types within the low-quality habitat types are considered high quality during summers when there is an abundance of over wintered whitebark pine seeds, but low-quality habitat if there is not.

The Zone of Influence along the Dunraven Road corridor consists mainly of high quality habitat (41.4 percent) during the fall, due to the productivity of the whitebark pine stands that are prevalent. These areas are concentrated on south-facing slopes of Mt. Washburn (the southern segment of the road) and in the large open meadows on Mt. Washburn, particularly Antelope Creek valley, the open meadows around Canyon Junction, and on the western slopes of Specimen Ridge. Low-quality habitat (25.5 percent) exists along the Yellowstone River near Canyon Junction and the lower elevation meadows of the Antelope Creek valley, Yancey's Hole, and other open areas around Tower/Roosevelt.

Grizzly bear habitat qualities are based on the utilization of vegetation and do not account for numerous protein-rich food sources. In spring and early summer two of these food sources are prevalent along the Dunraven Pass road corridor. Elk calf predation, which begins in May, is frequently observed in the Antelope Creek valley and on the north slopes of Mt. Washburn. Utilization of elk calves, as a protein-rich food source is not often observed after mid-July, because as elk calves become larger, they are more able to defend themselves. However between May 15 and July 1, elk calf predation provides a valuable food source to bears (Gunther and Renkin 1990).

Winter-killed ungulates also provide a protein-rich food source for bears during the spring. This food source is most abundant at lower elevations and in thermal areas where ungulates may winter. Most notable are the Cascade Meadows near Canyon Jct/Pleasant Valley and the west edge of the Specimen Ridge near Tower/Roosevelt.

A master's thesis that was written in 1999 (Podruzny) specifically studied the grizzly bear use of whitebark pine in areas that burned in the 1988 fires. Research found that 27.5 percent of the whitebark pine burned within the entire Yellowstone National Park boundary, (not just Dunraven Road). The researcher visited the same

plots before (1978-87), and after (1989-1997) the fire. Half of the study transects had burned. The researcher found that white pine blister rust was present in 9 percent of the whitebark pine in plots sampled.

Red squirrels are important intermediaries for grizzly bears foraging on pine seeds. Middens are food storage areas created by the squirrels and identified by accumulation of cone debris. Red squirrel midden density increased in burned areas, but decreased overall. Midden sizes were 51 percent smaller post-fire, and bear use of middens decreased by 64 percent post-fire.

BEAR MANAGEMENT AREAS IN THE DUNRAVEN ROAD AREA

Antelope Creek Bear Management Area	Closed March 10th through November 10th	The Dunraven Road and related pullouts are open. From May 25th through November 10th, foot travel is allowed on the old Road Trail from Tower Fall Campground to the old Buffalo Paddock area.
Washburn Bear Management Area	Closed August 1st through November 10th	From March 10 through July 31, the area is open by special permit only.

(From NPS 2000f)

Grizzly Bear Activity Along the Road Corridor

During the ten year period 1986-1995, a total of 1,577 grizzly bear activity reports were recorded within the Zone of Influence of the Dunraven Road corridor. Of these activity reports 266 grizzly bears (16.9 percent) were recorded during the spring, 1055 (66.9 percent) during the summer, and 256 (16.2 percent) during the fall. The road corridor ranks second out of the 15 major parks roads in the number of grizzly bear activity reports recorded from 1986-1995. Observed grizzly bear activity was concentrated in the Antelope Creek valley in the spring. During the summer season, concentrations of grizzly bear activity occurred near Antelope Creek valley, Mt. Washburn, and Canyon Junction. Most grizzly bear activity observed during the fall occurred along Mt. Washburn and near Canyon Junction.

Sightings of Grizzly Bears within the 4-km (2.5-mile) Zone of Influence along Yellowstone National Park's Road Corridors 1986-1995 (edited)

ROAD SECTION	SPRING	SUMMER	FALL	TOTAL
Fishing Bridge to Canyon Village	454	866	328	1,648
Canyon Village to Tower Jct	**266**	**1,055**	**256**	**1,577**

Fishing Bridge to East Entrance	342	796	247	1,385
Fishing Bridge to West Thumb	234	517	162	913
Norris Jct. to Canyon Village	150	394	194	738
Tower Jct. to Northeast Entrance	206	337	103	646

Grizzly and Black Bear Activity and Habitat along the Dunraven Pass Road Corridor, (NPS 1996b) page 11, edited.

The high level of grizzly bear activity along this road segment is likely the result of the combination of year-round food sources in the Antelope Creek/Mt. Washburn area and the lack of human activity in the Antelope Creek Bear Management Area, which reduces displacement of bears.

Areas of High, Moderate, Low/Minimal Use by Grizzly Bears within the 4-km (2.5-mile) Zone of Influence of the Tower-Roosevelt to Canyon Village Road 1986-1995

Level of Use	Spring	Summer	Fall
High	Antelope Creek	Antelope Ck, Mt. Washburn, Canyon Junction	Mt. Washburn Canyon Junction
Moderate	Canyon Junction	Cascade Lake	Antelope Creek
Low/Minimal	Tower Junction	Tower Junction	Tower Junction

Grizzly and Black Bear Activity and Habitat along the Dunraven Pass Road Corridor (NPS 1996b) page 12, edited.

Grizzly Bear Cub Production Compared to Adjacent BMUs

The Dunraven Road corridor is entirely within the Washburn Bear Management Unit (BMU). This BMU has produced an annual average of 1.5 unduplicated female grizzly bear with cubs over the ten years from 1986-1995. The Washburn BMU ranks sixth out of the 18 Yellowstone ecosystem Grizzly Bear Recovery Zone BMUs in mean annual number of reproductively successful adult females per year (NPS 1996b).

Sightings of Female Grizzly Bears with Cubs

From 1986-1995 there were 236 observations of female grizzly bears with cubs along the Dunraven Road, ranking it highest in the number of sightings out of the 15 park road corridors. Activity of females with cubs was concentrated in the Antelope Creek valley within the Zone of Influence, but a considerable distance from the road. Numerous sightings of females with cubs also occurred away from the road on Mt. Washburn, between Antelope Creek and Mt. Washburn, and in the Canyon area (NPS 1996b).

Lynx

A biological assessment of Canada lynx activity and habitat was finished in November 2000. This research included the evaluation of the Canyon to Tower road

(NPS 2000e). While there are historical records of lynx within the Greater Yellowstone Ecosystem, and the project area contains habitat suitable for lynx, this assessment found no sign of lynx. Five scent stations were placed along sections of the road corridor, and left out to provide a total of 164 total nights coverage of detection time in the fall of 1999. There were an additional 42 camera nights at another location within 500 meters (1,640 feet) of the Tower to Canyon road. In addition, researchers sought to document the presence or absence of snowshoe hare, which can make up 35 percent to 97 percent of the lynx diet. However, no observations or sign of snowshoe hares were made. This does not establish with complete assurance that lynx are not present in these areas, as habitat potential suitable for lynx is near all road corridors. In addition, that amount of potential lynx habitat along the road corridors may increase in the future due to the vegetation changes from post-1988 fire regeneration.

Bald Eagle

Resident and migratory bald eagles use the park. Nesting sites occur primarily along the margins of Yellowstone, Shoshone, Heart, and Lewis lakes and along the shoreline of several of the larger rivers in the park. Park personnel believe eagle populations to be generally stable and possibly nearing maximum density. No bald eagles or their nests were found in or near the study area. The habitat found along the Tower to Canyon road is marginal for bald eagles, since this road segment lies primarily in the subalpine zone far removed from large bodies of water which characterize habitat for this species in the park (NPS 2000c).

Whooping Crane

Whooping cranes have been occasional summer residents of Yellowstone. At present there is not a whooping crane population in the park. The single individual from the Gray's Lake experiment currently resides west of the park in Idaho. In recent years this crane has summered in the southern half of the park. This crane is the last of the initial experiments, to cross-foster whooping crane eggs under sandhill crane nests, at Gray's Lake in Idaho. Whooping cranes were not found during the surveys, nor are there historical records of occurrence of the species in this area of the park (NPS 2000c).

At the request of the Fish and Wildlife Service, two whooping cranes were released as an experiment in the vicinity of Slough Creek Campground in May 1998. One of these cranes died of unknown causes, and the other resides elsewhere outside the park.

Gray Wolf

Wolves in Yellowstone area are designated as an experimental population, and therefore no areas are designated as critical habitat for wolves (USFWS 1994). Human-caused mortality and availability of prey are the two most limiting factors for wolf populations (Mech 1970). To date most human-caused mortality of wolves in the Greater Yellowstone Area has come from management removals (mostly related to livestock depredations), illegal kills (from poaching), and collisions with vehicles. Within Yellowstone National Park, there has been no mortality of wolves due to either management removals or illegal kills. Nine wolves within the park have been

killed in collisions with vehicles. Prey for a wolf is considered abundant in the park, with elk being the primary prey species.
As of December 2000, 164 to 169 wolves in 16 groups or packs inhabit the Greater Yellowstone Area. At that time 57 wolves were radio-collared in Yellowstone National Park, and 73 wolves were collared in the Greater Yellowstone Area. Wolves travel widely and do not appear to be disturbed by human presence, except during denning. Wolf pups are generally born in late March to May. Wolves from two packs use the area in winter (Rose and Druid packs). During the summer, only a portion of one pack (Rose) uses the area- and then only occasionally.

Candidate or Proposed Species

The Yellowstone cutthroat trout is a native fish species present in Antelope Creek petitioned for listing under the Endangered Species Act (50 CFR Part 17). A status review conducted in 2000 determined that the species was not eligible for listing on either threatened or endangered species lists. National Park Service management goals mandate protection and restoration of native species. It has been determined that fluvial Arctic Grayling meet the criteria to be a candidate species to add to the list of threatened and endangered wildlife and plants. However, this species has not been found in Antelope Creek.

CULTURAL RESOURCES

Prehistory

Early humans have occupied and used the greater Yellowstone area for more than 11,000 years and possibly for as long as 13,000 years. The earliest archeological evidence of use of Yellowstone National Park (YNP) dates back to almost 10,000 years before present when small groups of Paleoindians are thought to have moved through the area hunting large game animals, and likely fishing, as evidenced by lakeside campsites. By about 7,500 years ago, major environmental changes greatly altered the range and quantity of plant and animal species. Archaic groups adapted to these changing conditions by developing new lithic technologies and by hunting small game and increasing their use of gathered wild plants.

From around 3000 BC to AD 1600, prehistoric groups such as McKean, Pelican Lake, and Avonlea cultures utilized Yellowstone and its resources leaving behind archeological traces of campsites, some with food processing areas, quarries, and lithic workshop areas. Once again the climate cooled and during the period known as the Little Ice Age (AD 1450 to AD 1850) archeological evidence indicates there was little use of the area. Yellowstone has material remains of cultures whose core areas were the Great Plains, the Great Basin, and the Intermountain Plateau.

History

A number of tribes are known to have used this area historically, including the Crow and Blackfeet, both of whom had early treaty interests in the greater Yellowstone River drainage area. Early Euroamerican explorers documented summer occupation of areas within the park by Shoshonean-speaking bands known as "Sheepeaters" and occasionally raiding bands of Blackfeet during the early and middle nineteenth

century (Haines 1977:1:79 and 1:20l). By 1840, the great buffalo herds west of the Continental Divide had been decimated, and some native peoples began traveling through YNP and the surrounding area in search of the bison herds to the north and east of the park. The Hayden survey party, undertaking the first mapping of Yellowstone National Park, found the Bannocks (and Shoshone) traveling through YNP on ancient trails. The Nez Perce, in their flight of 1877, also traveled through YNP on ancient trails. With ratification of treaties in 1882, the remaining Indians were moved out of the park to the Wind River, Shoshone, and Lemhi reservations.

Today the tribes who are affiliated with Yellowstone National Park, and with whom consultation occurs on a semi-annual basis, are (listed in alphabetical order): Assiniboine and Sioux Tribes of Ft. Peck, Blackfeet, Cheyenne River Sioux, Confederated Tribes of Salish & Kootenai, Coeur d'Alene tribe, Crow, Crow Creek Sioux, Eastern Shoshone, Flandreau Santee Sioux, Gros Ventre & Assiniboine, Kiowa Tribe of Oklahoma, Lower Brule Sioux, Nez Perce of Lapwai, Nespelem, and Colville, Northern Arapaho, Northern Cheyenne, Oglala Sioux, Rosebud Sioux, Shoshone-Bannock, Sisseton-Wahpeton Sioux, Spirit Lake Sioux, Standing Rock Sioux, and Yankton Sioux.

During the latter part of the nineteenth century, Euroamericans homesteaded in the upper Yellowstone area. Increasing numbers of explorers, scientists, and visitors publicized Yellowstone's resources and scenery, leading to formal establishment of the area as Yellowstone National Park in 1872. Conflicts with the Nez Perce and Bannock Indians, combined with inadequate funding and personnel needed to control poaching and vandalism, resulted in transfer of park management to the United States Army in 1886. Early park management (the Army and after 1918 the National Park Service) helped to shape the philosophical direction for the park. This philosophy carried over into design and construction of visitor facilities, including roads, stage stops, resorts, hotels, camps, and dumps. Included in this construction were numerous structures built in a style that has come to be known as rustic architecture. Examples include the Old Faithful Inn; the Norris, Madison, and Fishing Bridge museums; and the Northeast Entrance Station, all National Historic Landmarks.

Development of the Yellowstone road system was a crucial element in park management and the growth of area tourism. The Grand Loop Road was the first large scale designed, planned system giving people access into the "scenic splendors" of the park. This effort by the Army Corps of Engineers created a national road in an isolated region at a time when American road building was in its infancy. The massive scope of the project, the extraordinary engineering problems posed by the climate and area geology and the difficulty of transport and logistics made this a landmark effort. Additionally, the techniques pioneered for building roads in a wilderness setting established precedents for later construction all over the nation.

The Yellowstone road system began in 1877 when Superintendent Philetus Norris proposed a route or bridle path running along the Gibbon River from the North Entrance at Mammoth Hot Springs to the West Entrance to provide access to all of the major points of interest on the west side of the park. The Tower Junction to

Canyon Junction segment was the last piece of the Grand Loop Road to be constructed, with survey work starting in 1899. The actual construction, under the watchful eye of Captain Hiram Chittenden, began in 1903 and was nearing completion at the end of 1904 with crews working through the winter in the Overhanging Cliff area. There were two crews, one building road from Canyon Junction heading north and the other crew working from the Tower Junction heading south. By the end of the 1904 season, a passable wagon road on the Canyon side was opened to within 1.6-km (1-mile) beyond Dunraven Pass and 4 kilometers (2.5 miles) from the summit of Mt. Washburn. Captain Chittenden stated in his report from 1904 that "This will be by far the finest road for scenery in the park."

In 1926, after the Bureau of Public Roads (BPR) took over road improvements and construction in Yellowstone National Park, a reconnaissance survey was conducted to develop plans for the improvement of the Tower Junction to Canyon Junction road. Although the NPS wanted to use the existing alignment for scenic reasons and to maintain a connection to Mt. Washburn, the BPR survey indicated that continued use and widening the higher parts of the alignment were not feasible. Both parties agreed to re-route the alignment using a more direct and economical lower elevation for the route. In 1930, work was begun to re-construct the road, abandoning 7.6 kilometers (4.7 miles) of road traversing the top of Mt. Washburn. Since then the abandoned segment of road over Mt. Washburn was documented and evaluated for inclusion to the National Register of Historic Places. Named the Chittenden Road Historic District (48YE826), the road has been determined eligible for listing under the National Historic Preservation Act. The present Tower Junction to Canyon Junction road retains the alignment constructed in 1930-1933 with the preferred alternative for the current road to be reconstructed on the existing alignment.

This Tower Junction to Canyon Junction segment of the Grand Loop Road is often referred to as the "Dunraven Road." Lord Dunraven (4th Earl) spent time traveling through Yellowstone National Park in 1876. When he returned to London Lord Dunraven published a book, *The Great Divide,* which introduced Europeans to the Yellowstone Park area. For this, the Hayden Survey put Dunraven's name on the peak just west of the pass used to cross over the Washburn mountain range and Superintendent Norris later applied the name to the pass also.

Documentation of Cultural Resources

Early archeological research in the park generally was limited in scope and confined to non-systematic inventory. In conjunction with the present road re-construction work on this segment of road, site-specific surveys have been conducted along the Tower Junction to Canyon Junction segment of the Grand Loop Road. The intensive archeological inventory of the 29.34 kilometers (18.23 miles) of road was conducted in 1995 by the Office of the Wyoming State Archaeologist. The pedestrian inventory of the road to 100 meters (328 feet) on either side of the road (unless prevented by topographic barriers) provided re-documentation of previously recorded sites and identified undocumented archeological resources. The sites were evaluated for National Register eligibility using the contexts identified in the

treatment plan, and the inventory report provided initial data needed to assess the effect of the undertaking on the sites (Sanders et al. 1996). An additional archeological survey was conducted in 1999 to identify sites located along four road segments. Two of these road segments were abandoned extant old road alignments between campgrounds and the current alignment, the lower portion of the north end of the Chittenden Road leading to the trailhead parking area, and the entrance road and parking area previously associated with the bison viewing arena. The work was conducted through a cooperative agreement with the Museum of the Rockies. An inventory was conducted in July of 1999 to identify any cultural resources located within the road corridor. In 1998, National Register testing was conducted at one multi-component site (prehistoric lithic scatter with historic trash) located near the road in the Tower Fall area. One historic soldier station site was tested during the summer of 2000 using magnetromitry to identify buried features to assess the need for and guide future excavation. Archeological inventory of the Roosevelt Lodge area was previously conducted by Stephen A. Aaberg in conjunction with concession projects in the Roosevelt area. The 1994 inventory and subsequent project monitoring and data recovery provided detailed information for archeological sites located within the road corridor in the Roosevelt area.

A systematic survey and documentation of the bridges, drainage structures, and other historic features of the road was conducted in 1997. Documentation of the historic bridges, retaining walls, box culverts, masonry culvert headwalls, and other landscape elements of this segment of the Grand Loop Road was combined with information from the historic resource study, *The History of the Construction of the Road System in Yellowstone National Park, 1872-1966, (*Culpin 1994) and used to evaluate the historic district.

An ethnographic overview and assessment of Yellowstone National Park was compiled by Nabokov and Loendorf (in prep). The ethnographic overview and assessment is used to help identify traditional cultural properties that may be located in the project area. The ethnographic overview and assessment did not identify any specific resources within the project area. In the early planning phases of this project, the park initiated consultation with affiliated tribes through scoping letters and during tribal consultations held every spring and fall with the 24 tribes affiliated with YNP. No ethnographic resources have yet been identified within the project area.

Description of Cultural Resources

All prehistoric and historic archeological sites and historic structures, including road features, were documented and evaluated for National Register of Historic Places status. Consultation with the Wyoming State Historic Preservation Officer provided concurrence on those NR eligible archeological sites and structures found within the area of potential effect along the roadway between Tower Junction and Canyon Junction. Refer to the cultural resource tables found in the Environmental Consequences section on pages 101, 116, and 121 that itemizes the NR eligible sites within the area of potential effect, describes the effect of the project, and identifies any additional compliance needed.

Prehistoric Archeological Sites

The park's prehistoric archeological sites provide evidence of human occupation in this area for approximately 11,000-13,000 years. These tangible remains provide the only viable means of understanding past cultures, which lacked written records and provide the basis for continued scientific research.

Site 48YE101 is a small site located on a gently sloping surface between the Tower Junction to Canyon Junction road and the Tower Campground road, and consists of a surface lithic scatter with a buried prehistoric campsite component from the late archaic period. The site also has two surface scatters of historic trash. The prehistoric component of the site is eligible for the NR with the historic trash component not contributing to eligibility.

Another site, 48YE742, is located on the south east side of the intersection of the Tower Junction to Canyon Junction road, the Northeast Entrance road, and the Roosevelt Lodge access road, within the Roosevelt Lodge Historic District area. Site 48YE742 is a multi-component prehistoric lithic scatter with a historic trash component. The Wyoming State Historic Preservation Officer concurred that the prehistoric component of the site is eligible for the NR with the historic component not contributing to eligibility. The Grand Loop Road in that area is sufficiently wide, already having turn lanes, and no further impact to the site would be foreseen.

48YE743 is a prehistoric site in the Roosevelt Lodge corral area containing surface lithic scatter and subsurface buried cultural material. Although this site has had main impact from the development of the Roosevelt Lodge area, it still retains enough integrity to be eligible for the NR. The major portion of the site is located outside the area of potential effect of the road reconstruction project. A small part of the site boundary abuts the Tower to Canyon road, but the road is sufficiently wide in that area, and no further impact to the site would be necessary.

Located along the road corridor are four small prehistoric surface scatters of lithic material, all of which are ineligible for the NR. They are 48YE103, 48YE108, and 48YE180, and 48YE856. All four sites are located sufficient distance from the current alignment as to not be impacted by the road reconstruction.

Historic Archeological Sites

Yellowstone's historic resources reflect a number of noteworthy historical themes, including the growth of tourism, Yellowstone as a "proving ground" for America's national park system, Army protection and management of the park's resources, and the park's pioneer road transportation system. The "Archeological Treatment Plan for the Yellowstone Federal Highways Projects, Historical Archeological Resources" (NPS 1993b) was developed prior to beginning the 20-year road improvement program, and provides guidance in identification, interpretation, and excavation of Yellowstone's historic archeological sites. The historic sites located along the Tower Junction to Canyon Junction segment of the Grand Loop Road consist of Army camps, road construction camps, tourist camps, remnants of water systems, construction debris, and trash scatters. There are numerous piles of logs

and gravel pits, the results of past road clearing and construction work.

Site 48YE163, the NR eligible ruins of the Tower Fall Soldier Station site, are located close to the road north of Calcite Springs. The site was originally documented in the 1995 archeological inventory of the road corridor and further work in magnetic mapping and archival historic research was completed in 2000. The site consists of depressions with buried building foundations, depressions filled with historic trash, and a historic corral area. The soldier station was located at this site for about five years when it was moved to the Tower Junction area. The site was then used briefly as a temporary road construction camp and later as a tourist camping area. The site abuts the current road alignment and two small features of the site would be impacted by the road widening. Data recovery is scheduled for 2001.

Sites 48YE102 and 48YE177 are remnants of an abandoned water supply system that once served the Tower Fall auto campgrounds. Both sites are ineligible for the NR.

48YE190 is a concrete dam and remnants of a water diversion system that was constructed during the Mission 66 era and abandoned because of malfunction of other components of the system. The site lacks integrity and is ineligible for the NR.

Archival photographs show that site 48YE176, which consists of historic debris on the top portion of Overhanging Cliff, is a remnant of the 1934 work done to remove landslide debris and "trim" and stabilize Overhanging Cliff to prevent further rockfall. The site is not eligible for the NR.

Sites 48YE104, 48YE178, 48YE179, 48YE194, and 48YE195 are all historic gravel pits, used for previous road construction. None have prehistoric components or historic trash and all are ineligible for the NR.

Sixteen historic log piles are located along this road segment and are the result of cutting and clearing activities from previous road construction. All sixteen sites are not eligible for the National Register. They are 48YE106, 48YE107, 48YE109, 48YE110, 48YE181, 48YE182, 48YE183, 48YE184, 48YE185, 48YE186, 48YE187, 48YE188, 48YE189, 48YE191, 48YE192, and 48YE193.

The Historic Road System

The Tower Junction to Canyon Junction segment of the Grand Loop Road Historic District has been determined eligible for the National Register of Historic Places. As a component of that historic district, the bridges, culverts, stone walls, and other historic structural components of the road are important contributing features.

The early wagon and auto roads, constructed first by the Army Corps of Engineers and later reconstructed by the Bureau of Public Roads, were used to bring visitors and supplies into the interior of the park. More recent reconstruction has obliterated many of these early roads; others run parallel to the existing road alignment. A 7.03-km (4.37-mile) segment of the original 1903-04 Chittenden Road over the

summit of Mt. Washburn has been nominated to the National Register and comprises the Chittenden Road Historic District (48YE826). It extends from the Chittenden Road parking area on the north end to the Dunraven parking area on the south end. Other extant segments of the original road are still visible, and some still usable, although they are not eligible for the National Register due to lack of distinctive engineering and composition features. Obliteration and re-vegetation of former roadbeds was a deliberate practice during the 1920s and 1930s.

The historical significance of the Tower Junction to Canyon Junction road, also known as the Dunraven Road, derives from the overall site and setting and the long-standing function of conveying visitors to special places within the park.

The road structures and features on the Dunraven Road have been documented and are considered eligible and contributing to the National Register significance of the Grand Loop Road (48YE520).

The only historic bridge on this road segment is the Tower Creek Bridge, 48YE799, and it is eligible for the National Register. It has been documented using the Historic American Engineering Record (HAER No. Wy-33). The bridge was constructed in 1933 by McLaughlin Construction Company of Livingston, Montana. The stone masonry, arched bridge was constructed with a roadway width of 9.2 meters (30 feet), with 0.9-meter (3-foot) sidewalks on either side. The bridge is in good condition, wide enough to accommodate the 7.3-meter (24-foot) roadway, and would not be impacted by this undertaking.

Between Tower Junction and Canyon Junction there are three segments of masonry retaining walls, each topped with crenellated stone guardwalls. The retaining wall at Overhanging Cliff, which was reconstructed in 1935 after a massive rockfall event, is experiencing areas of cracking and bulging due to a natural fault line that passes through the road alignment into the basalt cliffs. Geologic research is being conducted to identify the most appropriate way to repair the damage. A second masonry retaining wall located north of Overhanging Cliff is experiencing bulging at one end. The wall would be repaired and stabilized and the guard wall reconstructed using existing materials to provide the same look as the existing walls. In various areas along the road segment masonry guard walls would be restored to their original height by pealing the layers of asphalt overlay down and repairing sags in the roadway.

Ten box culverts are located on this road segment, many of which were constructed many feet below the road surface. They have a concrete culvert structure with stone masonry headwalls. Several also have dry-laid rubble stone retaining walls above the box culvert. Most of the culverts are in excellent repair. Several of the culverts would need minor repairs such as the stone headwalls tied back into the concrete structure, minor in-kind replacement of rock that has become dislodged, and hand repair of the concrete floors of several culverts.

Numerous corrugated pipe culverts with stone masonry headwalls are located on the road segment, and the headwalls are considered contributing to the National

Register eligibility of the road. There are 148 type A culverts (stone headwall with a single pipe); three type C culverts (culvert headwalls with small wing walls); 24 type E culverts (stone headwalls with stone flumes); and 10 type K culverts (rubble headwalls). Also, there is stone curbing, log curbing, a stone flume, and a stone swale, all considered contributing. Repairs to the road features would be done in accordance with the guidelines set forth in the programmatic agreement (Appendix C). Stone headwalls that retains integrity and are visible from the road or other visitor use areas, or that are architecturally significant would be documented, dismantled, and later reassembled over the new culvert pipes. Other headwalls would be documented, dismantled, and the stone would be salvaged for rehabilitation of other stone road features in the park.

The Cultural Landscape

According to the National Park Service's *Cultural Resource Management Guideline* (DO-28), a cultural landscape is

> ...a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions.

Thus, cultural landscapes are the result of the long interactions between people and the land, the influence of human beliefs and actions over time upon the natural landscape. Shaped through time by historical land-use and management practices, as well as politics and property laws, levels of technology, and economic conditions, cultural landscapes provide a living record of an area's past, a visual chronicle of its history. The dynamic nature of modern human life, however, contributes to the continual reshaping of cultural landscapes; making them a good source of information about specific times and places, but at the same time rendering their long-term preservation a challenge.

The road system in Yellowstone National Park represents the continuing design philosophy first recognized by the Army Corps of Engineers, and later expounded upon by the landscape architects of the National Park Service. The road and its features are considered part of the landscape rather than separate from the landscape, and as such, the road has evolved into a historic landscape. The design of the Grand Loop Road system was intended to provide the visitor with scenic and interesting views as well as access to the geysers and other places of special beauty in the park. The designed features such as the guardrails or guardwalls, culverts, embankments, and designed pullouts are considered part of the system, and impart to the visitor a feeling of "blending with nature."

The use of the road has remained the same, but an historic landscape is not static and changes to meet the needs of visitors and to improve with advancing technology. Other changes in the road system demonstrate the impacts of weather and geology. The continuation of the earlier design philosophy in most cases has produced a road system with a high degree of feeling, compatible with the natural

surroundings.

The road from Tower Junction to Canyon Village possesses some of the most dramatic views and sweeping vistas in Yellowstone National Park. While still under construction, Captain Chittenden described the road as providing the finest views in the park. Today the road still possesses those qualities.

SOCIOECONOMIC ENVIRONMENT

General

Yellowstone plays a prominent role in the social and economic life of the Greater Yellowstone Area. Gateway communities have developed outside the park's five entrances - Cody, Dubois, and Jackson in Wyoming and Cooke City/Silver Gate, Gardiner, and West Yellowstone in Montana. The Montana gateway communities are on the immediate border of the park or within a few miles. The Wyoming gateway communities are an hour's drive or more from the park's boundary.

The gateway communities provide food, lodging, medical services, groceries, gasoline, other automotive supplies/services, gifts, souvenirs and other goods and services to the public. The availability of services varies from community to community. Quantity and quality of services depend on the size of the community and the volume of traffic passing through. The gateway communities are relatively small. The link between tourism and all the gateway communities is evident. Remote areas the size of these local communities would not have the types and number of permanent and seasonal businesses if they were not located near Yellowstone National Park and did not have access to the visitors the park attracts. The economic viability of the gateway communities depends heavily on the recreation and tourism traffic that is generated by Yellowstone and other public recreation destinations. The flow of traffic through the park, in turn, depends on the maintenance and improvement of the park's road system. Gateway communities understand this relationship.

The 2000 Census documented the following gateway populations: West Yellowstone, MT (pop 1,177); Gardiner, MT (pop 851); Cody, WY (pop 8,835) Jackson, WY (pop 8,647); and Dubois, WY (pop 962). All of these areas' populations increase in the summer with tourism.

Throughout the Greater Yellowstone Area, public lands provide the basis for much of the economic activity (recreation, mining, forestry, and agriculture) that occurs within the region. Over the last few years many communities in the area have experienced a structural change in their economies. The communities are now less dependent on extractive industries (mining, timber) that are subject to boom-and-bust cycles.

Less than two percent of Yellowstone National Park is developed. Park infrastructure includes utilities, trails, roads, employee housing, administrative headquarters, and visitor services facilities in various areas throughout the park. The

total developed area has decreased in recent years, as park managers have removed some developments from resource areas and other developments have been consolidated.

The large volume of visits the park receives each year has resulted in Yellowstone National Park being the focus of much of the economic activity in the area. Within the park itself economic activity is concentrated at six locations along the road system: Fishing Bridge, Lake Village, and Bridge Bay; Canyon Village; Tower/Roosevelt; Mammoth Hot Springs; Old Faithful; and Grant Village. A wide range of services including campgrounds, food, gas, lodging, transportation, horse and boat rentals, and medical services are provided by the private sector through concession contracts. The park's developed areas are established near popular, scenic features of the park. These developed areas evolved because of the need for goods and services within the park by the visiting public, the administrative and operational needs of the park, and the distance and isolation from other goods and services.

Peak summer NPS employment (permanent and seasonal) averages approximately 750 persons (2000 figures). Most of these people and the majority of over 3,600 employees hired by concessioners during the summer season live in the park. Park staff and concessioners employees make up several small communities centered on the above park locations plus six other smaller developments.

Tower-Roosevelt and Canyon are within the project area. Tower-Roosevelt is comprised of a campground at Tower Fall, a government administrative area with employee housing, maintenance facilities, and a ranger station. Concession facilities include lodging and food service, two stores, a service station, horseback and wagon rides, and an area for western outdoor cookouts.

A new solicitation for concession services requires the concessioner to remove the existing Tower Fall Store by November 1, 2004 and construction of a new general store near Tower Junction by June 1, 2007. These stipulations were included in the prospectus that was advertised for bid in summer 2001.

Currently 53 concession employees, predominately working for Hamilton Stores, are housed near Tower Fall. The Tower Fall Campground and Tower Fall housing area would be closed for periods of time during the second phase of this project. Construction activities would block access to the campground and housing, particularly during work at the Overhanging Cliffs section, thereby requiring a total closure to the Tower Fall area. An exact schedule for closures could not be made until final construction specifications were completed.

Canyon is comprised of government facilities including, maintenance areas, employee housing, a visitor center, and a ranger station. Concession facilities include overnight lodging, food service, two stores, gift shops, a campground, public showers, a public laundry, horseback rides, and employee housing.

Visitor use and economic activities supporting this use are highly seasonal. June,

July, and August are the months of highest use; with 50 percent of the park's visitation arriving in July and August. The shoulder-season months, May and September, receive less use but the volume is still heavy. Use in the winter months is relatively low, accounting for about six percent of the overall visitation. In the late 1980s and early 1990s, winter use grew 10 to 15 percent annually, reaching more than 140,000 in 1992-93. In 1996-97, winter use had dropped to approximately 113,000. The winter of 2000-2001 saw winter use back up to 139,000.

In 1996, the park received in excess of 3 million recreational visits, and visitation during the past five years has ranged from 2.9 million to 3.14 million. These visits represented more than one million vehicles entering the park and using the road system within the six-month period from May through October. The West Entrance accounted for approximately 37 percent of the vehicles, and the North Entrance provided access for approximately 19 percent of the total. The Northeast Entrance was the least used, providing for little more than one-twentieth of the total traffic entering the park. The remaining amount was split between the South and East Entrances, with the South receiving slightly more.

Five park entrance roads lead into the Grand Loop Road, which is the main road providing access to the interior of the park. The seasonal nature of park use is dictated by climate and local weather patterns. During the winter season snow covers the road system. Park roads are closed from approximately November 1 to late April. Most snow-covered roads are currently open for snowcoach, snowmobile, and cross-country ski use. The only exception is the road through the park that connects Gardiner and Cooke City, Montana, which is plowed for winter access to both Cooke City and Silver Gate, Montana.

Only the lower sections of Dunraven Road are open for over-snow use. The area from Canyon to Washburn Hot Springs Overlook is currently open to snowmobile use, and the lower portion of the road on the Tower side is open to cross-country ski use. Visitor use of the park during the winter season is becoming more important for some gateway communities, especially West Yellowstone.

Nearly 529 kilometers (329 miles) of park roads are open to the public and are intended to accommodate various types of vehicles. Everything from bicycles to commercial tour buses uses the roads. A moratorium was placed on additional bicycle tours in 1998. Great stress is also placed on some segments of the road system by the large numbers of tour buses that regularly come to the park. A fully loaded tour bus can have axle weights exceeding those of a loaded logging truck. Commercial truck traffic is prohibited from using park roads as thoroughfares. However, some large trucks and equipment must pass through the park to provide the goods and services required by the visiting public. Maintaining the facilities and roadways in the park also requires equipment, vehicles and personnel using these same travel routes. Emergency vehicles such as fire trucks, ambulances, and tow trucks also use the road, and snow plows, snow blowers and graders are used on plowed roads. Snow removal to open the roads for the summer season requires a variety of snow removal equipment to remove snow depths up to 6.0 meters (20 feet) and the ice layers at pavement level.

Many segments of the park's road system are paved to a width of 6.1 to 7.23 meters (20 to 24 feet) with no discernible shoulders. Recreational vehicles up to eight feet six inches wide with side mirrors extending out another 45.7 cm (18 inches) on each side are common throughout the park. Automobiles, recreational vehicles, and pickup trucks are the most common vehicles on the roads. Visitors frequently bring their recreational trailers, or boat trailers into the park. The existing poor road condition is the result of a variety of factors. Increased number of vehicles, heavy vehicles, poor road materials, inadequate ditching and drainage structures, winter use that contributes to the frost depth and inadequate width to protect against rockfall. The lack of cyclic maintenance including chipseals, overlays, ditching and shoulder maintenance, inadequate and poorly constructed pullouts and age have resulted in a potholed, frost heaved, soft, cracked, rutted roads. Rockfall, weather, wildlife and other unforeseen conditions also add to the hazards of driving.

Accidents occur more frequently on two-lane, narrow, winding roads with poor surface conditions and obstructions close to the travelway. The present road system has numerous segments that meet all of these criteria. The guidelines in the *Park Road Standards* (NPS 1984) present design criteria to provide a safe travel route for visitors. Emphasis is placed on width to accommodate vehicle numbers and types, and grades, sight distances and consistency criteria are presented to address safety concerns.

Traffic patterns that are hard to equate in normal traffic terminology include vehicles parked in the middle of the road, doors open and driver and passengers by the side of the road or in the woods observing wildlife. One car becomes two, two becomes three, and soon there is a traffic jam more commonly known in park terminology as a wildlife jam. Designing pullouts to allow the traffic to pull off the road to observe the wildlife is difficult when the feature is moving. The road becomes the parking area. The narrower road widths do not provide a width that allows the traffic to move to the shoulder and still allow other vehicles to travel through the congestion. The lack of a shoulder also does not provide a safe area for pedestrians to observe wildlife. In an attempt to pull to the side of the road, vehicles destroy vegetation as well as damage the road edge. Wildlife jams can sometimes result in gridlock of the roadway as well as create hazards from having vehicles stopped in areas with poor sight distances.

Canyon to Tower Road Conditions and Use

The Canyon to Tower section of the Grand Loop Road is a major south to north connector in the transportation network in the park. The road provides access to various natural features along this route as well as provides opportunities for hiking, wildlife viewing, picnicking, and other recreational activities. The road from Canyon to Tower is an integral part of the Grand Loop transportation system for both the visitor traffic as well as the support system of suppliers, vendors, emergency services, administrative, maintenance, and other support functions provided by the park concessioners and the National Park Service. Visitor use and users are well documented in various studies, and design standards such as the *Park Road*

Standards (NPS 1984) document, also reflect this emphasis. Other users of this road segment are included to provide a more complete look at the users of this road. The concessioners must restock their food service, grocery operations and gift shops almost daily during the summer season.

Park Service support includes operations such as garbage pickup; trail and overlook maintenance; hazard tree removal; snow plowing; and road maintenance activities such as pothole patching, ditch cleaning, chip sealing, and overlaying. Road maintenance also includes hauling of aggregates, asphalt, and the graders, laydown machines, and rollers to place this material. Due to the limited construction season in this mountainous climate, these activities must be performed during the same time as high visitation. This work often disrupts traffic flow and requires coordination of both the park visitors' safety as well as the safety of the workers. The present road creates hazards during these maintenance activities due to limited sight distances and the lack of adequate working room for flaggers, graders and traffic passing through the area.

Other functions using the road include law enforcement and assistance personnel, emergency response personnel in ambulances and fire trucks, maintenance personnel hauling materials and equipment on transports, as well as various workers and supervisors accessing their job locations.

The Dunraven Road segment has a slower rate of increase in accidents than other roads within the park. Additionally this segment of road ranks as the second lowest in vehicle/wildlife collisions within the park. Some accident causes include large vehicles swerving to avoid vehicles that have crossed the centerline as a result of avoiding potholes or animals, or careless drivers whose attention drifts to view an animal or scenic view, or some driver's riding the centerline for fear of dropping off the edge of the road. Most of the road offers no recovery area if a vehicle wanders off the paved road surface.

The Dunraven Road gets some of the highest snow depths within the park. The park's goal is to have the road open from Memorial Day to Columbus Day. This road typically is the first road to close in the park, usually the first week of October. The road does not open to public travel again until late May to mid-June, the last road to open. Removing the winter snow load requires roadway width to accommodate the snow removal equipment, to provide snow storage area and to allow for proper drainage during the spring runoff period. The existing snow removal operation has difficulty with the present lack of storage, lack of road width to provide safe passage of two way traffic including large snow removal equipment as well as inadequate drainage structure to prevent the road base from becoming saturated and losing its ability to support traffic loads. The plows have often gouged large sections of pavement or sunk through the pavement when the road structure underneath failed to support the load.

Pullouts and passing zones are also needed to allow for the variable speeds of the travelers, users, and the power of the various types of vehicles. The existing road has very limited passing zones, undersized pullouts, have steep grades dropping off

the road, and pullouts are difficult to see and use until the driver is almost beyond the pullout. Informal pullouts have developed where adequate pullouts do not exist. These pullouts often damage resources as the edges continue to creep and expand the disturbance.

ENVIRONMENTAL CONSEQUENCES

OVERVIEW

The National Environmental Policy Act (NEPA) requires that environmental documents disclose the environmental effects or consequences of a proposed federal action and any adverse effects that cannot be avoided should the proposed action be implemented. In this instance, the proposed federal action involves road improvement between Canyon Junction and Tower Junction, as described in this document.

The intent of this section is to provide an analytical basis for comparison of the alternatives and the impacts that would result from implementation of these alternatives. Impact topics have been selected for the analysis based on the potential for effects on significant resources and other key issues identified during planning. This section is based on scientific and analytical review of information collected by the National Park Service and provided by other agencies. Expected impacts are described for each of the four alternatives considered.

Regulatory guidelines for implementation of NEPA require an analysis of the cumulative effects of a proposed action as defined in 40 CFR 1508. These guidelines state that a cumulative effect is the effect on the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions.

In addition to determining the environmental consequences of the preferred and other alternatives, National Park Service policy, *Management Policies* (NPS 2001a) requires analysis of potential effects to determine whether or not actions would impair park resources.

The following analysis of impacts was based upon whether the impacts would be:

- **beneficial** (a positive change in the condition of the resource, or a change that moves a resource toward its desired condition);
- **adverse** (a negative change in the condition of the resource, or a change that moves a resource away from its desired condition);
- **direct** (an effect that is caused by an action and occurs at the same time and place);
- **indirect** (an effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable);
- **short-term** (and effect which in a short amount of time would no longer be detectable, as a resource returns to its pre-disturbance condition; generally less than 5 years);

- **long-term** (a change in a resource or its condition that does not return to pre-disturbance levels and for all practical purposes is considered permanent).

The analysis is also based upon whether the intensity or severity of the impacts are,

- **negligible** (the impact is at the lowest levels of detection);
- **minor** (the impact is slight, but detectable);
- **moderate** (the impact is readily apparent)
- **major (**the impact is a severe or adverse impact or of exceptional benefit).

Impairment

In addition to determining the environmental consequences of the preferred and other alternatives, National Park Service policy *Management Policies* (NPS 2001a) requires analysis of potential effects to determine whether or not actions would impair park resources.

The fundamental purpose of the National Park System, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others

operating in the park.

Because the impacts described in the following four alternatives (A, B, C, and D) do not severely affect a resource or value whose conservation is as described above, there would be no impairment of the park's resources or values.

ALTERNATIVE A (PREFERRED): RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 7.2-METER (24-FOOT) PAVEMENT WIDTH

Natural Resources

Geology, Topography, Soils, and Vegetation

Approximately 35 to 38 hectares (86 to 94 acres) of soils and vegetation would be disturbed along the roadside during road reconstruction. Construction of new or relocation of existing parking areas/pullouts outside of the existing road prism would impact an additional 2.5 hectares (6.2 acres). Approximately 0.5 hectares (1.2 acres) of land would be recontoured and revegetated to establish a more natural landform following the removal 0.4 kilometers (0.25 miles) of road near the Calcite Springs parking area.

Topsoil would be salvaged during construction for later revegetation work. No imported topsoil would be used in reclamation. Reclamation and revegetation efforts would follow the Yellowstone National Park policy on vegetation management for construction (see Appendix A). Borrow and aggregate materials from sources outside the park would be heated (or the source would be certified weed-free), and construction equipment would be carefully checked to avoid the importation of exotic vegetation. Indigenous native plant materials would be used for revegetation, and areas disturbed by construction would be monitored for early detection and removal of exotic species. A revegetation plan has been prepared for these areas. Standard approved erosion control techniques and structures such as silt fencing would be implemented during and following construction. The large cliff face at Overhanging Cliff would have a small portion of the cliff face taken back, perhaps 2 meters (6.5 feet), to allow for placement of the 7.2-meter (24-foot) wide road. Some blasting would be necessary to widen in this area. Approximately 1,000 to 2,000 cubic meters (1,196 to 2,392 cubic yards) of material would be removed.

The proposed access road for the Grebe Lake pit would have a direct adverse affect on approximately 0.18 hectares (0.44 acres) of predominately lodgepole pine forest. The reclamation of the existing access road would have a direct beneficial effect by restoring approximately 0.5 hectares (1.24 acres) to a more natural condition. This reclamation would also include the restoration of a disturbed thermal site that was bisected by the existing access road.

There would be a direct, short-term, moderate, adverse effect on soils and vegetation disturbed. In the long-term, revegetation efforts would reduce the

severity of impacts to a minor level, as defined above. These impacts would not constitute an impairment to this park resource.

Rare Plants

Species were located and mapped during a ground survey of the road corridor. The area contained within 61 meters (200 feet) on either side of the road was walked, during different seasons of the year, to search for plants.

Six rare plant sites totaling 750 m² (8,073 sq. feet) would be affected along the road corridor from Canyon to Tower over Dunraven Pass during the reconstruction of the road. These sites are located in three different areas along the road segment and are inhabited by three plant species of special concern; Cock's-comb paintbrush (*Castilleja crista-galli*), Bolander's sedge (*Carex deweyana* var. *bolanderi*) and Parry sedge (*Carex parryana* var. *parryana*). The impacts to the rare species on these sites would be adverse, direct, and of moderate severity. Bolander's sedge and Parry sedge would be affected long-term due to loss of the immediate habitat. There would be a short-term impact on Cock's-comb paintbrush since this species is adapted to rocky areas and talus slopes, habitat that would be expected to still exist within the area of disturbance after road reconstruction.

Mitigation efforts would focus on seed collection from the immediate area, with reseeding in appropriate habitat after road reconstruction is completed. Cock's-comb paintbrush would be expected to re-establish on at least some of the previous habitat after conclusion of the road construction.

The proposed access road to Grebe Lake pit had a rare plant survey conducted during 2001. No rare plants were found. These impacts associated with this alternative would not constitute an impairment to rare plants.

Hydrothermal Resources

There are a few thermal features located close to this section of road. The Calcite Springs hydrothermal features are located below road grade, to the east side of the road on the west river bank. The Washburn Hot Springs also lie to the east of the road midway between Canyon Junction and Dunraven Pass. None of these hydrothermal features are located directly under or adjacent to the road and would not be impacted by this road project. Therefore there would be no impairment to hydrothermal resources in the park.

Wetlands and Other Waters of the United States

In general short-term local siltation and turbidity of Antelope Creek other drainages adjacent to the roadside might occur as a result of construction activity and erosion of disturbed soils before vegetation became established. Scheduling and standard erosion control measures and barriers would be implemented to prevent runoff from degrading water quality. The emphasis would be on techniques that do not need to be later removed (mulch vs. silt fences).

The preliminary engineering road designs sought to avoid and minimize impacts to wetlands whenever possible, through use of such techniques as shifting the

centerline to avoid wetlands and steepening fill slopes or constructing rock walls to minimize the extent of fill. However, because of the prevalence of wetlands bordering the road, the increased road prism width and associated cut or fill work would result in impacts to some wetlands on both sides of the road. A total of 95 individual wetlands would be affected for this alternative. The total area of wetlands lost would be approximately 0.39 hectares (0.96 acres). The majority of these wetlands are classified as palustrine emergent wetlands, either saturated or seasonally flooded. The design and location of all but one new or relocated parking area/pullout would avoid wetlands. The majority of wetland impacts would be the parking area at Dunraven Pass, consisting of 0.20 hectares (0.49 acres). The total area of wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 0.39 hectares (0.96 acres). Mitigation would be accomplished through restoration of portions of the abandoned East Entrance Road. These impacts would not constitute an impairment to park wetlands.

Air Quality

There would be no long-term adverse impacts on air quality or visibility in the park or region. In the short-term, effects would be minor, temporary and limited to the duration of construction. Dispersed dust and mobile exhaust emissions would be caused by truck traffic and equipment activity. Dust and hydrocarbons would not be in sufficient quantities to degrade park air quality. All contractor activities would comply with state and federal air quality regulations, and contractors would operate under applicable permits. There would be no impairment to air quality.

Wildlife

Overview

Negligible adverse long-term impacts are anticipated to elk, mule deer, bison, mountain lion, or other mammals discussed in the affected environment chapter. Considering that all portions of previously undisturbed ground has the potential to be used as some sort of habitat, approximately 35 to 38 hectares (86 to 94 acres) of potential wildlife habitat adjacent to the road would be impacted by construction. In the long-term the loss of habitat due to increased roadbed would have a negligible adverse impact to wildlife populations as a whole. Habitat loss would be limited to areas immediately adjacent to the road. Areas impacted outside the proposed road (e.g. cut/fill slopes) would be reclaimed or revegetated. It is likely that wildlife would, in the short-term, be temporarily displaced from habitat adjacent to the road due to construction equipment and activity for the duration of the project.

Blasting near elk calving areas (in the Antelope Creek drainage) in and around June 1st could cause some disturbance to elk. However it is not anticipated that blasting would cause displacement of elk from the area.

Mountain lion are not likely to be affected by this project due to the distance of the road from the Yellowstone River Canyon.

All staging or material storage areas would be confined to previously disturbed

areas along the road corridor, resulting in no long-term effects. Road construction would not occur during the winter season, eliminating added potential winter stress to wildlife.

Closing the road to public travel during the construction period could help reduce visitor-related impacts to wildlife. However, concentrated construction activities could displace animals in the short-term from those specific activity areas.

Irrespective of the road project, potential visitor-use increases in the future could lead to increased disturbance posing a potential increased barrier to daytime animal movements across the roadway. People feeding animals at pullouts would have the potential to increase due to more people choosing to use the due to its improved condition. Food and garbage would be managed to ensure that it was not available to bears or other wildlife.

Bears are predominantly active during evenings, night, and early morning time periods. Nighttime work would occur, over much of the project, overlapping the active time of bears. A nighttime closure for work activities would be implemented after September 1st within whitebark pine zones. Most observed bear activity along the road corridor was reported in spring and summer seasons, with fewer reports recorded during the fall. Most construction would occur during the late spring to fall months, thus somewhat overlapping the time when bears are most active. The presence of humans and associated food attractants can lead to wildlife/human conflicts, in particular conflicts with bears, which sometimes requires removal of the animal from a roadside. Orientation sessions, including information on bears, would be conducted for construction personnel to reduce the potential for conflicts at construction sites and along the project route.

The impacts associated with this alternative would not constitute an impairment to wildlife in the park.

Bighorn Sheep

The proposed widening of the Dunraven Road would have a negligible long-term impact on bighorn sheep. Roadside designs could reduce the availability of forage along roads, which may be attracting sheep in late summer. The migrations made by this group occur before and after the peak traffic season. The heavy use of the road corridor by the sheep near Tower Fall and Calcite Springs in October should be carefully considered if changes in road closure schedules vary from normal years. The migratory Mt. Washburn ewe group had the greatest degree of human contact, but one of the lower levels of disturbances. This indicates that bighorn sheep can habituate to certain types of activities and may be more disturbed by other activities (Ostovar 1998a).

Changes in road closures status and the timing of opening and closing roads could cause the most disturbances to the Mt. Washburn group of bighorn sheep. Additionally, other activities (such as mountain biking, dogs, and helicopter traffic) could increase the level of disturbance to the Mt. Washburn group. Human, auto, and foot traffic around Mt. Washburn during the summer does not seem to currently

disturb these bighorn sheep. During the fall migration the sheep spent more time near the road on Mt. Washburn and eventually moved down to the Tower Fall area. At this time in mid-October the road is usually closed and the sheep are very active on the road corridor west of Calcite Springs. Changes in road closure dates would bring humans in contact with bighorn sheep with greater frequency during the fall. In addition, Ostovar (1998b) recommended that major construction activities should be curtailed at this time of year

Construction activities would occur before July when lambs are still maturing and the group is less mobile. At lower elevations construction would continue, as allowed by weather conditions into mid October or later in most areas including Calcite Springs. The short-term consequences to bighorn sheep appear to be minor, as a result of construction occurring while the bighorn sheep are present. The potential for disturbance to this particular group, already habituated to human presence, would be less than for other groups of sheep in different areas of the park. Short-term impacts to bighorn sheep could include displacement from very active construction zones. As bighorn sheep currently forage for food near the road's edge, alteration of this road edge due to construction could have negligible long-term impact on the locations where bighorn sheep congregate. There is no evidence to suggest that because of this project, sheep would change their migration or general feeding areas along the Dunraven Pass Road. The impacts to bighorn sheep would not constitute an impairment to this park resource.

Birds

Of particular concern to protection of birds are the sensitive cliff environments of Tower Fall, Overhanging Cliff, and Calcite Springs. Because of the complexity of the birds found in this area, dynamite blasting should not occur during the incubation period that would extend from late April until mid-June depending on the species (NPS 2000c).

An active peregrine eyrie occurs in the vicinity of the road. The most critical time for nesting peregrines is during the incubation period. Typically, this occurs during the entire month of May, but can extend into June. Blasting restrictions would be used in this alternative to mitigate adverse effects to peregrine falcons. In addition, the nest would be monitored during construction in the nest vicinity. Therefore, no short- or long-term effects are expected.

Construction activities along the road corridor would cause short-term temporary displacement of various bird species. A long-term consequence of this alternative would include previously undisturbed ground being developed. A negligible but permanent loss of habitat would occur. A short-term impact on some nesting birds could be displacement due to tree-cutting activities that may occur prior to July (the typical end of their nesting period). The effect to these birds would be adverse but minor in scope.
These impacts would not constitute an impairment to this park resource.

Amphibians and Reptiles

At the Rainy Lake site, widening of the roadway could result in impacts to

amphibians and reptiles during and after construction. The potential reconstruction activities would include activities such as removal and replacement of existing fill; expansion of roadbed; operation of heavy machinery, possible replacement or extension of the existing culvert (Patla and Peterson 1996).

Impacts to amphibian habitat may include degradation of water quality, changes to pond substrate and shoreline characteristics, disruption of breeding activities and larval development, direct and indirect mortality of adult and larvae due to human activities and operation of equipment, etc. (Patla and Peterson 1996).

Impacts to reptile habitat may include loss or reduction of summer shelter and winter den sites for snakes, reduction in prey abundance if amphibian populations are reduced, and direct or indirect mortality (Patla and Peterson 1996).

Due to fill material being placed near the edge of Rainy Lake the following mitigation would occur to maintain or enhance habitat for amphibians and/or reptiles once the project is completed. Design of the expanded roadway would provide important shallow water areas along the edge of Rainy Lake rather than a sharp gradient at the shoreline. These conditions would allow emergent vegetation to grow along the roadside lakeshore; maintain rocky area suitable for snake dens and summer shelter. Construction stipulations for all alternatives would prevent toxic runoff during construction from the road surface and sediment from road shoulders from entering the lake. No water for construction purposes would be pumped from Rainy Lake.

It is likely that there would be a direct, adverse, long-term effect on amphibians in this area. Mitigations described above would likely reduce the severity of these impacts to a "minor" level, meaning they are slight but detectable to populations as a whole for this area.

It is possible that roadway reconstruction at the Rainy Lake wetland directly across the road from Rainy Lake would result in partial loss of this site as amphibian habitat. It is possible that chorus frogs breed in shallow portions of Rainy Lake, and that no large change in the area’s population of chorus frogs would result if a portion of the wetland is filled. However, male chorus frogs calling in the spring of 1995 was very weak (three or fewer individuals calling) from Rainy Lake, indicating that the lake may currently only provide poor or marginal habitat. There are no other known chorus frog breeding sites in the Tower-Tower Fall area.

Both Rainy Lake and the Rainy Lake wetland across the roadway are unique features of the area between Tower and Tower Fall. There appear to be no other permanent bodies of water west of the Yellowstone River in this area, and there are no other known amphibian breeding sites in the vicinity of the roadway between Rainy Lake and the Canyon area. Design alternatives that leave the road at its current width through this area, span the area with a bridge, or re-route the highway around the lake basin, are potential mitigation measures that were not considered viable, due to design objectives and cost.

The pools north of Canyon Junction appear to be at a sufficient distance from the

roadway to be safe from impacts from any of the proposed road project alternatives.

The Canyon pools in the area south of Canyon Junction are of unique importance. The site is not located in the area to be impacted by this project. No project related activities of any kind are planned at this site or any of its surrounding areas.

Impacts to amphibians and reptiles would not be of a degree that would constitute an impairment to this park resource.

Important Herpetological Sites in Study Area- 1995

Site	Blotched Tiger Salamander	Boreal Chorus Frog	Spotted Frog	Wandering Garter Snake	Remarks
Rainy Lake	Adults, Larvae	Adults calling		Adults	**Lake edge is < 4m from road shoulder. Site character is likely to be affected by Alternative A.**
Rainy Lake Wetland		Adults, tadpoles			**Wetland is adjacent to road. Site likely to be reduced by Alternative A.**
Pools North of Canyon Junction		Adults, Tadpoles Juveniles	Adults, Tadpoles		**Pools 90 m or more from road. Not likely to be affected by Alternative A.**
Canyon Pools	Adults, Larvae	Adults, tadpoles	Adults, Tadpole		**Not near project activities. Important breeding site with 2 pools. Warrants protection from any road construction activities.**

Source: Amphibians and Reptiles Along Grand Loop Road (Patla and Peterson 1996)

Dunraven Road Kill and Rare Animal Observations

Road kills would continue to contribute to wildlife mortalities. However, the numbers of wildlife mortalities on this road are expected to remain low. Maintenance of existing 56 km/hr (35 mph) posted road speeds, continued curves throughout the alignment that would temper speeds, and addition of pullouts for slower traffic should minimize the potential for road-kills.

An increased risk for vehicle-animal collisions and vehicle-caused, large mammal road-kill mortality may also result. Initial analysis of alternatives contained in the Dunraven Road corridor study (BRW, Inc. 1997), did not predict how much vehicle speeds were likely to increase under each of the different road width options. Therefore, it is difficult to predict how much the different alternatives would affect wildlife populations. Under this alternative a slight increase in average vehicle

speed, regardless of the posted speed limit, would be expected. Because of this, a small 'Incidental Take" of grizzly bears, wolves, or lynx could potentially occur. However, it is not believed that this alternative would have negative, population level impacts on any large mammal populations in the park listed as threatened, endangered, nonessential experimental, or candidate species or on any non-listed species of large or small mammals (NPS 2000a).

There would also be potential temporary displacement of wildlife from habitat adjacent to the road, due to construction equipment, activity, and noise during the resurfacing (reconstruction) project (NPS 1996a). Road kill mortality rate increases from this alternative would be expected to be negligible in the long-term. These impacts would not constitute an impairment to this park wildlife.

Fisheries and Aquatic Resources

Meehan (1991) reviewed extensive literature and described the changes that may occur in streams as a result of roads, recognizing that only rarely can roads be built that have no negative effects on streams and their ecosystem components. Direct effects may include the acceleration of erosion and sediment loading, alteration of channel morphology, and changes in the runoff characteristics of watersheds. All such changes affect fish habitats. Other changes may include changes in rainfall-runoff relationships, hillslope drainage, chemical contamination, the amount and type of organic debris in stream channels, and human access to streams and fish populations.

Runoff characteristics and important sources of flow may be altered on both a short-term and long-term basis. In general, minimal short-term effects would include increased disturbance to riparian soils and potential increases in runoff due to the removal of road fill and steeper exposed slopes. In the long-term minor increases in run-off from increased pavement placed on the road surface, would enter Antelope Creek, from roadside ditches and culverts.

Disturbance to soils and vegetation could directly impact aquatic flora and fauna by degrading water quality. Research has shown that turbidity and siltation has a profound effect on benthic invertebrate communities, in that abundances are reduced in fine sediments (Waters 1995). These invertebrates, which are important food sources for fish, are observed at much lower densities in streams subject to sedimentation. For example, studies by Mackay and Waters (1986) on annual productivity of filter feeding caddisflies (order Trichoptera) revealed a higher species diversity and six-fold increase in biomass production downstream of a sediment trap where substrates lacked significant sand and silt deposits.

Studies have shown that turbidity and siltation has long been implicated in the reduction or loss of fish populations. An accumulation of fine sediments in pools reduces wintering habitat for adults and fry and decreases optimal habitat for growth. In addition, suspended sediments can reduce feeding and growth through loss of visual capabilities and orientation. Each of these effects are cumulative when considering sediment related problems such as the initial loss to invertebrate

production, all of which result in decreased fish production in the system. The decline in a fishery would also have impacts on the recreational value (Mackay and Waters 1986).

Sediment loading or removal of trees along banks could reduce stream stability. In the few places where fill material may be added to areas adjacent to Antelope Creek, there would be possibilities of constriction of the flood channel. This could cause an increase in water velocity, and digging out of the banks or head cutting of the stream. The effect, if any, primarily depends on the bank characteristics (soft material vs. rock). In the short-term, fish may be temporarily displaced upstream of construction. Due to the increased square footage of road pavement, Alternative A has the potential for increasing stormwater runoff due to an approximate 17 percent increase in pavement area over existing road conditions. Stormwater runoff has the potential to transport sediments into the stream causing negligible short-term impacts. It is not anticipated that this road project would have any long-term adverse affects on fish populations or the physical characteristics of the stream itself. As Dunraven Road only parallels Antelope Creek for about 3.6 kilometers (2.25 miles), it is not anticipated that this project would have anything more than a negligible increase in sediment lading. A sediment control plan would be in place to reduce any potential sedimentation to Antelope Creek. Impacts associated with this alternative would not constitute an impairment to park fisheries and aquatic resources.

Threatened and Endangered Species

Grizzly Bears

Sanitation would be a priority during the construction phase of the project. Proper storage of human foods, garbage, and other bear attractants by road crews is essential to prevent possible bear-human conflicts along the roadway. Road construction employee orientation programs have been highly successful in addressing this concern with past road construction projects (D.P. Reinhart, NPS, personal communication).

Roadside areas with high bear density have the potential for bear-vehicle collisions. The Dunraven Road corridor, however, has one of the lowest road-kill rates out of the 15 park roads (NPS 2000a). This, along with the fact that only two bears have been hit and killed along the road corridor between 1986 and 1995, emphasizes the limited mortality effects of the road corridor on bears.

Along the Dunraven Road corridor 12 different vegetation cover types exist. A total of about 16.2 hectares (40 acres) of whitebark pine and potential whitebark pine habitat, and meadows containing known vegetative food sources favored by bears would be impacted by this alternative.

Current or future cone producing whitebark pine cover types impacted by this alternative would be 3.2 hectares (7.93 acres). Non-whitebark pine cover types containing current or future cone producing whitebark pine trees impacted would be 7.0 hectares (17.45 acres). Non-whitebark pine cover types containing whitebark

pine regeneration, but with very low potential to produce cone producing whitebark pine trees under current environmental conditions would be 3.9 hectares (9.60 acres). Non-forested meadows in whitebark pine zone, over 2,377 meters (7,800 feet), contain biscuit root, yampa, and other bear foods. The amount of non-forested meadows impacted would be 2.2 hectares (5.46 acres). The estimated whitebark pine densities for trees 1.8 meters (6 feet) and taller and for whitebark pine saplings of each of these cover types can be found in Appendix B.

More than a quarter of Yellowstone's whitebark pine zone burned in 1988 (Renkin and Despain 1992) including approximately 30 percent subalpine forests of the Washburn range and half of the red squirrel study transects (Podruzny 1999). Stand-replacing fires may benefit whitebark pine populations by creating open sites where regeneration is most successful (Morgan et al. 1994). However, as cone production remains relatively low until stands are more than 100 years old (Weaver et al. 1990), a considerable amount of effective whitebark pine habitat for grizzly bears has been removed for much of the next century (Podruzny 1999). It's also true those burned habitats facilitate whitebark pine regeneration by providing more seed-catching sites for Clark's nutcrackers (Tomback 1994) and may produce other foods used by bears (Blanchard and Knight 1996). Even so, the roots and grazed foods used more commonly in burns after fires do not provide the bears with as much energy and fat as do pine seeds (Pritchard and Robbins 1990). Although mortality from white pine blister rust in northwestern Montana is estimated at 42 percent, and infestation rates range from 50 to 80 percent, colder and drier Yellowstone has low whitebark pine mortality from this disease. There is a local estimated four percent mortality (Kendall in press); however, stands which now contain low levels of blister rust infestation may become imperiled under global warming scenario (Romme and Turner 1991). The researchers (Podruzny 1999) stated that while more study is needed on the ecological effects of fire and fire management on whitebark pine, "encouraged caution in the management of whitebark pine habitats. I would discourage any large scale losses of whitebark pine habitat and seed-producing trees from management-prescribed fire or timber harvesting. Management of whitebark pine forests for grizzly bears should emphasize maintaining large, secure areas of diverse habitat types that support stable whitebark pine stands and red squirrel populations."

Specific management recommendations in *Grizzly and Black Bear Activity and Habitat along the Dunraven Pass Road Corridor,* (NPS 1996b) include:

1. To minimize displacement of bears, this road construction project should avoid areas of seasonally high concentrations of bear activity. Road construction should be avoided in the lower areas along Antelope Creek in the spring and early summer (due to use of elk calves and biscuit root) and the higher elevations areas of Mt. Washburn should be avoided during the late summer and fall (due to yampa root and whitebark pine seeds).

2. Whitebark pine seeds are one of the most important foods for threatened grizzly bears in Yellowstone National Park. Whitebark pine trees themselves are at a significant risk of extirpation due to infections of the exotic fungal disease white

pine blister rust (*Cronartium ribicola*). Whitebark pine trees may also be declining due to changes in forest successional replacement caused by the suppression of wildfires. Road alternatives that keep the road at existing widths would have less impact on whitebark pine trees and threatened grizzly bears, than alternatives that widen the road.

3. To prevent habituation and human-caused mortality, use of temporary road closures should be considered during periods when bears are feeding along the road corridor, (i.e. during elk calving season, when bears are digging biscuit root or yampa, or feeding in whitebark pine areas) and causing large bear jams.

4. Slower average vehicle speeds minimize the chance of bears being injured or killed by vehicles. Bears often travel at night increasing the likelihood of them being hit by vehicles. Few road-kills have occurred on this road, likely the result of the slower average vehicle speeds necessary due to the poor condition and narrow winding configuration of the road, which limit vehicle speeds. Once the road has been rebuilt, the likelihood of increased numbers of bear road-kills may increase. Road design standards that prevent vehicle speeds from increasing from current average speeds would prevent an increase in road-killed bears.

5. Because most grizzly bears are active during night-time and crepuscular (dusk and dawn) time periods, limiting the construction process to day-time hours and avoiding dusk, dawn, and night-time hours would reduce displacement of bears from adjacent high quality bear habitat.

6. As part of this project, adequate funding for interpretive displays and long-term management of bear jams on this road segment should be sought to enhance visitor experience of bear viewing from the road, while minimizing the negative impacts of the road on bears.

7. An increase in the number of pullouts along the road corridor would minimize damage to vegetation at the road edge while providing a safe environment to view bears.

8. Bear orientation sessions should be conducted for construction crews working on the project to reduce the potential for bear-human conflict at construction sites.

9. Adequate bear-proof food and garbage storage should be provided in all areas frequented by construction workers to minimize the risks of bears becoming food conditioned. Food conditioned bears are often removed from the population due to concerns for human safety.

10. Housing for contractors should be managed to minimize impacts to bears. Including providing bear-proof garbage storage, facilities to store cooking grills in a bear-proof manner, living and working in bear-country orientation sessions, and adequate staff to enforce bear related sanitation regulations.

11. To improve human safety, we recommend that the construction contractor provide bear repellent to flaggers working in isolated areas of high quality bear habitat, especially if construction occurs at dawn, dusk, or night.

Park roads within or adjacent to bear habitat can affect bear populations, both directly and indirectly. Direct effects include human-caused bear mortality (including road-killed bear mortality) and a long-term loss of habitat when it is paved during road and pullout construction. Indirect effects include reduction of habitat effectiveness due to human-caused displacement of bears from habitat adjacent to road corridors. Bears may also be indirectly affected by roads through habituation to humans and other behavior modifications.

Bears may be temporarily displaced from roadside habitat by the noise and disturbance of construction activities. Human-caused displacement of bears from habitat near recreational developments (Mattson and Henry 1987, Reinhart and Mattson 1990), roads (Green and Mattson 1988, Craighead et al. 1995), backcountry campsites (Gunther 1990) and recreational trails in non-forested areas (Gunther 1990) has been documented. Bears generally exhibit the strongest avoidance of occupied front country human developments (Mattson 1990). Restrictions on construction activity at individual staging/storage areas and work sites would be implemented based on the presence of carrion and bear related activity.

Some bears would not be displaced by human activity along the road, but may become habituated to people in an effort to access habitat along the road corridor. Bears that frequent roadsides and developed areas are females with young, the segment of the population that is most critical for recovery (Knight and Eberhardt 1985). Females with young and subadult males have the highest energy requirements with the least access to quality food sources. As a result, habituation is represented more in these sex and age classes than in other cohorts (Mattson 1990). As the population nears carrying capacity, the frequency of roadside bear activity increases and thus the number of habituated animals increases. Female and subadult male grizzly bears are likely to be pushed out of the higher quality secluded habitat by more dominant male bears. The less dominant bears are then forced to choose between a lower quality habitat in the wild or a higher quality habitat near humans. As a result, there is a disproportionately high representation of these age classes in habituated animals and hence among the animals in which management actions are required. Because habituated bears are perceived as possible threats to human safety, they are often removed from the population (Gunther 1994). This project may affect, but is not likely to adversely affect grizzly bears. There would be long-term minor adverse impacts to local whitebark pine stands due to loss of cone production. These effects would not constitute an impairment to this park resource.

Lynx

Whenever possible, highways traversing lynx habitat should not be upgraded (e.g., straightening of curves, widening of roadways, etc.) in a manner that is likely to lead to increases in traffic volumes, traffic speeds, or increased width of the cleared right-of-way. Such projects may increase habitat fragmentation, create a barrier to

movements, increase mortality risks due to vehicle collisions, and generate secondary adverse effects by generally increasing human use of lynx habitat (USDA Forest Service 2000).

Due to the widening of the pavement and road prism of this alternative, it was concluded that the Canyon Junction to Tower Junction road reconstruction project may have some minor negative impacts, but are not likely to adversely affect any lynx that may inhabit the project area (NPS 2000e). Therefore any impacts would not constitute an impairment to lynx found within the park.

Bald Eagle

No bald eagles or bald eagle nests were found within or near the project area. Therefore this alternative would have no effect on bald eagles, and no impairment would result.

Whooping Crane

In recent years one to two whooping cranes have summered separately in the backcountry in the southern half of the park, in areas distant from this road project. The habitat along this section of road does not represent characteristic whooping crane habitat. There are very few open meadows, and the meadows are too dry to support whooping cranes. Because this species is not present in the area and little if any potential habitat exists, the whooping cranes would not be affected or impaired by this alternative.

Gray Wolf

While some wolves may be temporarily displaced from roadside habitat by noise and disturbance of construction activities, wolves travel widely and have not appeared to alter their habits even when being viewed by hundreds of visitors. The project stipulations outlined for grizzly bears would include an orientation on wolves. Similar to bears, if wolf activity occurs in the immediate project area, restrictions on a contractor's activities may be imposed. The proposed project would not be likely to adversely affect gray wolves in either the short or long-term and no impairment would result.

Cultural Resources

A summary of the potential project impacts on the prehistoric and historic archeological sites and the cultural landscape of the road are included in the table below (page 101). Sites recorded in the project vicinity, but are outside the area of potential effect; would not be affected by construction or indirect project effects and will not be discussed here. Also sites determined to be not eligible for the National Register will not be included in the discussion of project effect. Projects impacts would not constitute an impairment to this cultural resources.

DESCRIPTION OF CULTURAL RESOURCES - Alternative A

Site Number & Description	Project Effects	Further Compliance Needed
48YE101 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic	Alternative A: No effect , 24-ft road would not impact slope where site is located.	No further compliance needed.

trash not contributing to eligibility		
48YE742 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic trash component not Contributing to eligibility	Alternative A: No adverse effect , road previously widened in inter-section.	No further compliance needed
48YE743 Prehistoric lithic scatter with buried cultural road deposits	Alternative A: No adverse effect, previously widened for corral access road.	No further compliance needed.
48YE163 Tower Fall Soldier Station, site of historic road Camp, soldier station, and tourist auto camp	Alternative A: Data recovery needed to mitigate the impact of road widen-ing on depressions near road.	Alternatives A require data recovery plan, Excavation, and data recovery report per the provisions of the Road Programmatic Agreement.
48YE520 Grand Loop Road including historic road features such as retaining walls, box culverts, culvert headwalls	Alternative A: No adverse effect, road retains original alignment, features repaired in-kind, and according to Programmatic Agreement. One area of Overhanging Cliff would need to be trimmed.	Final concurrence (WYSHPO & ACHP) No historic properties adversely affected.
48YE826 Chittenden Road Historic District	Alternative A: No adverse effect, grading and improvement to gravel road to Mt. Washburn trail parking area would stay within the road footprint. No new impact.	No further compliance needed.
48YE799 Tower Creek Bridge	Alternatives A: No adverse effect, driving surface on bridge deck currently 30-ft wide.	No further compliance needed.

Prehistoric and Historic Archeological Resources

Designs for road improvements, including pullouts, staging, material source, materials storage areas, parking, and road centerline alignments have been modified to avoid affecting previously identified archeological sites to the extent possible. Sites located along this road segment that have previously been determined ineligible for the National Register consist of historic remnants of water works, borrow pits, construction debris, and four small prehistoric lithic scatters. The prehistoric sites, and most of the historic sites ineligible for the NR, are located outside the area of potential effect of all the road widening alternatives.

Near the two multi-component prehistoric sites located in the Roosevelt Lodge Historic District, close to the current road alignment, site design would be monitored to ensure the sites are not impacted by the reconstruction of the road, under all alternatives considered. Because turn lanes have previously been incorporated into the east-west portion of the Grand Loop Road at Tower Junction

there would be no need to further widen the road. The limits of construction impact for this project would not exceed the disturbed area of previous road construction in the area. The prehistoric archeological site in the Tower Fall area is on top of a rise near the road. The centerline would swing to the other side of the road, avoiding impact to the knoll and the prehistoric site.

A feature of the Tower Fall Soldier Station (site 48YE163) would be impacted by Alternative A, the 7.2-meter (24-foot) road width alternative. Several different road alignment alternatives were explored in an effort to reduce impact to this historic site. Because of the curve and angle of the road through the site area, the limited visibility, and the presence of glacial boulders and old-growth Douglas-firs, impacts to a portion of the historic site are likely unavoidable. Additional historic archival research was conducted and magnetic survey of the area completed to identify subsurface historic debris and artifacts. Following the procedures identified in the programmatic agreement for the parkwide road improvement program (Appendix C), a data recovery plan for the excavation and recovery of information from those features that may be impacted by road reconstruction has been developed and provided to the WYSHPO and the ACHP for review and comment. Excavation of the portion of the site to be impacted would be done in summer 2001. A final report would be issued to provide information concerning the artifacts recovered, addressing the research questions identified in the treatment plan for historic archeology. According to the road programmatic agreement (Appendix C), the recovery of information mitigates the impact effect to the site caused by the road reconstruction.

The proposed access road to Grebe lake pit was surveyed for archaeological features in 2001, with no features found.

The Historic Roadway System

The proposed action alternatives for the reconstruction of the Tower Junction to Canyon Junction segment of the National Register eligible Grand Loop Road (48YE520) would have direct impacts on the road and its contributing features (including retaining walls, guardwalls, masonry box culverts and culvert headwalls, and stone curbing). The Chittenden Road Historic District (48YE826) would have an indirect impact to a portion of the road due to the reconstruction of the Grand Loop Road to the Mt. Washburn trail parking area. The abandoned roadbeds from previous alignments do not contribute to the National Register eligibility of the current alignment.

The historical significance of the Tower Junction to Canyon Junction road derives from the overall site and setting and the long-standing function of conveying visitors to special places within the park. It is the continuation of the philosophy of designing a road that incorporates features constructed of natural materials such as stone retaining walls and culvert headwalls, pullouts with landscape features, natural vegetation along the roads, and the introduction of elements of grace in the alignment. The road over Dunraven Pass traverses scenic alpine terrain while "laying lightly on the land." The road evokes the feeling that it is distinctive, a park road, and differs from roads found outside the boundary of the park.

All of the alternatives proposed for the widening and reconstruction of the Tower Junction to Canyon Junction road retain the present road alignment. The man-made features of the road would be repaired using the natural materials from which they were constructed. New features that may need to be constructed would also incorporate natural materials whenever possible and would be designed to blend with the existing features and consistent with other segments of the Grand Loop Road. Work on the road would be guided by protective and mitigation measures described in the 1993 programmatic agreement among the NPS, SHPOs, and ACHP.

Considering all three action alternatives, widening and reconstructing the existing road would affect all 195 culverts and several of the retaining walls and guardwalls. However, as described in the programmatic agreement, rehabilitated and reconstructed culverts, walls, parking areas, or other features would retain the appropriate scale and form within the natural and historic setting. All culverts, retaining walls, and guardwalls have been documented as has the historic Tower Creek bridge (48YE799). The documentation of the road features and bridges was reviewed by the WYSHPO who concurred that the park's survey responsibilities for structures, as described in the programmatic agreement, have been completed. Culvert headwalls that retain integrity and are visible from the road or other visitor use areas would be carefully dismantled and reassembled to preserve their historic appearance. Existing or similar materials would be used for new/rebuilt culverts, and the original design and quality of workmanship would be retained. Retaining walls would be repaired in a fashion compatible with their construction. The retaining walls at Overhanging Cliff are experiencing cracking caused by a natural fault line, and bulging caused by land-slumping activity not related to the reconstruction of the road. Those repairs would be made in a fashion compatible with the original construction. The repair of the bulge in the retaining wall near Calcite Springs would be completed using existing stone so the repaired portion of the wall would retain its original appearance.

Simulated stone retaining wall, using the masonry patterns consistent with the road segment, would be considered in areas, such as the Antelope Creek drainage. The addition of rockeries (un-mortared, stacked rock) along the Dunraven Pass area would be compatible with the historic road landscape.

The cultural landscape of the historically designed road would retain integrity continuing the design philosophy in which the designed features impart to the visitor a feeling of "blending with nature." Visual aspects of the cultural landscape of the road would be altered during and immediately following construction until vegetation has had a chance to grow, and rock cuts have aged and developed a patina. The design and materials used in new or reconstructed stone walls, redesigned parking areas, and rockeries would match existing historic stonework, would be consistent with other areas of the Grand Loop Road, and would not intrude on the cultural landscape.

Ethnographic Resources

The ethnographic overview and assessment and tribal review of the document

provided no information on ethnographic resources present on the Tower Junction to Canyon Junction current road alignment. The reconstruction of this segment of road was discussed at the regular tribal consultations held in 1999 and 2000 with no ethnographic resources yet being identified during or after consultation. There are no currently known ethnographic resources in the project area of potential effect.

Socioeconomic Environment

Road closures during the entire 2002 and 2003 visitor seasons and again during the entire 2005 and 2006 visitor seasons would create moderate but short-term adverse impacts to visitors, concessioners, park staff and park operations. Also partial closures (such as nighttime, 9p.m. to 9a.m.) and daytime delays may occur in the 2004 and 2007 visitor seasons. These closures would have a minor short-term effect on all travelers of this roadway.

Park visitors, park staff, concessioner employees, park residents, and businesses at the Tower-Roosevelt and Canyon areas would be impacted from construction activities for extended periods during the life of the project. Concession operations and visitor services at Roosevelt and Tower would receive a moderate negative economic impact by the Dunraven Road project. The majority of Roosevelt's overnight guests leave the area after breakfast and return for dinner. The majority of the remaining business in the area is from anglers and visitors crossing Dunraven Pass from the east side of the park to see Tower Fall and the Roosevelt area. Roosevelt's overnight guests who want to travel to Canyon, Lake and Grant Village would be required to drive to Mammoth, Norris Junction and on to Canyon approximately 82 kilometers (51 miles) rather than over Dunraven Pass a distance of 31 kilometers (19 miles). It is assumed that very few visitors would drive to the Roosevelt/Tower area for a day visit and then double back 82 kilometers (51 miles) to return to their overnight destinations. Supply vehicles servicing both Roosevelt/Tower and Canyon would be required to drive an additional 82 kilometers (51 miles) back to West Yellowstone or Gardiner, adding a moderate, short-term expense to concessioners. Canyon should not be as impacted, since it is more centrally located than the Roosevelt/Tower area.

During the second phase of the construction contract, concession employees housed in the Tower Fall area would be moderately impacted. This would be the result of relocation to other housing during full road closure periods, and when commuting to Tower Fall when the road is open to administrative traffic.

The Tower Fall campground (approximately 30 campsites) would be closed during the initial periods of phase two of construction and likely to be re-opened in the later years of that phase. This would create a direct, short-term, minor impact to visitors wishing to camp in this portion of the park. It would also displace these campers to other campsites in Yellowstone, creating a negligible impact to those other campgrounds.

Tour groups, or those offering field trip classes, would have disrupted schedules and travel routes due to road closures in effect on Dunraven Road. Operators would

receive notifications in advance of these closures, thereby allowing their publications to be correctly updated with necessary route changes or class offerings. Costs of conducting business may increase, or loss of revenues may result to these businesses. Actual levels of revenue loss would depend upon actions taken by these businesses.

Although some park visitors would be inconvenienced by construction activities in the short term, visitors may be able to adapt their behavior and travel plans to avoid possible inconveniences. Multiple highway projects may be underway at the same time within the park, so construction schedules would be adjusted to minimize inconvenience. Some road closures may overlap. Annual Average Daily Traffic on some road segments including Norris to Mammoth and Norris to Canyon would increase during the construction periods as visitors and staff would seek alternative routes. A variety of information sources would be employed to inform visitors, staff and businesses about construction activities. In the long term all travelers would benefit from improved traffic flow and safety. For the duration of the road closures on this road segment, there would be an increase of traffic on various other roads segments.

Roads in the park that would be used for hauling road-building materials would experience large volumes of heavy truck traffic during the construction period. Visitor traffic would be affected by this use within the park, and perhaps some gateway communities, but the effect on tourist spending is expected to be negligible to minor.

Short-term benefits would include economic gains for businesses and individuals within the Greater Yellowstone Area. Direct benefits would flow from construction related expenditures (the approximate cost of the project is $21.9 million) such as purchase and transport of road-building materials and employment of construction workers. Some new construction-related, temporary jobs may be created within the regional economy due to this road project. These benefits would be affected by the location of the contractor's base of operations, sources of materials, and source of the labor supply. Indirect benefits would occur in proportion to the amount of direct expenditures that occur within the region and the degree to which these funds are re-circulated within the regional economy.

Businesses in local communities would benefit in the short-term from expenditures within the local economy by the contractors and their employees. For instance, many construction employees might stay in local motels, as the rental housing market is insufficient to satisfy the demand. Some new jobs would be created within the local economy due to construction activities. These jobs and other construction-related spending by contractors and their employees would provide minor benefits to the local community.

Long-term benefits for visitors would include improved safety for motorists. As a direct result of this reconstruction work, the potential for accidents and vehicle damage could be reduced by a minor degree.

The long-term quality of visitor experiences would also improve. A moderate beneficial effect would result from better road design and additional vehicle pullouts that would provide additional high quality opportunities for viewing scenery and wildlife along this road segment. Redesign of the parking areas would directly enhance and greatly improve safety by adequately separating parking from through traffic.

Indirectly, the tourism segment of the regional economy would be made more secure by improvements to the road system within Yellowstone National Park. Park operations would see moderate improvement because of reduced road maintenance costs, better access for park vehicles, and a safer roadway. Immediate short-term inconveniences to visitors and others would be offset by short- and long-term benefits.

Parking Areas and Pullouts and Visitor Facilities

Approximately 50 gravel pullouts would be paved. Approximately 75 new parking spaces would be added in parking areas, other than the pullouts as a result of this project. Paving of informal pullouts and the placement of edge barriers would help reduce natural resource impacts by a moderate degree. These impacts include trampling of vegetation; damage to adjacent trees and shrubs; increased erosion; safety concerns with soft shoulders, narrow parking spaces, and poor sight distances. Formally designed pullouts would offer additional width not found with the existing informal pullouts, thereby directly improving safety by allowing adequate room for vehicles to pull totally off the road and allow traffic to pass. Removal of informal pullouts on blind curves, or areas with poor site distances, reduces the chance of vehicle/vehicle or vehicle/pedestrian collisions. The improvement of existing pullouts to meet Federal Highway design standards should encourage large or slow vehicles to use these pullouts. Additionally, these pullouts would allow an increased number of opportunities for vehicles to pull off the road and view wildlife. This would also improve traffic flow and moderately help alleviate congestion due to animal jams.

Placement of three new vault toilets at three separate locations along this route would directly improve visitor comfort. The addition of new restrooms would help alleviate current congestion problems at sites associated with heavily used restrooms. Park maintenance programs would see minor additional increased funding needs related to pumping, cleaning, and maintaining these new facilities.

Tower Fall Store Closing and Parking Area Redesign

With the removal of the Tower Fall store, a new parking area design would be implemented. Redesign of this parking area should have a direct beneficial consequence of creating a more intuitive traffic circulation, improving safety by removing the ability to park vehicles on the opposite side of the Grand Loop Road along the road edge. Additionally, the redesign of the parking area would eliminate the need for pedestrians to cross the road. Placement of approximately 20,000 to 30,000 cubic meters of fill would cause a disturbance of up to 0.75 hectares (1.85

acres) of adjacent fill-slopes and previously undisturbed land and existing vegetated fill slopes of the existing parking area. This would have a direct and long-term, adverse impact to areas not previously disturbed that would be paved. There would be a minor, short-term adverse effect to areas that would be disturbed then revegetated.

While some visitors may picnic after discovering six tables at this location, the area would not be signed as a destination picnic area. Since maintenance crews already maintain the existing restrooms and empty trash containers, the added workload associated with minor amounts of picnic use is not expected to adversely increase maintenance time requirements.

The proposal to relocate the Tower Fall store to the Tower Junction area approximately 4.0 kilometers (2.5 miles away) may cause minor inconveniences to users of the Tower Campground, located across the road from the store's present location. This could mean only the small Roosevelt store facility would be available for the 2005 and 2006 season in the Tower/Roosevelt area. If visitors seek shopping at larger facilities they would need to travel to Mammoth Hot Springs or Cooke City, requiring advanced planning or additional driving. The planning and environmental evaluation of a new store at a Tower Junction location will be considered in separate documentation.

Level of Service (LOS)

In this alternative the LOS is expected to be maintained at Level D to the year 2010, on Dunraven Road. This would have a direct, beneficial impact on traffic flow and visitor's driving experience on this road segment. This would be accomplished by immediately posting Dunraven Road with a recommendation of a 9.2-meter (30-foot) vehicle length limit. Further, if necessary in the future as traffic increases, this recommendation would change to a 9.2-meter (30-foot) vehicle length restriction enforced by the park. Implementation of this length restriction would have a moderate impact on visitors driving oversized vehicles by disallowing the use of those vehicles on this road segment. Since tours would still be available, transportation alternatives would exist for those visitors wishing to visit the Dunraven area.

Cumulative Effects

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act, requires assessment of cumulative impacts in the decision-making process for federal projects. 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, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

The analysis of the cumulative effects includes a discussion of current development plans within Yellowstone National Park and information about development plans for the lands surrounding the park within the Yellowstone ecosystem. Development

plans in the immediate project area, north and central Yellowstone National Park are primary factors in the analysis of cumulative impacts.

Although numerous construction and maintenance projects are planned for the Greater Yellowstone Area over the next 20 + years, the major emphasis of these projects is to replace, repair, and rehabilitate existing facilities that are approaching the end of their useful service life. Where new facilities are needed, they would be concentrated in and adjacent to existing developed areas to minimize the creation of new, isolated developments. Although some commitment of previously undisturbed resources is inevitable, as are some adverse cumulative effects, many of the project efforts to be undertaken involve the removal of existing development and the revegetation of other human activity scars.

Several hectares of previously undisturbed land are currently identified for commitment in construction projects in the park. Lands also are slated for reclamation and revegetation, almost half of which are in the sensitive grizzly bear habitat at Fishing Bridge. In addition, reclamation of past material, spoil sites, and road scarring may become possible through the Abandoned Mine Lands Program, a cooperative effort of the state of Wyoming and the National Park Service, and other restoration efforts (see "Beneficial Development Effects" below).

The time span of development projects is also critical. This analysis primarily covers the period 2001 through 2007 and beyond as appropriate. The purpose of this discussion is to recognize the cumulative effects on resources, visitors, area residents, and staff of the Canyon Junction to Tower Junction road improvement project in concert with the effects of other activities in the vicinity of the project, within the park, and on nearby lands.

Roadway Projects

The *Parkwide Road Improvement Plan* (NPS 1992) outlines a 20-year program of road reconstruction throughout the park to bring Yellowstone's principle park road system up to current National Park Service standards. Under this action, both the positive and negative impacts on natural, cultural, and socioeconomic resources associated with the original development of all the park roadways would persist. Positive effects include access to the park, enjoyment of its features, and financial expenditures both in and outside the park. Negative effects include the disturbance of bedrock, soils, and vegetation; loss, degradation, and fragmentation of habitat; temporary disturbance and displacement of some wildlife during construction; possible loss of historic and prehistoric resources; and waste production.

Reconstruction of the East Entrance Road began in summer 1994 and is expected to continue through 2004. Reconstruction of the Grand Loop Road between Madison and Biscuit Basin has been completed. The Northeast Entrance Road was resurfaced in 1997 and that is expected to extend the life of the road until it can be reconstructed in 2014-2020. A section of the West Thumb to Lake Junction segment of the Grand Loop Road was reconstructed with completion in 2000. Other future road projects include the Canyon Rim drives to be overlaid beginning in 2004. Reconstruction between Norris and Mammoth would start in 2006. Reconstruction

of Mammoth to North Entrance is scheduled to start in 2007. A study would be completed prior to construction to determine if any changes in the location of this road would be needed. Start-up and completion dates for these projects are dependent on available funding.

The reconstruction of 12.4 kilometers (7.7 miles) of the Grand Loop Road between the Madison to Norris Junctions of Yellowstone National Park, work began in May 2001 and will continue through the fall of 2003. Completion of the first phase is slated for 2002.

The National Park Service proposes to resurface, restore, and rehabilitate the road and associated pullouts and parking areas, between Canyon Junction and Fishing Bridge Junction, also known as the "Hayden Valley Road." This is an interim measure starting in 2002 until the road can be reconstructed in 2014. The proposal would be to recycle and overlay the entire 25.3 kilometers (15.7 miles) of road on the existing alignment to the same 6-meter (19.7-foot) width. A number of pullouts would be formalized; others would be obliterated. Aggregate and borrow material would be obtained from the Sylvan Pass pit.

The Federal Highway Administration (FHWA) has awarded a contract for hauling 200,000 metric tons of material from Sylvan Pass to the Grebe Lake Pit near Canyon Village. Hauling began in June 2001 and will continue until late October 2001.

The park is currently reclaiming 4.0 km (2.5 miles) of an abandoned road known as the Turbid Lake Road. The Turbid Lake Road was part of Yellowstone National Park's East Entrance Road from 1902 until the road was reconstructed between 1928-1936. That reconstruction realigned a portion of the road to follow the shore of Yellowstone Lake. Reclamation work began in 1997 and will be completed in 2001. Prime grizzly bear habitat and wetlands would be restored.

Other Projects Within the Park

Other actions would be occurring in the park during the course of this action, adding to the overall cumulative impact within the Yellowstone ecosystem.

The Canyon Visitor Center is scheduled for rehabilitation starting in 2003 and lasting at least two years. An EA is being prepared to evaluate a contractor's RV area in the Canyon area. This may be constructed to more efficiently house contractor employees working on Federal Lands and Highway Programs (FLHP) and other projects. At Canyon Village employee housing would be replaced, as funds become available. Under the approved Canyon lodging plan, some obsolete guest cabins have been replaced and more will be replaced soon. Completion of an employee housing four-plex was accomplished in 2000.

In the Tower/Roosevelt area, concessioner cabins have been upgraded and replaced in conjunction with rehabilitation of Roosevelt Lodge. Employee housing will be replaced pending funding.

The Finding of No Significant Impact (FONSI) for the *Yellowstone Employee Housing Plan* (part of the service-wide housing initiative) was signed in December 1992. Construction of some housing units is proposed each year. In 11 developed areas, approximately 125 year-round and 347 seasonal housing units would be upgraded, replaced, or newly constructed if the plan was fully implemented. Current funding levels allow replacement or rehabilitation of a few housing units annually. Work at East Entrance is completed and one four-plex unit was constructed at West Entrance. Work began in Lake and in Tower in 1997 and was completed in 1998. The Mammoth Housing Plan was released in 1998. The concessioner is also upgrading employee housing at several developed areas.

At Grant Village, housing to replace trailers may be constructed.

Development projects in the Mammoth Hot Springs area include continued housing rehabilitation, interior renovations of several buildings, and implementation of a visitor restroom facility in 2001 and 2002.

At Old Faithful a number of projects are ongoing or scheduled to implement the approved *Development Concept Plan, Old Faithful* (NPS 1985). Planning is completed and construction started to replace the aging sewage treatment plant. Construction of employee housing (two, four-plex units) to replace deteriorated quarters began in 2001 and will continue as funding becomes available. Planning is currently underway for the 40,000-sq. foot facility to replace the current Old Faithful Visitor Center. The project is currently scheduled for construction in 2004.

A number of development projects are planned that would have effects in more than one area of the park:

If the proposed Fishing Bridge campsite replacement project were approved, 100 replacement campsites would be built at Canyon Village, with an additional 175 replacement sites at Norris. This project would eventually result in positive impacts on visitors and resources (see "Beneficial Development Effects" below) but at the cost of short- and long-term cumulative impacts through resource commitment, construction activities, and inconveniences to staff and visitors.

At Mammoth, the Administration Building is scheduled to have seismic strengthening and interior renovations started in 2002.

A Commercial Services Plan and EIS, will formulate and assess impacts of alternatives relating to the commercial services and facilities within and through out the park.

A Heritage and Research Center is currently in the planning and design stages, with construction proposed to start in late 2002 or early 2003.

At Norris the water and sewage systems are scheduled to be upgraded and/or replaced in 2002.

To comply with the 1992 Leaking Underground Storage Tank Act (40 CFR 240, 281) many fuel oil tanks currently in use at residences throughout the park are being replaced after testing as a part of routine maintenance procedures.

Projects Outside the Park

A number of projects outside the borders of the park have cumulative effects on the Yellowstone ecosystem.

The Wyoming Highway Department is reconstructing 40 kilometers (24.9 miles) of U.S. Highway 14/20 (Cody Highway) between the east entrance and the east boundary of Shoshone National Forest.

A Forest Highway project coordinated by the Federal Highways Administration and State of Montana would reconstruct portions of US 212, the Beartooth Highway. An initial portion of the project would be from the Northeast Entrance gate to the Montana/Wyoming state line. The project award date is expected to be in the fall of 2001. Work would start at that time or in the spring of 2002, and extend over at least two seasons. A minor amount of work would also occur inside of the park boundary, between the boundary and the entrance gate that is located approximately ½ kilometer ($3/10^{th}$ of a mile) inside the park. The goal of this project is to widen the roadway to a 9.75-meter (32-foot width). Another portion of the project would occur on the Shoshone National Forest in the State of Wyoming between milepost 25.6 and milepost 44.0.

Oil and gas leases exist outside the park boundaries, but currently no wells are in production. The only known potential oil or gas exploration near Yellowstone is the proposed Ruby Exploratory oil/gas well on the Line Creek Plateau, south of Red Lodge, Montana, and 53 kilometers (32.9 miles) east of the park.

Beneficial Development Effects

A number of resource restoration and rehabilitation projects have been noted in the above discussions. These include restoration of abandoned quarries, roads, and gravel pits in several locations throughout the park. The park has obtained funds from the Abandoned Mine Lands Program to begin this work. Pertinent to this project, the Little Thumb and Dry Creeks pits and access roads were restored in 1997. Reclamation of the abandoned Turbid Lake road is underway. The reclamation of the Ice Lake pit is also take place as part of this project. AML funds are currently being used to reclaim the Natural Bridge Quarry pit, Lone Star Geyser pit, and Sedge Creek pit. A segment of the Norris to Madison road will be realigned away from the riparian zone of the Gibbon River.

Power and telephone lines have been buried at Grant Village and from Mammoth to Roosevelt, and new telephone lines have been buried at many developed areas around the park. Some buried lines have been replaced with microwave systems. Burying lines provides visual benefits because of the removal of overhead lines from scenic areas. Restoration of the utility corridors also becomes possible once the poles and wires are removed.

Conversion of 5 kilometers (3.1 miles) of the Fountain Freight and side roads to trails, combined with wetland mitigation projects, has reduced the effects of the Madison to Biscuit Basin project, particularly on wildlife. The Fishing Bridge campground removal and other rehabilitation projects in the Fishing Bridge/Pelican Creek area are examples of projects that reduce the impacts of existing and proposed developments on grizzly bears. Similar projects would continue to restore areas that are no longer necessary for park management or intensive visitor use. All would certainly disturb nearby wildlife and other resources while they were being implemented, but their long-term goal would be to restore park resources such as wildlife habitat.

The National Park Service is also in the process of formulating a memorandum of understanding (MOU) with the U.S. Fish and Wildlife Service, Corps of Engineers, and the State of Wyoming to initiate wetland banking. This MOU would cover wetland actions in Yellowstone National Park, and would assist the Park Service in crediting wetland restoration projects against losses of wetlands in future construction projects. The MOU might not be in effect for this project. However, it would be beneficial in maintaining a positive net effect on wetlands during future projects.

Analysis Results

The cumulative effects on most wildlife species of the various actions occurring or proposed in the park would generally be localized. Although these localized effects appear to be short-term in nature, the long-term effects are unknown. Certain wide-ranging wildlife species, such as the grizzly bear, could be affected by construction projects in widely dispersed locations. However, most construction projects would occur within current development zones and along roadways, areas which bears are aware of and tend to avoid. Stringent proposed mitigating measures should help improve the effects on these species.

Most of the projects are of a maintenance type (road rehabilitation, housing construction, and sewage treatment facilities), providing appropriate facilities for visitors and employees. The other projects involve rehabilitation and are a result of Yellowstone's commitment to restoring disturbed areas in the park to natural conditions as directed by NPS management policies.

In the reasonably foreseeable future, the potential exists for the projects described in this analysis, when added to the past and present projects occurring in the Greater Yellowstone Area, to cause some cumulative impacts through long-term loss of habitat from construction, wildlife avoidance of developed areas, and from incidental mortality.

Wildlife avoidance affects animals in two ways. There is a displacement effect when animals avoid otherwise suitable habitat because of human activities in the area. This results in a long-term loss of habitat. The other effect is an increase in animal density on the remaining habitat. Increased density can affect the ability of individual animals to survive.

Fixed resources (cultural sites, vegetation, and some wildlife) have the highest chance of disturbance from the development of previously undisturbed land. However, park managers are aware of these possibilities and are taking steps to mitigate any negative cumulative impacts. These steps include data recovery plans for cultural resources as well as wetland and other natural habitat restoration on lands that are expected to be rehabilitated. These steps should lessen or completely cancel any negative impacts from this action, when considered with the other projects in this analysis, that would otherwise add to the cumulative effects on the Yellowstone ecosystem.

The cumulative effects of the various actions within the park on visitors would primarily be felt by visitors who stay a short time in one area. Their entire visit might be disrupted by construction activities. Employees and area residents could be inconvenienced for a number of days or weeks by local construction projects. However, road reconstruction could inconvenience employees for several seasons.

Park managers have considered road closures combined with an effective public information program to alert the public to the closures and delays. With closures, reconstruction could be completed in a shorter time, thus significantly reducing the overall delay created by additional construction seasons and the degree of cumulative effects of the project on area residents, visitors, and the Yellowstone ecosystem.

Impairment Determination

Because the actions described in this alternative do not severely affect a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Yellowstone National Park; (2) key to the natural or cultural integrity of the memorial or to opportunities for enjoyment of the memorial; or (3) identified as a goal in the park's master plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

ALTERNATIVE B: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 9.2-METER (30-FOOT) PAVEMENT WIDTH

Natural Resources

Geology, Topography, Soils, and Vegetation

In Alternative B, there would be approximately 48 to 53 hectares (119 to 131acres) of disturbance to soils and vegetation along the roadside during road reconstruction. Also, (same as Alternative A), construction of new or relocation of existing parking areas/pullouts outside of the existing road prism would impact an additional 2.5 hectares (6.2 acres). Approximately 0.5 hectares (1.2 acres) of land would be recontoured and revegetated to establish a more natural landform following the removal 0.4 kilometers (0.25 miles) of road near the Calcite Springs parking area.

Topsoil would be salvaged during construction, and reclamation and revegetation efforts would follow the Yellowstone National Park policy the same as described under Alternative A.

The large cliff face at Overhanging Cliff would have a small portion of the cliff face taken back, perhaps 2 meters (6.5 feet), to allow for placement of the 7.2-meter (24-foot) wide road in this area. The 7.2-meter (24-foot) road would then transition back to a 9.2-meter (30-foot) on each end of Overhanging Cliff. Some blasting would be necessary to widen in this area. Approximately 1,000 to 2,000 cubic meters (1,308 to 2,616 cubic yards) of material would be removed in this area.

Long and short-term effects to soils and vegetation would be of similar magnitude for this alternative as those described in Alternative A. These effects of ground disturbance and vegetation removal would occur over a larger total acreage than in Alternative A as this wider road width alternative would disturb a larger amount of adjacent ground. These impacts would not constitute an impairment to this park resource.

Rare Plants

Species were located and mapped during a ground survey of the road corridor. The area within 61 meters (200 feet) on either side of the road was walked, during different seasons of the year, to search for plants.

Rare plant sites totaling 950 m² (10,226 sq. feet) would be affected along the road corridor from Canyon to Tower over Dunraven Pass during the reconstruction of the road. These sites are located in three different areas along the road segment and are inhabited by three plant species of special concern; cock's-comb paintbrush (*Castilleja crista-galli*), Bolander's sedge (*Carex deweyana* var. *bolanderi*) and Parry sedge (*Carex parryana* var. *parryana*). The impacts to the rare species on these sites would be adverse, direct, and of moderate severity. Bolander's sedge and Parry sedge would be affected long-term due to loss of the immediate habitat. There

would be a short-term impact on cock's-comb paintbrush since this species is adapted to rocky areas and talus slopes, habitat that would be expected to still exist within the area of disturbance after road reconstruction.

Mitigation efforts would focus on seed collection from the immediate area, with reseeding in appropriate habitat after road reconstruction is completed. Cock's-comb paintbrush would be expected to re-establish on at least some of the previous habitat after conclusion of the road construction. Actions proposed in this alternative would not constitute an impairment to rare plants.

Hydrothermal Resources

As in Alternative A, there would be no thermal features affected, therefore no impairment to this park resource would result.

Wetlands and Other Waters of the United States

Same as Alternative A except that wetlands disturbed would be 0.45 to 0.55 hectares (1.10 to 1.35 acres) in this alternative. These impacts would not constitute an impairment to wetlands.

Air Quality

Impacts on air quality would be the same as described in Alternative A. They would be short-term in nature and there would be minor effects on park or regional air quality or visibility. These impacts would not constitute an impairment to this park resource.

Wildlife

Overview

Same as Alternative A except that approximately 48 to 53 hectares (119 to 131 acres) of wildlife habitat adjacent to the road would be impacted by construction, however this would not constitute an impairment to park wildlife.

Bighorn Sheep

Same impacts as in Alternative A, however with additional ground disturbance beyond what would occur with the 7.2-meter (24-foot) road alternative. These impacts would not constitute an impairment to bighorn sheep.

Amphibians and Reptiles

Same impacts as in Alternative A except that Rainy Lake and Rainy Lake wetland would have additional ground disturbance beyond what would occur with the 7.2-meter (24-foot) road alternative. See Wetland Impacts discussion for acreage amounts. These impacts would not constitute an impairment to amphibians and reptiles.

Birds

Same as Alternative A, except that clearing limits for trees would increase with this alternative. Additional tree removal could displace more birds by tree cutting activities that occur prior to July (the typical end of their nesting period). These impacts would not constitute an impairment to birds.

Dunraven Road Kill and Rare Animal Observations

This alternative could result in the highest increase in average vehicle speeds. This alternative could also result in the greatest potential increase in the frequency of vehicle-wildlife collisions and road-kill mortality. Thus, this alternative would have the greatest impact of wildlife populations. Since under this alternative there would be an expected increase in road-kill wildlife mortality above existing levels, a small "Incidental Take" of grizzly bears, wolves, or lynx could potentially occur. However, it is not expected that this alternative would have significant, negative, population level impacts on the numbers of any mammal listed as threatened, endangered, nonessential experimental, or candidate species or on any non-listed species of large or small mammals (NPS 2000a). These impacts would not constitute an impairment to wildlife.

Fisheries and Aquatic Resources

The impacts for this alternative would be the same as described in Alternative A, except that this alternative could place additional fill material adjacent to Antelope Creek. Additional fill would be placed to accommodate the wider road prism. Additionally, the increased square footage of road pavement for this alternative has the potential for increasing stormwater runoff due to an approximately 46 percent increase in existing road pavement. It is not anticipated that this road alternative would have any long-term adverse affects on fish populations or the physical characteristics of the stream itself. An erosion control plan would be part of this proposed project and sediment control features would be installed. No impairment to these park resources would result.

Threatened and Endangered Species

Potential impacts and mitigation measures would be similar to Alternative A, other than the amount of habitat impacted would be approximately 10 to 18 hectares (25 to 45 acres) more than in Alternative A.

Grizzly Bears

This alternative may affect but is not likely to adversely affect grizzly bears. Also see the following section and the road-kill paragraph below. All other impacts to grizzly bears are the same as discussed for Alternative A.

Along the Dunraven Road corridor twelve different vegetation cover types exist. A total of about 23 to 25 hectares (56 to 62 acres) of whitebark pine and potential whitebark pine habitat, and meadows containing known vegetative food sources favored by bears would be impacted by this alternative. Estimated whitebark pine densities for trees 1.8 meters (6 feet) and taller and saplings of each of these cover types can be found in Appendix B

All other environmental consequences for this topic are the same as those described for Alternative A. There would be long-term minor adverse impacts to local whitebark pine stands due to loss of cone production. These impacts would not constitute an impairment to grizzly bears.

Lynx

The increased road width of this alternative along with the increased width of the cleared right-of-way would further increase fragmentation of "potential lynx habitat". Also see road kill paragraph above. These impacts would not constitute an impairment to lynx.

Bald Eagles, Whooping Cranes, Gray Wolf

Same as Alternative A, also see road kill paragraph above. No impairment to bald eagles, whooping cranes, or gray wolves would occur.

Cultural Resources

Alternative B

DESCRIPTION OF CULTURAL RESOURCES

Site Number & Description	Project Effects	Further Compliance Needed
48YE101 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic trash not contributing to eligibility	Alternative B: No effect, 30-ft : road would not impact slope where site is located.	No further compliance needed.
48YE742 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic trash component not contributing to eligibility	Alternative B: No adverse effect , road widening still in area of impact.	No further compliance needed.
48YE743 Prehistoric lithic scatter with buried cultural deposits	Alternative B: No adverse effect, road previously widened for corral access road.	No further compliance needed.
48YE163 Tower Fall Soldier Station, site of historic road camp, soldier station, and auto camp	Alternative B: Data recovery needed to mitigate the impact of road widen-ing to several features. .	Alternatives A and B require data recovery plan, excavation, and tourist recovery report per the provisions of the Road Programmatic Agreement.
48YE520 Grand Loop Road including historic road features such as retaining walls, box culverts, culvert headwalls.	Alternative B: No adverse effect, but road width through Overhanging, Cliff area would be reduced to 24-ft.	Final concurrence (WYSHPO & ACHP). No historic properties adversely affected.
48YE826 Chittenden Road District	Alternative, B.: No adverse effect, grading and improvement of gravel road to Mt. Washburn trail parking area would stay within the road footprint.	No further compliance needed.
48YE799 Tower Creek	Alternatives B. No adverse	No further compliance

Bridge	effect, driving surface on bridge deck currently 30 foot wide.	needed.

Cultural Resources

The following impacts listed for cultural resource topics would not constitute an impairment to this park resource.

Prehistoric and Historic Archeological Resources

Same impacts as Alternative A, except that two features of the Tower Fall Soldier Station (site 48YE163) would likely be impacted by Alternative B, the 9.2-meter (30-foot) alternative.

The Historic Roadway System

Same impacts as listed for Alternative A.

Ethnographic Resources

Same as listed for Alternative A.

Socioeconomic Environment

Impacts on the socioeconomic environment would have a minor difference from those of Alternative A. Some safety problems, especially bicycle and motor vehicle conflicts from traveling in the same direction, would be more adequately addressed by this alternative. Safety and traffic flow would receive a moderate benefit in Alternative B due to the wider pavement width of this alternative. However if higher speeds occurred on a road designed for 56 km/hr (35 mph) that could lead to additional accidents. Less traffic congestion and the likelihood of traffic interruptions or delays would also be a moderate beneficial outcome. Restrictions on bicycles would not be required.

Also, in Alternative B, the direct monetary benefits from construction related expenditures such as purchase and transport of road-building materials and employment of construction workers would see a minor increase over those for Alternative A.

Parking Areas and Pullouts and Visitor Facilities

Same as in Alternative A. However in this alternative the wider 1.2-meter (4-foot) shoulders on each side of the road would allow traffic to negotiate past vehicles parked on the shoulder. This would be the case even when there is no formal pullout available and vehicles are protruding into the roadway.

Tower Store Closing

Same effects as discussed in Alternative A.

Level of Service (LOS)

In this alternative the LOS would be maintained at Level D to the year 2010. This would be accomplished with the reconstruction of the road to 9.2-meter (30-foot). No additional restrictions would be required.

Cumulative Effects

This alternative would have a greater cumulative effect upon park resources and those resources of the Greater Yellowstone Ecosystem than those effects described for Alternative A.

These increased effects would include additional ground disturbances, greater removal of whitebark pine, increased wetland impacts and a probable increase in duration of construction activities, as described in the narrative for Alternative B.

All additional cumulative effects associated with the project list described in Alternative A, would be the same with this Alternative B.

Impairment Determination

Because the actions described in this alternative do not severely affect a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Yellowstone National Park; (2) key to the natural or cultural integrity of the memorial or to opportunities for enjoyment of the memorial; or (3) identified as a goal in the park's master plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

ALTERNATIVE C: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 6.0-METER (20-FOOT) PAVEMENT

Natural Resources

Geology, Topography, Soils, and Vegetation

Due to curve-widening, guardrail off-sets, and installation of drainage ditches, there would be approximately 27 to 30 hectares (67 to 74 acres) of disturbance that would require reclamation and revegetation due to the cuts and fills. The large cliff face at Overhanging Cliff would be left as is, as no widening of the road bench would be necessary for this alternative. No blasting would be necessary to widen in this area. However the same disturbances would occur as described under Alternative A for repair to the slumping road section. These impacts would not constitute an impairment to these park resources.

Rare Plants

Species were located and mapped during a ground survey of the road corridor. The area within 61 meters (200 feet) on either side of the road was walked, during different seasons of the year, to search for plants.

Rare plant sites totaling 600 m² (6,458 sq. feet) would be affected along the road corridor from Canyon to Tower over Dunraven Pass during the reconstruction of the road. These sites are located in three different areas along the road segment and are inhabited by three plant species of special concern; cock's-comb paintbrush (*Castilleja crista-galli*), Bolander's sedge (*Carex deweyana* var. *bolanderi*) and Parry

sedge (*Carex parryana* var. *parryana*). The impacts to the rare species on these sites would be adverse, direct, and of moderate severity. Bolander's sedge and Parry sedge would be affected long-term due to loss of the immediate habitat. There would be a short-term impact on cock's-comb paintbrush since this species is adapted to rocky areas and talus slopes, habitat that would be expected to still exist within the area of disturbance after road reconstruction.

Mitigation efforts would focus on seed collection from the immediate area, with reseeding in appropriate habitat after road reconstruction is completed. Cock's-comb paintbrush would be expected to re-establish on at least some of the previous habitat after conclusion of the road construction.

These impacts would not constitute an impairment to rare plants.

Hydrothermal Resources

Same as in Alternatives A and B. No impairment to hydrothermal resources would result.

Wetlands and Other Waters of the United States

The consequences of this alternative would be the same as described in Alternative A except that the area of wetlands disturbed would be 0.30 to .40 hectares (0.75 to 1.00 acres) in this alternative. These impacts would not constitute an impairment to wetlands.

Air Quality

Impacts on air quality would be the same as described in Alternative A. Effects would be temporary in nature and there would be minor effects on park or regional air quality or visibility. These impacts would not constitute an impairment to air quality.

Wildlife

Overview

Same as Alternative A except that approximately 27 to 30 hectares (67 to 74 acres) of potential wildlife habitat adjacent to the road would be impacted by construction. These impacts would not constitute an impairment to wildlife.

Bighorn Sheep

Reconstruction of the road at its current width would still alter roadside topography and vegetation. It would be expected that short-term displacement of bighorn sheep would occur during active construction on limited sections of road. In the long-term, bighorn sheep would continue to feed along road edges. These impacts would not constitute an impairment to bighorn sheep.

Birds

There would be much less dynamite blasting with this alternative, and none

envisioned at Tower Fall, Overhanging Cliff and Calcite Springs. Therefore nesting birds in these sensitive cliff environments would not be affected. These impacts would not constitute an impairment to birds.

Amphibians and Reptiles

This alternative would allow the road to be reconstructed on the existing road prism. There is the potential for some spillover of material into Rainy Lake and the adjacent wetland. Most of the existing shoreline characteristics would remain intact. The impacts in this alternative would be less than for either Alternative A or B because of smaller ground disturbance. See Wetland impacts discussion for acreage amounts. These impacts would not constitute an impairment to amphibians and reptiles.

Dunraven Road Kill and Rare Animal Observations

Under this alternative it is not expected that the completed project would result in an increase in average vehicle speeds. Thus under the 6-meter (20-foot) road width alternative, it would not be expected that an increase in the rate of vehicle-wildlife collisions or large mammal road-kill mortality would occur. Therefore, it should not have any significant negative impacts on the population numbers of any mammals listed as threatened, endangered, nonessential experimental, or candidate species. It is also not expected that this alternative would cause any additional negative impacts (through road-kill mortality) above existing levels on the population of any non-listed species of large or small mammals inhabiting areas adjacent to Dunraven Road corridor (NPS 2000a). These impacts would not constitute an impairment to wildlife.

Fisheries and Aquatic Resource

There is a potential for some fill to be placed adjacent to Antelope Creek as it runs adjacent to the road. Fill placed in this alternative would be less than in Alternatives A and B. Stormwater runoff for this alternative would have only a negligible increase over present conditions. There would be nor impairment to fisheries and aquatic resources.

Threatened and Endangered Species

Potential impacts and mitigation measures would be similar to Alternative A. However the difference in the amount of habitat impacted would be up to 11 hectares (27 acres) less than in Alternative A.

Grizzly Bears

This alternative may affect but is not likely to adversely affect grizzly bears. Also see the following section and the Road Kill paragraph below. All other impacts to grizzly bears are the same as discussed for Alternative A.

Along the Dunraven Road corridor twelve different vegetation cover types exist. A total of about 13 to 14 hectares (31 to 35 acres) of whitebark pine and potential whitebark pine habitat, and meadows containing known vegetative food sources favored by bears would be impacted by this alternative. Estimated whitebark pine densities for trees 1.8 meters (6 feet) and taller and saplings of each of these cover types can be found in Appendix B. All other environmental consequences for this

topic are the same as those described for Alternative A. There would be long-term negligible adverse impacts to local whitebark pine stands due to loss of cone production. These impacts would not constitute an impairment to this grizzly bears.

Lynx

The increased width of the cleared right-of-way, needed for improving ditches, could further increase fragmentation of "potential lynx habitat". These impacts would not constitute an impairment to lynx.

Bald Eagle; Whooping Crane; Gray Wolf

Same as Alternative A, also see road kill paragraph above. These impacts would not constitute an impairment to bald eagle, whooping crane, and gray wolf.

Cultural Resources

Alternative C

DESCRIPTION OF CULTURAL RESOURCES

Site Number & Description	Project Effects	Further Compliance Needed
48YE101 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic trash not contributing to eligibility	Alternative C.: No effect, 20-ft road would not impact slope where. site is located.	No further compliance needed.
48YE742 Multi-component site with prehistoric lithic scatter and buried cultural deposits. Historic trash component not contributing to eligibility	Alternative C: No effect .	No further compliance needed.
48YE743 Prehistoric lithic scatter with buried cultural deposits	Alternative C: No effect.	No further compliance needed.
48YE163 Tower Fall Soldier Station, site of historic road camp, soldier station, and tourist auto camp	Alternative C.: No adverse affect.	No further compliance.
48YE520 Grand Loop Road including historic road features such as retaining walls, box culverts, culvert headwalls	Alternative C: No adverse effect.	Final concurrence (WYSHPO & ACHP) No historic properties adversely affected.
48YE826 Chittenden Road Historic District	Alternative C: No adverse effect grading and improvement to gravel road to Mt. Washburn trail parking area would stay within the road footprint.	No further compliance needed.
48YE799 Tower Creek Bridge	Alternative C: No adverse effect, driving surface on bridge deck currently 30 foot width	No further compliance needed.

Cultural Resources

The following impacts to cultural resources would not constitute an impairment.

Prehistoric and Historic Archeological Resources

Alternative C, the 20-foot alternative, would not impact any portion of the Tower Fall Soldier Station (site 48YE163).

The Historic Roadway System

Same impacts as listed for Alternative A.

Ethnographic Resources

Same as listed for Alternative A.

Socioeconomic Environment

Impacts on the socioeconomic environment would be similar to those of Alternative A, except many of the safety-related problems associated with the narrower road width would not be adequately addressed. Commercial bicycle use would be restricted. Also traffic flow would not be appreciably improved. Traffic congestion and the likelihood of traffic interruptions or delays would persist. Also, in Alternative C, the dollar direct benefits from construction related expenditures would be less than that for Alternative A and Alternative B. Commercial bicycle tours would not be allowed on this road segment.

Parking Areas and Pullouts and Visitor Facilities

Same as Alternative A.

Tower Store Closing

Same as Alternative A.

Level of Service (LOS)

In this alternative the LOS is expected to be maintained at Level D to the year 2010. This would be accomplished by immediately posting a restriction of a 6.7-meter (22-foot) vehicle length limit, over the Canyon Junction to Tower Junction road segment, enforced by the park.

Cumulative Effects

This alternative would have a cumulative effect upon park resources and those resources of the Greater Yellowstone Ecosystem that is less than those effects described for Alternative A and B.

These decreased effects would be the result of less ground disturbances, less removal of whitebark pine, smaller wetland impacts and probable fewer total hours of construction activities.

All additional cumulative effects associated with the project list described in Alternative A, would be the same with this Alternative C.

Impairment Determination

Because the actions described in this alternative do not severely affect a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Yellowstone National Park; (2) key to the natural or cultural integrity of the memorial or to opportunities for enjoyment of the memorial; or (3) identified as a goal in the park's master plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

ALTERNATIVE D: NO ACTION

If the proposed projects are not undertaken, there would be less short-term minor to moderate impacts to visitors, to wildlife, and park staff (noise, road closures, traffic delays).

Under the No Action Alternative there would be no construction and no surface disturbance on roadside slopes. Maintenance of the existing roadway and ditches would not be likely to disturb soils, vegetation, or geologic features on the slopes beyond ditches. However there would also be continued degradation of resources from visitors using informal/undefined pullouts along the roadway and from uncorrected erosion problems. These ongoing impacts would be moderate in the short-term, but could continue over time leading to long-term adverse effects as more visitors use the road in the future.

Natural Resources

Geology, Topography, Soils, and Vegetation

The large cliff face at Overhanging Cliff would be left as is, as no widening of the road bench would be necessary for this alternative. No blasting would be necessary to widen in this area. Negligible direct adverse impacts on soils and vegetation adjacent to the existing road would be expected due to ongoing road maintenance activities. No impairment to soils and vegetation would result.

Rare Plants

Routine maintenance should not adversely impact any rare plant sites along this section of roadway. No impairment to rare plants would result.

Hydrothermal Resources

There are a few thermal features located close to this section of road. The Calcite Springs hydrothermal features are located below road grade, to the east side of the road on the west river bank. The Washburn Hot Springs also lie to the east of the road midway between Canyon Junction and Dunraven Pass. None of these hydrothermal features are located directly under or adjacent to the road and would not be impacted by road maintenance projects, therefore no impairment to hydrothermal resources would occur with this alternative.

Wetlands and Other Waters of the United States

Maintenance activities such as ditch cleaning, maintenance of drainage structures,

and patching asphalt near the edge of the roadway would have the potential for negligible adverse affects to ditch wetlands, though these impacts would not constitute an impairment of wetlands.

Air Quality

There would be no significant impacts on air quality or visibility in the park or region. Any effects from road maintenance activities would be short-term, minor and limited to the duration of the activity. No impairment to air quality would result.

Wildlife

Overview

The existing road and traffic probably cause some displacement of wildlife and reduction of roadside habitat use, but this is difficult to measure. Most animals that are not hunted appear to habituate or become tolerant of regularly occurring, predictable human presence. Traffic results in some inevitable road kills, but recorded incidences are low. No more than minor adverse long-term impacts on bird or mammal populations are expected from the existing and predicted roadwork and traffic. No impairment to these resources would result.

Bighorn Sheep

Maintaining the current condition of the road would not alter roadside topography or vegetation, aside from minor ditching activities. Bighorn sheep would continue to feed along road edges. Research studies of the current situation did not disclose any short or long-term impacts that were of more than a negligible effect on bighorn sheep. No impairment to bighorn sheep would result.

Birds

There would be no dynamite blasting with this alternative, therefore nesting birds in the sensitive cliff environments of Tower Fall, Overhanging Cliff and Calcite Springs would not be affected. No impairment would result.

Amphibians and Reptiles

As this alternative does not propose any reconstruction of the Dunraven Road, shoreline characteristics of Rainy Lake and Rainy Lake Wetlands would not be altered. No improvements to shoreline habitats for amphibians and reptiles would occur. This alternative would have no new adverse effects to amphibians and reptiles at the four locations listed in the Affected Environment. No impairment to these resources would occur.

Dunraven Road Kill and Rare Animal Observations

This alternative would be expected to see peak seasonal daily traffic to rise in excess of 20 percent by the year 2010. While no predictions for this road have yet been calculated, it would be expected that an increase in vehicle-animal collisions would occur. Given the current low number of collisions with wildlife on this road section, it is not expected the increase would be of a magnitude that would cause adverse, long-term impacts to wildlife populations. No impairment to wildlife would result.

Fisheries and Aquatic Resource

Maintenance of this road segment would not place fill adjacent to the road in the Antelope Creek area. Stormwater runoff would not change over existing conditions. A negligible increase in sedimentation in Antelope Creek in the short-term would be expected due to maintenance ditching activities associated with this alternative. No impairment to these resources would result.

Threatened and Endangered Species

Grizzly Bears

The potential always exists for human/grizzly bear interactions that would directly affect bears, such as vehicle accidents or habituation to human food sources from illegal feeding or available garbage. However, vehicle-caused grizzly deaths have been rare in the entire park and along this road, and current policies and enforcement seem effective in preventing human/grizzly problems along the roadway. Maintenance and use of the existing road are not expected to adversely affect grizzly bears.

This alternative is not expected to remove any whitebark pines adjacent to the road. As in Alternatives A, B, and C, the use of pine seeds by grizzly bears as a food source, would depend on the abundance of the cone crops produced each particular year. In this alternative, without removal of roadside whitebark pines, cones on these trees would also be available to bears. Under the No Action Alternative, there would be no planting of native whitebark pine trees in locations of disturbance near the road. At this time whitebark stands are being monitored by various researchers and park staff for white pine blister rust. This No Action Alternative does not appear to have any positive or negative influence on the spread of white pine blister rust.

No impairment to these resources would result.

Lynx

It is not anticipated that this alternative would have any effect on lynx. No impairment to lynx would result.

Bald Eagle; Whooping Crane; Gray Wolf

Bald eagles, and gray wolves are found in the general vicinity, but there are no known effects on these species from the existing road or traffic, and no future effects are anticipated. Whooping cranes do not use the road corridor, so there would be no effects on cranes. No impairment to these resources would result.

Cultural Resources

No impairment to cultural resources would result from this alternative.

Prehistoric and Historic Archeological Resources

No new impacts would occur to prehistoric components of sites 48YE865 and

48YE867, both eligible for the National Register of Historic Places. No new impacts would occur to historic archeological resources.

Historic Roadway Resources

No repairs would be made to the historic structures and features of the road. So these features would further deteriorate.

Ethnographic Resources

Affiliated tribes have been consulted, and no specific ethnographic resources have been identified for the project area. Thus there would be no effect on known ethnographic resources.

Cultural Landscape

The Grand Loop Road is an integral part of the cultural landscape. In some areas, the landscape in the vicinity of the highway could be adversely impacted from use of unauthorized pullouts and subsequent erosion and loss of plant materials. Ongoing park maintenance may help mitigate these effects.

Socioeconomic Environment

Under this alternative there would be no construction-related disturbance of visitor traffic or loss to businesses either inside or outside the park due to road closures. Also, there would not be the positive economic effects from road reconstruction work accruing to the regional economy.

Without road improvements visitors and staff would continue to be subjected to failing roadways and poor safety characteristics, including inadequate sight distances and inferior pullouts. Continual, expensive and yet inadequate maintenance activities would be required to keep the road open. These maintenance activities would negatively affect the visitor experience on an unpredictable basis. Accidents attributable to these conditions would increase and perhaps have more serious consequences. Driving and recreational experiences would be diminished by the deteriorating condition of the roads in the project area. Visitor inconveniences and complaints would increase. Recreational activities along the existing roads would remain unchanged.

Park operations would continue to be adversely affected by the deteriorating road system. The road is expensive to maintain in its present state. High levels of traffic and increasing numbers of heavy vehicles (e.g., buses) would continue to damage the road surface and base material. Excessive flexing of base and pavement structures, as well as the natural process of freezing and thawing would exacerbate problems. Normal road maintenance would be required more frequently, and these activities would become more expensive and less effective as the present road surface and base deteriorated. Increased maintenance expenses for this road segment would continue to drain resources (funds, material, and personnel) from other park operations.

In some roadway sections, regular road maintenance would not be up to the task because the road would have become altered to the point where substantial improvement would be necessary. As the road continues to be negatively impacted, restrictions on the number, size, and/or type of vehicles may be necessary in the long-term. Eventually, maintenance could no longer prevent road failure. Continuing deterioration would result in road closures for safety reasons. Emergency road closures would cause unacceptable disruption of park operations and visitor travel plans. Lengthy closures might affect the local/regional tourism-related economy.

In summary, continuing the current situation in the project area would not improve visitor experiences and would expose visitors, staff, and their property to increasing risk of injury and damage. Although the cost of road improvements would be avoided in the short-term, those savings would be achieved at the threat of damage to life and property and much greater operational expenditures in the long run. On-going maintenance and safety problems would not be resolved.

Parking Areas and Pullouts and Visitor Facilities

There would be no improvement in traffic flow due to improved pullouts, or increased shoulder width with this alternative. Animal jams would continue to occur. Visitor frustration and poor traffic flow would be the result. Current congestion problems at existing high use toilet facilities would not be improved. The limited number of existing large pullouts on this road would continue existing insufficient opportunities for slow or large vehicles to pull over and allow backed-up traffic to pass.

Tower Fall Store Closing

Same as Alternative A, except that no parking area modifications would be made.

Level of Service (LOS)

In this alternative the LOS is expected to degrade to Level E by the year 2010. This would be the consequence of maintaining the current road with the projected increase in visitor traffic.

Cumulative Effects

This Alternative D would have the least cumulative effect upon park resources and resources of the Greater Yellowstone Ecosystem than those effects described for all action alternatives.

Cumulative effects would be generated from those projects listed under Alternative A, along with maintenance actions that would be required under this Alternative D. Cumulative effects from maintenance of the Dunraven Road could include visitor delays, short term displacement of animals, and further drain on park operating funds. Ongoing maintenance of the road would continue to result in the use of aggregate sources, possibly from existing sites needing reclamation within the park, as well as the disturbance of roadside soil and vegetation.

All additional cumulative effects associated with the project list described in Alternative A, would be the same with Alternative D.

Impairment Determination

Because the actions described in this alternative do not severely affect a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of Yellowstone National Park; (2) key to the natural or cultural integrity of the memorial or to opportunities for enjoyment of the memorial; or (3) identified as a goal in the park's master plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

COMPLIANCE STATUS

If, based on the results of the environmental assessment, the project would significantly affect the human environment, a notice of intent (NOI) to prepare an environmental impact statement (EIS) would be issued. Conversely, a finding of no significant impact (FONSI) would be issued if it was determined that there would be no significant impact from this project.

Consultation with the U.S. Fish and Wildlife Service on threatened and endangered species under 50 CFR Part 402, which implements the Endangered Species Act, would be completed. As part of the consultation process, the National Park Service would seek Fish and Wildlife Service concurrence with the environmental assessment's determination of effect on threatened and endangered species.

A section 404 permit from the Army Corps of Engineers, with concurrence from the Fish and Wildlife Service, would be required to comply with the Clean Water Act. This permit is required for discharge/placement of fill material into waters of the United States. A 401 certificate would also be required from the Wyoming Department of Environmental Quality.

Park roads are excepted from compliance with Executive Order 11988, "Floodplain Management," under NPS final implementation procedures as outlined in Special Directive 93-4, "Floodplain Management Guideline," July 1, 1993.

In compliance with Executive Order 11990, "Protection of Wetlands," a statement of findings (SOF) issued for impacts on wetlands would be prepared. The SOF would be approved by the regional director of the National Park Service. Wetland reclamation plans would be developed for all proposed reclaimed wetland sites.

A national pollution discharge elimination system (NPDES) permit for stormwater runoff would also be secured from the Wyoming Department of Environmental Quality before construction. The Stormwater Rule (Clean Water Act, PL 95-217, Sec. 402) requires a NPDES permit on certain categories of stormwater discharge. Road reconstruction, which would involve clearing and grading activities that exceed 2 hectares (4.9 acres) on this particular road project, would require an NPDES permit.

All contractor activities would comply with state and federal air quality regulations, and contractors would operate under applicable permits.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires all Federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations or communities. The alternatives are not expected to result in significant changes in the socioeconomic environment, and therefore it is not anticipated that any of the

alternatives would result in significant direct or indirect disproportionately negative or adverse effects on any minority or low-income population or community.

Nomination forms for the Grand Loop Road Historic District (including the Tower Junction to Canyon Junction segment) have been drafted for formal nomination to the National Register of Historic Places. Because the roadway districts, including historic elements such as culverts and retaining walls, are eligible for the National Register, compliance with Section 110 and 106 of the National Historic Preservation Act is necessary. Section 106 compliance procedures for all of the Yellowstone Road projects began in 1992 with the publication and public review of the *Parkwide Road Improvement Plan* (NPS 1992). In 1993, the signing of the programmatic agreement among the Advisory Council on Historic Preservation, the National Park Service, and the Wyoming and Montana State Historic Preservation Officers (Appendix C) provided direction for protection and preservation of cultural resources during the parkwide road system reconstruction.

All historic and prehistoric archeological sites within the area of potential effect have been inventoried, documented and tested. NPS recommendations for potential National Register eligibility were sent to the Wyoming SHPO, who concurred with NPS recommendations regarding determinations of eligibility on sites that might be affected by the project.

In accordance with the programmatic agreement, a comprehensive treatment plan was developed for the evaluation and mitigation of archeological properties. The Advisory Council on Historic Preservation, and the Wyoming and Montana State Historic Preservation Officers reviewed this plan during the summer of 1993 (Appendix C). The archeological sites located within the road corridor of the Tower Junction to Canyon Junction segment of the Grand Loop Road that could be affected by reconstruction and widening of the road segment were evaluated under the guidelines established in this document. Historic roadway features have been inventoried and documented as described in the programmatic agreement (Appendix C).

Sections of this environmental assessment itemize cultural resource inventories and documentation done in support of this project. The environmental assessment also contains a listing of further compliance needed, including data recovery at the Tower Fall Soldier Station site. This environmental assessment will be sent to the Advisory Council and the Wyoming State Historic Preservation Officer for review and comment, and the document will provide data concerning overall project effect. Project designs and descriptions for each of the two segments of the Tower Junction to Canyon Junction undertaking will be submitted to the Wyoming SHPO and the ACHP for review, comment, and concurrence of effect.

Plans and detailed descriptions for the reconstruction of this segment of road were discussed with the 22 Native American Tribes affiliated with Yellowstone National Park at regularly scheduled consultations in April 2000, October 2000, and April 2001. Requests for comment on the reconstruction of this segment of road were sent to all affiliated tribes not attending the consultation. No ethnographic concerns

have yet been identified within the area of potential effect of the undertaking.

CONSULTATION AND COORDINATION

PERSONS, ORGANIZATIONS, AND AGENCIES CONTACTED

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Persons, Organizations, and Agencies Contacted

This Environmental Assessment is being sent to approximately 240 individuals, agencies and groups soliciting comments on the problems, issues, and alternatives addressed. A press release was issued on September 24, 2001. The Environmental Assessment is posted on Yellowstone National Park's web page:

http://www.nps.gov/yell/technical/planning

Agencies/Libraries That Will Receive This Environmental Assessment

US Fish and Wildlife Service - Cheyenne, WY
Wyoming Office of Federal Land Policy
Wyoming State Historic Preservation Office
Billings, MT Public Library
Bozeman, MT Public Library
Cody, WY Public Library
Jackson, WY Public Library
Yellowstone National Park Research Library

Agencies, Organizations, And Tribes That Will Be Notified Of This Environmental Assessment

Beaverhead National Forest
Big Hole National Battlefield
Bridger-Teton National Forest
Custer National Forest
Environmental Protection Agency, Region 8 - Denver
Gallatin National Forest
Glacier National Park
Grand Teton National Park
Grant-Kohrs Ranch NHS
Idaho Department of Commerce
Idaho Department of Parks and Recreation
Idaho Fish and Game Department
Idaho State Historic Preservation Office
Little Bighorn Battlefield NM
Montana Department of Commerce
Montana Department of Fish Wildlife and Parks
Montana Intergovernment Review Clearinghouse
Natural Resource Conservation Service - Bozeman and Cody
Shoshone National Forest
Targhee National Forest
Teton County Certified Local Government
Town of West Yellowstone
US Army Corps of Engineers
Western Federal Lands Highway Division
Wyoming Department of Transportation
Wyoming Game and Fish Department
Wyoming State Clearinghouse
Wyoming State Lands and Investments
Wyoming State Library
Wyoming Travel Commission
ACHP Western Office of Project Review
Alliance for Wild Rockies

American Fisheries Society
American Wildlands
AMFAC
Bear Creek Council
Beartooth Alliance
Billings Chamber of Commerce
Bozeman Area Chamber of Commerce
Buffalo Bill Historical Center
Center for Urban Affairs
Cheyenne High Plains Audubon
Citizens for Teton Valley
Cody Chamber of Commerce
Cooke City/Silver Gate Chamber of Commerce
Defenders of the Rockies
Defenders of Wildlife
Fremont County Audubon Society
Gallatin County Commissioners
Gardiner Chamber of Commerce
Great Bear Foundation
Greater Yellowstone Association of Conservation Districts
Greater Yellowstone Coalition
Hamilton Stores, INC
Idaho Falls Chamber of Commerce
Idaho Wildlife Federation
Jackson Hole Alliance for Responsible Planning
Jackson Hole Chamber of Commerce
Lander Chamber of Commerce
Livingston Chamber of Commerce
Montana Audubon Council
Montana State University
Montana State Preservation Office
Montana Wildlife Federation
National Audubon Society
National Parks and Conservation Association
Nature Conservancy - Idaho Chapter
Nature Conservancy - Montana Chapter
Nature Conservancy - Wyoming Chapter
National Wildlife Federation
Northern Plains Resource Council
Northern Rockies Conservation Cooperative
Northwestern University
Park County (MT) Commissioners
Park County (WY) Commissioners
Park County Environmental Council
Pinedale Chamber of Commerce
Red Lodge Chamber of Commerce
Riverton Chamber of Commerce
Sacajawea Audubon Society

Sierra Club Idaho Chapter
Sierra Club Northern Plains Regional Office
Sierra Club Teton Group
Sierra Club Utah Chapter
Snake River Audubon Society
Star Valley Development Association
Stone Fly Society
Teton County Commissioners
Teton County Historic Preservation Board
University of Colorado
University of Wyoming
Upper Missouri Breaks Audubon Society
Utah Audubon Society
Utah Wilderness Association
Utah Wildlife Federation
West Yellowstone Chamber of Commerce
Wild Forever
Wilderness Society
Wyoming Wildlife Federation
Wyoming Association of Professional Historians
Wyoming Heritage Society
Wyoming Outdoor Council
Yellowstone Association
Yellowstone Park Foundation
Yellowstone Valley Audubon Society
Northern Arapaho Tribe
Blackfeet Tribe
Northern Cheyenne Tribe
Coeur d'Alene Tribe
Confederated Tribes of Salish and Kootenai
Crow Tribe
Crow Tribe/Apsaalooke Nation
Kiowa Tribe
Nez Perce Tribe of Lapwai
Nez Perce Tribe of Nespelem
Nez Perce Tribe of Colville
Eastern Shoshone Tribe
Shoshone-Bannock Tribes
Assiniboine and Sioux Tribes of Fort Peck
Gros Ventre and Assiniboine Tribes
Cheyenne River Sioux Tribe
Crow Creek Sioux Tribe
Flandreau Santee Sioux Tribe
Lower Brule Sioux Tribe
Oglala Sioux Tribe
Rosebud Sioux Tribe
Standing Rock Sioux Tribe
Spirit Lake Sioux Tribe

Sisseton-Wahpeton Sioux Tribe
Yankton Sioux Tribe

APPENDIX A: VEGETATION MANAGEMENT FOR CONSTRUCTION IN YELLOWSTONE NATIONAL PARK

Revegetation efforts within the park have focused on careful management of topsoil as the only available growing medium and seed source. This is based on a park policy that seed obtained from sources outside the park would contaminate the park gene pools. Although it is a conservative method, the topsoil management approach has worked well.

The park has an interagency agreement with the Bridger Plant Material Center to assist in the formation of a park seed bank. The park has also tested mulches and can make this information available upon request.

All construction work within the park involving ground disturbance would meet the following criteria for revegetation accepted by the park.

1. All construction will be limited to that area necessary to complete required work. No activity, including vehicle or material use or storage, will be allowed outside the predetermined zone. If vehicles are to be traveling through an area numerous times, the same tracks will be used to prevent compaction in other areas. Compacted zones will be treated (raking, aerating, and replacement of topsoil) to assist revegetation. Topsoil will not be driven on at any time.

2. Excavation and improvement will be handled in manageable sections that reflect changes in the soil and vegetation. Trenching routes and disturbance zones will be flagged and approved by the park. All flagging and debris will be removed from the area after work is completed.

3. Sections will be rehabilitated as soon as possible. Topsoil will not be stockpiled over the winter or for longer than two months in sagebrush/rabbitbrush zones or longer than four months in grass-dominated zones. Any deviation must be approved by the park.

4. Topsoil refers to the uppermost soil horizon; it is usually found in the top 2 to 6 inches. Topsoil will be removed and replaced from the same area. Care will be taken to ensure that topsoil and fill material are not mixed and are stockpiled in separate areas (e.g., topsoil to the right of the trench and fill to the left).

5. Vegetation over three feet in height will be removed before the removal of topsoil and in a manner that least disturbs the topsoil. Topsoil will not be driven on, gouged, or compacted as vegetation is removed. Topsoil will be removed before stumps are pushed. Any deviation from this process must be approved by the park.

6. After large trees are removed, topsoil will be removed from an area in a single cut, including any vegetation that is three feet tall and under. Grubbing is not

permitted.

7. Irregular land surfaces are recommended for a natural effect. Some rock outcropping and boulders may be left in place to create natural pockets for revegetation (see # 11). Deadfall snags may be stockpiled for later use on slopes that are very steep to provide catch points for soil.

8. Topsoil will not be used as bedding material. Separate bedding material will be obtained from sources approved by the park.

9. Topsoil will be replaced on site in a mixture of topsoil and vegetation associated with the topsoil and will be reworked over the site in a manner that preserves the seed source while spreading the soil over the area.

10. No topsoil will be imported from outside the park or moved internally within the park unless approved by the park. Any imported fill will be checked for exotic plants.

11. Trees and shrubs will be avoided if possible during trenching or excavation. Any trees removed during construction will be removed from the site unless specified by the park.

12. If replacement seed is required for revegetation in an area, the park will provide seed at cost to the contractor. Advance notice of six months to one year is required on projects exceeding 1,000 square feet.

13. Boulders unearthed during construction may be reburied or left exposed (with lower third buried) depending upon the location and extent of rock naturally occurring in the area.

14. If a trench is required, the surface of the trench will be left mounded to allow for settling along the line.

15. If mulch is required in sensitive areas due to visibility or exotic plant infestation, the park will specify the type and depth of mulch to be used. Nitrogen may be added in small quantities to any wood product used on slopes to balance nitrogen lost through decomposition.

16. No fertilizer will be used in any revegetation work unless requested by the park.

17. If relocated due to road reconstruction, junction boxes or cans will be placed in the field and approved by the park. Locations should be well screened by vegetation, topography, or large boulders.

18. All access to the site and stockpiling or staging areas will be identified by the contractor and approved by the park. These areas will be revegetated using approved techniques upon completion of the project.

19. All debris will be removed from the site to an approved pit or hauled away as approved by the park.

20. Final review and inspection will be made by the park before the work is accepted.

APPENDIX B: COVER TYPE DEFINITIONS & WHITEBARK PINE SURVEY RESULTS

Lodgepole Pine Types

Cover type-- 30 (LPO)
Recently burned or harvested lodgepole pine stands in the grass to seedling/sapling stage before canopy closure. Approximately 0-40 years post fire.

Cover type-- 31 (LP1)
Closed canopy of even-aged, usually dense, lodgepole pine where trees are younger and shorter that those of neighboring stands. Young pole successional stage. On outwash at West Yellowstone, it is represented by islands of scattered short trees next to islands of scattered larger trees. Approximately 40-100 years post fire.

Cover type-- 32(LP2)
Closed canopy dominated by lodgepole pine. Overstory still largely intact. Mature lodgepole pine successional stage. Understory usually small to medium engelmann spruce and subalpine fir seedlings and saplings but also may be mostly lodgepole pine. Approximately 100-300 years post fire.

Cover type--33 (LP3)
Canopy quite ragged predominately of overmature lodgepole pine but containing some engelmann spruce, subalpine fir, and whitebark pine in the pole sized class. Old growth lodgepole pine successional stage. Understory of small to large spruce and fir seedlings and saplings. Three hundred plus post fire.

Cover type--34 (LP)
Canopy dominated by overmature lodgepole pine beginning to break up. Understory of lodgepole pine and whitebark pine. Stands usually on rhyolite and multi-aged. Lodgepole is climax or persistent seral species. Three hundred years plus post fire.

Spruce-Fir Types

Cover type--40 (SF0)
Recently disturbed wet areas or high elevation cirques where reproduction is clearly dominated by engelmann spruce and subalpine fir. Canopy closure has not yet been achieved.

Cover type--41 (SF1)
Even-aged, closed stands dominated by sapling to pole sized engelmann spruce and subalpine fir. Whitebark pine may also be a significant member. These stands commonly occur in high elevation cirques where shade and late melting snow make conditions unfavorable for lodgepole pine and whitebark pine. They may also be found in wet sites at lower elevations.

Spruce-Fir Types

Cover type-- 44 (SF)
Stands dominated by engelmann spruce and subalpine fir in both overstory and understory. Lodgepole pine, douglas-fir or whitebark pine may be present, but are a minor stand component.

Whitebark Pine Types

Cover type-- 50 (WB0)
Recently burned whitebark pine stands usually near upper timberline where whitebark pine clearly dominates reproduction.

Cover type-- 51 (WB1)
Even-aged, closed whitebark pine stands where trees are younger and shorter than those of neighboring stands. Trees are small pole sized.

Cover type-- 52 (WB2)
Closed canopy dominated by whitebark pine. Overstory still largely intact. Trees pole to mature sized. Understory usually small to medium engelmann spruce and subalpine fir seedlings and saplings but may be mostly whitebark pine. Approximately 100-300 post fire.

Cover type-- 53 (WB3)
Stands dominated by mature whitebark pine and may also contain considerable engelmann spruce, subalpine fir, or lodgepole pine. Understory is a combination of engelmann spruce, subalpine and whitebark pine.

Cover type-- 54 (WB)
Stands of mature to overmature whitebark pine where the reproduction is nearly all whitebark pine.

The following information was collected in summer 2001 by Bear Management staff, Yellowstone National Park.

Whitebark Pine Survey Methods

The National Park Service is planning to widen the Dunraven Road in Yellowstone National Park. Widening the road will require removing whitebark pine trees that are adjacent to the road corridor. Whitebark pine is a keystone species important to watersheds and wildlife. Whitebark seeds are an important food source for threatened grizzly bears in the Greater Yellowstone Ecosystem. To evaluate potential impacts to whitebark pine and grizzly bears from widening the Dunraven Road, we surveyed whitebark pine along the road corridor.

We sampled 15 x 25-meter (49x82-foot) plots adjacent to the road in the whitebark pine zone along the road corridor. The whitebark pine zone along the Dunraven Road corridor occurs approximately from the Chittenden Road south to Canyon

Junction. The plots were placed every 0.8-km (0.5-mile) on alternating sides of the road from the Chittenden Road to Canyon Junction. Cover-type for each plot was recorded.

Stakes were placed at each corner of and string strung around a 15 x 25 meter rectangle. Plots were oriented with the 15-meter (9-foot) edge paralleling the road. Each plot was subdivided with string into three 5 x 25 meter (16x82-foot) subplots labeled A, B,& C. In forest cover types, live tree over-story and understory (> 6 ft.) in each subplot were tallied by Diameter Breast Height (DBH) and species. We further divided subplot B into five 5 x 5 meter micro-plots numbered 1 - 5. To measure seedling regeneration (< 6 ft.), whitebark pine seedlings were counted in each micro-plot. Non-forest cover types were revisited to sample other bear foods, such as biscuit root. Individual plants were counted in subplot B for each of the five micro-plots.

Existing cover-type maps for the Dunraven Road corridor indicated that there were 12 different cover types present along the road corridor. Those plots placed every 0.8-km (0.5-mile) on alternating sides of the road were within 8 different cover types, LP0, LP1, LP2, LP3, SF0, SF1, WB2, and WB3. We later added one plot each of LP, SF, and WB cover types which were not sampled originally but expected to be affected by the road work. Cover type maps indicated that WB0 was present along the road corridor but we were unable to locate this cover type.

Estimated number of whitebark pine trees over 1.8 meters (6 feet) in height that would potentially be removed as part of the Dunraven Road reconstruction project.

ALTERNATIVE A-

Forest Cover Types Along Dunraven Pass Road Corridor Containing Whitebark Pine Trees	**Total Acres Disturbed By Reconstruction in the Whitebark Pine Zone**	**Average Cone Producing Whitebark Pine Trees Per Acre in Cover Type**	**Estimated Number of Whitebark Pine Trees Over 6' in Height to be Removed**
LP	**1.91**	**130 ± 86**	**248**
LP0	**6.94**	**0**	**0**
LP1	**1.33**	**11 ± 17**	**14**
LP2	**6.3**	**335 ± 153**	**2,107**
LP3	**5.62**	**140 ± 75**	**788**
Wb	**3.88**	**421 ± 171**	**1,633**
WB0	**0.75**	**0**	**0**
Sf	**4.54**	**0**	**0**
Nf	**5.46**	**0**	**0**
WB/Nf	**3.66**	**210 ± 86**	**770 ± 315**
Total	**40.39**		**5,560 ± 2,551**

Estimated number of sapling size whitebark pine tree regeneration that would potentially be removed as part of the Dunraven Road reconstruction project.

Forest Cover Types Along Dunraven Road Corridor Containing Whitebark Pine Trees	Total Acres Disturbed by Reconstruction in the Whitebark Pine Zone	Average Whitebark Pine Tree Regeneration (Saplings) per Acre in Cover Type	Estimated Number of Sapling Whitebark Pine Trees to be Removed
LP	1.91	486 ± 499	948 ± 953
LP0	6.94	0	0
LP1	1.33	1,311 ± 1,586	1,744 ± 2,109
LP2	6.3	421 ± 520	2,652 ± 3,276
LP3	5.62	97 ± 144	546 ± 809
Wb	3.88	291 ± 290	1,131 ± 1,125
WB0	0.75	0	0
Sf	4.54	65 ± 89	294 ± 404
Nf	5.46	0	0
WB/Nf	3.66	146 ± 145	533 ± 531
Total	40.39		7,828 ± 9,207

Estimates of the number of whitebark pine trees affected by the Dunraven Road reconstruction project under different proposed alternatives.

Alternative	Estimated Acres Impacted by Reconstruction in Whitebark Pine Zone	Estimated Number of Whitebark Pine Trees Over 6' Tall Affected by Alternative
A (Preferred)	40 - 44	5,560 - 6,118
B	56 - 62	7,786 - 8,620
C	31 - 35	4,310 - 4,866
D (no action)	0	0

Estimates of the number of whitebark pine saplings affected by the Dunraven Road reconstruction project under different proposed alternatives.

Alternative	Estimated Acres Impacted by Construction in Whitebark Pine Zone	Estimated Number of Whitebark Pine Saplings Affected by Alternative
A (Preferred)	40 - 44	7,827 - 8,609
B	56 - 62	10,957 - 12,131
C	31 - 35	6,066 - 6,848
D (no action)	0	0

Estimated number of whitebark pine of cone producing size, pole and sapling size, and seedling regeneration that will potentially be impacted as part of the Dunraven Road reconstruction project under the preferred alternative.

		Whitebark Pine Cone Producing Tree's (> 14 cm DBH & > 6 ft. tall)		Pole & Sapling Size Whitebark Pine (< 14 cm DBH & > 6 ft. tall)		Whitebark Pine Seedling Regeneration (< 6 ft. tall)	
Cover Type	**Acres Impacted**	**Per Acre**	**Total Tree's Impacted**	**Per Acre**	**Total Pole and Sapling Size Impacted**	**Per Acre**	**Total Seedlings Impacted**
LPO	6.94	0	0	0	0	0	0
LP1	1.33	0	0	11 ± 17	15 ± 23	1,311 ± 1,587	1,744 ± 2,111
LP2	6.30	0	0	335 ± 153	2,110 ± 964	421 ± 520	2,652 ± 3,276
LP3	5.62	0	0	140 ± 75	787 ± 422	97 ± 145	546 ± 815
LP	1.91	0	0	130 ± 86	248 ± 164	486 ± 499	928 ± 953
SF-Types	4.54	4 ± 11	18 ± 50	36 ± 57	163 ± 259	76 ± 104	345 ± 472
WB-Types	4.63	181 ± 117	838 ± 542	157 ± 175	727 ± 810	478 ± 581	2,213 ± 2,690
WB/NF	3.66	91 ± 59	419 ± 271	79 ± 88	289 ± 322	146 ± 145	534 ± 531
NF [a]	5.46	0	0	0	0	0	0

[a] Non-Forested meadows in whitebark pine zone (above 7,800 feet), our sample plots indicated that biscuitroot (*Lomatium cous*), a common bear food was present in these meadows. Sample plots indicated 9,858 ± 2,657 biscuitroot plants per acre in these meadows..

APPENDIX C: PROGRAMMATIC AGREEMENT

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