Alternative 5 – Economic Alternative with Moderate Hauls *(NPS Preferred)*

Objectives

The primary objective of this alternative would be to authorize the testing, extraction and use of a reasonable number of source sites near the park road to provide economical material sites with moderate haul distances. At the western end of the park road the first phase would entail developing access to and extraction at Beaver Pond and Downtown Kantishna, with the ultimate goal of reclaiming the former mining claims in Downtown Kantishna. The second phase would involve the development of the North Face Corner site after other appropriate sites near the western end of the park were exhausted to supply projects at the western end of the park road. Potential new or expanded source sites would be tested and delineated to determine more accurately the deposit characteristics and sizes. All active source sites within the park could be used for road repair and rehabilitation and any new park construction projects. This alternative would easily meet the estimated 10-year needs for park projects.

Overview of Material Sources and Uses

This alternative would authorize the use of up to 5 material source sites within the park at any one time, and 6 sites total. These would be Teklanika Pit (MP 27.2), East Fork River (MP 43), Toklat River (MP 53.4), Beaver Pond (MP 70), North Face Corner (MP 89), and Downtown Kantishna (MP 91). Consistent with the direction in the Frontcountry Plan, the development and use of the North Face Corner site would not be initiated until material at Downtown Kantishna was appropriately exhausted for projects along road segments 8 and 9. External material sources would also be used, particularly for construction projects along park road segments 1-3. Only material from external sources would be used for park road maintenance or construction projects along road segment 1 (entrance area to the Savage River Bridge). Material from both external sources and Teklanika Pit would be used on road segments 2 and 3 (Savage River Bridge to Igloo Creek Canyon.) A nearly limitless supply of gravel could be procured from external sources along the George Parks Highway, but this alternative would likely use about 12,500 cy of material from outside sources over the next 10 years. Estimates and procedures to produce mineral materials at the various source sites in this alternative are provided below.

Alternative Details for Source Sites

Teklanika Pit

The Teklanika Pit would be expected to supply up to 73,500 cy over the next 10 years. As with all of the alternatives, pit-run and screened material from this site would be reserved largely for road surfacing material on road segments 2-4.

East Fork River

The East Fork River would be authorized to supply an estimated maximum average of 5,400 cy/yr or 54,000 cy in 10 years, as discussed previously for Alternatives 2 and 4. The cost analysis indicates the likely 10-year volume from this site would be approximately 43,000 cy.

Toklat River

The Toklat River site would be authorized to supply about 11,100 cy/yr or about 111,000 cy of material over the next 10 years. The cost analysis indicates that approximately 102,000 cy would likely be obtained from this site. The site would be a primary source of material for all park projects along road segments 2-7.

Beaver Pond
Though the Beaver Pond site could produce up to 70,000 cy, this alternative would likely result in removal of approximately 20,000 cy from Beaver Pond over the next 10 years, as discussed previously for Alternative 4.

North Face Corner
This site would be developed as Phase 2 for the western end of the park road after Downtown Kantishna extraction is completed. Up to 110,000 cy could be supplied over the 10-year period, although the cost analysis shows the likely total is approximately 32,000 cy. The site would be accessed from the north end of the deposit and worked from the park road to the western side of the deposit. Material would be extracted from this end, out of sight of North Face Lodge, but processed at the widened part of the road until a large enough area (1 to 2 acres) was opened up at the western end to provide space for processing equipment and material stockpiles.

Downtown Kantishna
Up to 59,000 cy of material from Downtown Kantishna would be produced as a by-product of site reclamation. Site development and material use for this site would be the same as described previously for Alternative 4.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER EVALUATION

Numerous permutations of the above alternatives were considered but eliminated from detailed consideration in the EA for one reason or another. On one extreme, no source sites within the park would be used, and on another extreme, the park road surface would be hardened with a hi-float or chip seal surface resembling a gravel road.

Use Only External Sources

This alternative was eliminated from further consideration because the cost of hauling all mineral material needed for maintaining the park road from external sources is considered to be excessive. In general, the break-even point for hauling mineral materials from the park entrance appears to be Mile 15 of the park road for pit-run material, and approximately Mile 16 for crushed or specialty materials (see cost analysis for external sources in Appendix B). In addition, this alternative would require total haul-truck mileage considerably greater than any of the alternatives evaluated in the EA. The wear and damage to the park road from frequent passes by dump trucks would require more maintenance and expense, and could increase safety hazards for park buses and visitors. The increased traffic loads could also adversely impact visitor experiences along the park road, and possibly push wildlife away from the road corridor. The expected effects of increased truck traffic are addressed in Chapter 4.

Minimize Gravel Needs with Hi-Float or Chip-Seal Road Surface

Though mimicking a gravel road surface after installed, these road surfaces are pressed into an asphalt or tarry base. The gravel surface tends to wear down or roll off over time, leaving an oily asphalt-like surface. The NPS is monitoring a road surface test of similar products on the Red Dog Mine Haul Road in Cape Krusenstern National Monument, where 100-ton ore trucks traverse the surfaces. Nevertheless, the NPS has determined this design is essentially a hardened road surface with an asphalt base, which is not consistent with the historic character of the Denali

Park Road. The NPS believes maintaining a gravel road, with the use of palliatives and binders in certain sections to reduce dust and loss of fine materials and gravel, is the preferred road surface at this time. The NPS may re-evaluate these road surface techniques over the next 10 years, however, for the transition portion of the road between Savage River (MP 14.9) and the Teklanika River (MP 30).

ENVIRONMENTALLY PREFERRED ALTERNATIVE

It is NPS practice in conducting environmental reviews to identify the "environmentally preferred alternative" for the subject proposal. The "environmentally preferred alternative" is the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic, cultural and natural resources. For this EA, the environmentally preferred alternative is one that:

- Fulfills the NPS responsibility as trustee for the park environment in an unimpaired condition for succeeding generations;
- Preserves important natural and cultural aspects of our natural heritage and maintains, where possible, an environment that supports biological diversity.
- Ensures for all Americans a safe, healthful and esthetically pleasing surrounding;
- Attains the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences; and
- Enhances the quality of renewable resources and approaches the minimum uses of depletable resources.

The environmentally preferred alternative would provide the mineral material resources needed to maintain the park road and facilities in a safe and esthetic condition, while minimizing adverse impacts to park natural and cultural resources. Such an alternative would preserve non-renewable resources to the extent feasible and minimize direct and indirect impacts to park surface area, vegetation, wetlands, wildlife, air quality, water resources and park visitors.

Identification of the environmentally preferred alternative provides NPS decision-makers and the public with the relative merits of the choices before making a final decision. The NPS is not required to select the environmentally preferred alternative, however, because such alternative may not provide the resources and services needed.

SUMMARY AND COMPARISON OF ALTERNATIVES

Table 2.1 provides an overview of the five GAP alternatives, indicating the maximum volume of material potentially available from each site and the sites proposed for use in each alternative. The table also indicates the approximate volume of material from each site for each alternative, based on the results of the cost analysis. Actual production volumes could vary somewhat from those indicated, however, based on actual conditions encountered in the future and potential satisfaction of the 10% contingency factor applied to the projected gravel needs. The contingency factor is not reflected in the site-specific material volumes.

Table 2.2 identifies the stockpile, restoration and testing sites that are common to all five alternatives, as discussed in the Process Overview section of Chapter 2. Table 2.3 summarizes the expected environmental impacts for the alternatives, based on the impact analysis documented in Chapter 4.

In developing the alternatives the NPS concluded that Alternative 4 or Alternative 5 would be the NPS preferred alternative, based on their anticipated level of impacts and ability to meet the purpose and need for the gravel acquisition plan. The two alternatives are quite similar in configuration; both feature phased development of extraction sites near the west end of the road corridor, and both offer a moderate number of sites and moderate haul distances. The NPS has no clear preference between Alternative 4 and Alternative 5, and will evaluate public review comment on the EA for additional perspective on the alternatives.

Based on the results of the environmental impact analysis, it is not clear which alternative should be considered the environmentally preferred alternative. Alternative 3 would meet the projected need for mineral materials with comparatively little impact associated with developing new gravel source sites. Alternative 3 would require a comparatively large level of trucking activity for hauling gravel, however, and would therefore cause greater disturbance impacts along the park road. Alternative 4 or 5 would involve new disturbance at more source sites than Alternative 3, but would create less disturbance from gravel hauling.

Table 2.1 Summary of Alternatives for Denali National Park Gravel Acquisition Plan[1]

Gravel Source Sites Name, Estimated Available Volume (cy/10yr), Milepost	**Alternative 1** **No Action**	**Alternative 2** **Maximum Flexibility/ Short Hauls**	**Alternative 3** **Minimum Visual Intrusion/Long Hauls**	**Alternative 4** **Phased Development of Moderate Number of Sites** ***(NPS Preferred)***	**Alternative 5** **Economic Alternative with Moderate Hauls** **(NPS Preferred)**
External Sources (enough), MP 0	+ (221,000)	+(12,500)	+(121,000)	+(12,500)	+(12,500)
Teklanika Pit, (75,000), MP 27	+ (35,000)	+(64,000)	S (<10,000)	+(73,000)	+(73,000)
East Fork River (54,000), MP 43		E(51,000)		E(43,000)	E(43,000)
Toklat River (111,000), MP 53	+ (75,000)	+(110,000)	+(110,000)	+(102,000)	+(102,000)
Beaver Pond (70,000), MP 70		+(20,000)		+(19,000)	+(19,000)
Boundary (40,000), MP 88		+(11,000)		R	
Moose Creek Terrace (640,000), MP 89			+(105,000)	2(32,000)	
North Face Corner (193,000), MP 89	+ (10,000)>R	P&S>R	R	R	2(31,500)
Camp Ridge[2] (72,000), MP 90		E>+(3,000)			
Downtown Kantishna (59,000), MP 91		+(57,000)		1 > R (59,000)	1 > R(59,000)
Kantishna Airstrip[3] (15,000), MP 93		R(9,000)			

+ = gravel mining, processing and stockpiling
E = gravel extraction only
R = reclaim site
P = processing
S= stockpiling
1 or 2 defines the phase of source use

1. Volumes indicated for each site and alternative are projected amounts based on cost analysis and do not reflect 10% contingency factor included in projected 10-year gravel needs. Actual volumes could vary somewhat, depending on actual conditions encountered in the future.
2. This site requires processing for 2 years at North Face Corner or elsewhere until room is established for processing and stockpiling
3. This site is to be used for Kantishna Airstrip projects and last 2 miles of Denali Park Road only

TABLE 2.2: STOCKPILE, RESTORATION AND TESTING SITES[a]

Stockpile Sites	Restoration Sites	Testing Sites
Teklanika Pit MP 27	Parks Highway Pit MP 234	Old Teklanika Pit MP 27.5
Ghiglione Bridge MP 42	4-Mile Pit MP 4	Moose Creek Terrace MP 89
East Fork River MP 43.6	7-Mile Pit MP 7	Camp Ridge MP 90
Toklat Road Camp MP 53.4	Soapberry Turnout MP 51	Kantishna Airstrip MP 93
Beaver Pond MP 70	Toklat Alluvial Fan MP 53.4	
North Face Corner MP 89	Mile 57 (Carwile Pit) MP 57	
Downtown Kantishna MP 92	Rainy/Stony Bench MP 60.5	
	73-Mile Pit MP 73	
	Joe's Pit MP 76.8	
	Dalle-Molle-ville MP 84.8	
	Boundary Pit MP 88.0	
	North Face Corner MP 89.0	

[a] These sites would be available for the indicated use for any/all of the GAP alternatives. Stockpiling activity would likely vary by alternative, particularly based on the volume of material obtained from external sources. The extent of site restoration could vary with the amount of surface disturbance by alternative. Priorities for testing potential source sites would depend on the volume of in-park material available by alternative.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE

	Alternative 1: No Action	Alternative 2: Maximum Flexibility/Short Hauls	Alternative 3: Minimum Visual Intrusion/Long Hauls	Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*	Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*
Natural Resources					
Air Quality	Little or no change in localized dust and exhaust emissions from ongoing gravel operations at 3 authorized sites; moderate overall impacts to air quality from fugitive dust emissions from increase in gravel hauling to 16 % of total road traffic.	Minor increase in localized dust and exhaust emissions from gravel operations at up to 9 sites (6 new). Minor increase in dust emissions from gravel hauling to 7 % of road traffic. Overall air resource impacts would be minor.	Minor increase in dust and exhaust emissions from gravel operations at up to 3 sites (1 new). Moderate increase in dust emissions from 12 % of road traffic from gravel hauling traffic. Overall impacts to air resources would be moderate overall.	Minor increase in dust and exhaust emissions from gravel operations at up to 6 sites (4 new). Minor increase in dust and exhaust emissions from 7% of road traffic from gravel hauling. Overall impacts to air resources would be minor.	Minor increase in dust and exhaust emissions from gravel operations at up to 6 sites (3 new). Minor increase in dust and exhaust emissions from 7 % of road traffic from gravel hauling. Overall impacts to air resources would be minor.
Geologic Resources	Consumption of up to 130,000 cy of gravel from in-park resources, up to 245,000 cy from external sources. Negligible slope stability, erosion, or permafrost concerns. Overall minor impacts to park geological resources.	Consumption of up to 362,500 cy of gravel from in-park resources, up to 12,500 cy from outside sources. Negligible slope stability, erosion, or permafrost concerns. Overall moderate impacts to park geological resources.	Consumption of up to 240,000 cy of gravel from in-park resources, up to 135,000 cy from outside sources. Negligible slope stability, erosion, or permafrost concerns. Overall moderate impacts to park geological resources.	Consumption of up to 362,500 cy of gravel from in-park resources, up to 12,500 cy from outside sources, same as Alternative 2. Negligible slope stability, erosion, or permafrost concerns. Overall moderate impacts to park geological resources.	Consumption of up to 362,500 cy of gravel from in-park resources, up to 12,500 cy from outside sources, same as Alternatives 2 and 4. Negligible slope stability, erosion, or permafrost concerns. Overall moderate impacts to park geological resources.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	**Alternative 2: Maximum Flexibility/ Short Hauls**	**Alternative 3: Minimum Visual Intrusion/Long Hauls**	**Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)***	**Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)***
Hydrology	Continued gravel extraction from Toklat River at rate of 7,500 cy per year, with no adverse effect on river hydrology. Negligible impacts on local hydrology at Teklanika and North Face Corner sites.	Gravel extraction from Toklat (11,100 cy/yr) and East Fork (5,400 cy/yr) at sustainable rates, with no adverse effects on river hydrology. Potential short-term effects on Moose Creek hydrology from gravel mining at Downtown Kantishna minimized through mitigation procedures, likely long-term benefits from reclamation. Negligible overall impacts to hydrology.	Gravel extraction from Toklat River at rate of up to 11,100 cy per year, with no adverse effect on river hydrology. Negligible impacts on local hydrology at Teklanika and Moose Creek Terrace sites.	Gravel extraction from Toklat and East Fork Rivers same as alternative 2, with no adverse effects on river hydrology. Minor temporary effects on Moose Creek from gravel mining at Downtown Kantishna with likely long-term benefits, as for Alternative 2. Negligible overall impacts.	Gravel extraction from Toklat and East Fork Rivers same as alternative 2, with no adverse effects on river hydrology. Minor temporary effects on Moose Creek hydrology from gravel mining at Downtown Kantishna, with likely long-term benefits. Negligible overall impacts on local hydrology.
Water Quality	Negligible water quality impacts from continued operation of 2 upland gravel sites and extraction from Toklat River channel. Continued excellent water quality in the park	Minor water quality impacts from 5 acres of surface disturbance at up to 8 gravel sites. Intermittent and localized increases in turbidity from in-channel extraction at Toklat and East Fork Rivers and gravel extraction at Downtown Kantishna.	Minor water quality impacts from 2-3 acres of surface disturbance at 3 gravel sites. Intermittent and localized increases in turbidity from in-channel extraction at Toklat River.	Minor water quality impacts from 3 acres of surface disturbance at 6 gravel sites. Intermittent and localized increases in turbidity from in-channel extraction at Toklat and East Fork and gravel extraction/ reclamation at Downtown Kantishna.	Same as Alternative 4.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	**Alternative 2: Maximum Flexibility/ Short Hauls**	**Alternative 3: Minimum Visual Intrusion/Long Hauls**	**Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)***	**Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)***
Aquatic Resources	Negligible impacts to aquatic resources from continued gravel operations at Toklat River, Teklanika and North Face Corner sites.	Minor impacts to aquatic resources from gravel operations at 5 upland sites, plus East Fork and Toklat Rivers; aquatic resources in Moose Creek protected and likely enhanced by mitigation/reclamation measures at Downtown Kantishna site.	Negligible impacts to aquatic resources from continued gravel operations at Toklat River and Teklanika, and new operation at Moose Creek Terrace; continued excellent water quality in the park.	Minor impacts to aquatic resources from gravel operations at 4 upland sites, plus East Fork and Toklat Rivers; aquatic resources in Moose Creek protected and likely enhanced by mitigation/reclamation measures at Downtown Kantishna site.	Minor impacts to aquatic resources, similar to Alternative 4.
Wildlife Values & Habitats	Little habitat loss and displacement, plus intermittent, localized disturbance of wildlife movements near 3 authorized gravel sites from continued operation; comparatively high potential for disturbance along road corridor from gravel hauling; moderate overall impacts.	Minor increase in habitat loss and displacement, plus intermittent, localized disturbance of wildlife movements near 8 gravel sites; comparatively low wildlife disturbance from truck traffic on park road; minor overall impacts on park wildlife resources.	Minimal increase in habitat loss and displacement, plus intermittent, localized disturbance of wildlife movements near 3 gravel sites; comparatively high wildlife disturbance from increased truck traffic on park road; moderate overall impacts on park wildlife resources.	Minor increase in habitat loss and displacement, plus intermittent, localized disturbance of wildlife movements near 6 gravel sites; comparatively low wildlife disturbance from truck traffic on park road; minor overall impacts on park wildlife resources.	Minor increase in habitat loss and displacement, plus intermittent, localized disturbance of wildlife movements near gravel sites; comparatively low wildlife disturbance from truck traffic on park road; minor overall impacts on park wildlife resources.
Vegetation & Wetlands	Permanent loss of 0.2 acres of common low shrub community at North Face Corner, plus long-term loss of minimal vegetated area at Toklat and 1 acre of	Long-term loss of 5 acres of upland vegetation from development at 8 gravel sites. Up to 19.4 acres of affected palustrine scrub-shrub, palustrine emergent and unconsolidated	Long-term loss of 2.6 acres of upland vegetation from development at 3 gravel sites. Up to 8.5 acres of affected palustrine scrub-shrub and unconsolidated	Long-term loss of 3+ acres of upland vegetation at 6 gravel sites. Up to 12.4 acres of affected palustrine scrub-shrub, palustrine emergent and unconsolidated riverine	Long-term loss of 3+ acres of upland vegetation at 6 gravel sites. Up to 11.55 acres of affected palustrine scrub-shrub, palustrine emergent and unconsolidated riverine

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	**Alternative 2: Maximum Flexibility/ Short Hauls**	**Alternative 3: Minimum Visual Intrusion/Long Hauls**	**Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)***	**Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)***
	low birch shrub community at Teklanika from continued operation of authorized sites; minor overall impacts to vegetation. Negligible potential new impact to wetlands.	riverine shore or bottom wetlands, with associated loss of wetland functions. Largest wetland area and least common wetland types among the alternatives, moderate overall impacts.	riverine shore or bottom wetlands, with associated loss of wetland functions. Least amount of wetland area and most common wetland types among the action alternatives, minor overall impacts.	shore or bottom wetlands, with associated loss of wetland functions. Less wetland area and function affected than Alternative 2; affected wetlands are common throughout park, moderate overall impacts.	shore or bottom wetlands, with associated loss of wetland functions. Less wetland area, function than Alternative 2 or 4; affected wetlands are common throughout park, moderate overall impacts.
Floodplains	Negligible impacts to Toklat River floodplain resources from continued in-channel excavation.	Minor impacts to floodplain resources from continued in-channel excavation at Toklat River and same activity at East Fork River. Negligible long-term impacts to floodplains of Moose and Eldorado Creeks from restoration at Downtown Kantishna.	Negligible impacts to Toklat River floodplain resources from continued in-channel excavation, at somewhat higher annual rate.	Same as Alternative 2.	Same as Alternative 2.
Cultural Resources	No future cultural resource discoveries or impacts expected at existing approved gravel sites. Unknown potential for discovery of cultural sites not yet inventoried at external gravel sources. Negligible overall impacts.	No adverse effects on known cultural resources from development of 6 new gravel sites, and negligible potential for presence of unrecognized resources. Low potential for discovery of cultural sites at external gravel sources. Negligible overall impacts.	No adverse effects on known cultural resources from development of 1 new gravel site, and negligible potential for presence of unrecognized resources. Unknown potential for cultural sites at external gravel sources, but lower than for Alternative 1. Negligible overall impacts.	No adverse effects on known cultural resources from development of 4 new gravel sites, and negligible potential for presence of unrecognized resources. Low potential for discovery of cultural sites at external gravel sources, same as for Alternative 2. Negligible overall impacts.	No adverse effects on known cultural resources from development of 3 new gravel sites, and negligible potential for presence of unrecognized resources. Low potential for discovery of cultural sites at external gravel sources, same as for Alternative 2. Negligible overall impacts.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	**Alternative 2: Maximum Flexibility/ Short Hauls**	**Alternative 3: Minimum Visual Intrusion/Long Hauls**	**Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)***	**Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)***
Social and Economic Resources					
Visitor Use & Experience	Moderate impacts on visitor experience from increased gravel hauling activity.	Minor incremental increase to potential for disturbance of visitor experience in developed zones (road corridor), primarily from gravel operations at 6 new sites and secondarily from gravel hauling. No adverse impacts to major visitor facilities; greatest potential disturbance to Kantishna visitors, with 5 sites in area.	Moderate increase in potential for disturbance of the visitor experience in developed zones (road corridor), primarily from increased gravel hauling and secondarily from gravel operations at 2 existing sites and 1 new site. No adverse impacts to major visitor facilities; least potential disturbance to Kantishna visitors, with 1 site on spur road in area.	Overall impacts similar to Alternative 2, but with less potential disturbance to Kantishna visitors from 2 sites in area.	Overall impacts similar to Alternative 2 or 4; less potential disturbance to Kantishna visitors than Alternative 2, but more visible activity than Alternative 2 with use of North Face Corner.
Scenic Values	Negligible impacts to scenic values from landscape change and industrial activity at 3 existing sites, potentially visible for total of 2 miles of park road; minor impacts from increased gravel hauling on park road.	Moderate localized landscape change and increased evidence of industrial activity at 6 new sites visible for over 9 miles along road corridor; insignificant incremental change to park scenic values.	Minor localized landscape change and increased evidence of industrial activity at 1 new site not on park road and 2 existing sites visible for 2 miles along road corridor; negligible incremental change to park scenic values.	Impacts similar to Alternative 2, but somewhat less (moderate overall) as result of activity associated with 4 new gravel sites; sites visible for total of 8+ miles along park road.	Impacts similar to Alternative 2, but somewhat less (moderate overall) as result of activity associated with 3 new gravel sites and 3 existing sites; sites visible for total of 9 miles along park road.
Public Access & Safety	Insufficient in-park gravel production to meet 10-year material demand, primary reliance on external	Sufficient gravel production to meet 10-year material demand and support adequate road maintenance. Possible	Same as Alternative 2 with respect to gravel production, support for road maintenance, visitor safety and comfort.	Same as Alternative 2 with respect to gravel production, support for road maintenance, visitor safety and comfort. No	Same as Alternative 2 with respect to gravel production, support for road maintenance, visitor safety and comfort. Minor

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	Alternative 2: Maximum Flexibility/ Short Hauls	Alternative 3: Minimum Visual Intrusion/Long Hauls	Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*	Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*
	sources; greater potential for degradation of roadway condition, especially in west end. Overall impacts potentially major.	increase in visitor comfort and safety. Minor increases in safety hazards for park visitors or employees, primarily from traffic interactions in Kantishna area.	Greater increases in gravel hauling than Alternative 2, but minor increases in safety hazards for park visitors or employees.	significant increases in safety hazards for park visitors or employees. Negligible impacts to visitor access and safety overall.	increases in safety hazards for park visitors or employees, primarily from traffic interactions in North Face Corner area.
Park Management	Future gravel supply not consistent with park management objectives, particularly for west end of road corridor. Large volumes of gravel hauling from external sources would increase gravel costs, wear on the park road, more road maintenance, and possible decrease in visitor vehicles under the road limits. All this would result in major impacts to park management.	Gravel supply and road maintenance support consistent with park management objectives. A small increase in traffic from gravel hauling activity and the need for temporary bridge in Kantishna would result in minor impacts to park management.	Similar to Alternative 1, except for less increase in gravel hauling traffic from external sources and source at western end of park road reduces excessive hauling at that end of the road resulting in moderate overall impacts.	Virtually the same as Alternative 2.	Virtually the same as Alternative 2.
Local Economy	Increased expenditures for purchase of gravel from external sources, with potential employment and income benefits in local economy. Possible	Minor increase in NPS seasonal employment to operate new gravel sites; minor local economic impacts from NPS employment or external gravel purchases. No	Increase in expenditures for purchase of gravel from outside sources, similar to but less than Alternative 1, with potential employment and income benefits in local	Similar to Alternative 2, but with less increase in NPS seasonal employment.	Same as Alternative 4.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	Alternative 2: Maximum Flexibility/ Short Hauls	Alternative 3: Minimum Visual Intrusion/Long Hauls	Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*	Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*
	increased costs for Kantishna businesses if road condition deteriorates. Minor overall impacts.	influence on visitor patterns or local service economy. Negligible overall impacts.	economy. No influence on visitor patterns or local service economy. Minor overall impacts.		
Subsistence	Negligible effects on wildlife and fish resources or access to them for subsistence uses.	Possible slight redistribution of wildlife from activity at 5 sites in Kantishna area, with minor effect on subsistence resources because of existing human use in the area. Overall, minor effects on subsistence resources or uses.	Similar to Alternative 2, with less overall activity in Kantishna area but minor disturbance in Moose Creek valley. Overall, minor effects on subsistence uses.	Similar to Alternative 2, with less overall activity in Kantishna area but minor disturbance in Moose Creek valley. Overall, minor effects on subsistence uses.	Similar to Alternative 2, but with less overall activity in Kantishna area and no disturbance in Moose Creek valley. Overall, negligible effects on subsistence resources or uses.
Wilderness	Gravel sites located in development zones with no direct impacts on wilderness. No new indirect impacts (noise and/or visual intrusion) on wilderness values from continued operation at existing sites, but additional noise from increased gravel hauling. Minor overall impacts on wilderness values.	Additional noise and/or visual intrusion in wilderness areas near park road corridor, from operations at 6 new sites and gravel hauling. Minor effects on wilderness values from incremental addition to extent of existing noise from developed areas.	Impacts similar to Alternative 1, but with 1 additional gravel site and somewhat less hauling activity on park road. Minor effects on wilderness values from incremental addition to extent of existing noise from developed areas.	Impacts similar to Alternative 2, but with 2 fewer gravel sites. Minor effects on wilderness values from incremental addition to extent of existing noise from developed areas.	Impacts essentially the same as Alternative 4. Minor effects on wilderness values from incremental addition to extent of existing noise from developed areas.

TABLE 2.3 SUMMARY OF IMPACTS BY ALTERNATIVE (CONT'D)

	Alternative 1: No Action	**Alternative 2: Maximum Flexibility/ Short Hauls**	**Alternative 3: Minimum Visual Intrusion/Long Hauls**	**Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)***	**Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)***
Cumulative Impacts					
All Resources	Negligible expansion of disturbed/developed area within the park. Moderate increase in existing traffic-related disturbance along park road. Future long-term disturbance reduced through GAP site reclamation and restoration of former sites. No change relative to area disturbed by mining in Kantishna Hills.	Minor expansion (<1 %) in disturbed/developed area in park. Negligible increase in existing traffic-related disturbance. Future long-term disturbance reduced through GAP site reclamation and restoration of former sites. Long-term reduction of area disturbed by mining in Kantishna Hills.	Cumulative aspects of impacts similar to those for Alternative 2, except negligible expansion of disturbed/developed area and no change relative to area disturbed by mining in Kantishna Hills.	Minor temporary increase in disturbed/developed area in park. Negligible increase in existing traffic-related disturbance. Future long-term disturbance reduced through GAP site reclamation and restoration of former sites, including 55-acre reduction of area disturbed by mining in Kantishna Hills.	Cumulative impacts very similar to those for Alternative 4.

CHAPTER 3
DESCRIPTION OF THE AFFECTED ENVIRONMENT

The area that would be affected by implementation of the proposed plan consists, in general, of the Denali National Park lands that are adjacent to the park road corridor. For some resources, potential impacts could extend to some distance beyond the road corridor.

Chapter 3 of the EA describes the existing characteristics of the park resources that could potentially be affected by gravel acquisition activities carried out under the plan. The focus of this content is on the road corridor environment in general and the resources near the specific gravel extraction and/or restoration sites that would be operated under one or more of the plan alternatives. A more complete description of the natural, cultural, social and economic resources of Denali National Park is provided in the following NPS documents:

- General Management Plan, Land Protection Plan, Wilderness Suitability Review, Denali National Park and Preserve. 1986.
- Environmental Assessment for a Borrow Use Management Plan to Maintain the Denali Park Road. 1992.
- Final Entrance Area and Road Corridor Development Concept Plan/Environmental Impact Statement, Denali National Park and Preserve. 1997.

CLIMATE AND AIR QUALITY

Denali National Park is in a subarctic continental region characterized by long cold winters and short cool summers. Most precipitation falls in the summer. While weather data are scarce, measurements have been taken at Park Headquarters and at Wonder Lake. Both are at approximately 2000 feet above mean sea level. Mean annual air temperature at Wonder Lake is 24°F; the January mean is 2°F, while the July mean is 53°F. At Park Headquarters, temperature extremes range from a record high of 90°F to record low of –51°F.

The project area within the park lies south of the Outer Range and on the north side of the Alaska Range, which creates a rain shadow that prevents cool moist air from the Gulf of Alaska from getting to the interior of Alaska. The average annual precipitation is 20 inches, making the climate at the upper end of the precipitation range for semiarid areas. Average annual snowfall is 75 inches, and the highest mean snowfall by month occurs in March. Snow cover usually remains until late May or early June, and drifts in sheltered areas may last much later.

The 1977 amendments to the federal Clean Air Act (42 USC 7401 et seq.) designated the Mount McKinley (now Denali) National Park wilderness as a federal Class I air quality area. The 1980 ANILCA additions to the park and preserve are also Class I areas. Air quality in the park is generally very good, and no cases of exceeding the national ambient air quality standards (NAAQS) have been documented (NPS 1996). Air quality is monitored through several networks, and the park and preserve are managed to maintain the air quality and visibility standards established by the applicable laws and regulations.

GEOLOGIC RESOURCES

The project area is dominated physically by Mount McKinley and an east-west trending line of towering mountains knows as the Alaska Range. The Alaska Range forms the northernmost portion of the Pacific Mountain System and is one of the great mountain uplifts in North America, rising above 500- to 2,000-foot-elevation lowlands to the pinnacle of Mount McKinley at 20,320 feet. Numerous other peaks near Mount McKinley reach elevations ranging from 10,000 to 17,000 feet. These peaks have permanent snow cover above approximately 7,000 feet on the north side of the range and support several large glaciers. The largest glacier on the north side is the 34-mile-long Muldrow Glacier, which extends northward toward the road corridor in the area west of the Eielson Visitor Center.

North of the Alaska Range is a series of east-west trending foothill ridges, which extend eastward from the Kantishna Hills north of Wonder Lake. The foothills area ranges from 3 to 7 miles in width, and has summit elevations generally between 2,000 and 4,500 feet. The foothills are separated at intervals by broad, flat, glacial valleys that generally drain from south to north. The park road corridor that represents the project area lies north of the Alaska Range and crosses along the southern margins of the foothills.

Four periods of glaciation are recognized in the Denali region. On the north side of the Alaska Range beyond the existing glaciers, morainal and outwash deposits extend into the foothills belt and cover large areas of bedrock. Except for some valleys, the foothills section was never glaciated. The extensive deposits left in previous glacial periods include the gravel resource sites that are evaluated in this GAP/EA.

Soils within the park vary according to parent material, topography and vegetative cover, and can be classified into three types. Mountain or tundra soils are shallow soils that form directly from bedrock and the slow accumulation of organic matter. Bog soils or histosols consist mostly of clay and glacial moraine materials. These poorly drained soils typically possess a subsurface accumulation of organic matter and peat layers. Underlying forested areas are sandy and silty clay soils that support mosses and lichens.

Another important feature of the project area is the presence of discontinuous permafrost, which can be found as deep as 2,000 feet below the surface. It consists of soil and rock that have been at a temperature of 32°F or colder for 2 or more years. A delicate heat balance exists between permafrost and the "active layer" above it. Thus, changes in the vegetative mat, snow, or other characteristics of the upper layer can significantly alter the thermal regime, with resultant changes at ground level. This can cause melting of permafrost. In addition, an increase in solifluction, or soil movement, is possible. These phenomena can cause heaving, sagging, soil slumping, and erosion at the surface during successive periods of freeze-thaw in the active layer. The result can be detrimental to buried cables, utility poles, paved surfaces, and roadbed foundations. The term "thermokarst" describes a landform developed when permafrost is partially or totally melted. Thermokarst is highly irregular and forms variously shaped polygonal depressions. Thermokarst has been created in other parts of Alaska due to construction projects.

HYDROLOGY, WATER QUALITY AND AQUATIC RESOURCES

Hydrology

The most prominent rivers within the park road corridor are, from east to west, the Nenana (which flows along the eastern edge of the park), Savage, Sanctuary, Teklanika, East Fork of the Toklat, Toklat and McKinley Rivers. Almost all are large, braided rivers flowing from major glaciers in the Alaska Range. The glacial rivers are laden with glacial silt and gravel that cut broad, intermingling channels that sometimes extend over 2 miles in width. The two largest creek s in the project area are Riley Creek, which flows into the Nenana River near the park entrance, and Moose Creek in the Kantishna Hills. There are numerous small lakes, ponds and wetlands scattered along the road corridor, most of which are unnamed. Wonder Lake, located near the western end of the road corridor, is the largest lake (about 2.5 miles long) in the park frontcountry and is a popular visitor destination.

Gravel extraction both affects and is affected by hydrological processes. These processes in turn create considerations for water quality and aquatic habitat. Two of the 10 candidate gravel extraction sites are within gravelly floodplains, while one is in the vegetated floodplain of a creek. Thus hydrology is of great importance when considering the effects and even the planning of gravel extraction. The hydrologic characteristics of the three sites with these close riverine connections are summarized below; additional detail is provided in Chapter 4. The other seven candidate gravel extraction sites are upland sites and were described previously in Chapter 2; their hydrology is described generally by the climate discussion for the project area.

The East Fork of the Toklat River and the mainstem Toklat River have glacial headwaters. This indicates fairly uniform flow throughout the summer (in contrast to non-glacial streams, which have very low flows in late summer). In subarctic Alaska, the typical hydrological pattern is dominated by snowmelt runoff in the late spring and early summer. Denali National Park has a semiarid climate, and rainfall events do not account for the highest flows. Peak snowmelt, and thus peak flows, likely occurs in early summer (early to mid-June). However, there are no gages on either stream to confirm this observation. The ice-free period on streams in the project area usually runs from mid-May until mid-October, when streams freeze over. Both the East Fork and mainstem Toklat Rivers are braided streams, which is typical of streams with glacial headwaters. These streams are "transport-limited," which means that there is more sediment than the stream can move (Ritter 1978). This condition results in many unstable, anastomosing channels that make up the active floodplain. The channels can change location and form seasonally, and usually do so during the peak runoff period of the year.

Moose Creek drains a large area east and north (downstream) of the proposed gravel extraction sites in the Kantishna area. Although the majority of the basin is of relatively low relief, Moose Creek does drain portions of the eastern Kantishna Hills, which range up to 4,700 feet, and Mt. Galen, at 5,000 feet. No glaciers are present in either drainage basin; hence, Moose Creek is quite different from the Toklat and East Fork rivers. Eldorado Creek drains a portion of the Kantishna Hills, a low range west of Moose Creek. The Downtown Kantishna site is on the west bank and floodplain of Moose Creek, beginning just downstream from the Kantishna Roadhouse and extending downriver almost to the Denali Backcountry Lodge. Eldorado Creek flows through this site. The Downtown Kantishna site has been substantially disturbed by mining activities in the past 50 years. In addition to numerous tailing piles and constructed features such as an airstrip, access roads and trails, the mouth of Eldorado Creek and the lowermost 1,000 feet of its channel have been moved from their original locations.

Water Quality

Water quality of streams within Denali National Park is generally very good. There are no streams present that have been listed on the Alaska Department of Environmental Conservation 303(d) list of impaired water bodies. A study conducted between 1994 and 1997 (Edwards, et. al. 2000) presented the results of water sampling that spanned seasons of the year, glacier- and non-glacier-fed streams, altitude differences, and various geographic areas within the park. Streams on the north side of the Alaska Range tended to be alkaline, with an average pH of 7.77. South-side streams averaged pH 7.00. Electrical conductivities also varied from north to south; south-side streams had much lower conductivities than did the north-side streams. The north-side streams had much higher ionic concentrations, on average, than south-side streams. Differences in ionic concentrations between north- and south-side streams were attributed to differences in lithology (marine sedimentary vs. igneous intrusives).

Notably, with turbidity and suspended sediment, north-side streams were significantly higher than south-side streams, although when compared the difference between glacial and non-glacial streams was less. Differences between glacial and non-glacial streams followed expected patterns. The mean turbidity of glacier-fed streams on the north side of the Alaska Range was 258 nephelometric turbidity units (NTUs) during the period 1994 to 1996 (Edwards and Tranel 1998). South-side glacial streams had an average turbidity of only 79.1 NTUs.

Aquatic Habitat

The glacial character of many of Denali's rivers prevents the development of significant fisheries in the frontcountry. Arctic grayling, the most common species in park waters, inhabit several streams near the road corridor including Caribou, Hogan, Igloo and Little Stoney Creeks. Grayling prefer clear, cold, gravel-bottomed streams, and do not tolerate the silt-laden flows of glacial rivers during the summer months. The glacial rivers also generally contain few pools or slow-moving sections that would provide suitable rearing habitat for fish.

Other fish found in park waters include Dolly Varden char, lake trout (also a char), sculpin, and chinook and coho salmon. In the Kantishna area, chum salmon, grayling, round whitefish and slimy sculpin are known to inhabit Moose Creek in the vicinity of the bridge. Chinook and coho salmon and northern pike inhabit areas of Mosse Creek further downstream. Salmon migrating up Mosse Creek generally reach the vicinity of the bridge by mid- to late August (NPS 1996).

WILDLIFE VALUES AND HABITAT

Denali National Park was created in 1917 to protect the outstanding assemblage of wildlife resources and to allow natural processes to continue unaltered by human activities. The expansion of the park in 1980 was done in part to include areas large enough to provide habitat for large mammals. Tourists from all over the world visit Denali for the outstanding opportunities to view wildlife including Dall sheep, barren ground caribou, grizzly bear and moose, as well as more elusive species such as wolves, lynx and wolverine, in their natural settings. In addition to the notable large mammals, Denali supports a wide variety of avian and small mammal species.

The park road traverses several different ecotones and types of wildlife habitat as it winds through Denali. The area along the eastern end of the road corridor, from park headquarters to about the Savage River (MP 15), supports a relatively high-density moose population for interior Alaska.

Moose are also likely to be observed in the Kantishna Hills and near ponds and lakes that are scattered the length of the park road. Caribou are highly migratory and may be found almost anywhere in the park, and are most commonly observed in open areas above treeline. Caribou use historic calving grounds along the Alaska Range. Dall sheep are common in the mountain and foothill areas adjacent to the park road, including nursery areas near Toklat and Polychrome Pass. Grizzly bears inhabit open tundra areas throughout the park and are often visible from the park road. The area around Sable Pass is particularly noted for relatively high grizzly bear use. Black bears are also present within Denali, but they primarily inhabit forested areas that are limited in extent within the park. The park road traverses wolf habitat for its entire length; the areas most conducive to wolf sightings are open areas above treeline, and most wolf observations occur in the central part of the road corridor, between Savage River and Eielson Visitor Center. NPS managers close the areas around known wolf dens and rendezvous sites to human activity. Chapter 4 provides more specific information on species use and habitat types relative to the candidate gravel extraction sites.

VEGETATION AND WETLANDS

Vegetation

Vegetative cover in Denali consists of two major plant associations, taiga and tundra. The vegetation layer is typically shallow, usually only several inches thick, and is underlain by continuous permafrost. Taiga is a forested association typically found below 2,700 feet in elevation. Taiga generally gives way to tundra, the area above treeline, at elevations above approximately 2,700 feet.

Taiga areas within the park consist of low brush-bog, bottom land spruce-poplar forest or upland spruce-hardwood forest associations. Low brush-bog associations are typically found within river drainages and around permanent bodies of water. Bottom land spruce-poplar forest also occupies lowland areas, but is found on relatively well-drained soils adjacent to the larger drainages. The upland spruce-hardwood association typically occurs in areas below treeline and above bottom land forest. Moist tundra (also referred to as tussock tundra) and alpine tundra are the two major vegetation associations found above treeline. Moist tundra typically includes dwarf shrubs and/or tussocks of grasses and sedges. Alpine tundra consists of a thin mat of low-growing, herbaceous and shrubby plants, often with outcrops of bare rock.

The park road corridor predominantly crosses tundra areas. Tussock tundra is most common in the eastern end of the corridor, from the headquarters area to near the Teklanika River, and from Eielson out to the western end of the road. Alpine tundra and barren ground typifies the area between Teklanika and Eielson. Consequently, vegetative cover at the candidate gravel extraction sites identified in the GAP tends to be exclusively or predominantly tundra. The Teklanika, North Face Corner, Moose Creek Terrace, Camp Ridge and Kantishna Airstrip sites and their adjacent lands include some forest vegetation, generally of white spruce, in addition to tundra. The East Fork and Toklat sites are located in the floodplains or braided rivers and generally consist of unvegetated gravel bars. The Downtown Kantishna site has been heavily disturbed by past mining operations; much of the site is unvegetated, while some of the site has new growth of poplars, alder and willows.

Wetlands

Wetlands are transitional areas between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands are found throughout the Denali frontcountry along major tributaries, in lowland areas and in tundra communities. They include riparian areas adjacent to streams and lakes, shallow tundra ponds, wet tundra, wet scrub-shrub and forested wetlands.

Wetlands are present at all 10 of the candidate gravel extraction sites considered in the GAP. Wetland delineations at eight of the sites were performed in 2001 under contract to the NPS and are documented in a delineation report (Hart Crowser 2001). Wetlands at the East Fork River and Downtown Kantishna sites have not yet been delineated, but have been characterized for this EA based on existing source information. Non-jurisdictional/isolated wetlands were identified at the Teklanika, Boundary, North Face Corner, Moose Creek Terrace, Camp Ridge and Kantishna Airstrip sites, while jurisdictional wetlands were identified or inferred at the East Fork River, Toklat River, Beaver Pond and Downtown Kantishna sites. The most common wetland type found at the sites is palustrine scrub-shrub, often intermixed with palustrine emergent wetlands. The gravel bars and braided channels at the three floodplain sites (East Fork and Toklat) are classified as unconsolidated shore gravel and/or unconsolidated bottom wetland types.

FLOODPLAINS

As discussed under Hydrology, most of the rivers in Denali are large, glacier-fed streams with braided channel patterns and broad floodplains. These characteristics apply to the Sanctuary, Teklanika, East Fork Toklat and Toklat Rivers, which cross the park road corridor, and to the McKinley River, which flows generally parallel to the road corridor toward the west end near Wonder Lake. Streams fed predominantly by snowmelt, such as Moose Creek in the Kantishna area, have much narrower and more confined floodplains. The floodplain areas along the streams in the park have not been mapped, except in the vicinity of the Toklat River site for which the NPS previously requested a floodplain delineation from the U.S. Army Corps of Engineers. However, floodplain areas can be identified with reasonable accuracy from evaluation of topography, surficial geology, historical maps and aerial photography. Among the 10 candidate extraction sites, the East Fork, Toklat and Downtown Kantishna sites are located entirely within the floodplain of the associated streams.

CULTURAL RESOURCES

Numerous cultural resources, including archeological sites and historic structures, have been identified in the entrance area, along the park road corridor and in Kantishna (NPS 1996). The park headquarters complex is an historic district that is listed on the National Register of Historic Places. There are approximately 25 other cultural sites and features located in the park entrance area, many of them associated with the former McKinley Park Station community. Thirty-one additional cultural sites have been identified along the road corridor west of the entrance area. Most of those are archeological sites and include the Teklanika Archeological District, located near the Teklanika River. Six patrol cabins located along the road corridor are listed on the national register. The Old Eureka/Kantishna Historic Mining District, which includes the road corridor from Wonder Lake to the Kantishna airstrip, was determined to be eligible for listing on the national register in 1993.

The regulations (36 CFR 800) for implementing Section 106 of the National Historic Preservation Act (NHPA) require initiation of a formal process to assess the effects of undertakings involving the federal government on historic properties. The first step in the process is identification. The standard for identification may include background research, consultation, oral history interviews, sample field investigation, and field survey. Over the past 2 years NPS cultural resource personnel have completed reconnaissance-level archeological surveys of all active and alternative material source sites located within the park boundaries. All surveys were negative for the presence of a significant historic property or archeological resource. Based on the observed attributes of site geomorphology and environmental setting, NPS has evaluated all listed material sites as having negligible potential for the presence of an unrecognized significant historic or archeological resource.

VISITOR USE AND EXPERIENCE

Denali National Park is a primary visitor destination in Alaska and among the more popular large, natural parks in the country. Since it was created in 1917 visitor use has steadily increased to the present. Its popularity among recreational visitors is derived from its unique natural resources and accessibility. The park entrance lies between Alaska's two population centers, Anchorage and Fairbanks, and along the George Parks Highway (Alaska Route 3).

Visitor Activities

Visitor experiences and recreation in the park rely almost exclusively on the park road. The road extends 93 miles from the park entrance into the park's interior, ending at Kantishna a few miles north of Wonder Lake. The activities most often reported by respondents to park visitor surveys include wildlife observation, photography, and landscape or scenery viewing; 70 to 75 % of all park visitors report participation in each of these activities.

Access to the park has been limited since 1986, when the General Management Plan (NPS 1986) established a traffic limit of 10,512 vehicles on the park road beyond the Savage River Check Station (MP 14.9) during the summer. Consequently, the majority of visitor activities at Denali involve trips on a shuttle or tour bus along the Denali Park Road. The bus transportation system was established in 1972 to reduce vehicle traffic and negative impacts on wildlife to maintain opportunities for visitors to view wildlife. Four different bus systems serve visitors to the park: the courtesy buses, Visitor Transport System (VTS), tour buses, and lodge transport. The courtesy buses operate only in the entrance area. The green shuttle buses (VTS) transport visitors into the park's interior as far as Wonder Lake and Kantishna. Two formal bus tours offer a 3-hour roundtrip to Primrose Ridge (Denali Natural History Tour) or 8- to 10-hour roundtrip to Stony Hill (Tundra Wilderness Tour). Kantishna area lodges are authorized to transport their guests to and from Kantishna in lodge-operated buses. A round trip from the park entrance to Wonder Lake takes approximately 11 hours.

Denali offers camping opportunities at seven standard campgrounds with a total of 293 sites. The campgrounds listed in Table 3.1 are all open to the public and are all located along the park road. Also listed in the table are the closest candidate gravel mining sites and their approximate distances. Most of the Denali campgrounds are open from May through September. Riley Creek, the only exception, is open all year.

Backcountry camping or backpacking is also available to visitors. Backcountry management includes regulation of the number of people permitted to travel at any one time in each of the more than 40 backcountry zones. This assures a pristine wilderness experience free from other people, unique to Denali. Permits to travel into one of the zones are obtained from the visitor center and are only issued a day in advance. Most of the zones that are adjacent to the park road have a quota of either four or six people. Some of the larger zones and the zones that cannot be accessed directly from the road have quotas from 8 to 12. The most popular areas are zones 12, 13, and 18 in the tundra area south of Eielson Visitor Center. Other more popular zones include 8, 9,10, and 11, which include both branches of the Toklat River and tundra area south of Polychrome Pass; 27, north of Sanctuary Campground; and 15, just west of Wonder Lake.

TABLE 3.1: DENALI NATIONAL PARK CAMPGROUNDS

Campground	Milepost	No. of camp sites	Nearest candidate gravel site	Approx. distance (miles)
Riley Creek	.25	147	Teklanika	27
Morino	2		Teklanika	25
Savage River	13	33	Teklanika	14
Savage Group	13	3	Teklanika	14
Sanctuary River	23	7	Teklanika	4
Teklanika River	29	53	Teklanika	2
Igloo Creek	34	7	Teklanika	7
Wonder Lake	85	28	Boundary	3

Hiking opportunities are also available to visitors, although there are few constructed trails beyond the entrance area and most hiking is done across open terrain. Several maintained hiking trails, each from 1.5 to 5 miles round-trip length, are located around the park entrance area. The NPS offers numerous guided day hikes available to the public. All the lodges in the Kantishna area offer their guests guided day hikes through the Moose Creek and Skyline Drive areas. Visitors also engage in mountain biking, boating rafting and canoeing, and sport fishing. No fishing license is required in the original portion of Denali National Park, but a license is required in the ANCILA park additions.

Visitor Facilities

There are numerous other park facilities, in addition to the seven campgrounds, that have been developed for the use and comfort of park visitors. The park entrance area serves both as the staging area for bus tours and transportation into the park's interior and as the primary destination for many visitors. Facilities in the entrance include the visitor's access center, Riley Creek and Morino campgrounds, a railroad depot, the airstrip, and several nearby trails. The park headquarters, located 3.4 miles from the entrance consists of administrative buildings, offices, dog kennels, housing, and park maintenance facilities. Visitors may use the park dog kennels, where sled dog demonstrations are held. The Eielson Visitor Center at Mile 66 of the park road is the primary visitor destination in the park interior. The center offers wildlife viewing and views of Mount McKinley. It also contains an exhibit room and a small publications sales area. There is a short maintained loop trail near the center. Rest areas are located at nearly every major development node along the road corridor. Picnic tables are provided at Savage River, Toklat River, and Wonder Lake rest areas and at the Eielson Visitor Center. The only designated picnic area within the park is located near the Riley Creek campground.

Many visitors choose to travel to Kantishna and stay in one of the privately owned facilities at the west end of the road corridor. Four lodging and visitor services businesses currently operate in Kantishna, all of which offer overnight accommodations. Kantishna is primarily a destination for lodge visitors and backpackers wanting a base area for backcountry access.

Visitor Use Statistics

Visitor use increased steadily following the establishment of Mount McKinley National Park in 1917. The park attracted 7 visitors in 1922; by 1962 that number increased to 16,500 (NPS 1996). Prior to the 1970s access to the park was limited to rail or the dirt-surfaced Denali Highway from Paxton. When the George Parks Highway linking Anchorage and Fairbanks was completed in 1972, visitor numbers increased by 100%; 88,615 visitors arrived at the park in 1972 (NPS 1996). The dramatic increase was also the result of an increased number of package tours bringing visitors by bus to the park. Visitor numbers continued to increase until 1986, when the General Management Plan limited the total number of vehicles allowed into the park interior. Between 1990 and 1995 the average number of recreational visitors to the park was approximately 525,000. Since 1996, the annual average number of recreation visits reported has dropped to about 363,000, although the apparent decrease is due, at least in part, to a change in counting methods.

In 2001, 360,191 recreation visits were recorded at Denali National Park (NPS Website; Public Use Statistics Office), along with 791,764 non-recreation visits[1]. Visits were highly concentrated in the summer months; 83% of all recreation visits occurred in June, July and August, with an additional 16.5% in May and September combined. By activity, 42,870 people participated in camping (both RV and tent), and there were 35,301 backcountry campers in 2001. Another 19,106 visitors stayed at concessionaire lodging in the park. Kantishna-area lodge visitors are conservatively estimated at approximately 7,000 per year (NPS 1999). Although these data are for 2001 or somewhat earlier, only minor physical or management changes have occurred since then.

SCENIC VALUES

The opportunity to view outstanding scenery and wildlife is the main visitor attraction at the park, with the concessioner-operated Tour and VTS bus systems providing the primary means of access for park viewers. The majority of VTS (shuttle bus) riders board at the Visitor Access Center located at MP 0.5 for travel as far as Kantishna, with the option of debarking at any point in between. Other visitors, primarily those on packaged tour plans, utilize the Tour bus system. Depending on the choice of long (Tundra Wilderness Tour) or short (Denali Natural History Tour) tour, visitors may travel as far as the Stony Dome turnaround (MP 60), or Primrose Ridge at MP 17. In addition to bus riders, major user groups include campers, backpackers, and hikers. During the main visitor season (May through August), private vehicle access to the interior of the park is restricted beyond the Savage River check station (MP 14.9).

While most viewing occurs while visitors are in transit along the park road, some viewing opportunities also exist at visitor facilities such as the Visitor Access Center, park campgrounds, Teklanika Rest Stop, Polychrome Rest Stop, Toklat Rest Stop, Stony Hill overlook and Eielson Visitor Center.

The character of the road and its relationship with the landscape is considered an integral part of the visitor experience. Between Mileposts 15 and 30, the gravel roadway has two gravel lanes and crosses broad sweeping terrain. The roadway is narrower from Mileposts 30 to 93, with some two-lane sections but typically one lane with pullouts at various locations in areas of more rugged terrain. The location and setting of the park road, between the high peaks of the Alaska Range and the foothills to the north and in an area of limited forest cover, provide an excellent vantage point and

[1] Non-recreational visitors include all administrative trips, photographer trips, Kantishna inholder trips and bus training trips.

long-distance views to travelers on the park road. Because virtually all human disturbance in the park is confined to the road corridor and the non-wilderness development nodes along the corridor, the scenic views available to park visitors typically show minimal modification of the natural landscape.

PUBLIC ACCESS AND SAFETY

In 1972 the NPS instituted shuttle bus service into the park and restricted the operation of private vehicles on the gravel section of the park road beyond Savage River (MP 14.9). Visitors camping at Teklanika for a 3-night minimum stay, Kantishna property owners, individuals with special use permits and NPS personnel on official business are allowed to drive private vehicles past Savage River. Since 1995 the shuttle bus system has been operated by the park concessioner under contract to the NPS. The concessioner also operates bus systems for the Denali Natural History Tour (operating from the entrance area to about MP 17) and the Tundra Wilderness Tour (to Toklat or Stony Overlook at MP 62). Shuttle buses and concessioner courtesy shuttles also operate within the entrance area. Courtesy buses provide transportation between the entrance area and lodging facilities outside of the park entrance. The current park transportation systems have been successful at providing their primary function, which is to minimize wildlife disturbance while providing public access to the interior of the park.

The park road was designed as a low-speed route for wildlife viewing. Much of the road west of the Teklanika River is essentially unchanged from its original construction. Since paving of the park road to Savage River and reconstruction of a wider roadway to Teklanika was completed in 1972, the only major road improvement activity (other than routine maintenance) was an upgrade of the road in the Thorofare Pass area in the mid-1980s. Use and climate conditions have affected the condition of the park road over time. Along much of the road the gravel surface has worn off and the shoulders have eroded, reducing the usable width of the roadway. Subsurface drainage problems require a high level of maintenance along certain sections just to keep the road passable and to meet minimal safety standards.

PARK MANAGEMENT

Park management functions include administration, operations and maintenance of park facilities (including the park road), visitor services, natural resources management, cultural resource management, and access and minerals management. Overall management guidance for the park is established in the General Management Plan (GMP); the current GMP for Denali was adopted in 1986. The NPS also prepares and implements specific action plans, such as a resource management plan and development concept plans for specific developed areas, to supplement the direction provided in the GMP.

The current General Management Plan for Denali (NPS 1986) assigns all lands within the park to one of four management zones: the natural zone, which includes over 97% of the park and preserve acreage; the historic zone; the park development zone, which includes the road corridor and all major developed facilities; and the special use zone, which applies to all lands within the park boundary that are owned or used by parties other than the NPS. All 10 of the candidate gravel extraction sites under consideration in this EA are within the park development zone. Lands in this zone are managed to accommodate major development and intensive use.

One of the key park management activities is the operation and maintenance of the park road. In accordance with the GMP, the Denali National Park and Preserve road must be managed to provide park visitors an opportunity to access the Denali wilderness, provide circulation and access to public and administrative facilities, and provide reasonable access to private property in the Kantishna Hills area (NPS 1986). While meeting these goals, the National Park Service must maintain the character of the road and protect the park's resources.

LOCAL ECONOMY

Most of Denali National Park and Preserve, including the entire entrance area and road corridor, lies within the municipal government boundaries of Alaska's Denali Borough. The area is sparsely populated due to the harshness of the climate, remote lifestyle, and difficulties making a living. Relatively few high-paying economic opportunities are available to attract and support a large population. According to the 2000 Census, the total population of the Denali Borough was 1,893 (U.S. Bureau of the Census 2000).

In the summer of 1996 the seasonal peak employment in the Denali Borough was estimated at 2,585 (Adams 1997). The 2000 Census estimated that Denali Borough had a total employment of approximately 1,065 (U.S. Bureau of the Census 2000). Based on these figures, it can be assumed that about two thirds of the local work force is seasonally employed. Four main economic sectors dominate employment in the Denali Borough: tourism, services, mining, and the federal government (NPS 1999). The National Park employed 88 permanent employees and 160 seasonal employees in 1999 (NPS 2001). According to the 2000 Census 126 people (15% of the total) in the Denali Borough were employed in agriculture, forestry, fishing, hunting, and mining (U.S. Bureau of the Census 2000). According to the U.S. Bureau of Economic Analysis, the vast majority of those jobs were in mining.

Healy is the closest community to the park entrance. Healy's population is approximately 1,000, accounting for 53 percent of the total population in the Denali Borough (U.S. Bureau of the Census 2000). Healy has Alaska's largest coal mining operation and supplies about 1.5 million short tons of coal per year to various sources, including the Healy Coal-fired Electrical Plant. The mine employs about 110 full-time employees, while the power plant employs another 25 (NPS 1999). The statistics available for the local economy do not distinguish the size of the local gravel mining industry. Based on the available data on coal mining and total employment, however, the external material sources near the park entrance appear to account for a relatively small portion of total employment locally.

Virtually all (approximately 95%) of the seasonal population of Kantishna is composed of employees of the four lodges (and the air service) and lodge guests. These individuals reside in Kantishna from early June to mid-September. There are approximately 110 to 130 lodge employees. A conservative estimate of 7,000 people visit or reside in Kantishna during the summer period (NPS 1999).

SUBSISTENCE

Title I and Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) require that all proposed actions within Alaska national parks address potential impacts on the area's legally permitted federal subsistence users. Many native and non-native local and rural residents engage in, and depend on, resources from the parks and other rural areas for personal consumption resources, cultural identity, and to maintain a subsistence way of life.

Subsistence uses are allowed within the 1980 additions to Denali National Park and Preserve in accordance with Titles II and VIII of ANILCA. Lands within the former Mount McKinley National

Park, which are virtually all designated as wilderness, are closed to subsistence uses. The entrance area and road corridor lie within the original boundary of Denali National Park, but are not designated wilderness. They are, however, closed to subsistence uses. The park road from mile 88 to the Kantishna airstrip (mile 93) and the Kantishna Hills are within the 1980 park additions where subsistence uses are allowed.

The NPS determines eligible local and rural subsistence users through the use of resident zone communities and individual subsistence use permits. The subsistence resident zone communities for Denali are Cantwell, Lake Minchumina, Nikolai, and Telida. Subsequently, local and rural residents of these communities are permitted to engage in subsistence activities in the new park and preserve. In addition, as of 1999 there were 15 other local rural families with Denali subsistence use permits who do not live with in one of these designated resident zone communities. These users must acquire a subsistence use permit from the park superintendent.

WILDERNESS

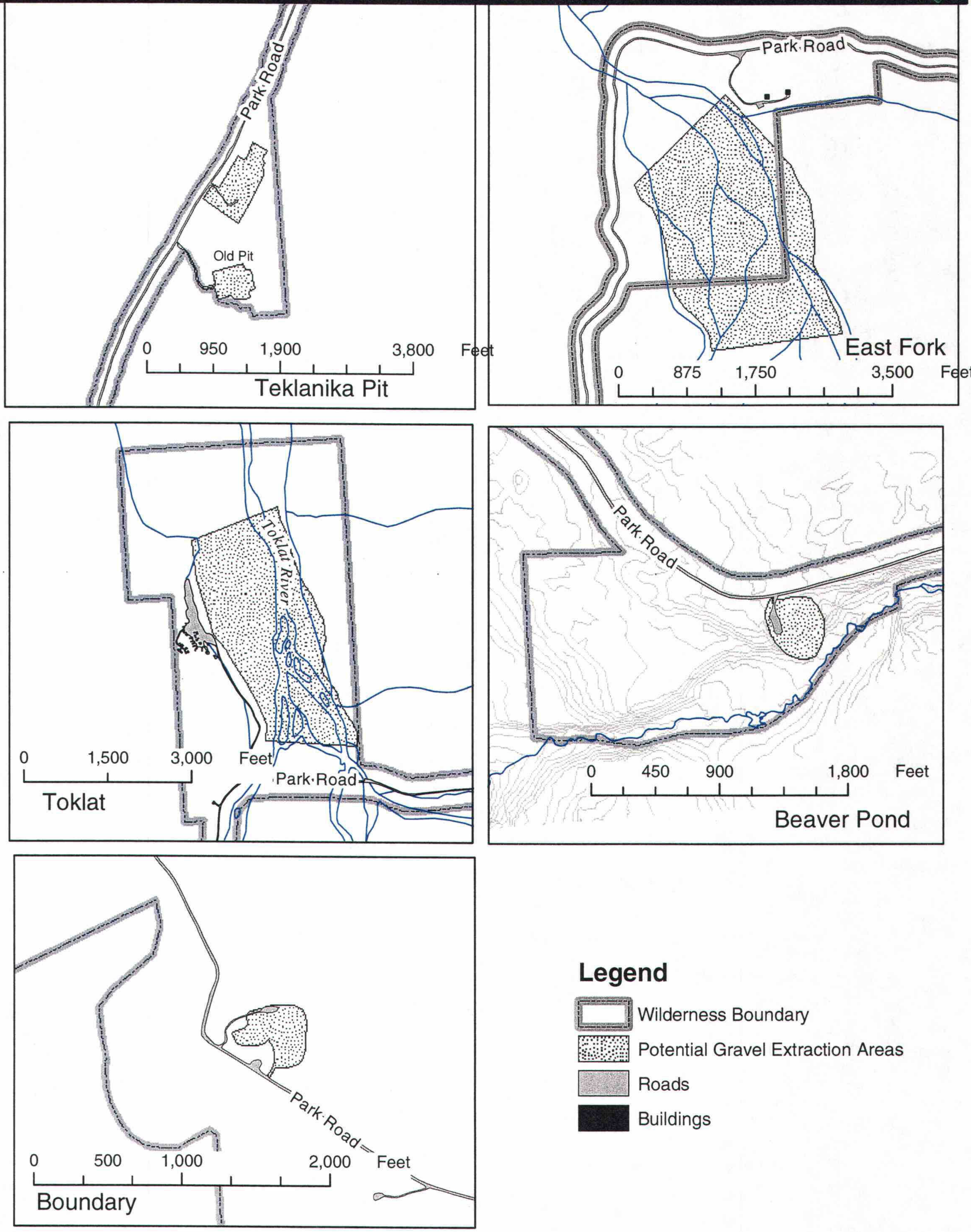
The Wilderness Act of 1964 (PL 88-577) describes wilderness as an area "untrammeled by man...retaining its primeval character and influence, without permanent improvements or human habitation...[with] outstanding opportunities for solitude or a primitive and unconfined type of recreation." Much of the land within Denali National Park and Preserve meets the above criteria, offering superlative opportunities for wilderness recreation in an environment where human influences are minimal. Denali is one of the few places in Alaska where visitors of all ages and abilities can experience wilderness first hand. Not only does the park afford outstanding opportunities for primitive wilderness recreation, it also affords visitors an opportunity to confront wilderness in a safe and controlled environment.

In 1980, Section 701 of ANICLA designated most of the former Mount McKinley National Park as wilderness. The more than 2-million-acre Denali Wilderness is managed under the 1964 Wilderness Act, with special provisions for Alaska wilderness areas as established under ANILCA. Map 3.1 shows the location of the wilderness boundary near five of the potential gravel extraction sites. As required by section 1317(a) of ANILCA, in 1988 the NPS completed a wilderness suitability review for all non-wilderness lands within park boundaries. Of the approximately 3.9 million acres determined eligible as wilderness, the study recommended 2.5 million acres for wilderness designation. However, the Department of the Interior did not forward the recommendation to Congress for approval. Until Congress acts on this recommendation, it is NPS policy to manage areas of potential wilderness as if they were designated wilderness.

The 2001 NPS *Management Policies* mandate that wilderness areas be managed to preserve their wilderness character and resources while providing for appropriate use. Appropriate uses do not degrade the wilderness environment and include activities such as recreation, scientific inquiry, education, and historical uses. NPS policies further direct that when wilderness has been established within an NPS unit, an additional statutory purpose of the park becomes the preservation of wilderness resources and values in those areas.

Map 3.1 - Wilderness Boundary

Denali National Park and Preserve
National Park Service
U. S. Department of the Interior



CHAPTER 4
IMPACTS OF THE ALTERNATIVES

Chapter 4 of the EA documents the analysis of impacts expected to result from the GAP alternatives evaluated in detail. This chapter is organized according to the same topic headings included in Chapter 3 and the issue topics identified in Chapter 1. The focus of the analysis is the specific resources, primarily those within or immediately adjacent to the park road corridor, that would most likely be subject to changed conditions resulting from gravel extraction, processing and hauling activities.

The characteristics of the five GAP alternatives, as described in detail in Chapter 2, provide the basis for the determination of the type and level of impacts expected to occur for each resource and alternative. Aside from the location of the respective activities, the key characteristics include the volume of material to be removed at the potential extraction sites, the corresponding area of disturbance at the sites and the site-specific plans for the configuration of mining activity at each site. These site-specific plans are documented in Appendix C.

The impact analysis has been conducted in a consistent manner based on standardized impact-level definitions. For each resource or issue area, direct, indirect and cumulative impacts have been characterized as negligible, minor, moderate or major. The impact level identified for each case was based on considerations of the applicable dimensions of the impact, including timing and duration, intensity and geographic extent. Table 4.1 summarizes impact definitions corresponding to the respective impact topics.

For many of the resources, assessment of the level of expected impacts is at least partially dependent upon the area of disturbance at the potential gravel sites. Table 4.2 summarizes the estimated area of surface disturbance for each site under the respective alternatives. The table distinguishes between new disturbance or expanded disturbance at previously developed material sites, as is the case for most of the potential extraction sites, and re-working of a previously disturbed mining area at the Downtown Kantishna site. Data addressing the total deposit area and the area expected to be disturbed for access road development are also included. The implications of the data presented in the table are discussed elsewhere in Chapter 4 for the respective resources.

The area of surface disturbance created by gravel extraction and processing is compared to the baseline level of existing development and disturbance within the road corridor. This has been done to provide context for the identified direct and indirect impacts, and to provide a quantitative basis for discussion of cumulative impacts. NPS estimates of the existing disturbed area within the park road corridor are indicated in Table 4.3. In Table 4.3 visitor facilities include features such as campgrounds, rest stops and other structures developed specifically to serve the park visitor population. The area for the park road is based on an assumed 30-foot average width of disturbance along the 93-mile length of the road. The Other Infrastructure category includes sewage lagoons, the airstrip and railroad depot, and existing gravel pits (active and inactive) within the park.

TABLE 4-1 DEFINITIONS OF IMPACT LEVELS

IMPACT TOPIC	IMPACT LEVEL			
	Negligible	Minor	Moderate	Major
Physical Resources (Air & Water Quality, Geologic Resources, Floodplain, & Hydrology)	Little or no change in physical resources.	Short-term changes to physical resources that occur in a small geographic area.	Short-term changes to physical resources occur over a large geographic area or long-term changes occur over a small, localized area.	Long-term changes to physical resources occur over a large geographic area
Vegetation & Wetlands	Little or no change in vegetation or wetlands.	Short-term changes to vegetation or wetlands occur in a small geographic area.	Short-term changes to vegetation or wetlands occur over a large geographic area or long-term changes occur over a small, localized area.	Long-term changes to vegetation or wetlands occur over a large geographic area.
Wildlife & Aquatic Resources	Little or no change in wildlife or aquatic resources.	Short-term local changes in wildlife or aquatic resource populations or habitats.	Short-term widespread changes to wildlife or aquatic resource populations or habitat.	Long-term widespread changes to wildlife or aquatic resource populations or habitat.
Cultural Resources	Little or no change in cultural sites.	Some change to a limited number of cultural sites and/or a unique representative class of cultural resources	Some change to widespread/numerous cultural sites and /or unique representative class of cultural resources.	Complete or near complete change of multiple cultural sites and /or a unique representative class of cultural resources.
Visitor Use & Experience	Little or no change in visitor use or experience.	Short-term, local change in visitor use or experience.	Short-term, widespread change in visitor use or experience.	Long-term, widespread change in visitor use or experience.
Scenic Values	Little or no change in scenic values.	Short-term changes to scenic values occur in a small geographic area.	Short-term changes to scenic values occur over a large geographic area or long-term changes occur over a small, localized area.	Long-term changes to scenic values occur over a large geographic area.
Public Access & Safety	Little or no change in public access or safety.	Short-term, local change in public access or safety.	Short-term, widespread change in public access or safety.	Long-term, widespread change in public access or safety.
Wilderness	Little or no change in wilderness character or status.	Small changes in wilderness character affect only a small part of the park.	Modest changes in wilderness character affect a substantial part of the park or large changes affect a only a small part of the park.	Substantial changes in wilderness character affect a large portion of the park.
Park Management	Little or no change in staffing levels, or management operations or priorities.	Required management adjustments can be made over the short-term (1-2 years).	Most management adjustments can be made over the short-term (1-2 years), some require an additional 1-2 years.	Broad –based management adjustments, generally require several years to implement.
Local Economy	Little or no noticeable change in economic activity.	Local changes in economic activity.	Regional changes in overall economic activity.	Widespread significant changes in overall economic activity.

TABLE 4.2 AREA OF DISTURBANCE, BY SITE AND ALTERNATIVE

Gravel Source	Total Volume of Deposit (cy)	Total Deposit Area (ac)[1]	Area of Access Roads[4]	Area Disturbed Alt. 1	Area Disturbed Alt. 2	Area Disturbed Alt. 3	Area Disturbed Alt. 4	Area Disturbed Alt. 5
New Disturbance								
Teklanika	75,000	1.5	-	0.7	1.3	0.1	1.4	1.4
East Fork River	[2]	[2]	-		[5]		[5]	[5]
Toklat River	[2]	[2]	-	[5]	[5]	[5]	[5]	[5]
Beaver Pond	70,000	3.5	0.1	0.0	1.2	0.0	1.1	1.1
Boundary	39,000	2.4	0.1	0.0	0.8	0.0	0.0	0.0
Moose Creek Terrace	164,000	3.7	0.1	0.0	0.0	2.5	0.8	0.0
North Face Corner	157,500	3.6	-	0.2	0.0	0.0	0.0	0.7
Camp Ridge	72,000	4.5	-	0.0	0.2	0.0	0.0	0.0
Kantishna Airstrip	77,000	7.6	0.2	0.0	1.1	0.0	0.0	0.0
New In-Park Total		**26.8**	**0.5**	**0.9**	**4.6**	**2.6**	**3.3**	**3.2**
Previously Disturbed Sites								
Downtown Kantishna	59,000	55.2	0.0	0.0	42	0.0	42	42
Total In-Park Area			**0.5**	**0.9**	**46.6**	**2.6**	**45.3**	**45.2**
External Sources	[3]	[3]	-	34.1	2.0	18.1	2.0	2.0
Total Disturbed Area			**0.5**	**35.0**	**48.6**	**20.7**	**47.3**	**47.2**

[1] Represents maximum possible area of disturbance at site if contingencies required shifting of volumes among sites.
[2] Not applicable, because the excavation would be in active floodplain.
[3] Estimated from ratio of average volume to average area of in-park sources.
[4] Where dashed, there is either an existing road, or source is immediately adjacent to Park Road
[5] Surface disturbance for equipment access and mirror-channel extraction cuts would occur seasonally, be obliterated in short term through natural processes.

TABLE 4.3 EXISTING AREA OF SURFACE DISTURBANCE, PARK ROAD CORRIDOR

Type of Facility	Surface Area (acres)
Visitor Facilities	83
Park Road	335
Other Infrastructure	47
NPS Administrative Facilities	60
Total	**525**

Another key measure in the impact analysis for several resources is the amount of gravel hauling activity that would be added to the park road through implementation of the respective GAP alternatives, and the relationship of that activity to the existing level of total vehicle miles on the park road. The NPS estimates that total annual visitor and administrative traffic on the park road amounts to nearly 1.5 million vehicle miles, distributed as shown in Table 4.4.

TABLE 4.4 ESTIMATED CURRENT ANNUAL VEHICLE MILES BY TRAFFIC TYPE

Traffic Component	Vehicle Miles
Shuttle Buses	702,000
Long Tour Bus Trips	267,000
Short Tour Bus Trips	43,000
Teklanika Private Vehicles	64,000
Kantishna Inholders	216,000
NPS Admin Travel	189,000
Total	**1,481,000**

The aggregate annual figure of 1.5 million vehicle miles is based on the number of vehicle trips of each type recorded at the Savage River check station and an assumed average or typical round-trip distance for each traffic component. (For example, short tour bus trips typically have a turnaround-point at MP 17, and therefore account for 34 total miles on the park road for each trip, and only 4 miles on the gravel part of the park road.) The vehicle mileage estimate includes very little existing trucking activity associated with hauling gravel to maintenance locations within the park road corridor, because of the manner in which vehicle trips are recorded. A dump truck used for hauling gravel would be counted as a single vehicle trip for the entry and exit by the Savage River Checkpoint, but it could actually log dozens of trips shuttling loads of gravel between Toklat, for example, and various points along the park road. Consequently, the current gravel-hauling vehicle mileage is not monitored by the NPS and is unknown. NPS maintenance personnel estimate each dump truck is driven about 400 hours each season at an average 20 mph or 8,000 miles per season. The park's 6 dump trucks would then be estimated to contribute about 48,000 vehicle miles each year. This estimate does not include the gravel truck miles from contractor trucks passing the Savage Checkpoint, which would be included in the administrative travel in Table 4.4.

The five GAP alternatives would generate gravel-hauling activity producing about 105,000 to 228,000 average annual vehicle miles. The primary determinants of the total level of gravel truck mileage for a given alternative are the volume of material to be supplied by external sources and the geographic distribution of in-park gravel sources. Table 4.5 summarizes the estimated vehicle miles per alternative, as reported in the detailed estimates in Appendix B. Because the existing level of gravel-hauling activity was not tracked, it is not possible to make a direct comparison of the vehicle mileage figures shown in Table 4.5 to the corresponding baseline figures for gravel hauling. However, the approximate relationship can be illustrated by comparing gravel volumes used in recent years to the volumes anticipated under the GAP. As indicated in Appendix A, actual park gravel use amounted to approximately 33,000 cy in 2000, 25,000 cy in 2001 and 48,000 cy in 2002, for an annual average of about 35,000 cy over the past 3 years. The volume of gravel needed over the next 10 years is projected to average about 37,500 cy per year. This represents a slight increase (approximately 7 percent) compared to the annual average for the 2000-2002 period.

TABLE 4.5 SUMMARY OF GRAVEL TRUCK VEHICLE MILES, BY ALTERNATIVE[1]

Alternative	Total Miles (10 years)	Ave. Miles per Year	Percent of Current Total
1	2,279,919	228,000	16
2	1,103,780	110,000	7
3	1,746,164	175,000	12
4	1,061,371	106,000	7
5	1,051,131	105,000	7

[1] Stated as equivalent percentage to current estimated baseline level of approximately 1,481,000 annual vehicle miles

From Table 4.5 it is evident that Alternatives 2, 4 or 5 would result in essentially the same level of gravel-hauling activity on the park road, while Alternatives 3 and 1 would result in considerably higher levels of activity. This comparison is discussed at several points in the impact analysis, along with the level of gravel-hauling activity relative to the existing volume of visitor and administrative traffic on the park road.

CLIMATE AND AIR QUALITY

Current park management activities, including gravel acquisition operations along the park road corridor, generate minor amounts of airborne pollutants. The primary in-park sources of air pollution include dust and vehicle exhaust emissions generated by traffic along the park road, and dust and vehicle exhaust emissions by vehicles and equipment used for gravel acquisition and road maintenance activities.

Airborne pollutants produced by construction equipment (including gravel extraction, processing, and hauling equipment) include emissions of carbon monoxide, sulfur dioxide, nitrogen oxides, volatile organic compounds (e.g., reactive hydrocarbons) and particulate matter. Gasoline and diesel-powered vehicles traveling on the park road emit many of these same pollutants, in addition to causing an increase in ambient dust levels along the road corridor. Gravel extraction and processing activities also produce particulate matter in the form of dust.

Road dust may interfere with plant respiration, and has been associated with major increase in the pH of the organic layer and a decline in the height of live moss (Walker and Webber 1980; Spatt and Miller 1981; Walker and Everett 1987; NPS 1996a; NPS 1996b). To mitigate potential impacts, the NPS would continue to apply dust palliatives and particle binders to the road surface. Expansion of the area of the park road on which dust palliatives are used could help to reduce the dust emissions created by gravel hauling and other traffic.

The GAP alternatives would have impacts on air quality similar to those caused by existing activities. The activity sources of airborne pollutants resulting from implementation of the plan would be (1) operation of extraction, processing, and construction equipment and (2) trucks hauling gravel on the park road. In all cases the relative emission contribution from extraction and processing equipment would depend on the volume of material extracted. Likewise, the contribution of emissions from material hauling would depend primarily on the volume of material transported and the total vehicle mileage traveled. Emissions and dust from road repair and maintenance would be equivalent for all of the alternatives, as these activities would not change due to the chosen alternative.

Although activities associated with the gravel acquisition plan might cause short-term and localized degradation of air quality, the impact would be minor in the context of the park's overall excellent air quality, which has been monitored near park headquarters for over 15 years (NPS 2002.) Adherence to the seasonal traffic limits established in the GMP would keep total traffic on the park road, and therefore total vehicle emissions and dust volumes associated with visitor and administrative traffic, at or near existing levels. While the four action alternatives would result in an increase in the volume of gravel extracted and processed in the park over the 10-year planning period, this would be an incremental change to the level of an existing airborne pollutant source and not a major new source. In addition, vehicle emissions and dust associated with gravel operations would be produced on an intermittent basis within a long, narrow corridor of the park; they would likely be dispersed to background levels relatively near the road corridor. Based on such volume and distribution conditions, the emissions associated with any of the five alternatives would represent minor to moderate changes to air quality in the park, as discussed for each alternative below.

Alternative 1: No Action

Under this alternative gravel acquisition, processing and storage would continue at currently approved sites. Direct impacts to air quality from gravel extraction and processing would continue as at present, and no additional sources of air pollutants would be introduced through this alternative. As indicated in Table 4.5, however, total gravel hauling mileage would amount to approximately 228,000 vehicle miles, representing a figure equivalent to about 16 percent of the current volume of park road visitor and administrative traffic. Compared to actual miles driven by gravel trucks over the past three years, Alternative 1 would likely result in a doubling of gravel-hauling activity. These impacts would be long-term, intermittent, and limited to a relatively small area (the park road corridor); based on the impact level definitions presented in Table 4.1 they would be considered moderate in the road corridor.

Cumulative Impacts: Existing human-caused air emissions in the park primarily consist of exhaust and fugitive dust created by vehicle traffic along the park road. Airborne contaminants from Eurasian industrial and agricultural practices travel across the Pacific Ocean, peak in the spring, and have caused periods of moderate arctic haze. Future actions in and around the park area, such as increased tourism activity, air traffic, and off-road vehicle use are likely to have little impact on air quality in the park road corridor. The 16% increase in vehicle mileage on the park road from gravel hauling activity that is due to this alternative would cause an incremental increase in the volume of airborne pollutants. Due to the localized and repetitive nature of the current and future impacts to air quality, the cumulative impacts on air quality in the park would be moderate.

Conclusion: With the two-fold increase in trucking activity resulting in 16% of the overall traffic and widespread increase in dust emissions along the park road, the overall impacts to air quality along the road corridor from the no-action alternative would be moderate. The level of impacts to air quality from Alternative 1 would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

Alternative 2 would authorize extraction and/or processing of mineral material at up to nine sites (three existing sites and six new extraction sites) distributed along the park road corridor from Teklanika to the Kantishna area. Direct impacts to air quality would include exhaust emissions from gravel extraction and processing equipment operating at the source sites, and dust generated by extraction and processing activities. Because this alternative involves the greatest number of operating sites, the geographic distribution of dust and emissions produced at extraction and processing sites would be most widespread under this alternative. The total volume of airborne pollutants from gravel extraction would result in a small increase over the volume produced by recent gravel operations.

Indirect impacts would occur as a result of trucks hauling mineral materials to various locations along the park road, and would also include exhaust emissions and dust from the vehicular activity. Dust and emissions produced by trucks hauling material along the park road would be comparatively low, as the aggregate hauling distance (110,000 miles) under this alternative would be equal to about 7 percent of the current annual visitor and administrative traffic on the park road (1,481,000 miles.) Dust and engine emissions generated by extraction operations and truck traffic would represent a small incremental addition to the volume of other traffic on the park road and the associated emissions. Because this alternative relies primarily on in-park resources and would provide relatively short average haul distances, it is possible that total vehicle mileage for hauling gravel would actually be less than the current baseline level. Both types of air emissions would occur intermittently during the annual operating season and would be localized in the vicinity of the road corridor. Based on the incremental nature of these air quality impacts and their timing characteristics, the airborne pollutants from this alternative would have a minor direct and indirect impact on air quality in the park.

Cumulative Impacts: Existing human-caused air emissions in the park primarily consist of exhaust and fugitive dust created by vehicle traffic along the park road. Airborne contaminants from Eurasian industrial and agricultural practices travel across the Pacific Ocean, peak in the spring, and have caused periods of moderate arctic haze. Future actions in and around the park area, such as increased tourism activity, air traffic, and off-road vehicle use are likely to have little impact on air quality in the park road corridor. The 7 % increase in vehicle mileage on the park road from gravel hauling activity that is due to this alternative would cause an incremental increase in the volume of airborne pollutants. Due to the localized and repetitive nature of the current and future impacts to air quality, the cumulative impacts on air quality in the park would be moderate.

Conclusion: The overall level of impacts to air quality under Alternative 2 would be minor and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

The air quality impacts of Alternative 3 would be similar to those described above for Alternative 1. Dust and vehicle emissions from gravel extraction and processing operations would occur at three sites, including the Teklanika and Toklat River sites used in Alternative 1 and the new Moose Creek Terrace site. These emissions would be localized, intermittent, and long-term (10 years.) Indirect air quality impacts associated with 175,000 gravel truck miles would be 25 % less than for Alternative 1 but much more than in recent years, resulting in widespread new dust emissions along the park road corridor.

Cumulative Impacts: Existing human-caused air emissions in the park primarily consist of exhaust and fugitive dust created by vehicle traffic along the park road. Airborne contaminants from Eurasian industrial and agricultural practices travel across the Pacific Ocean, peak in the spring, and have caused periods of moderate arctic haze. Future actions in and around the park area, such as increased tourism activity, air traffic, and off-road vehicle use are likely to have little impact on air quality in the park road corridor. The 12 % increase in vehicle mileage on the park road from gravel hauling activity that is due to this alternative would cause an incremental increase in the volume of airborne pollutants. Due to the localized and repetitive nature of the current and future impacts to air quality, the cumulative impacts on air quality along the park road corridor would be moderate.

Conclusion: The overall impacts to air quality along the park road from alternative 3 would be moderate. The level of impacts to air quality from Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of a Moderate Number of Sites *(NPS Preferred)*

This alternative would authorize the use of six borrow sites, with the sites in the Kantishna area utilized in two phases. Dust and vehicle emissions from gravel extraction and processing would be somewhat more widely distributed than with Alternative 3 and somewhat less widely distributed than with Alternative 2, but the same in volume. Pollutants from truck miles along the park road would be virtually the same as for Alternative 2 (see Table 4.4), and at most a slight increase over the effects of current traffic on the park road. Airborne pollutants from this alternative would have a minor direct and indirect impact on air quality in the park.

Cumulative Impacts: Existing human-caused air emissions in the park primarily consist of exhaust and fugitive dust created by vehicle traffic along the park road. Airborne contaminants from Eurasian industrial and agricultural practices travel across the Pacific Ocean, peak in the spring, and have caused periods of moderate arctic haze. Future actions in and around the park area, such as increased tourism activity, air traffic, and off-road vehicle use are likely to have little impact on air quality in the park road corridor. The 7 % increase in vehicle mileage on the park road from gravel hauling activity that is due to this alternative would cause an incremental increase in the volume of airborne pollutants. Due to the localized and repetitive nature of the current and future impacts to air quality, the cumulative impacts on air quality in the park would be moderate.

Conclusion: The air quality impacts of Alternative 4 would result in minor levels of airborne pollution within the park road corridor. The overall level of impacts to air quality under Alternative 4 would be minor and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*

This alternative is virtually the same as Alternative 4, with the difference being that North Face Corner would be used instead of Moose Creek Terrace after the supply of gravel from Downtown Kantishna was exhausted. The total volume of dust and vehicle emissions and their time distribution would be virtually the same as for Alternative 4, and the impacts from this alternative would be minor.

Cumulative Impacts: Existing human-caused air emissions in the park primarily consist of exhaust and fugitive dust created by vehicle traffic along the park road. Airborne contaminants from Eurasian industrial and agricultural practices travel across the Pacific Ocean, peak in the spring, and have caused periods of moderate arctic haze. Future actions in and around the park area, such as increased tourism activity, air traffic, and off-road vehicle use are likely to have little impact on air quality in the park road corridor. The 7 % increase in vehicle mileage on the park road from gravel hauling activity that is due to this alternative would cause an incremental increase in the volume of airborne pollutants. Due to the localized and repetitive nature of the current and future impacts to air quality, the cumulative impacts on air quality in the park would be moderate.

Conclusion: The air quality impacts of Alternative 5 would result in minor levels of airborne pollution within the park road corridor. The overall level of impacts to air quality under Alternative 5 would be minor and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

GEOLOGIC RESOURCES

Pertinent issues associated with geologic resources include the need for long-term availability of borrow source material, the potential for extraction activities to undermine overlying strata and compromise slope stability, the potential for accelerated erosion and potential impacts related to the influence of extraction activities on permafrost.

The glacial history of Denali and the Alaska Range created extensive gravel resources in the morainal and outwash deposits on the north side of the range. Even within the confines of the road corridor and its adjacent development nodes, readily accessible gravel supplies are abundant. The 10 candidate gravel extraction sites evaluated in this EA represent a potential gravel supply of well over 750,000 cy, or more than double the total gravel needs identified by the NPS for the 10-year planning period. The NPS has identified other possible gravel sites along the road corridor that are not now under consideration for active use, but that could potentially supply gravel in the future if conditions warranted. Deposits along the park road corridor are constrained by designated Wilderness, the road corridor itself, wetlands, and other screening criteria identified in Chapter 1. Extraction at these finite resources in the next 10 years would diminish the available supply for future generations, except from replenished sites like Toklat River.

The potential for slope stability effects from implementation of the proposed plan is limited by site conditions and operating plans. Slopes within the active working area of upland gravel pits would, by definition, be unstable while they were being excavated. However, the active pit areas would not be adjacent to slopes that could be undermined and subject to failure. The candidate upland excavation sites are generally located on topographic benches in areas of little local relief. Areas within the mining operation that were not needed for stockpiles, access and loading would be reclaimed concurrently with extraction operations, and at the end of the operating period each site would be recontoured and restored. Gravel mining at the floodplain extraction sites would occur within the braided river channel areas, and would not be located adjacent to riverbanks that could be undercut. Therefore, it is unlikely that extraction operations for any of the alternatives would create slope stability risks outside of the defined extraction areas.

Disturbed areas within the active extraction sites would be subject to potential erosion during the interval between vegetation clearing and site restoration. The mining plans for all sites include provisions to limit erosion and control surface runoff during the active operating period for each site, and operational monitoring would include erosion and related resource protection concerns. All mined areas would be fully restored after operation, including revegetation and measures to control runoff. Consequently, none of the alternatives under consideration should result in accelerated erosion in off-site areas of the park.

The main effect of alteration of permafrost is to create potential for damage to buildings and infrastructure. Differential settlement of the soil due to thawing of permafrost can damage foundations, disrupt linear utilities (buried pipelines and cables) and damage roadbeds. However, none of the proposed gravel removal sites in the park is near buildings or other infrastructure, and no buried pipelines or cables cross in or near the proposed sites. While the park road is near the proposed extraction sites, the site locations are generally uphill and/or several hundreds of feet from the road. Therefore, any influence of extraction activity on thermokarst development would be unlikely to affect the road. Similarly, no existing structures are located close to any of the candidate extraction sites. Therefore, none of the alternatives would have off-site effects related to permafrost or thermokarst.

Alternative 1: No Action

Gravel extraction activities at three locations within the park would result in consumption of approximately 120,000 to 130,000 cy from in-park resources (including the contingency allowance) over a 10-year period. About 75,000 cy of this material would come from Toklat River, which is replenished by river bed load transport over a short term following removal. Alternative 1 would also consume approximately 220,000 to 240,000 cy of material from an undetermined number of external gravel sources, which would presumably represent a small quantity relative to the total supply available in river valley locations outside of the park. . Extraction activities at three sites within the park and at undetermined external source locations would be unlikely to result in off-site slope stability or erosion concerns. No structures within the park would be subject to potential damage through changes in permafrost/thermokarst conditions. The activities undertaken to implement Alternative 1 would result in virtually no change at Toklat River and a small change at Teklanika Pit and North Face Corner as indicated in Tables 4.2. The impacts from this alternative on geological resources would be negligible.

Cumulative Impacts: Previous impacts to geological resources have occurred along the park road and entrance area, primarily from the removal of mineral materials to construct the park road and other park facilities (see Table 4.3). Numerous borrow sites occur along the road corridor, many of which have become overgrown with native vegetation. Past placer mining and related access in the Kantishna Hills impacted about 1,500 acres of area. Less than one acre of area would be affected in the next ten years with this alternative. The total impacts of the past, ongoing, and proposed gravel mining operations would be moderate to geological resources.

Conclusion: Alternative 1 would create negligible off-site impacts involving slope stability, erosion or permafrost and would permanently remove less than 45,000 cy of gravel resources from about one acre of area within the park. The overall level of impacts to geologic resources under Alternative 1 would be minor and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

Gravel extraction activities at eight locations within the park would result in consumption of a total of up to about 330,000 to 360,000 cy from in-park resources, about half of the volume identified in the site plans. About 56 % of that volume would not be renewable, creating a subtle, localized, and long-term impact on identified gravel resources. Alternative 2 would also consume approximately 12,500 cy of material from external gravel sources, which would presumably represent a minimal quantity relative to the total supply available in river valley locations outside of the park. Gravel volumes removed from the East Fork and Toklat River floodplains would be replenished through natural sediment deposition over a short term following removal. Extraction activities at the eight sites within the park and at undetermined outside source locations would be unlikely to result in off-site slope stability or erosion concerns. No structures within the park would be subject to potential damage through changes in permafrost/thermokarst conditions. The activities undertaken to implement Alternative 2 would impact up to 4.6 acres of new area and 42 acres of previously disturbed area over the next 10 years (Table 4.2), leading to a moderate impact to geological (gravel) resources along the park road corridor.

Cumulative Impacts: Previous impacts to geological resources have occurred along the park road and entrance area, primarily from the removal of mineral materials to construct the park road and other park facilities (see Table 4.3). Numerous borrow sites occur along the road corridor, many of which have become overgrown with native vegetation. Past placer mining in the Kantishna Hills and related access impacted up to 1,500 acres of area. Less than five acres of area would be affected in the next ten years with this alternative. The total impacts of the past, present, and proposed mining operations would be moderate to geological resources.

Conclusion: Alternative 2 would create the potential for negligible off-site impacts involving slope stability, erosion or permafrost and would not be likely to have a measurable effect on the integrity of geologic resources within the park. About 200,000 cy of gravel would be permanently removed from a small area of previously undisturbed upland sites resulting in a moderate impact to gravel resources. The overall level of impacts to geologic resources under Alternative 2 would be moderate and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

Gravel extraction activities at three locations within the park would result in consumption of a total of approximately 220,000 to 240,000 cy from in-park resources. About half of that volume would be nonrenewable gravel, resulting in a subtle, localized or minor impact on identified park gravel sources. Alternative 3 would also consume approximately 121,000 to 130,000 cy of material from external gravel sources, which would presumably represent a small quantity relative to the total supply available in river valley locations outside of the park. Geologic resource impacts would affect about 2.6 acres of previously undisturbed upland area and the direct and indirect impacts would be minor.

Cumulative Impacts: Previous impacts to geological resources have occurred along the park road and entrance area, primarily from the removal of mineral materials to construct the park road and other park facilities (see Table 4.3). Numerous borrow sites occur along the road corridor, many of which have become overgrown with native vegetation. Past placer mining in the Kantishna Hills and related access impacted up to 1,500 acres of area. Non-renewable gravel would be removed from about 2.6 acres of area in the next ten years with this alternative. The total impacts of the past, present, and proposed mining operations would be moderate to geological resources.

Conclusion: Alternative 3 would create the potential for negligible off-site impacts involving slope stability, erosion or permafrost and would have no measurable effect on the integrity of other geologic resources within the park. About 110,000 cy of gravel would be permanently removed from a small geographic area (2.6 acres), leading to a moderate impact to geological resources along the park road corridor. Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*

Gravel extraction activities at six locations within the park would result in consumption of up to approximately 330,000 to 360,000 cy from in-park resources, the same volume as estimated for Alternative 2. Non-renewable gravel would be reduced by about 200,000 cy from about 3.3 acres of undisturbed upland area and 42 acres of previously disturbed mining claims. Alternative 4 would also consume 12,500 cy of material from gravel sources outside of the park, which would represent a minimal quantity relative to the total supply available in river valley locations outside of the park. Potential off-site impacts involving slope stability, erosion and permafrost for Alternative 4 would be very similar to those discussed previously for Alternative 2. The overall direct and indirect impacts would be moderate.

Cumulative Impacts: Previous impacts to geological resources have occurred along the park road and entrance area, primarily from the removal of mineral materials to construct the park road and other park facilities (see Table 4.3). Numerous borrow sites occur along the road corridor, many of which have become overgrown with native vegetation. Past placer mining in the Kantishna Hills and related access impacted up to 1,500 acres of area. Non-renewable gravel would be removed from about 3.3 acres of area in the next ten years with this alternative. The total impacts of the past, present, and proposed mining operations would be moderate to geological resources.

Conclusion: Alternative 4 would create the potential for negligible off-site impacts involving slope stability, erosion or permafrost and would not be likely to have a measurable effect on the integrity of geologic resources within the park. Because about 200,000 cy of non-renewable gravel would be removed from a small geographic area, the overall level of impacts to geologic resources under Alternative 4 would be moderate. This alternative would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*

Gravel extraction activities at six locations within the park would result in consumption of up to approximately 330,000 to 360,000 cy from in-park resources, the same as estimated for Alternative 2 or 4. Non-renewable gravel would be reduced by up to 200,000 cy. Alternative 5 would also consume 12,500 cy of material from external gravel sources, which would represent a minimal quantity relative to the total supply available in river valley locations outside of the park. Potential off-site impacts involving slope stability, erosion and permafrost for Alternative 5 would be very similar to those discussed previously for Alternative 2 or 4. The overall direct and indirect impacts would be moderate.

Cumulative Impacts: Previous impacts to geological resources have occurred along the park road and entrance area, primarily from the removal of mineral materials to construct the park road and other park facilities (see Table 4.3). Numerous borrow sites occur along the road corridor, many of which have become overgrown with native vegetation. Past placer mining in the Kantishna Hills and related access impacted up to 1,500 acres of area. Non-renewable gravel would be removed from about 3.2 acres of area in the next 10 years with this alternative. The total impacts of the past, present, and proposed mining operations would be moderate to geological resources.

Conclusion: Alternative 5 would create the potential for negligible off-site impacts involving slope stability, erosion or permafrost and would not be likely to have a measurable effect on the integrity of geologic resources within the park. About 200,000 cy of non-renewable gravel would be removed from a small geographic area. The overall level of impacts to geologic resources under Alternative 5 would be moderate and would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

HYDROLOGY, WATER QUALITY AND AQUATIC RESOURCES

Site-Specific Hydrologic Conditions

Toklat River

The Toklat River drains a mountainous, 100-square-mile watershed on the north side of the Alaska Range. Several large glaciers feed the river and cover approximately 2 percent of the watershed area. The Toklat River gravel extraction site is 19 miles upstream from the nearest park boundary. The river has a braided channel in the project area, typical of streams that are transport limited (Ritter 1978). Multiple anastomosing channels are present, and the location of active channel changes seasonally and annually. Stream banks are irregular and poorly defined. The active floodplain is approximately 1,200 to 1,800 feet wide. It is composed predominantly of gravel-sized material with occasional cobbles and boulders. The floodplain is at its narrowest where the proposed extraction site is located. The riverbed has a gradient of 1.5 percent in the reach where gravel extraction is proposed.

Abandoned channels are interlaced throughout the active floodplain, with gravel bars present at various heights between the channels. Typical of glacially fed braided streams, the Toklat carries a large amount of suspended sediment and bed load (coarse sediment carried along the channel bottom, rather than in suspension). The high concentration of suspended sediment during the summer makes the water milky in appearance. The estimated average discharge for the Toklat River is 344 cubic feet per second (cfs). The 1.5-year flood was estimated at 1,324 cfs. The average annual bed load discharge at the proposed gravel removal site was estimated at 222,000 cubic yards (cy) per year (Emmett 2000).

East Fork Toklat River

The East Fork Toklat River drains a 77-square-mile watershed on the north side of the Alaska Range that is similar to the main Toklat River basin. Upstream of the study site are five sub-basins, all of which are fed by glaciers. The tributaries from these sub-basins join to from the main stem just upstream from the East Fork Bridge. The East Fork is a tributary of the Toklat River; their confluence is about 20 miles north of the park road.

Like the Toklat River, the East Fork River is a braided stream. The East Fork River occupies a bed that is up to 2,000 feet wide; this gravel drainage course contains the active channels carrying the stream flow. The streambed is composed of gravel-sized material with occasional cobbles and boulders. Abandoned channels criss-cross the drainage course with intervening gravel bars (interfluves). Typical of glacier-fed streams in mountainous terrain, the East Fork River carries a large amount of suspended sediment and bed load. The large amount of suspended fines causes the water to be milky in appearance during the melt season. Before the glaciers begin to melt in the spring and after freeze-up in the fall, river water is clear. The river has a gradient of 1.2 percent in the reach where gravel extraction is proposed.

The estimated bankfull discharge of the East Fork River is 1,000 cfs and the average annual bed load discharge is approximately 108,000 cy (Emmett 2000). Based on advice from research hydrologists and years of excavation experience at the Toklat River site, the NPS previously decided to limit annual excavation of gravel from active alluvial sites to 5 percent of the annual bed load discharge. For the East Fork River, the 5 percent limit is 5,400 cy per year (Emmett 2002).

Moose Creek/Downtown Kantishna

The Downtown Kantishna site is on the west bank and floodplain of Moose Creek, beginning just downstream from the Kantishna Roadhouse, and extending down river almost to the Denali Backcountry Lodge. Laterally, it extends west across the floodplain, from ordinary high water at the Moose Creek channel to a parallel drainage roughly 850 feet away. The length of the site is approximately 3,700 feet and it is approximately 55 acres in size. Eldorado Creek drains a portion of the Kantishna Hills, a low range west of the site. Moose Creek drains a large area east of the proposed gravel extraction site. Although the majority of the basin is of relatively low relief, Moose Creek does drain portions of the eastern Kantishna Hills. No glaciers are present in either drainage basin; hence, Moose Creek is quite different from the Toklat and East Fork Rivers.

This site itself has been substantially disturbed by mining and related development activities in the past 50 years. As part of this historical disturbance, the mouth of Eldorado Creek and the lowermost 1,000 feet of its channel have been moved from their original locations.

Hydrology Impact Variables

The primary criterion for determining the significance of the potential effects on hydrology is whether implementing the GAP would cause substantial changes to the sediment load or channel patterns of a stream. An extensive study by the U.S. Fish and Wildlife Service (Follman 1980) indicates that one of the main effects of gravel extraction on braided streams is to increase the number of channels. Follman (1980) looked at six braided rivers in subarctic Alaska, and at two main types of excavation: shallow excavation (2 to 3 feet) and deep pits (up to 50 feet). He found that the increase in number of channels, an indicator of channel instability, was accompanied by a tendency toward flow diversion out of the main channel. Additionally, Follman (1980) found effects on channel configuration, hydraulic geometry, sedimentation, ice characteristics and hydrology.

Although the channel configuration is one of the variables most likely to change following gravel removal, Follman (1980) observed that braided channels show the least amount of change in this regard, mainly because they already consist of unstable, multiple channels. Changes in hydraulic geometry include changes to the width, depth, velocity, and conveyance volume. Changes to hydraulic geometry are important mainly because they imply potential for change in physical parameters of streams, such as planform and cross-sectional area. Changes in sedimentation, mainly related to changes in the hydraulic geometry, included changes in sediment size distribution. Sediment size typically decreases after gravel removal, owing to the decrease in velocity at the mined area.

Ice characteristics can change dramatically as a result of gravel mining. The primary mechanisms are ice jamming and aufeis formation. Aufeis forms when water is forced to the surface from underneath ice covering a stream. Successive flows build upon each other, forming a raised surface. Both ice jamming and aufeis can be affected by the widening of a channel, followed downstream by a reduction in width and/or depth, obstructions in the floodplain or relocation of a channel. Follman (1980) noted that these changes are more likely to occur in single channel, sinuous, or meandering streams than in braided streams.

Changes to hydrology can occur through surface flow converting to subsurface flow. This happens when the surface flow is lost to intra-gravel flow in the mined area. Notably, this occurred in only 2 of 25 sites studies by Follman (1980), neither of which was a braided stream.

The literature contains several sources of useful guidelines for minimizing the hydrologic effects of in-channel gravel extraction. Joyce and others (1980) discuss guidelines for removal of gravel from braided streams in subarctic Alaska. Their guidelines are summarized as follows:

- The active channel should not be mined;
- Gravel should be scraped, and should not be scraped to a level lower than the summer low-flow level;
- Scraping should be conducted in a way that minimizes the chance of flow diversion through the mined area;
- Vegetated islands, especially mid-channel "islands," should not be disturbed;
- The general configuration of the channel should be maintained;
- Exposed deposits in the active floodplain should be selected for gravel removal, over vegetated terraces; and
- Excavation pits should only be considered when amounts of gravel greater than 50,000 cubic meters are needed.

In addition, Follman (1980) presents several recommendations with regard to gravel mining in subarctic streams:

- "Small" rivers should not be mined;
- Braided rivers are preferable to other types of rivers (e.g., sinuous, meandering);
- Pit excavations should be located on terraces or the inactive floodplain;
- Gravel operations in the active floodplain should not disturb the edge of the active channel;
- Excavation sites should mimic high-water channels;
- The bed slope of the gravel removal area should be similar to the natural active channel slope;
- Excavations should be configured for proper drainage;
- Stockpiles, overburden piles, and dikes should be located away from active channels; and
- Excavation sites should be located well away from low-flow channels.

Similar studies have been conducted on specific potential gravel sources within the park. Karle (1989) determined that, given the appropriate quantity and style of extraction, gravel could be removed without significant alterations to the floodplain. More recent work has indicated that the amount of gravel that can be extracted without detrimental effects may be somewhat more than previously thought (Emmett 2002). The National Park Service (1990) originally concluded that 7,500 cy of gravel could be excavated without significantly altering the Toklat River channel. Based on a revised estimate of the bed load, Emmett (2000) concluded that 11,100 cy could be extracted each year without affecting the channel.

The procedures currently employed by the NPS for gravel extraction are not entirely consistent with the guidelines recommended by Joyce and others (1990) and Follman (1980b). The analysis done by Karle (2002) states "Excavation would proceed downstream to upstream. The final scrape would open the excavated mirror channel to flow from the natural channel. The flow diversion into the new mirror channel should consist of approximately half the total channel water discharge." This procedure differs from the research guidelines listed above, which maintain that 1) flow diversion should be avoided; 2) the edge of the active channel should not be disturbed; and 3) scraping should not go below the depth of the low-water channel. According to the earlier literature, the proposed procedure could cause significant changes to channel form locally. However, the mirror-channel cut procedure has been used by the NPS for several years without substantial changes to the Toklat River floodplain. It is likely that, due to the wide expanse of channel and high bedload flux, the alterations to individual channels (such as localized aggradation) are rapidly attenuated. Therefore, long-term effects would be minimal in degree and extent.

Impacts By Alternative

Alternative 1: No Action

Under this alternative, gravel excavation at the Toklat River site would continue at the present rate of 7,500 cy per year. Based on the estimates of Karle (1989) and Emmett (2000), this would not be likely to modify the sediment load or channel patterns upstream or downstream. This amount of gravel extraction is much less than the recommended maximum amount of 11,100 cy per year. Additionally, monitoring conducted during recent years indicated no changes in channel cross-section or pattern that were out of the normal variation of braided rivers (Emmett 2002). The impacts of this alternative to stream hydrology would be negligible.

Cumulative Impacts: Cumulative impacts of placer mining in the Kantishna Hills were evaluated in the mining EIS (NPS 1990) and past effects were determined to be major. Since that time, the NPS has restored about half of the affected stream areas. The NPS plans to restore the Downtown Kantishna area regardless if gravel is removed from the site. Replacement of the Toklat River bridge is the only other human activity with the potential for altering the hydrology of a river. The existing causeway has backed up water and caused upstream deposition of gravel. Based on the recent monitoring results, the additive effects of Alternative 1 would result in little or no change. The overall cumulative effects with this alternative would be moderate.

Conclusion: Alternative 1 would result in negligible direct, indirect and/or cumulative impacts to stream hydrology and would not be likely to have a measurable effect on the integrity of stream resources within the park. The overall level of hydrology impacts under Alternative 1 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

This alternative would include gravel extraction at both the Toklat and East Fork Rivers. However, because the amount extracted would remain within the 5 percent threshold recommended by Emmett (2000) and Karle (2002) as sustainable, and for the reasons discussed above, little or no effects on channel cross section or planform would be expected and potential hydrology impacts would be negligible. The amount of gravel extraction on the Toklat would be 50 percent higher per year than previously thought to be the maximum sustainable amount. This represents a somewhat higher risk of channel planform and/or cross sectional change. Continued monitoring is called for under the proposed action; should significant channel change occur on either river, the extraction operations could be altered to minimize the effects.

This alternative also includes extensive excavation and regrading at the Downtown Kantishna site. Specific restoration plans for the site are not available at the time of this writing, but conceptual reclamation and mitigation plans are discussed in a separate, recent report (Karle, 2003) prepared for the NPS (included in Appendix C.) This analysis addresses these plans and options for controlling sedimentation, maintaining channel stability, and minimizing floodplain impacts. The report discusses measures to be taken concerning Eldorado Creek, Moose Creek, the extraction area itself, and the options for a bridge across Moose Creek. When followed up with site-specific hydrologic, hydraulic and geomorphologic study, long-term effects to the floodplain and local hydrology and hydraulics could be minimized through the implementation of these measures.

Cumulative Impacts: As discussed above for Alternative 1, past placer mining impacts would continue to have moderate effects. Little to no change to stream hydrology at the East Fork and Toklat River sites would be expected. . Alternative 2 would result in the restoration of natural stream hydrology conditions at the Downtown Kantishna site, and therefore would reverse the adverse hydrologic effects from historical mining operations. Consequently, Alternative 2 would result in little additive effect, but the overall cumulative impact to hydrology would be moderate.

Conclusion: Alternative 2 would result in negligible direct and indirect impacts to stream hydrology (including likely positive effects at Downtown Kantishna) and would not be likely to have a measurable effect on the integrity of stream resources within the park. The overall level of hydrology impacts under Alternative 2 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

Under this alternative, gravel excavation at the Toklat River site would increase to an extraction rate of 11,100 cy per year. Based on the estimates of Karle (1989) and Emmett (2000), this would not be likely to modify the sediment load or channel patterns upstream or downstream. This amount of gravel extraction is up to the recommended maximum amount of 11,100 cy per year. Monitoring conducted during recent years indicated no changes in channel cross-section or pattern occurred when 7,500 cy per year were extracted from the Toklat River (Emmett 2002). The impacts of this alternative to stream hydrology would be negligible.

Cumulative Impacts: Cumulative impacts of alternative 3 would be similar to the cumulative impacts for Alternative 1. Based on the recent monitoring results, the additive effects of Alternative 3 would result in little or no change to hydrologic functions. The overall cumulative effects with this alternative would be moderate.

Conclusion: Alternative 3 would not have a measurable effect on stream resources within the park and would result in negligible direct and indirect impacts to stream hydrology. The overall level of hydrology impacts under Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*

This alternative includes in-channel gravel extraction at the Toklat River and East Fork River sites. Gravel extraction would also occur at the Downtown Kantishna site under this alternative. The measures discussed by Karle (2003) would minimize the temporary adverse effects on the hydrology, hydraulics, and geomorphology of the site and associated streams, while restoration of more natural stream channel conditions would likely improve the local hydrology on a long-term basis. For the reasons stated under Alternatives 1 and 2 above, effects on hydrology at these sites would be negligible.

Cumulative Impacts: As discussed above for Alternative 1, past placer mining impacts would continue to have moderate effects. Little to no change to stream hydrology at the East Fork and

Toklat River sites would be expected. Restoration of natural stream hydrology conditions at the Downtown Kantishna site would reverse the adverse hydrologic effects from historical mining operations. Consequently, Alternative 4 would result in little additive effect, but the overall cumulative impact to hydrology would be moderate.

Conclusion: Alternative 4 would result in negligible direct and indirect impacts to stream hydrology (including likely positive effects at Downtown Kantishna). The overall level of hydrology impacts under Alternative 4 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*

This alternative includes gravel extraction at the Toklat River, East Fork River and Downtown Kantishna sites. The impacts would be negligible to hydrological resources, and would be the same as described for Alternative 4.

Cumulative Impacts: Overall cumulative impacts would be moderate, and would be the same as discussed for Alternative 4.

Conclusion: Alternative 5 would result in negligible direct and indirect impacts to stream hydrology (including likely positive effects at Downtown Kantishna.) The overall level of hydrology impacts under Alternative 5 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Water Quality

Roads have been associated with accelerated turbidity. One of the main causes of increased turbidity is "pumping" of fines from the subgrade through road surfacing (Reid and Dunne 1984). Surfacing of a road is critical to preventing or at least minimizing increased turbidity in road surface runoff. Each year, between June and September, approximately 5,700 bus trips take place along the full length of the park road. This is enough to place the road in the "main line" category (highest use) characterized by Reid and Dunne (1984). There have been no studies of road surface runoff in Denali National Park. The park road surface is generally well maintained and, given the generally high quality of water in the park, it is unlikely that the park road has increased turbidity in park streams. Glacier-fed streams in the park tend to be relatively turbid, especially during warm weather and high runoff rates, and non-glacial streams such as Moose Creek are known to run turbid after heavy rains or spring runoff events.

The primary criterion for evaluating the potential of each GAP alternative to affect water quality is the potential to elevate turbidity in streams. This could occur due to runoff from excavated areas, or from the park road itself. One measure by which to judge the risk of surface erosion is to compare the amount of surface area disturbed in each alternative. Table 4.2 previously showed the total surface area of disturbance, over the 10 years for which the plan would be applicable, by alternative. Note that some sites, depending on alternative, would be restored within the plan period. The total area of new disturbance within the park would range from approximately 1 acre under Alternative 1 to nearly 5 acres under Alternative 2. In addition, Alternatives 2, 4 and 5 involve mining and restoration on approximately 42 previously disturbed acres at the Downtown Kantishna site. In comparison, the existing area disturbed by the park road is approximately 335 acres, and the total area of existing surface disturbance within the road corridor is approximately 525 acres (see Table 4.3).

Another way in which elevated turbidity could occur is through excavation of the channels at the in-river sites, alteration of the floodplain, and secondary erosion. Alternatives can be compared by how much instream activity would be allowed, and how each would specifically mitigate for the effects of gravel mining.

The amount of gravel hauling between source sites and where the gravel is needed would affect road usage and thus the potential for sediment delivery through road surface runoff. However, compared to the current amount of bus and administrative traffic, which would be the same under all alternatives, the effect of differences in hauling mileage between alternatives would be minor (as discussed initially under Air Quality).

Alternative 1: No Action

This alternative would rely heavily on external sources for gravel (see Table 2.1). The external sources are not as well defined as the in-park sources. To make a comparison to the surface disturbance of in-park sources, the ratio of average surface area to volume of deposit for the in-park sources was calculated and applied to the estimated volume to be obtained from external sources under this alternative. The total disturbance area includes an estimated 34 acres of external disturbance and only 1 acre of disturbance within the park, at the Teklanika Pit (primarily) and the North Face Corner Pit. The total area of new surface disturbance within the park is the least among the five alternatives, although the estimated 34 acres of surface disturbance at external source sites is the largest among the alternatives by a considerable margin. While it is difficult to estimate potential erosion at external gravel sources without site-specific mining plans, several factors contribute to a low probability of erosion.

First, there is a short amount of time during which erosion can occur. The ground remains snow-free for only about 4 months in the project area. This automatically restricts the potential for erosion. Additionally, most gravel deposits tend to have a relatively coarse median grain size—usually larger than sand. Because silt and sand are the most mobile particles, the nature of the deposits themselves would limit the amount of possible erosion. For example, the erosion hazard for a soil designated as a "likely" gravel source in the nearby Kantishna area (Brannan and Swanson 2001) had a "slight" erosion hazard. Thirdly, delivery of eroded sediment requires a direct surface water connection between the gravel pit and a stream. Best management practices typically used in gravel extraction require that the gravel pit have internal drainage, rather than allow runoff to leave the site.

The effects of the road itself on water quality would be the similar under all alternatives, because the same levels of maintenance would be required (i.e. the same amount of surfacing would be maintained). A minor amount of fine sediment would be generated by traffic and runoff during rainstorms on the park road. However, the effect is not likely to be significant, for several reasons. Reid and Dunne (1984) found that effects of road surface erosion in a watershed on the Olympic Peninsula of Washington State were noticeable when road densities approached 2 or 3 percent. Without calculating the road density within Denali National Park, it can be seen on the maps presented in Chapter 1 that there is a very low road density. In most of the watersheds in the park in which there are any roads, the park road is the only road. Furthermore, the length of the park road within each major watershed is relatively short, because the watersheds are oriented in a north-south direction and the road traverses them east to west. Additionally, many of the north-side streams have elevated levels of turbidity naturally, due to their glacial sources. Therefore, any effect of the road itself is likely to be small relative to background turbidity.

River gravel extraction would occur on the Toklat River, at a rate of no more than 7,500 cy of gravel per year. This would not be expected to increase turbidity on a consistent basis, although short-term increases could occur when the "mirror" channels are connected to the active channels. A short-lived increase in turbidity would occur during the initial flows through these excavated channels, as the fine sediment on the channel bottom was winnowed out by the flow. The turbidity would rapidly approach background levels, however, as the amount of fines available for entrainment dropped.

Based on the limited area of surface disturbance and the required use of best management practices, potential impacts from Alternative 1 on water quality would likely be negligible (little or no change to existing conditions); at most, there would be short-term and localized changes that would represent a minor impact level.

Cumulative Impacts: When considered in the context of existing stream turbidity patterns and the extent of existing surface disturbance within the road corridor, the cumulative impacts on water quality would be negligible.

Conclusion: Alternative 1 would result in negligible direct and indirect impacts to water quality. The overall level of water quality impacts under Alternative 1 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

Alternative 2 would result in new surface disturbance on 4.6 acres of land within the park, which is more than any other alternative. Alternative 2 would also involve gravel mining and reclamation on approximately 42 acres of previously disturbed area at the Downtown Kantishna site, and a small area of new disturbance at external source sites. This alternative would still have a low risk of affecting water quality through increased turbidity. The mitigation required by NPS regulations, and the reclamation of the Downtown Kantishna site, would minimize the potential for water quality degradation. Primary mitigation would be in gravel pit design; as mentioned above, drainage would be internal until the site was restored.

Most of the gravel extraction sites are small and relatively scattered along the park road corridor. While the Downtown Kantishna site covers 55 acres, only an estimated 42 acres would be disturbed for gravel extraction and reclamation, the report produced by Karle (2003; see Appendix C) outlines potential mitigation and reclamation procedures that would be carried out at this site. These procedures would minimize the risk of water quality impacts.

River gravel extraction would occur on the Toklat River (110,000 cy) and East Fork River (54,000 cy) over the course of 10 years. While more gravel would be taken from the rivers in Alternative 2 than under Alternative 1, this would increase turbidity for a short duration over a short reach of the rivers, as discussed under Alternative 1. Based on the limited area of surface disturbance and the required use of best management practices, potential impacts from Alternative 2 on water quality would likely be minor.

Cumulative Impacts: When considered in the context of existing stream turbidity patterns and the extent of existing surface disturbance within the road corridor, the cumulative impacts on water quality would likely be minor.

Conclusion: Alternative 2 would result in minor direct and indirect impacts to water quality. The overall level of water quality impacts under Alternative 2 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

The amount of land disturbed under this alternative would be less than any of the other action alternatives; approximately 21 acres would be disturbed over 10 years, including about 2.6 acres within the park. For the reasons described for Alternatives 1 and 2 (the coarse nature of deposits, a limited window for erosion, and the mitigation required), short-term effects to water quality over short stream reaches from the surface disturbance would be expected. The effects from in-channel excavation at the Toklat River would the same as described under Alternative 2; effects on water quality would be minor.

Cumulative Impacts: When considered in the context of existing stream turbidity patterns and the extent of existing surface disturbance within the road corridor, the cumulative impacts on water quality would be minor.

Conclusion: Alternative 3 would result in minor direct and indirect impacts to water quality. The overall level of water quality impacts under Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*

Under this alternative, approximately 47 total acres of land would be disturbed over 10 years. Most of this disturbance would occur at the Downtown Kantishna site (42 acres), and would involve mining and reclamation activity on land that was disturbed by placer mining during the1970s and early 1980s. Consequently, Alternative 4 would involve only 5 acres of new surface disturbance, including 3.1 acres within the park. Because mitigation and restoration would be the same as Alternative 2 while the area of surface disturbance would be slightly less, the effects on water quality from surface disturbance would be similar to but slightly less than those under Alternative 2. In-channel gravel mining would also occur at the Toklat and East Fork Rivers, with projected extraction volumes somewhat less than under Alternative 2. The effects would also be essentially the same, in that there would be minor (small, temporary) effects on water quality from in-channel excavation at these sites. Potential impacts from Alternative 4 on water quality would be somewhat less than those identified for Alternative 2, which would be minor.

Cumulative Impacts: When considered in the context of existing stream turbidity patterns and the extent of existing surface disturbance within the road corridor, the cumulative impacts on water quality would likely be minor.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to water quality. The overall level of water quality impacts under Alternative 4 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls (NPS Preferred)

Alternative 5 is virtually the same as Alternative 4, except that phase 2 of source site development in the western end of the road corridor would involve the North Face Corner site in place of the Moose Creek Terrace site. The area of new surface disturbance, mining and reclamation on previously disturbed sites and in-channel gravel extraction would be virtually the same, and would result in the same level of impacts identified for Alternative 4. Therefore, potential impacts from Alternative 5 on water quality would be minor.

Cumulative Impacts: When considered in the context of existing stream turbidity patterns and the extent of existing surface disturbance within the road corridor, the cumulative impacts on water quality would be minor.

Conclusion: Alternative 5 would result in minor direct and indirect impacts to water quality. The overall level of water quality impacts under Alternative 5 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Aquatic Resources

Impact issues related to fisheries and other aquatic resources include (1) the potential for gravel operations to cause direct disturbance of aquatic habitat in water bodies and (2) the potential for indirect effects to aquatic habitat through changes in hydrology and/or water quality.

Among the 10 candidate gravel extraction sites evaluated in this EA, physical proximity to water bodies at 6 of the sites suggests a potential for aquatic effects. The East Fork and Toklat River sites are within the floodplains of the respective rivers, and operation of these sites would involve in-channel mining activity. Similar circumstances apply to the Downtown Kantishna site, where excavation and processing would occur within the floodplain of Moose Creek and Eldorado Creek and the stream channels would be modified through operation and reclamation. The Beaver Pond site is near an unnamed tributary of the Thorofare River. The Moose Creek Terrace site is within a short distance of Moose Creek and the North Face Corner site is within a similar distance of Moose Creek, indicating that the potential for indirect aquatic effects through hydrologic and/or water quality changes needs to be considered for these sites. The remaining four candidate sites (Teklanika Pit, Boundary, Camp Ridge, and Kantishna Airstrip) are located a sufficient distance from water bodies capable of providing aquatic habitat that that there should be minimal potential for aquatic resource impacts near these sites.

Prior evaluation of gravel operations at the Toklat River site concluded that significant impacts to aquatic resources would not occur (NPS 1999). The abrasive bedload and constant channel changes during most of the summer prevent development of significant aquatic resources in the affected reach of the stream. The Toklat River in this area does not support a fishery, although Arctic grayling have been observed moving through the area in small numbers in the early fall, when sediment loads are lower and water clarity (preferred by grayling) is greater. Because the physical and habitat characteristics of the East Fork River are very similar to those of the Toklat River, the conclusion of insignificant potential effects on aquatic resources is likewise applicable to gravel operations at the East Fork site.

Moose Creek is a generally clear, non-glacial or precipitation-fed stream that is known to be used in various reaches by grayling, round whitefish, slimy sculpin, northern pike and three species of salmon. Mining and reclamation plans for the Downtown Kantishna site would include in-water activity that would temporarily disturb aquatic habitat in the affected reach of the creek. Instream habitat would presumably be restored and likely even improved (primarily in Eldorado Creek) on a long-term basis through the reclamation objectives identified for the site. The mining and reclamation plans that are currently available are not sufficiently detailed to allow a thorough evaluation of the potential impacts. For example, one of the key project features with the potential for effects on aquatic species and habitat is construction of the proposed bridge across Moose Creek, but detailed plans concerning location, characteristics and construction methods for the bridge have not yet been defined. The plans available at this time (see Appendix C) do provide information concerning stormwater management, stream bank stabilization and similar measures that are relevant to the likelihood and possible extent of hydrologic and/or water quality changes that could affect aquatic habitat in the creeks.

The boundary of the proposed Moose Creek Terrace operating area is approximately 100 feet from the banks of Moose Creek at the closest point, so there would be no in-channel disturbance of aquatic habitat in the creek as a result of mining operations. The pit would intercept some groundwater flow and intermittent surface flow from heavy rains and spring snowmelt. Because the substrate has a good infiltration capacity and the drainage area uphill from the pit is relatively small, flow interception should not result in significant changes to local hydrology. Stormwater would be contained within the pit area rather than discharged to the creek and erosion and sedimentation control measures would be employed to prevent sediment or contaminant discharge to the creek. Consequently, the site operating plans should be sufficient to avoid any significant water quality effects in the adjacent reach of Moose Creek. Based on a lack of expected hydrologic or water quality changes, operation of the Moose Creek Terrace site would not be likely to create indirect impacts on aquatic habitat in the creek.

Each alternative that includes Downtown Kantishna would likely result in beneficial effects on the aquatic resources of Eldorado Creek from the restoration actions that are part of the site plans.

Alternative 1: No Action

Previous NPS environmental assessments concluded that gravel extraction, processing, and storage activities at the Teklanika Pit, Toklat River, and North Face Corner sites would not cause significant impacts to aquatic resources near those sites. Based on the prior documentation and the previous conclusions with respect to hydrology and water quality, potential aquatic habitat effects of Alternative 1 would be negligible and current aquatic habitat conditions in the park would continue for the foreseeable future.

Cumulative Impacts: The EIS evaluating cumulative impacts of mining in the Kantishna Hills, including tributaries to Moose Creek, indicated past placer mining activities had a major impact on aquatic habitat (NPS 1990). The NPS has since restored several miles of aquatic habitat after acquiring mining claims in the area, and plans are be developed to continue placer claim reclamation in disturbed areas of the Kantishna Hills. The additive effects of the no-action alternative to aquatic habitat in the Toklat River would be inconsequential, and the overall cumulative impacts from placer mining to aquatic habitat are judged now to be moderate.

Conclusion: Alternative 1 would result in negligible direct and indirect impacts to aquatic habitat. The overall level of aquatic resource impacts under Alternative 1 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

Continued or expanded gravel extraction, processing and storage activities at the Teklanika Pit, Toklat River and North Face Corner sites would cause little or no change to aquatic resources near those sites, for the reasons discussed under Alternative 1. Development of a new in-channel mining operation at the East Fork River would involve the same characteristics as at the Toklat River, and would result in short-term effects to aquatic resources a short distance below the extraction area. New mining operations at four other sites along the park road corridor (Beaver Pond, Boundary, Camp Ridge and Kantishna Airstrip) would not cause direct or indirect changes to water bodies and would result in little or no change to aquatic resources.

Alternative 2 includes mining and reclamation of the Downtown Kantishna site. While the Downtown Kantishna site covers 55 acres, about 42 acres of previously disturbed land would be affected under this alternative. Based on the mitigation procedures identified in the recent reclamation plan developed for this site (Karle 2003; see Appendix C), gravel extraction and reclamation at this site could be performed in a manner that would minimize the risk of short-term water quality and aquatic habitat impacts. Restoration of the channels and aquatic habitats in Moose and Eldorado Creeks at this site would likely result in positive long-term impacts for aquatic resources.

Given the site development, mitigation and monitoring procedures adopted by the NPS (see discussion in Chapter 2), the overall direct and indirect effects of Alternative 2 on aquatic resources in the park would be minor.

Cumulative Impacts: Any adverse cumulative impacts at East Fork and Toklat Rivers would likely be at most minor, and the potential to reverse some of the historic impacts to aquatic habitats in Eldorado and Moose Creeks at the Downtown Kantishna site would result in net positive cumulative impacts from Alternative 2. The overall persistent impacts to aquatic resources from former placer mining impacts would remain moderate.

Conclusion: Alternative 2 would result in minor direct and, impacts to aquatic habitat. The overall level of aquatic resource impacts under Alternative 2 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

Continued and/or expanded gravel extraction, processing and storage activities at the Teklanika Pit and Toklat River sites would cause short-term impacts to aquatic resources near those sites, as discussed for Alternative 1. New mining operations at Moose Creek Terrace would not cause direct or indirect changes to Moose Creek and would result in little or no impacts to aquatic resources in the creek. Overall, the potential for effects on aquatic habitat among the four action alternatives would be least for Alternative 3 and would be negligible.

Cumulative Impacts: The cumulative impacts under Alternative 3 would be similar to those described for alternative 1. The additive effects of Alternative 3 to aquatic habitat in the Toklat River would be inconsequential, and the overall cumulative impacts to aquatic habitat from past effects of placer mining in the Kantishna area would remain moderate.

Conclusion: Similar to the discussion for Alternative 1, Alternative 3 would result in negligible direct and indirect impacts to aquatic habitat. The overall level of aquatic resource impacts under

Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of Moderate Number of Sites *(NPS Preferred)*

The potential for impacts to aquatic resources under Alternative 4 would be essentially the same as for Alternative 2. Effects on aquatic habitat at or near the Teklanika Pit, East Fork, Toklat River, Beaver Pond and Moose Creek Terrace would result in short term, localized or no change to aquatic resources near those sites. The potential aquatic impacts resulting from in-channel disturbance and changes to hydrology and water quality at the Downtown Kantishna site is likewise expected to be short-term, localized, and ultimately positive, based on implementation of the mitigation and reclamation procedures identified by Karle (2003). The overall direct and indirect effects on aquatic resources would be minor under Alternative 4.

Cumulative Impacts: Cumulative impacts to aquatic resources with Alternative 4 would be the same as described for Alternative 2. Alternative 4 would result in minor additional effects in East Fork and Toklat Rivers and positive changes at Eldorado and Moose Creeks near Downtown Kantishna, but overall persistent impacts to aquatic resources from former placer mining impacts would remain moderate.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to aquatic habitat. The overall level of aquatic resource impacts under Alternative 4 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*

The impacts to aquatic resources under Alternative 5 would be essentially the same as for Alternative 4 (or Alternative 2) and would be minor overall.

Cumulative Impacts: Would be the same as for Alternative 4 (and Alternative 2) and would be moderate overall due to ongoing effects from former placer mining.

Conclusion: Alternative 5 would result in minor direct and indirect impacts to aquatic habitat. The overall level of aquatic resource impacts under Alternative 5 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

WILDLIFE VALUES AND HABITAT

Site Specific Conditions

All of the specific sites evaluated in this EA have the potential to receive some use by wildlife. As part of the effort to assess impacts of the gravel acquisition plan on wildlife in Denali National Park, NPS staff catalogued wildlife resource concerns within 500- and 1000-meter buffers around each of the proposed gravel extraction and processing sites. These inventoried buffers serve as the primary measure of the types of wildlife that would be affected at each of the sites. In general, extraction and processing activities might disturb wildlife, alter their movement or degrade habitat.

There are currently no federally listed endangered species that occur within Denali National Park. The Alaska Department of Fish and Game (ADF&G) maintains a list of Species of Special Concern. A species of special concern is any species or subspecies of fish or wildlife or population of mammal or bird native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance (ADF&G website). There are a few species from this list that might be affected by the proposed gravel acquisition plan. These species include: American peregrine falcon, arctic peregrine falcon, olive-sided flycatcher, gray-cheeked thrush, Townsend's warbler, and blackpoll warbler.

Although all of the alternatives have the potential for disturbance to wildlife species and their habitats, most if not all of these disturbances would be negligible. Most of the gravel acquisition activities would occur in areas already disturbed by human activities and therefore, most of the potential impacts to wildlife would have already occurred. Overall, the proposed activities would cause little or no change to wildlife populations or habitats. Any alternative that results in loss of conifer forest would have the greatest impact on nesting birds, as this habitat appears to be most limiting within the affected areas.

Teklanika Pit

No raptor nests were recorded in the Teklanika Pit area by the NPS. Moose density in the area is low (NPS 1992). The site does not contain Dall sheep habitat, and their nearest migration route is on the divide between the Teklanika and Sanctuary Rivers. Individual caribou are seen along the Teklanika flats, but the area is not known as a calving, rutting, or wintering ground. The site does not receive frequent grizzly bear use. The only recently active wolf den in the area is 5 miles away. Bird species possibly nesting adjacent to this site are olive-sided flycatcher, gray-cheeked thrush, and blackpoll warbler. These species would most likely nest in the adjacent white spruce forest. Gravel acquisition activities might cause failure of any nests within the area. Peregrine falcons may hunt in this area but their normal activities would probably not be altered.

East Fork River

There are several species of concern occurring within 1000 meters of this site. Within the 500-meter buffer, merlin and semipalmated plover nests have been observed. The site has been used as a foraging area by grizzly bears and serves as a travel corridor for other wildlife. A golden eagle nest is within the 1000-meter buffer around the proposed site, and a wolf denning area is also in the vicinity. Gray-cheeked thrushes and blackpoll warblers may nest in the adjacent upland habitat and might suffer local loss of brood production due to gravel acquisition activities. Peregrine falcons may hunt in the area but most likely would not be affected by gravel acquisition activities.

Toklat River

The 500-meter buffer around the Toklat River site is used by nesting semipalmated plovers and foraging grizzly bears. Within the 1000-meter buffer golden eagles occur as well as caribou, although primary caribou habitat does not exist in the immediate vicinity of the site (NPS 1992). A Dall sheep nursery is located on the broad ridge east of the site. Wolves have been seen occasionally in the drainage near the Toklat road camp and a wolf den, which is used intermittently is located downstream of the proposed extraction site. Gray-cheeked thrushes and blackpoll warblers may nest in the adjacent upland habitat and might suffer local loss of brood production due to gravel acquisition activities. Peregrine falcons may hunt in the area but most likely would not be affected by gravel acquisition activities.

Beaver Pond

Moose foraging habitat occurs within 500 meters of the proposed site, while beaver dams and lodges and foraging areas are located within 100 meters. No raptor nests were recorded in the vicinity.

Boundary

Moose foraging areas and riparian nesting birds on Lake Creek are of concern for this site. Gyrfalcon and merlin nesting sites, moose foraging area and waterfowl foraging area at the north end of Wonder Lake are within 1000 meters of the site. Olive-sided flycatchers may nest in the adjacent white spruce and might suffer local loss of brood production due to gravel acquisition activities.

Moose Creek Terrace

NPS personnel have observed nesting riparian birds, merlin nests, and moose and grizzly foraging area within 500 meters of the proposed Moose Creek site. Olive-sided flycatchers and blackpoll warblers may nest in the adjacent white spruce forest and riparian habitats. Local loss of brood production might occur as a result of gravel acquisition activities

North Face Corner

Wildlife use at North Face Corner is similar to the Moose Creek Terrace site. Moose foraging occurs within 500 meters of the proposed site. Kingfishers have built their nests in banks at the extraction site. Within 1000 meters of the site, nesting riparian birds and merlin are of concern. Olive-sided flycatchers and blackpoll warblers may nest in the adjacent white spruce forest and riparian habitats. Local loss of brood production might occur as a result of gravel acquisition activities.

Camp Ridge

Both nesting riparian birds and merlin occur within 500 meters of the proposed site extraction site. Camp Ridge is also close to the riparian zone of Moose Creek. Olive-sided flycatchers and blackpoll warblers may nest in the adjacent white spruce forest and riparian habitats. Local loss of brood production might occur as a result of gravel acquisition activities.

Downtown Kantishna

Nesting riparian birds and moose foraging occur within 500 meters of the proposed extraction site, and there is a riparian zone along Moose Creek. No raptor nests have been recorded in the vicinity. Olive-sided flycatchers and blackpoll warblers may nest in the adjacent white spruce forest and riparian habitats. Local loss of brood production might occur as a result of gravel acquisition activities.

Kantishna Airstrip

The primary concern for this site relates to the riparian zone along Moose Creek, which supports nesting riparian birds within 500 meters of the site. Merlins nest to the north of the strip, within 1000 meters of the site. Blackpoll warblers may nest in the adjacent riparian habitats. Local loss of brood production might occur as a result of gravel acquisition activities.

Alternative 1: No Action

The impacts on wildlife from the Teklanika, Toklat River, and North Face Corner sites were assessed in the EA for the 1992 gravel acquisition plan, a 1999 EA for the Toklat site, and a 1999 EA for gravel acquisition at the North Face Corner. These prior studies found that operations at Teklanika Pit would cause local alteration in migration routes for the small groups of caribou that pass through the Teklanika flats (NPS 1992). Grizzly bear and wolf travel patterns can be a function of caribou utilization in the park road corridor, and thus might be altered as well. Moose travel in the vicinity of the site enroute to nearby habitat, but would not be significantly affected by operations.

The Toklat River floodplain is a travel corridor for grizzly bears and wolves (NPS 1999). The steep slopes to the east and west of the floodplain restrict local movement of these species. Migrating caribou travel past the area 1 or 2 miles upstream of the Toklat extraction site during the summer. Moose in the area are most often seen in the forest on the lower slopes, and not on the gravel bars. Similar local displacement impacts were identified for gravel extraction at the North Face Corner site, where operations could disrupt or shift movements of moose, grizzly bears, wolves and small groups of caribou (NPS 1999). These prior environmental analyses found that the subject operations would result in short-term adverse impacts on wildlife near the extraction sites.

Animal movements are already influenced to some degree by traffic on the park road. Because of findings by Singer and Beattie (1986), the park GMP established vehicle limits to preserve wildlife viewing opportunities. This alternative would result in a 16% increase in vehicle traffic (220,000 dump truck miles), including at night. The additional truck traffic would occur over the entire park road to make up for the dearth of developed gravel resources within the park. The disturbance to wildlife along the park road corridor would be transient but widespread. The direct and indirect impacts of this alternative on the park's wildlife would be moderate.

Cumulative Impacts: Nearly 1.5 million vehicle miles are driven on the park road each summer season, resulting in temporary disturbance to wildlife along the entire park road corridor, and this alternative would add 220,000 dump truck miles. The NPS has developed about 525 acres of former wildlife habitat along the road corridor and about 30 acres has been developed by private lodges in Kantishna. Another several hundred acres were disturbed on mining claims in the Kantishna Hills resulting in major impacts to wildlife habitat (NPS 1990). Some of this impact has been mitigated over the past 10 years with NPS restoration projects on recently acquired mining claims along Glen Creek, Caribou Creek, and Slate Creek. Impacts to wildlife habitat have been reduced and would continue to be reduced in the future with planned restoration projects in Glacier Creek in the Kantishna Hills. Temporary disturbance to wildlife movements along the park road, however, would be increased by 16 % with this alternative, and the overall cumulative impacts to wildlife are judged to be moderate.

Conclusion: Alternative 1 would result in moderate direct and indirect impacts to wildlife values and habitat. The overall level of wildlife resource impacts under Alternative 1 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 2: Maximum Flexibility/Short Hauls

Alternative 2 proposes to develop the greatest number of new sites (six) for gravel operations. Large mammals such as grizzly bears, wolves, caribou, and moose tend to avoid developed areas. These new sites could alter the travel patterns for animals migrating or foraging in the vicinity. However, travel patterns of large mammals are already affected by human activity along the road corridor and in the existing development nodes. With the exception of the Beaver Pond site, all of the sites that would be opened for gravel extraction under this alternative are located near existing developed uses and/or areas of concentrated human activity, particularly the sites in the west end of the road corridor. The incremental increase in disturbance would cause a minor (short-term and localized) change in the ability of large mammals to travel or forage.

Small mammals such as squirrels, shrews, voles, and birds would be displaced to adjacent habitat by activities within the actual extraction and processing sites. The loss of habitat in this manner would be long-term, but would be recovered with restoration of the sites. Alternative 2 would create the greatest area of site disturbance and thus the greatest loss of small mammal and bird habitat. However, the amount of acreage lost as habitat would be quite small (less than 5 acres) and widely distributed when compared to the remaining unaffected area along the road corridor. Consequently, the habitat loss would represent at most a minor reduction to small mammal and bird populations in the park, and it would have little or no effect on the populations of predator species.

This alternative would result in new disturbance on approximately 7 acres of wildlife habitat, including 5 acres within the park, which would be a minor impact to wildlife habitat overall. Truck traffic under this alternative would be about 110,000 miles each summer season or about 7% of the total traffic. This is commensurate with the recent level of truck traffic on the park road, which would be a negligible change from past operations. The overall direct and indirect impact of this alternative on wildlife habitat and values would be minor.

Cumulative Impacts: The past and present impacts to wildlife habitat and values from placer mining and vehicle traffic would be similar to Alternative 1. The effects from 110,000 truck miles and the loss of about 5 acres of habitat over 8 sites would add little additional impact to these resources. The overall cumulative impacts would remain moderate.

Conclusion: Alternative 2 would result in minor direct and indirect impacts to wildlife values and habitat along the park road corridor. The overall level of wildlife resource impacts under Alternative 2 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 3: Minimum Visual Intrusion/Long Hauls

The impacts on wildlife resulting from this alternative would be very similar to those resulting from Alternative 1. Impacts from the Teklanika Pit and Toklat River sites would be the same as described under Alternative 1. Development of the Moose Creek Terrace site would cause temporary displacement of some large mammal movement, although the Moose Creek area is already subject to some wildlife disturbance through existing human activity. Small groups of caribou that might otherwise move through the site would move up the slope to skirt the operations. Grizzly bears would also skirt around uphill of the operations. Wolves most often hunt in summer as individuals, and these would find easy access through the rest of the width of the Moose Creek Valley. Dall sheep generally do not use the Kantishna Hills and would not be affected. Small mammals, birds, and their predators would be affected in the same manner as described for Alternative 2, although the area of affected habitat would be smaller (2.6 acres of new disturbance within the park). These operations at gravel extraction sites in alternative 3 would result in short-term adverse impacts on wildlife over a small geographic area.

As noted in the discussion for Alternative 1, animal movements are already influenced to some degree by traffic on the park road. This alternative would result in a 12% increase in vehicle traffic (175,000 dump truck miles), including at night. The additional truck traffic would occur mostly over the eastern part of park road to make up for the dearth of developed gravel resources within the park and minimal extraction at Teklanika Pit. The disturbance to wildlife along the park road corridor would be transient and fairly widespread. The direct and indirect impacts of this alternative on the park's wildlife would be moderate, but less than under Alternative 1.

Cumulative Impacts: The past and present impacts to wildlife habitat and values from placer mining and vehicle traffic would be similar to Alternative 1. The effects from 175,000 truck miles and the loss of about 2.6 acres of habitat over 2 sites would add little additional impact to these resources. The overall cumulative impacts would remain moderate.

Conclusion: Alternative 3 would create the potential for moderate direct and indirect impacts to wildlife values and habitat along the park road corridor. The overall level of wildlife resource impacts under Alternative 3 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 4: Phased Development of Moderate Number of Sites (*NPS Preferred*)

Under this alternative extraction and processing activities at the Teklanika Pit and Toklat River would continue. Gravel extraction at the Downtown Kantishna site would occur as a by-product of site reclamation. New extraction activity would take place at the East Fork River, Beaver Pond and Moose Creek Terrace sites. The impacts to wildlife under this alternative include alterations to large mammal movement and minor loss of small mammal and bird habitat and the effects of the loss of those small animals on predator populations, as described for Alternative 2. In this case, only five of the potential extraction sites would be operating simultaneously throughout the year and throughout the life of the plan. A total of 47 acres would be affected by this alternative, including 42 acres of previously disturbed land at former placer mine sites at Downtown Kantishna and 2 acres at external source sites. There would be a direct loss of three acres of habitat inside the park. As concluded for Alternative 2, the direct and indirect effects of this alternative would not appreciably reduce large mammal, small mammal, or bird populations or habitat.

Truck traffic under this alternative would be about 106,000 miles each summer season or about 7% of the total traffic. This is commensurate with the recent level of truck traffic on the park road, which would be a negligible change from past operations. Overall, the impacts to wildlife resulting from this alternative would be minor.

Cumulative Impacts: Similar to Alternative 2, the past, present, and future effects to wildlife habitat and values would be moderate overall. This alternative would contribute slightly less additive impact than Alternative 2 because 3,000 fewer truck miles are estimated to operate from the extraction sites and only 3.3 acres of habitat would be lost.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to wildlife values and habitat along the park road corridor. The overall level of wildlife resource impacts under Alternative 4 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

Alternative 5: Economic Alternative with Moderate Hauls *(NPS Preferred)*

The wildlife impacts for this alternative would be nearly identical to those discussed for Alternative 4. The difference between alternatives would be that new impacts on wildlife would occur at North Face Corner instead of Moose Creek Terrace, but the same type and extent of impacts would occur. If belted kingfishers are nesting in the surface of the gravel wall at North Face Corner, gravel acquisition activities should be restricted or suspended until the nesting activities cease.

Truck traffic under this alternative would be about 106,000 miles each summer season or about 7% of the total traffic. This is commensurate with the recent level of truck traffic on the park road, which would be a negligible change from past operations. As concluded for Alternative 4, however, detrimental impacts to wildlife movement or habitat resulting from the incremental disturbance associated with Alternative 5 would be minor.

Cumulative Impacts: Similar to Alternative 2, the past, present, and future effects to wildlife habitat and values would be moderate overall. This alternative would contribute slightly less additive impact than Alternative 2, however, because 4,000 fewer truck miles are estimated to operate from the extraction sites and only 3.2 acres of habitat would be lost.

Conclusion: Alternative 5 would result in minor direct and indirect impacts to wildlife values and habitat along the park road corridor. The overall level of wildlife resource impacts under Alternative 5 would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are key to the natural integrity of the park.

VEGETATION AND WETLANDS

The candidate extraction sites are located in areas that have exclusively or predominantly tundra vegetation. At most of the sites the vegetation is a mosaic of upland and wetland tundra cover types, plus some upland forest. The East Fork and Toklat sites generally consist of unvegetated gravel bars, and the Downtown Kantishna site includes extensive areas of unvegetated gravel bars and tailings piles. Vegetative cover at the potential extraction sites has been characterized from interpretation of aerial photographs and on-site investigations.

Wetlands were delineated by technical staff from Hart Crowser, Inc. at 11 prospective gravel acquisition sites in August and September 2001 using the Routine Onsite Determinations methods described in the *Corps of Engineers Wetlands Delineation Manual* (U.S. Army Corps of Engineers 1987). The types, approximate areas, and functions of wetlands delineated at the sites considered in this EA are summarized from the jurisdictional wetland determination report prepared by Hart Crowser (2002). Wetland delineations have not been conducted at the Downtown Kantishna or East Fork River sites. Descriptions of wetlands at the latter two sites are based on a combination of field observations of nearby sites (Kantishna Airstrip, Camp Ridge, and East Fork Cabin), aerial photo interpretation, and National Wetland Inventory (NWI) maps. Wetland and upland vegetation types described herein follow the *Alaska Vegetation Classification* (Viereck et al. 1992). Wetlands are classified according to the U.S. Fish and Wildlife Service's *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). Plant nomenclature generally follows Hultén (1968), except where there have been recent taxonomic changes. More recent taxonomy follows Kartesz, as found on the Natural Resources Conservation Service National Plants Database (USDA NRCS 2000) website at http://plants.usda.gov/

Wetland functions at the delineated sites were assessed using *Wetland Values: Concepts and Methods for Wetland Evaluation* (Reppert et al. 1979), also known as the Reppert Method. Using this method a rating of high, moderate or low is given to major functions of wetlands including: natural biological functions, hydrologic support; storm and floodwater storage and retardation (or attenuation); groundwater recharge; and water quality protection or purification. Because of the relatively simple structure, small size, proximity to human activities, and homogeneous nature of site vegetation, functional values range from low to moderate for all sites and functions.

This section of the EA provides a summary of the specific upland vegetation and wetland conditions at each candidate site, followed by a review of the expected impacts for each alternative. Table 4.5 summarizes the wetland determinations, classifications and estimated acres at each site. Table 4.6 presents the summarized results of the functional assessment of the wetlands at the candidate sites. Wetland boundaries at the respective sites are included on the proposed mining plans in Appendix C, and in Appendix D. Existing upland and wetland conditions at each site are summarized, as are expected wetland impacts based on the mapped wetland locations relative to the mining plans. Because upland cover types were not specifically mapped for each site, Table 4.2 and the description of upland conditions at each site represent the expected level of upland impacts.

Teklanika Pit

East of the existing pit area the terrace slopes upward at an estimated 3 to 5 percent grade for a short distance before the gradient steepens to about 15 percent at the foot of the adjacent hills. Relatively poorly defined water tracks exist near the break in topography between the steeper slopes to the east and the gentler 3 to 5 percent slopes of the terrace. These appear to carry shallow surface water flow seasonally to the northwest, where it infiltrates into the ground. General drainage patterns based on topography within this area appear to be to the northwest and west towards the park road and the Teklanika River. There are no apparent surface water connections between these water tracks and the Teklanika River or the apparently perennial stream to the south that is tributary to the Teklanika River. West of the road is a second lower terrace above the Teklanika River.

<u>Uplands</u>

An open white spruce forest community type covers adjacent uplands between the road and the existing gravel pit. This community appears to occupy drier areas adjacent to the road and northwest of the existing pit. Dominant plants in this community include white spruce (*Picea glauca*), willows, dwarf birch, feathermoss (*Hylocomium splendens*), and bog blueberry (*Vaccinium uliginosum*). Other species observed or relatively abundant but not dominant included sedge species, a wintergreen species (*Pyrola* sp.), rough fescue (*Festuca altaica*), and shrubby cinquefoil (*Potentilla fruticosa*). White spruce covers approximately 20 to 30 percent of the area and ranges in size from small seedlings to more mature trees 8 inches in diameter at breast height (dbh). Mature trees are about 25 to 30 feet tall. This upland forest vegetation is found on coarser, drier mineral soils.

TABLE 4.6 SUMMARY OF WETLAND DETERMINATIONS, CLASSIFICATIONS AND ESTIMATED ACRES

Site	Jurisdictional Wetland Determination[1]	Wetland Classification[2]	Estimated Wetland Area on the Site
Teklanika Pit	Non-jurisdictional/isolated	PSS1B	1.2
Toklat River	Jurisdictional	R3US/UB	185
Beaver Pond	Jurisdictional	PSS/EM1B	0
Boundary	Non-jurisdictional/isolated	PSS1C PEM/SS1C	0.4
North Face Corner	Non-jurisdictional/isolated	PSS1/4B	5.7
Moose Creek Terrace	Non-jurisdictional/isolated	PSS1/4B	4.0
Camp Ridge	Non-jurisdictional/isolated	PSS1/4B PEM1B	1.5
Downtown Kantishna	Jurisdictional	PSS1/4B	13.1
	Jurisdictional	R3USCx	1.6
Kantishna Airstrip	Non-jurisdictional/isolated	PSS1/4B	9.1

1 Preliminary jurisdictional determination. Determinations are subject to verification by the Alaska District, U.S. Army Corps of Engineers.

2 Wetland classification follows Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979).

Wetlands

Palustrine scrub-scrub broad-leaved deciduous wetlands (PSS1B) associated with lower-lying areas and small water track features cover about 1.2 acres of the site (see Table 4.6). Scrub-shrub vegetation consists of a dwarf scrub community that varies in species composition across the site. Dominant plants include dwarf birch (*Betula nana*), willows (*Salix* sp.) that are generally less than 2 feet tall, sedges (*Carex* sp.), and polar grass (*Arctagrostis latifolia*). Cloudberry (*Rubus chamaemorus*), Arctic sweet coltsfoot (*Petasites frigidus*), cottongrass (*Eriophorum* sp.), sphagnum moss (*Sphagnum* sp.), and leatherleaf (*Chamaedaphne calyculata*) are associated species. Cloudberry, Arctic sweet coltsfoot, sphagnum and are most abundant in and immediately adjacent to the small water tracks that generally run from ESE to NNW from near the SE corner towards the north end of the site. The water tracks terminate south of the north boundary in a variation of the dwarf scrub community characterized by taller dwarf birch and willows, up to about 3 feet tall. Small tussocks are scattered throughout the area. Shallow, organic (peat) soils that support this wetland vegetation are seasonally or permanently saturated. Dwarf deciduous scrub-shrub wetland types are widespread in the park.

Wetland functions at this site were rated as moderate for biological functions and sanctuary/refuge, and low or relatively low for the four water resource functions (see Table 4.7).

TABLE 4.7 SUMMARY OF RESULTS OF MODIFIED REPPERT FUNCTIONAL ASSESSMENT

Wetland	Wetland Classification[1]	Natural Biological Functions	Study Area, Sanctuary, Refuge	Hydrologic Support	Storm & Floodwater Storage & Retardation	Ground water Recharge	Water Purification
TP	PSS1B	Moderate	Moderate	Relatively low	Relatively low	Low	Relatively low
EFR	R3US/UB	Relatively low	Relatively low	Relatively low	Moderate	Moderate	Relatively low
TR	R3US/UB	Relatively low	Relatively low	Relatively low	Moderate	Moderate	Relatively low
BP	PSS/EM1B	Moderately high	Moderate	Moderate	Relatively low	Low	Relatively low
B	PSS/EM1C	Moderately high	Moderate	Relatively low	Relatively low	Moderate	Relatively low
NFC	PSS1/4B	Moderate	Moderate	Moderate	Relatively low	Low	Relatively low
MCT	PSS1/4B	Moderate	Moderate	Moderate	Relatively low	Low	Relatively low
CR	PSS1/4B and PEM1B	Moderate	Moderate	Moderate	Relatively low	Low	Relatively low
DK	PSS1/4B	Moderate	Moderate	Moderate	Moderate	Low	Low
	R3USCx	Low	Low	Low	Moderate	Low	Low
KA	PSS1/4B	Moderate	Moderate	Moderate	Relatively low	Low	Relatively low

[1] Wetland classification follows Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979).

TP –Teklanika Pit; EFR – East Fork River; TR – Toklat River; BP – Beaver Pond; B –Boundary; NFC – North Face Corner; MCT – Moose Creek Terrace; CR – Camp Ridge; DK – Downtown Kantishna; KA – Kantishna Airstrip.

Wetland Impacts

Approximately 1.2 acres of PSS1B wetlands north of the existing operations in units 1 and 2 would be removed under the proposed extraction plans. Operations in unit 3 would not adversely affect any wetlands. These appear to be isolated and non-jurisdictional wetlands that are common throughout the park. Because of their small size and isolated nature, there would be a minor loss of wetland functions. Potential wetland impacts on the site have been avoided through the configuration of the proposed operational units. Wetlands east of the existing pit would be avoided entirely. It is unlikely there would be any indirect affects of proposed gravel mining on other nearby wetlands.

East Fork River

This site is located in the floodplain of the East Fork of the Toklat River. Because the site has a low gradient and the valley bottom is wide, the active channel has a very broad, shallow, and braided configuration. The gradient is estimated to be about 2 to 3%.

Uplands

The steep embankments of the river are covered by tall and dwarf scrub communities commonly found adjacent to braided rivers. Tall scrub communities are dominated by pioneer species, such as alders and willows. Where wetland hydrology and hydric (wetland) soils are present, these communities are considered scrub-shrub wetlands. Dwarf scrub communities are dominated by cranberry and blueberry species (*Vaccinium* spp.), crowberry (*Empetrum nigrum*), and Labrador tea (*Ledum palustre*). Soils often contain appreciable quantities of gravel (alluvium) and appear to be relatively well drained.

Wetlands

The entire site (111 acres) consists of unvegetated gravel bars within the active channel of the East Fork Toklat River (see Table 4.6). It is not clear why a part of these gravel deposits are identified as upland on the National Wetlands Inventory map for this area. Most gravel bars and braided channels are classified as riverine upper perennial unconsolidated shore/unconsolidated bottom (R3US/UB) wetlands. These wetlands are widespread in the park and associated with all of the larger rivers, including the Toklat River, Teklanika River, Sanctuary River, and Savage River.

These riverine upper perennial wetlands appear to provide moderate to low levels of most functions (see Table 4.7). The ratings are moderate for storm and floodwater storage and retardation (or attenuation) and groundwater recharge, given their large size and connectivity with other wetlands and adjacent uplands. The water quality protection or purification function appears to be relatively low because the only source of pollutants is atmospheric deposition.

Wetland Impacts

Approximately 1.3 acres of riverine upper perennial unconsolidated shore/unconsolidated bottom (R3US/UB) wetlands would be affected annually by gravel extraction. In addition, up to approximately 1 acre of wetlands would be affected by the temporary access road. These would likely result in minor temporary impacts to wetland functions. Turbidity is naturally high in the river from glacial flour. Gravel extraction might result in slight increases in turbidities downstream. However, these are not expected to result in measurable changes in primary or secondary productivity. In addition, removal of material would result in only temporary losses of habitat (interstitial spaces and substrate). Gravels removed in any one year would be replenished as new gravels are annually transported down the river during spring freshets and summer high flows. Temporary impacts to wetland functions would be reduced through construction of mirror channels and natural recruitment of new gravels from upstream through bedload transport processes.

Toklat River

This site is located in the floodplain of the Toklat River. Because the site has a low gradient and the valley bottom is wide, the active channel has a very broad, shallow, and braided configuration. The gradient is reported to be 1.5%.

Uplands

The embankments of the river are covered by tall and dwarf scrub communities commonly found adjacent to braided rivers. Tall scrub communities are dominated by pioneer species, such as alders and willows. Where wetland hydrology and hydric (wetland) soils are present, these communities are considered scrub-shrub wetlands. Dwarf scrub communities are dominated by cranberry and blueberry species (*Vaccinium* spp.), crowberry (*Empetrum nigrum*), and Labrador tea (*Ledum palustre*). Soils often contain appreciable quantities of gravel (alluvium) and appear to be relatively well drained.

Wetlands

The entire site (185 acres) consists of unvegetated gravel bars within the active channel of the Toklat River (see Table 4.6). The gravel bars and braided channels are classified as riverine upper perennial unconsolidated shore/Unconsolidated bottom (R3US/UB) wetlands. These wetlands are widespread in the park and associated with all of the larger rivers, including the Toklat River, Teklanika River, Sanctuary River, and Savage River.

These upper perennial wetlands appear to provide moderate to low levels of most functions (see Table 4.7). The ratings are moderate for storm and floodwater storage and retardation (or attenuation) and groundwater recharge, given their large size and connectivity with other wetlands and adjacent uplands. The water quality protection or purification function appears to be relatively low because the only source of pollutants is atmospheric deposition.

Wetland Impacts

Approximately 2.3 acres of riverine lower perennial unconsolidated shore (R3US/UB) wetlands would be affected by anticipated annual gravel extraction. Up to an additional acre would be affected by a temporary access road. These would likely result in minor temporary impacts to wetland functions similar to those described for the wetlands at the East Fork River site. Like East Fork River, the Toklat River is transport limited. Gravels removed in any one year would be replenished as new gravels are annually transported down the river during spring freshets and summer higher flows. Temporary impacts to wetland functions would be reduced through construction of mirror channels and natural recruitment of new gravels from upstream through bedload transport processes.

Beaver Pond

This site is located on a terrace approximately 40 to 55 feet above the floor of the unnamed perennial stream on the valley bottom. Historic gravel mining operations were conducted near the middle of this site. On the west side of the old gravel operations, the top of the terrace has very gentle slopes ranging from about 2 to 4 percent. The general drainage pattern appears to be to the SSW and WSW toward the unnamed stream. Slopes on the eastern portion of the site are slightly steeper (4 to 15 percent) and include a small apparently perennial and more or less beaded stream that is tributary to the larger stream downslope. Drainage on this side of the site is directly to the beaded stream. The side slopes on the south side of the terrace are steep, about 30 to 40 percent.

Uplands

Dwarf-low scrub, tall scrub, and graminoid-forb herbaceous communities occur on the portion of the site west of the old works. Soils on the hummocky topography supporting this vegetation were much coarser and were more well drained than those observed in the wetlands.

Wetlands

There is a mosaic of palustrine scrub-shrub broad-leaved deciduous and emergent wetlands (PSS/EM1B) that cover an area of approximately 0.4 acre east of the proposed mine site. Wetlands are composed of a mixture of dwarf scrub, tall scrub and mixed graminoid-forb herbaceous vegetation associated with a drainage and beaded stream downslope of the Denali Park Road. Dominant plants include willows, dwarf birch, bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*Vaccinium vitis-idaea*), sedges, and crowberry. Common but not dominant associates included rough fescue, Arctic sweet coltsfoot, mosses, shrubby cinquefoil, and a horsetail species (*Equisetum* sp.). Flow from a network of drainage channels and wetlands north of the park road appears to be concentrated and conveyed to this wetland through the culvert in the road. Surface water enters the wetland and spreads out in the tall scrub community at the south edge of the park road. Downslope surface water flow becomes more concentrated in a drainage channel and beaded stream that flows into the larger perennial stream on the valley floor to the south. Permanently saturated mineral soils around shallowly inundated areas and beads (ponds) of the stream are covered by the mixed graminoid-forb vegetation and scrub vegetation is in between the nodes of the stream and higher gradient areas. These palustrine scrub-shrub and emergent wetland types are common throughout the park.

Natural biological functions, including food chain production and general and specialized habitat are moderately high because of surface water connections to aquatic environments (the beaded stream) as well as the larger size of these wetlands. Hydrologic support functions are higher because of the presence of the beaded stream. Groundwater recharge appears low because the wetland is such a small proportion of the total subbasin area. Although vegetation density is high, water purification or protection appears to be only moderate because the only source of pollutants to this area, other than road dust, is from atmospheric deposition.

Wetland Impacts

Impacts to PSS/EM1B wetlands at this site would be avoided as a result of the configuration of the mining plan. It is expected there would be no direct impacts to wetlands and negligible indirect effects. In addition, proposed reclamation might result in the creation of new wetlands.

Boundary

Topography at the Boundary site consists of a series of small hills and depressions near the base of the mountain to the northeast. Evidence of historic gravel mining operations exists on the site. Slopes are variable, ranging from flat in the closed depressions to between 25 and 30 percent on the hillocks surrounding them. The general drainage pattern appears to be to the SSW from the mountain to the NE and towards the closed depressions from the surrounding hillocks.

Uplands

A more xeric (dry) dwarf-low scrub community is common on adjacent uplands on the tops and sides of the hillocks. Dominant plants in this community type are bog blueberry, lowbush cranberry, dwarf birch, Labrador tea, and crowberry. Other plants that are present but not dominant in this community include willows, white spruce, rough fescue, an alder (*Alnus* sp.), lichens, and mosses. Coarse mineral soils that support this community appear to be well drained. In addition to the dwarf-low scrub type, there was a mixed graminoid-forb herbaceous community located in another closed depression at this site. Dominant plants included sedges, rough fescue, violet, nagoon-berry (*Rubus arcticus*), bog blueberry, and willow. Dwarf shrubs covered about 20 percent of the entire area. Although this community was located in a depression, loamy mineral soils contained many large cobbles and appeared to be well drained.

Wetlands

Wetlands cover an area of about 0.4 acre and consist of an isolated, seasonally saturated, palustrine broad-leaved deciduous scrub-shrub and emergent system (PSS/EM1C) located in a closed depression. The dwarf-low shrub vegetation is dominated by dwarf willows, bog blueberry, lowbush cranberry, dwarf birch, crowberry, mosses and lichens. Crowberry is abundant and forms dense, continuous patches on the tops and sides of small hummocks. A sedge species is also present but not dominant. The emergent vegetation class is a mixed graminoid and forb community type. Dominant plants included sedges, violet (*Viola* sp.), rough fescue, an oxytrope species (*Oxytropis sp.*), bog blueberry, dwarf birch, moss, and scattered lichens. Mineral soils with an appreciable amount of fines are likely seasonally saturated

Natural biological support functions, storm and floodwater storage, and water purification or protection are rated moderate given the relatively simple vegetation structure, relatively small size, and isolated nature of the wetland. Hydrologic support and groundwater recharge appears low because of the wetlands small size and moderately poorly drained soils.

Wetland Impacts

Proposed mining (under Alternative 2 only) would remove approximately 0.4 acre of PSS/EM1C wetlands. These appear to be isolated and non-jurisdictional wetlands that are common throughout the park. Because of their small size, isolated nature, and historical impacts from past mining, there would be a minor loss of wetland functions.

North Face Corner

The North Face Corner site is on a terrace above the south side of the park road. The existing and active gravel pit exists on the north edge of this terrace, which is about 80 feet above Moose Creek and 30 feet above the road. Topography consists of relatively flat slopes of 2 to 3 percent that appear to drain W and NW towards Moose Creek.